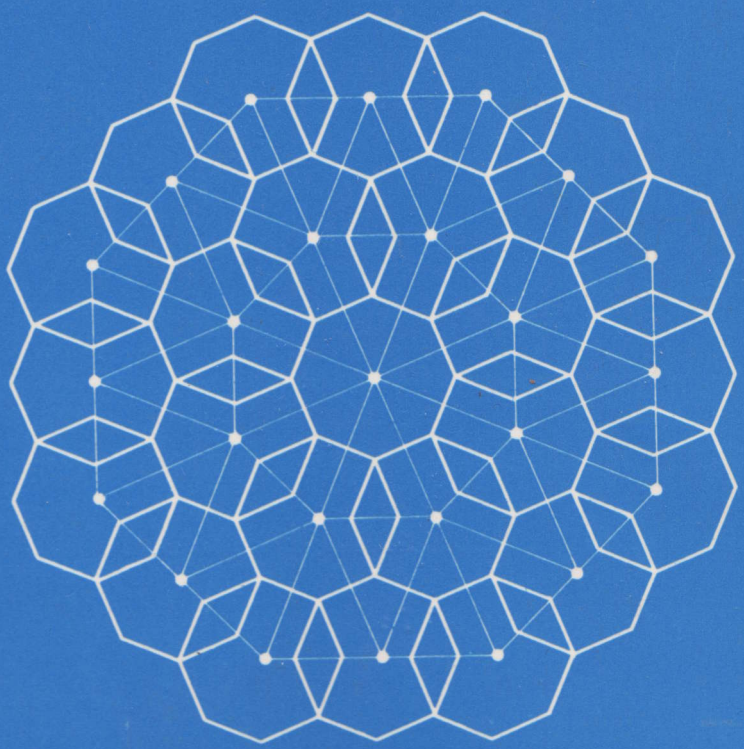
# TECHNOLOGY CULTURE AND DEVELOPMENT



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# TECHNOLOGY CULTURE AND DEVELOPMENT

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# TECHNOLOGY CULTURE AND DEVELOPMENT

**An International Symposium**
**at the University of Malaya**
**December 1983**

*Editors:*
Ungku A. Aziz
Yip Yat Hoong
Ling Chu Poh

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A brief explanation of the structure of this volume may be helpful to the reader. The volume has three main parts: opening and keynote addresses, papers, including closing addresses, and summary and discussion of the keynote addresses and papers. The main portion of the Symposium report comes under Part II where a total of 29 scholarly papers were presented and discussed at the Symposium. For those who do not have the time to go over these papers, they can skip over this part and go to Part III where a summary is given for each of the papers, accompanied by a note on the discussion that followed the presentation of that paper.

The editors of this volume are grateful to the Honda Foundation for meeting the bulk of the cost of organising the Symposium and to Boon Siew Sdn. Bhd. for giving a grant towards the publication of this volume. The editors wish also to thank the many participants who have presented scholarly papers at the Symposium. Finally, the editors feel indebted to the staff of the Institute of Advanced Studies, especially Mrs. Loong Lay Ling and Mrs. V. Fernando, for their assistance in the preparation of this volume.

Institute of Advanced Studies
University of Malaya

July 1984

Ungku A. Aziz
Yip Yat Hoong
Ling Chu Poh
**Editors**

## PREFACE

This volume contains three keynote addresses and 29 other scholarly papers which originated as invited papers at the International Symposium on Technology, Culture and Development, held at the University of Malaya, Kuala Lumpur, on 12-14 December 1983. It also contains an opening address by the Prime Minister of Malaysia, Y.A.B. Dato' Seri Dr. Mahathir bin Mohamad.

The Symposium was jointly sponsored by Centro di Ricerca e Documentazione Febbraio '74, the Honda Foundation, the International Association of Traffic and Safety Sciences and the University of Malaya. Its objectives were as follows:

(i) to achieve a greater understanding of the impact of advanced technology on culture and development through a series of case studies on the relationship between new scientific and technological innovations and cultural development in advanced countries like Japan and Italy;

(ii) to learn from the experiences of newly industrialised countries concerning the current and potential impact of technology on culture and development; and

(iii) to examine the impact of foreign technologies, adopted in Malaysia up to this point of time, on her culture and process of economic development through a series of empirically-based studies.

Because of the considerable interest generated by the Symposium at the time and the extensive press coverage given to it in subsequent weeks, the Organisers of the Symposium decided to bring out an advanced volume of the Symposium containing the most significant papers, namely, the opening and keynote addresses. This volume was published in February 1984.[1] The present volume, however, contains the full proceedings of the Symposium.

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[1] See Ungku A. Aziz; Yip, Yat Hoong; Ling, Chu Poh (eds.). International Symposium on Technology, Culture & Development - Addresses. Kuala Lumpur, Institute of Advanced Studies, University of Malaya, February 1984.

## INTRODUCTION

The Symposium brought together and highlighted three conceptual domains, namely technology, culture and development. Each of these constitutes a field that merits attention and scholarly effort. Scholars have invested considerable time and energy in these disparate fields of investigation. Despite the fact that they are familiar to the community of scholars, it is felt that these three conceptual domains together deserve a concerted look and analysis. This is based on the belief that they are intimately related to or are the causes of important events and phenomena in many societies which are so far-flung and, indeed, diverse. Consequently, we have focused on them to understand their overlap, myriad interrelationships and interactions. We are particularly interested in their joint and differential effects on different societies in regard to their past problems, present enigmas and future challenges. We are also committed to the stand that only through a multi-disciplinary approach to the study of their combined and interactive effects can we hope to unravel and understand the preplexing and often vexing issues that seem to confront so many societies at this juncture in our history.

The Symposium seeks to develop a perspective that is realistic, adventurous, useful and balanced. This search is sounded right from the beginning in the opening address delivered by Y.A.B. Dato' Seri Dr. Mahathir bin Mohamad, the Prime Minister of Malaysia. He delivered a clarion call to suggest that in the pursuit of the linchpin in the triadic relationship between technology, culture and development, it would be best for us to accord the concept of development a focal beginning. Development provides the impetus that integrates our understanding. For this concept of development to be meaningful it must be founded solidly on societal needs. These needs are pervaded by the people's philosophy, values, aspirations, goals, and the variety of means commonly available and used by them. It is these needs, both real and imagined, that underlie and propel development. As development proceeds, these needs may evolve, and may take on new forms and dimensions. Finally, development that serves societal needs could generate and create its own demands for new, complex and bewildering needs.

Development is often rightly or erroneously associated with concepts of modernization and change. These societal changes could be planned and unplanned. In addition, the rate of change could also vary over time,

situations and societies. We were firmly reminded by the Prime Minister of Malaysia and B. Grassetti that these changes could be well directed or freewheeling and directionless. We were cautioned to tread carefully as untrammelled and misdirected changes could tear asunder the very fabric of the nation. It is fairly apparent that the intended implications are that we should take great care to promote modernization and change along lines which are truly edifying for the society.

If we were to accept the premise that constructive change and modernization should proceed along lines which are determined and controlled by the society, we are in fact pleading for more enlightened and appropriate human intervention. This human intervention is embodied, for example, in the policies prevailing in the society. Mohamed Ariff, P.P. Lee, P.L. Chee and Y. Tsurumi touched on many important issues and their ramifications, pertaining to the necessity for human intervention through well formulated policies. This aspect of development and change through human intervention provides an important measure of the degree of control that we have in the direction that our society will finally take.

In this scenario that is emerging, we see technology as the handmaiden of and tool for human intervention. This especially makes sense if we were to define technology liberally to encompass the cumulative and systematised knowledge, skills and competencies existing and available. This totality of knowledge delineating the scope of technology includes both software and hardware aspects. Many of the papers explained that technology could be the source and catalyst of innovations in the society, and it could originate locally or have roots which are abroad. Whether it is local or abroad, it functions as a change agent and as a malleable instrument of human intervention. It is in this context that we understand the concerns expressed by S. Aida, and P. Ammassari in their papers. The issues of transfer of technology are related to and identified with the overriding motivation to harness technology to promote development, desirable changes, and the satisfaction of the needs that gave rise to them. S. Aida especially analysed the conditions and factors which are germane for the importation of appropriate and effective technology that is in consonance with the goals desired by that society.

Technological innovations, however, never occur in a vacuum. They must occur in a cultural context. This cultural milieu covers the way of life,

values, philosophy, goals and almost every conceivable component of a society. Technology spurs change and development. It is in turn changed. The cultural media which provide the stage and props for technology and development can impede or facilitate the desired change which we call progress. The culture prevailing is, however, not insulated from the effects of technology and development. Consequently, one of the foci that has attracted attention is cultural changes both centripetal and centrifugal. G. Quaranta explored and provided evidence pertaining to the role of culture as it interacts with and influences technological innovations and development. Concepts of cultural resistance and facilitation appear again and again in his seminal paper. The Prime Minister of Malaysia also emphasised the same theme when he referred to the issue of the contribution and characteristics of the people, as seen in their discipline and attitudes to change and development.

Development within a cultural context using specific technology is never brought about unaccompanied by problems and challenges. Different societies have different absorptive capabilities for technology, development and change. This was clearly illustrated by T. Shimizu as he traced the challenges, adjustments and travail that Japan had to go through during different periods before it emerged as a nation foremost among those which have transformed effectively and successfully. At a level closer to the grassroots, we have a comprehensive documentation of significant efforts addressed to specific problems related to technology, culture and development. These research efforts spanned concerns in the oil-palm industry, goat breeding project, new uses of tin, development of the pharmaceutical industry and management of urban traffic. These are but some of the empirical research efforts that the Symposium saw. They are examples of how creative research workers are engaged in development, technological innovations and cultural change through grappling with and solving many of the problems and challenges posed by a developing society with complex needs. These efforts also suggest a more important battle that they are engaged in. The products of their research work provide indicators of our successful mastery and solution of our problems. In this way, they provide us with hope that we indeed have a small but significant measure of control over our future.

The Symposium reached a high point when it transcended specific technological, cultural and development issues. This was achieved when the final focus was directed to issues of human and societal wellbeing within a

humane and humanistic framework. Permeating the discussions and papers presentd were constant reminders of issues in development for what purpose and for whom. With these, we were led frequently to examine closely the effects of technology, culture and development on people and their wellbeing. This emerged most clearly in Jamilah Ariffin, Rokiah Ismail, S. Lee and A. Alfonsi's presentations. They illustrated the profound impact of technological innovations, cultural change and development on peoples and societies. In this context of human concerns, the problem of the relevance of technological innovations, cultural changes and developmental directions was also constantly questioned by the speakers and discussants.

The community of scholars in the Symposium was both encouraged and pressed by Royal Professor Ungku A. Aziz concerning their role in pushing back the frontiers of knowledge, and the importance of their involvement in applied research of significance in the society. The participants were persuaded to demarcate more firmly the place and contributions of empirical research in the triadic relationship between technology, culture and development. The role of inter-disciplinary research work of excellence seems to be firmly entrenched in the Symposium as it drew to a close. We came to the conclusion that our most valuable contributions must continue to be in the realm of research of excellence which serves peoples and societies.

The Symposium with its diversity of papers on technology, culture and development found unity of foci and purpose in the integrating concepts outlined above.

# PART I

# OPENING ADDRESSES

# AND

# KEYNOTE ADDRESSES

**Opening Address**

**by**

**Y.A.B. DATO' SERI DR. MAHATHIR BIN MOHAMAD**

**Prime Minister of Malaysia**

I am honoured and delighted to have this opportunity to be with you on this auspicious occasion. It is a pleasure to welcome each and everyone of you to Malaysia and, in particular, to Kuala Lumpur. I wish you every success in your deliberations, and I hope you will find time to see a part of this country.

This is perhaps the first time that Technology and Development are to be linked and studied together with Culture. The tendency has always been to forget culture entirely when dealing with technology and development. The result is that importation of foreign technology and concepts of development has been disappointing to a lot of developing nations. As a newly developing country, which is fast industrialising and undergoing change, the theme of this Symposium is significant and very relevant to us. The interplay of technology, culture and development, while it can be complementary, can also tear a society apart if not fully appreciated, integrated and guided.

We know that man does not live by material gains alone. We must have a reasonably satisfying spiritual and cultural life. We should not forget that man requires spiritual nourishments in addition to the material necessities in order to enjoy a decent existence. It is probably this realisation that has influenced the organisers of this Symposium. I look forward to the results of your discussions, which I hope will not be entirely academic but will give due consideration to the need for practical application, particularly in the context of the complex Malaysian society and environment.

Indeed, I am rather envious of all the participants who will have a splendid opportunity to learn and exchange ideas concerning this rich mixture of vital topics. As this is not going to be my privilege I hope you do not mind if I take this opportunity to voice some of my thoughts on these subjects.

Firstly, let me say a few words about culture and its role in the advancement of technology and development. What a society is, is truly the result of the product of its culture - particularly the value system aspect of

culture. Of course, if we care to go further backwards we will find that the value system of a society is influenced by its environment. But the environment can be shown to affect different societies differently. Thus continuous hardship may either reduce a society to passive fatality or it may induce a hardiness which enables the society to overcome the challenges of life.

Assuming that the environment has produced passivity and a fatalist philosophy, the value system will be such that innovation and inventiveness will be uncommon. Indeed, lethargy normally develops. The struggle against adversity will not characterize that society. In the really bad cases, the society is given to extreme self-pity and dependence on others.

Self-pity and dependence on others is, in fact, a characteristic of a lot of under-developed or developing countries. Such countries are usually lacking in discipline and the will to fight adversity. The value systems and culture of the society in these countries are influenced by the basic philosophy of dependence on others and passivity. There is no reaching out for knowledge and advancement. Rather, there is a continuous clamour to be given everything in the ready-to-use state.

For such a society, technology transfer is not possible or at least is not easy to achieve. The attitude militates against it because the acceptance of new technology requires a certain degree of discipline and desire for change and self improvement. Basically, a transfer of technology is like the acceptance of a fishing rod in order to get food instead of getting the food itself when that is what is asked for. Few would have the patience to go fishing when hungry. Similarly, the passive society would not want to learn to make an electric fan when it is hot. It is easier to buy or be given an electric fan. This is a simplistic analogy of the cultural resistance involved in the transfer of technology but nevertheless it is an apt analogy.

The point that is being made is that before technology can be successfully transferred or while it is being transferred, the cultural resistance must be overcome. This can only be done if there is an understanding of the culture of the transferee community, or better still the differences of the cultures of the

transferors and the transferees. If there is this understanding, and the right allowances or preparations made, the transfer of technology will succeed. If culture is ignored, there will be resistance and failure or insignificant success at best.

That is why I am very attracted to the theme of this Symposium. It is the first time that culture is being discussed in conjunction with technology and development. Hitherto, there has been much talk on the need for technology transfer and the role of the transferor. The receptivity and capacity of the transferee has not received much attention. I hope this Symposium will give this aspect its serious attention.

On the question of the transfer of technology itself, I would like to look back into history, our best teacher. Over five thousand years ago, the Egyptians discovered the technique of glass blowing. This technique spread through the Mediterranean, Europe and Asia with very little improvement until recent times. There was no clamour for a transfer of technology nor any organised effort to do so. Nevertheless, technology transfer did take place and eventually improved upon. Mass production techniques for the manufacture of glass tubing and plate glass have now been devised and perfected. In navigation, the Arab travellers perfected the astrolabe, while the Europeans learned about the compass from the East. These are striking examples of the dissemination of technology. The social and political consequences of this diffusion are well known.

Today, the so-called third world countries are striving to achieve rapid material progress by wholesale importation of a variety of technologies from the advanced countries. However, analogous to the process of the life sciences, technology cannot always be transferred without considerable adaptation. The receiving country has to meet one vital prerequisite: trained manpower, before it can successfully absorb an imported technology. This principle seems to be commonsense, yet it is often forgotten in the surge of national pride and personal greed that lead to excessive absorption of foreign technology. The results have not been entirely to the good of the recipients' societies. If we look closely, we will find that the absorption of foreign technologies implies

and involves cultural changes. If the cultural changes are incompatible with the existing culture then disorientation and confusion results. Needless to say, a disoriented and confused society is not the kind of society that is desirable.

Perhaps it would not be irrelevant for me to refer briefly to the pricing of technology. No technology is too dear if the resulting outflow of economic benefits exceeds its aggregate real cost. On the other hand, no technology is too cheap if it involves a seemingly unending entanglement with servicing costs and inventories that ultimately impoverishes the recipient and renders it more and more dependent. There is an old proverb - "Beware of Greeks bearing gifts". I believe this refers to the story of the Trojan Horse. There is a significant precept here for all the newly developing countries.

Developing countries have to be careful not to acquire obsolete technology which some advanced countries may wish to dump on them. In finding a fair and reasonable price for purchased technology, a third world country has to take into account not only what it must pay the supplier, but also the whole of the real costs involved in adopting the technology and training local manpower to operate it.

It is my observation that the more dynamic the pace of modernisation in a country, the greater will be its need for new foreign technologies. Technolgy in development is not an one-off affair. It is a flow with an exponential growth rate. Any country which hopes to be a substantial recipient of the new technologies developed by the advanced countries must have an expanding capacity to absorb more of such technologies.

I have spoken of resources including manpower as prerequisites of this absorptive capacity. Now I will turn to one of the most critical aspects of economic progress. This is popularly known as "R & D", or Research and Development.

I would emphasise that while some 'R' and a little 'D' may have to be imported all the time, there is no real substitute for sustained R & D at home. In a world dominated by national self-interest, it would be naive to expect any country to carry out R & D for the benefit of another country. We must carry out our own R & D to meet our own needs. Any work done by other countries should be regarded as a bonus which may not be depended upon as a reliable source.

I do agree that research always seems to be rather expensive. And, good research must be terribly expensive. Yet, if we are to succeed in development, we must invest substantial resources in research. The high costs appear to be so because excellent work frequently needs to be spread over a long period before its applied value ultimately becomes apparent. Then an even longer period is needed before any application can yield worthwhile economic results. Third world countries must, therefore, be selective in research and may perhaps be forced to limit themselves to researches in application before they venture into pure research. It must be remembered that with such a wide field open to research, there is no way for any country to cover every aspect of research. Somewhere along the line it will have to buy the results of the work of others, no matter how advanced and rich that country is.

Our primary problem is to identify areas in which we wish to disburse our limited research funds. Whatever is funded should be adequate. Here, we enter the domain of politics and priorities. Research results are the tasks of scientists. Priorities for funding are the business of the policy makers. Harmony between these two parties will optimise progress.

Above all, in Research and Development the greatest problem is to frame the right question so that the proper lines can be laid down for rigorous empirical enquiry. That problem can be overcome if there is an understanding of the development needs of the country.

The sponsors of this Symposium - Honda Foundation of Tokyo, Centro Febbraio '74 of Rome, International Association of Traffic and Safety Sciences, (IATSS) of Tokyo, and Institute of Advanced Studies, University of Malaya - are people

who are very knowledgeable in the subjects that have been chosen. That they have chosen to hold this Symposium in Malaysia, a developing country, is significant. The participants too are people eminently qualified to discuss this important interaction between the sciences, and what is in fact the basics of the humanities, that is culture.

I have no doubt that there is much to be gained from this Symposium, for the developing world and for Malaysia, in particular. I look forward to the results of your deliberations. I look forward also to the follow-up actions that will have to be done if the Symposium is not going to be merely an exercise in philosophical thinking.

Finally, I would like to wish you a very warm welcome to Malaysia and an enlightening experience. Now I have great pleasure in declaring this International Symposium on Technology, Culture and Development open.

**ADDRESS**

**by**

**His Excellency Dr. Marcello Spatafora,**

**The Ambassador of Italy**

I have been asked to convey the following message, addressed by the President of the Republic of Italy, Sandro Pertini, to the organizing committee of this Symposium:

On the occasion of the opening ceremony of the International Symposium on Technology, Culture and Development, I wish, first of all, to extend to the government and the peoples of the Federation of Malaysia the warmest greetings of my country, whose relations with Malaysia are of intense and fruitful friendship and cooperation.

In hosting this Symposium, the University of Malaya is offering an important contribution to an in-depth study of issues related with cooperation and development, as well as their sensitive connections with the on-going process of technological innovation, which is radically changing, everywhere in the world, the terms of reference of the production, trade and communication systems.

It is meaningful that issues so vitally important for the common future are being here dealt with through a trilateral approach; in which different experiences can find, with a greater efficacy, ways and means of a possible complementary, so to emphasize, in view of a common interest, individual vocations and needs.

Of great value in this context is the contribution that Japan - here authoritatively represented by the Honda Foundation - will be able to offer, on the basis of its consolidated experience: an experience which is fast and continuously evolving, with an evolution that has rightly placed Japan in the forefront of technological innovation.

On the other hand, I believe that the Italians too can assure a qualified and extremely useful contribution, all the more so when the

traditionally open approach of our businessmen and the spirit of cooperation of our people, will be given the possibility of mixing with the hard work, the talent and the strong will power of the Malaysian peoples, who are actively aiming at progress, in a frame of a steady and promising development.

It is with this perspective in mind that I wish to convey to all those who are taking part in the Symposium, to its sponsors and to those who have in some way contributed to it, my most sincere congratulations, my best wishes and my most cordial greetings.

I am sure that, through initiatives such as this one, based on a spirit of cooperation and on a mutual esteem, the cause of peace will receive the most concrete and useful contribution.

Sandro Pertini
President of the Republic of Italy

To the message I would like to add some more few words.

The sponsors of this International Symposium have indeed brought up one of the most sensitive, controversial and politicised issues that we are facing nowadays. It is not only question of scientifically, assessing the interaction between technology, culture and development; we are in fact facing an issue which involves the need of political choices, as we have to decide which technology we consider the most suitable for the development of a certain country; which cultural pattern we want to preserve and enhance; and, most important, which development we have in mind, as the concept of development is certainly not identifiable with the concept of economic growth, as a result of applied technology.

When the Hon. Prime Minister stresses the need of a development focused on a balance between economic and spiritual values, or when he stresses that, in the case of Malaysia, "price of stability is a somewhat slower economic

development", well he is hinting, I think, at a concept of global development - it is to say, a development that brings stability to the country - that goes far beyond the concept of economic growth.

In fact, the political and ideological approach to the concept of development has undergone radical changes in these last forty years. Whereas initially there has been an indiscriminate emphasis on economic development, it has been later perceived that mere transplantation of technology does not create development, and that the so called transfer of technology is a complex and very sensitive issue.

The philosophy of development has therefore reached a further stage, in which are enhanced the social and cultural contents, of a development to be measured by the degree of improvement that has been achieved in the quality of life, both in individual and social terms. In other words, the society will have to acquire not only the means to assure its own economic growth, but also the capacity to direct this growth towards those aims which it can only find within itself.

Is a fact that, although the social and human sciences have assessed that there is no centre, and thus no periphery, still, in terms of social and cultural values, as well as national and ethnic realities, the temptation of a sort of western centrism is still powerfully attractive.

But in general terms I think that there is a growing awareness of the fact that a new international economic order requires the spread of a scientific and cultural pluralism. In fact it will be necessary to avoid new or resurgent conditions which would lead, once again, to the adoption of a model of development, held universally valid, and whose uniformity would correspond to conditions of substantial inequality. There is indeed the need of an "Indigenousation" of technology; there is the need to overcome ethnocentrism through recognition that every people and culture have its own creative responses, that can equally contribute to the advance of the civilisation.

In this perspective, I think that the Symposium will offer an invaluable opportunity to share common experiences, upon the assumption that, as there is not an uniformity of cultural patterns, so there is not "a" model of development. There are several models equally valid, among which the Malaysian, the Japanese, the Singaporean and the Italian ones. Each of them with specific characteristics, with its own merits, with its own shortcomings. So that for a developing country, as Malaysia for example, is a matter of being highly selective in the choice of the technology to be transferred from other countries. (And in fact I see that the Malaysian government, whereas practising a "Look East" policy having in mind the Japanese "work ethics". It is indeed practising an open minded and highly selective policy in the choice of the technology to be adopted, whether it comes from the "East" or the "West").

It would be certainly wrong to think, in general terms, that a certain country needs a certain type of technology, soft, hard or intermediate: only a case-by-case judgement can determine which technology should be selected, being suitable to the social and economic conditions of the country, in order to start and fuel a process of endogenous development, capable of preserving and enhancing the cultural identity of the country itself.

I would like to express here my best wishes for the success of the Symposium, hoping that it will not remain the only example of a trilateral joint approach between Malaysia, Japan and Italy. The possiblities and potentialities of such a joint venture are there. What we need is more imagination and a non-traditional approach. I am grateful to the Italian "Center of Research and Documentation February '74", and to its partners in this Symposium, for having paved the way in this direction.

**Address**

**by**

**His Excellency Mr. Akitane Kiuchi,**

**The Ambassador of Japan**

Let me, first of all, read the message of the Prime Minister of Japan, Mr. Yasuhiro Nakasone, to this Symposium which I have been asked to convey to you:

It is a great pleasure to offer my heartfelt congratulations on the occasion of the "Malaysia International Symposium" to be held here today, in the presence of His Excellency Prime Minister Dato Seri Dr. Mahathir Mohamad.

I visited your country this May and was deeply impressed by today's brilliant achievements of your country, I will never forget the cordial welcome extended to me by Prime Minister Dr. Mahathir and other Malaysian leaders.

It is truly meaningful that this Symposium, co-sponsored by University of Malaya, Centro Febbraio '74, Honda Foundation, and International Association of Traffic and Safety Sciences, is being held at the University of Malaya, providing a forum for a candid exchange of views, under the theme of "Technology, Culture and Development", by Malaysian, Singaporean, Italian and Japanese leaders in this field.

When I visited the ASEAN countries, this year, I delivered in your country, the last stop of my trip, my "Kuala Lumpur Speech", summarizing the tour. In this speech, I emphasized the necessity of "wider and deeper exchanges" between Japan and ASEAN in the aspects of "The Transfer of Industrial Technology", "Cooperation in the Field of Science and Technology", and "Personal Exchanges."

From this point of view, this Symposium is quite timely.

**ADDRESS**

I sincerely hope for the success of the "Malaysian International Symposium", the development of the four organizations co-sponsoring this Symposium, and further development of exchanges between Malaysia and Japan.

Yasuhiro Nakasone
Prime Minister of Japan

I would like to take this opportunity to congratulate the organizers of this Symposium for their magnificent work they have done and also for the great and unique idea of putting Malaysia, Italy and Japan together.

I would, particularly, pay the highest tribute to Royal Professor Ungku Aziz, Chairman of the Organizing Committee of this Symposium, for his untiring efforts to make the Symposium a great success. Royal Professor Ungku Aziz, as we all know, is a man embodying oriental spirits together with western civilization as we say "Wakon Yosai" in Japanese, and none will be more suitable than him to organize a seminar of this kind.

This Symposium, I believe, is of great significance in that not only Japanese and Malaysian speakers but also eminent speakers from Italy and Singapore are participating to exchange views on the inter-relationship among technology, culture and development.

Italy is, of course, a forerunner and a main pillar of the European civilization, and its impact on technology, culture and development of all the nations throughout the world has been immense and deep-rooted indeed.

The presence of Italy in this Symposium, therefore, will greatly contribute to widening the perspective of the discussions into multi-dimensional ones, and the Symposium, no doubt, will play an important role in guiding all of us to the better understanding of the impacts of technology on culture and development.

I hope that the Symposium will be a great success and bear many fruits to brighten our future.

# HARMONY BETWEEN RIGOROUS EMPIRICISM AND CREATIVE INSIGHT LEADS TO EXCELLENCE IN RESEARCH FOR DEVELOPMENT: AN OVERVIEW

by

Ungku A. Aziz*

I am overwhelmed by the great honour of being invited to present to you my perception of an overview of the topics of this Symposium. I sincerely hope that my humble efforts will be of some use in helping the participants to find their way through the rich mixture of papers that have been prepared by our learned colleagues. Perhaps with all due modesty, I would do better to call this an underview rather than an overview.

As we proceed, I hope the specific themes of technology, culture and development will emerge like stalagmites and stalactites as we traverse the caverns of our journey through the next ten sessions of this Symposium.

Actually, the problems of the modern world are not neatly packaged into separate boxes which conveniently allow scientists to burrow diligently into every corner of their cloisters. The problems of the real world especially in so far as technology, culture and development are concerned are unholy conglomerates of intermeshed spirals which shade off into one another in fine tints of grey.

To grasp even the simplest idea of the nature of a problem in such a situation in the real world, we could compare it to the human brain with its billions of inter-connected neurons, all of which if you accept it, also combine to help the human mind emerge. Such problems are composed of masses of interacting influences that are not only interacting but cumulative and are interacting at different speeds with differing intensities. Therefore, to have even the slenderest reflection of the real world, our Symposium has to be given certain perceptible characteristics.

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* Royal Professor Ungku A. Aziz is the Vice-Chancellor of the University of Malaya

In a good discussion, the voices should swing in a kind of contrapuntal harmony from 'Yin' to 'Yang', from the general to the particular, from the abstract to the concrete, from the pure to the applied, from the realm of the mind to the realm of the senses, and so on.

In the light of this dualistic grand design, my two swings will consist of one small abstract leap into multi-disciplinarity in academia followed by a somewhat aggressive thrust into the need for vigorous empiricism in research and study for development, especially in third world countries. Thus we swing between conceptual and theoretical approaches such as Tsurumi in Session 1 and Oka in Session 2 on one side, to empirical descriptive approaches in such papers as Ariff on Iron and Steel in Session 1 or The Planning of Singapore Changi Airport by Peng Giok Beng in Session 4. There are 'how-to-do-it' or more correctly 'how-it-is-done' studies like "Urban Planning and Transportation" by Ota in Session 8 or the Development of a Pharmaceutical Industry in the ASEAN Region by Ho also in Session 8.

Such an important subject as education is covered, for example, by the Development of Ingenuity in Engineering Education by Terano in Session 7 while Shimizu considers Dynamism in Technology Education in Japan in Session 9. Kamal Salih talks about Computer Applications at his University in Session 2 while Ozay Mehmet and my co-slave in the preparation of this Symposium, Yip Yat Hoong, talk about Technical, Scientific and High-Level Manpower Development in the Malaysian University System in Session 9. If we change our viewpoints and move from the analytical mode to the synthetical mode, a subject can be studied from a variety of points of view. For example, women workers in the electronics industry are examined from the points of view of epidemiology, employment, accommodation and even language.

Basically, we Malaysians have agreed to present slightly unfashionably empirical papers. We are describing objective work in progress. With due modesty we are also describing research work that we believe is of national significance in the sense that it will ultimately contribute, we hope, to our national development.

**AN OVERVIEW**

Naturally, there are many Malaysian scientists who prefer the way of the non-empirical approach. Indeed judging by a number of seminars held earlier this year, our capacity of speaking our minds or should I say our hearts, seems to be rather greater than our readiness to publish conclusions that are based on rigorous research supported by impeccable reasoning. It is this observation that has partly influenced me to seek out scientific research workers and to invite them to display their wares at this Symposium so that the balance may be corrected and harmony restored.

I also have two other important objectives.

Firstly, I want to promote not only the idea of empirical research but more specifically, excellent research that is oriented towards the goal of national development. I hope this international exposure of my colleagues will inspire and motivate large numbers of our friends in the sciences and the social sciences to think bigger and to be more pragmatic. I hope our decision-makers will take note of this objective.

Secondly, I hope to show the world that we do have a few scholars and researchers who are capable of achieving results that are comparable to international standards of excellent scholarhsip.

In the presence of friends from such venerable countries as Japan and Italy, I sincerely and modestly feel that I do not need to apologise for being somewhat nationalistic or proud of my nation: Malaysia.

How have we approached problems in a multi-disciplinary way? I shall now refer to papers that arise from two major research projects that are currently being carried out under the aegis of the Institute of Advanced Studies, University of Malaya. They concern girls and goats.

Let me begin with the girls. You may have noticed the three papers in Session 5 and the one at the end of the day in Session 6. These deal with the HAWA Project which I will come to in a moment and concerns the factory workers

in the electronics manufacturing industry. Then in Session 10, Mukherjee discusses the crossbreeding of goats and he is backed up by Ravoof and Sutanto's paper on the Utilization of Dried Palm Oil Mill Effluent in Session 8.

Let me go back to the girls. Some five years ago, we decided that one of the changes most likely to affect Malay society in the near future would be the new trends in the work roles of Malay women.

In Malaysia, women have always worked. However, with the recent growth of manufacturing industries especially electonics, specifically the preparation of integrated circuits, a relatively large demand has been created for female labour. It has been the Government's policy to disperse these electronics factories throughout the country. Many are located in the free trade zones of Penang, Kuala Lumpur and Malacca.

During the last five years, it has been estimated that over one hundred thousand young Malay girls of rural origin have left unpaid family farm work for regular employment in the electronics industry. Some have commuted to work from their rural homes located ten to fifteen kilometres away. Some have obtained accommodation in nearby hostels provided by their employers, but many have flooded the shanty towns that seem to occupy substantial parts of our burgeoning cities and larger towns.

To know what has really taken place: How they are living, their problems of adjustment and what links they maintain with their families etc., we have initiated a multi-disciplinary study of their total living and working conditions. We have used the research tools of economics, sociology, medicine and law not only for carrying out a study for the sake of just having a study but more importantly to collect reliable and valid data and to influence policy and planning. We intend to advise the Government, Women's Leaders, Workers' Organizations, Political Bodies, etc. as to how the women workers can be better cared for. We feel that such an approach is imperative because the women workers have no adequate protection, legally, economically, socially and morally. For example, they seem to have inadequate protection regarding hiring and firing. They have virtually no recreation nor education facilities. There

are no facilities for counselling. These are some of the more poignant examples of their current problems. Advanced countries have institutions like the YWCA or Toyota's Ikoi Noi Ie in Nagoya. Malaysian girls have nothing like such insitutions.

Our study is backed by over one thousand pages of discussion papers which are derived from hundreds of pages of computer printouts. We have interviewed about two thousand individual workers who have provided detailed answers to sixteen page questionnaires. We have carried out detailed in-depth studies of 100 workers. We have collected pictorial evidence of their living conditions, part of which is shown in Susan Lee's exhibition. Co-operating in this study, Gregory Thong discusses wages in Session 6. In Session 5, Rokiah reports on the health of workers based on blood and other bio samples obtained from one hundred girls. Incidentally, this is the first time such an epidemiological study of industrial workers has been done in our country. In Session 6, Nuwairi who is under the academic supervision of Nik Safiah tells us some interesting information about the kind of common spoken language that is evolving among these girls who come from various parts of the country where different dialects of the Malay language are spoken.

At this point I would like to acknowlege the generosity of the Toyota Foundation which has provided research grants totalling 260,000 ringgit and one of our prominent graduates who is now a leading industrialist, Tan Sri Ibrahim Abdullah of Promet who kindly donated 100,000 ringgit to make the continuance of this study possible.

These handsome donations over a period of four years have enabled us to carry out a variety of studies in a large number of areas. When we began, it was not clear where all the electronics factories were located in Malaysia or even how many persons were employed in this industry. Now we have good data. This can be related to studies made by other scholars about specific aspects of the electronics industry.

In brief, our multi-disciplinary approach will ultimately provide a kind of holographic picture of the case of farm girls now working in electronics

factories. Indeed, in due course, we should be able to be more certain about projecting their conditions into the nineteen-nineties through to the year two-thousand. We would like to feel that we will be more confident than our colleagues who indulge in the pseudo science of futurology by peering ahead through cloudy crystal balls unfounded on hard facts or perhaps, I should say gracefully reclining on a bed of soft facts.

May I now turn from the girls to the goats and refer to Mukherjee's paper entitled "Crossbreeding for Improvement of Local Goats using a Multidisciplinary Approach" in Session 10, and the related paper by Ravoof and Sutanto on the "Utilization of Dried Palm-Oil Mill Effluent: Present Status and Future Potentials" in Session 8.

The IAS has a breeding programme in goats that will ultimately result in the establishment of a new genetic strain of Malaysian goats which will be considerably larger, grow faster, be resistant to tropical diseases and able to exist on grass grown locally and concentrate, prepared from palm oil sludge and brewer's waste. In this multi-disciplinary programme incidentally, frozen semen imported from Germany and now produced locally are used for insemmination. If you are interested, the breeding cycle of females are regulated by hormone injections.

I would like to tell you about Ravoof's programme which uses Palm-Oil Effluent Waste and Rubber Waste that would otherwise be polluting our rivers, for the regeneration of infertile soils. We are growing napier grass which with other legumes forms the feed stock for these goats. This is another practical example of the multi-disciplinary approach adopted by Malaysian scientists and their colleagues.

Thus, you can see it is neither unacademical nor unreasonable for me to introduce such topics as girls and goats into my discussion in this Symposium.

To insert a few more pieces into our Malaysian mosaic of empirical studies, I should like to refer briefly to our two vital national export commodities,

rubber and tin and to water which determines the quality of life, if not life itself.

As the world's number one producer of Natural Rubber (NR) with a direct interest in consumer technology, it is only right for us to be the world's number one natural rubber researcher. This involvement should embrace all branches of science and technology. Indeed, as an economist, it is my private dream that one day Malaysia should be the number one producer of high-quality tyres as well as the most extensive exporter of popular tyres now used in such countries as Iran or Iraq who are supplied by countries like Korea or Japan which do not grow a single rubber tree. We should be able to find markets for our tyres all over the world because they would be as good as the best while our ordinary tyres would be among the cheapest and the most reliable.

In tin, if we can find better ways to identify and extract the organotins, we will be serving mankind by helping to make herbicides less toxic and also helping to lower production costs in the plastic manufacturing industry.

Regarding water, our efforts at innovating a handpump design have already led to arrangements for the production of several thousands of new model water pumps that will be cheaper, more efficient, more long lasting and easier to maintain than anything that exists at present. These water pumps would find a demand throughout the third world countries. All this is well described in Goh Sing Yau's paper in Session 10.

All the presenters are talking about scientific research work that they are actually doing. They are not as we say in Malaysian, "omong kosong" or speaking without substance. They are not speculating a priori or fantasizing without facts.

To those of you who come from the advanced countries with several hundred years of the inductive tradition, there is little need to establish the legitimacy of scientific research. However, in the third world because of the lack of support, especially the lack of funds, researchers are frequently driven

to think small, because we are apparently more ready to spend millions on palaces and ostentatious celebrations rather than on research for development. So, it is not surprising that frequently, large research projects are rarely initiated because of financial constraints. We tend to be parsimonious about scientific research but profligate on so called prestige projects or what some people think are image building ceremonies.

Many researchers have to depend on grants from foreign foundations for the financing of their projects. Even if they have the money for the research operations they are often faced with inadequate manpower support or obsolete equipment and, of course, they suffer from lack of time because they must bear heavy burdens of teaching and administrative work. Sometimes they must moonlight or even sunlight to supplement their relatively lowly emoluments.

Often they do not seem to be accorded sufficient respect by their own Governments. Foreign consultants are preferred to home grown experts. Hence, the sayings "No man can be a prophet in his own country" or, "Other grasses appear greener" etc.

The up-shot is that useful research of any substantial scale is seldom done and even less evident are research projects of an interdisciplinary or multi-disciplinary nature. This situation is exacerbated by the typical weltanschauung of those of our less industrious academic colleagues who when they are criticising others, become carmine radicals, yet when they themselves are the object of change they metamorphosize into the staidest of conservatives. In brief, multi-disciplinary collaboration tends to be anathema to certan academics, young or old.

So akin to a breath of fresh air, we Malaysians now present you with a cross-section of our empirical efforts to show you that with the cooperation of our colleagues from neighbouring Singapore, there do exist some people who are dedicated to the search for empirical solutions to our national problems.

We must overcome these constraints in order to achieve a satisfactory level of national development. We must endeavour to find better methods of producing natural rubber and its products or new methods of extracting organotin compounds. We must design a water pump that is cheaper to make, easier to install and simpler to maintain in the rural areas where potable water pump equals life or death. We need to find a genetic strain of goats able to survive in the tropics that will be an economical source of protein. In allied projects, we must develop methods of avoiding the polluting of our rivers while we are fertilising neglected barren soils.

If we want to know about the living conditions and everyday problems of newly employed factory girls, we must descend from our ivory tower and interview several hundreds of women selected from various locations. We should not generate pages of lurid gossip from a few casual forays into the living areas of these workers as is quite a common practice in Malaysia today.

All these efforts need to be done by patient, rigorous, scientific collaborative research and not by magic.

The motto on the Coat of Arms of this University is "Ilmu Punca Kemajuan" or "Knowledge is the Source of Progress". In both senses of the word, knowledge implies knowledge that is based on hard facts and on sound reasoning. That is why the Malaysian contributions to this Symposium are empirically oriented.

This is not to gainsay some papers for being inadequate because they are not empirical. Perhaps some are and perhaps some are not. Some are philosophical or theoretical statements of great merit. As I said at the beginning, we are in a dilectical situation where there is a "Yin" and there is a "Yang". There should be a deductive approach and there should be an inductive approach. There are facts and there are pure thoughts.

By fulfilling both swings we gain a complete picture.

# KNOWLEDGE, SOCIETY AND TECHNOLOGY

by

Paolo Ammassari*

## Introduction

The aims of this Symposium are of the utmost importance: gaining a greater understanding of the different impacts of advanced technology on culture and societal development will help us to achieve a deeper and more thorough awareness of the changes our societies are undergoing. In particular, if these technologies are foreign and if they are being introduced into newly industrialized countries, we want to be able to appreciate the social problems we encounter, the benefits we are attaining, and the uneasiness we might feel in our future life circumstances.

To learn from the experiences of other countries is a substantial step toward these aims. In regard to these experiences, one of the most important issues is the ways how a country has consciously reflected upon a new condition of its being. That is why I think that a familiarity with the various ways of coping intellectually with technology, and with technology's impact upon society and upon the meanings of daily life, is an indispensable preliminary step towards an understanding of how a country has faced technological change.

On a scientific level, this means that the study of social and culural impacts of technological change must also be framed within the theoretical perspective of a sociology of knowledge. In fact, in order to reach a full understanding of a country's social and cultural reactions to technological change, we need to penetrate the ways its traditional world-view has represented technology and science. Therefore, it is necessary to analyse the system of ideas which is responsible for both.

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The task is not an easy one. There are difficulties and entanglements, some are linguistically contingent, others are more culturally rooted. The purpose of this paper is to present some basic conceptualizations and analytical categories in order to provide a theoretical framework for empirical researh along this line of study.

## The Distinction Between "Knowledge-of-acquaintance" And "Knowledge-about"

In many languages, like Germanic and Romance languages, a distinction is currently made between two kinds of cognition. German distinguishes between Wissen and Erkenntnis, French between savoir and connaissance, Italian between sapere and conoscenza. Colloquial English has lost the terms for the distinctions, and William James had to resort to two periphrases to express philosophically the same meaning: "knowledge-of-acquaintance" and "knowledge-about". The first was connected with the sensational experience, the second with its abstract characters. But sensation did not mean, for him, the raw physiological process of bodily stimulation. In analogy to the corresponding meaning of Wissen, savoir, and sapere it stood for "a vivid, lively, and present" experience, which Kant called "intuition" (Empfindung), that is the direct and immediate apprehension of the external world or of the private state of mind. James' distinction is, therefore, strictly similar to the colloquial difference used in German, French, Italian and many other languages.

The colloquial distinction between an immediate, intuitive type of knowledge and an elaborated, reasoned one became a fundamental distinction of human cognition when a great Neapolitan philosopher, Gianbattista Vico, used it in his critical appraisal of Descartes' reduction of human knowledge to solely abstract reasoning. Vico, who I maintain was a sociologist in a very modern sense, did not accept the Cartesian view that the only valid human knowledge is the one expressed in abstract concepts. In fact, he held the position that those abstract concepts were mere conjectures, while the immediate subjective penetration of our intuitive knowledge (of acquaintance) provides us with concepts which are universal in character.

Thus, a simple, but basic, distinction of cognition which is built into our colloquial language became a philosophical dichotomy which was fundamental to the German Historicist School and to the Idealistic philosophical tradition. The Italian idealistic philosopher, Benedetto Croce, defined natural science concepts as "pseudo-concepts": real knowledge was not to be found in the instrumental, abstract cognition of the natural science. It was, instead to be derived by the penetration of the meanings which provide orientations to the making of mankind in its historical course.

This represents a very extreme and very partial view, and it was a typical reaction of the European intellectual world to the increasing primacy of the natural sciences within the learned academy of cultivated men.

But the distinction is more than sound, it is substantial. And I would like to take the lead from the German philosopher, Max Scheler, because of the important theoretial consequences of his thought for a research perspective based on sociology of knowledge. Knowledge-of-acquaintance is a knowledge which implies feeling, preferring, evaluating. It is immediate and direct knowledge of the poetic as well as of the practical world, of the religious as well as of the profane, of the ethical as well as of the economic, political and social world. It is a knowledge which bears on intuition and imagination, it is subjective and, for a large part, not communicable. In modern terms, it is a contextual perception of reality and, as long as it is communicated, it relies on the contextual meaning of personal interactions. On the other side, knowledge-about is essentially linguistically coded, reasoned elaboration of experiences, directly communicable, denotative in its nature. Therefore, it is inter-subjective, mostly conventional, rooted in a more or less learned community, more social and predominantly societal in character.

The first type of knowledge is deeply rooted in the group's "soul" and in the inter-personal relationships which delimit the daily existential horizon of the person, the second type is the expression of the larger social structure and it represents the group's "spirit" which is embodied into the societal institutions. The silent language depicted and analysed by E. Hall is the predominant means of communication of the first type of knowledge; the well

argumented verbal communication according to specialization and to school traditions is the prototypical means of transmitting the second type of knowledge.

Knowledge-of-acquaintance is mostly produced "out-of-awareness"; knowledge-about is purposively sought and often directed by individual and social interests. The first is responsible for traditional anonymous fairy tales, popular religious beliefs, folk traditions and, more importantly, for the cluster of those basic ideas, convictions and linguistically un-framed beliefs which constitute the "world-view" of a people and which are at the core of its feelings of identity.

Knowledge-about is a learned elaboration of knowledge-of-acquaintance through a reflexive thinking which is governed by rules and it is structured and conditioned by social demands. Social structure shapes this type of knowledge, which becomes more or less institutionalized in fields and disciplines, such as theology, philosophy, art, law and natural and social sciences. It is a type of knowledge which is relevant, and often crucial, to the make-up of what is often called the national character.

However, the two types of knowledge are not coincident with the distinction of folk versus elite knowledge and culture. Nor is it true that the first concerns social interactions which are not institutionalized, and the second those interactions patterned by institutional demands. Although the elites predominantly rely on knowledge-about for communication and role performances, knowledge-of-acquaintance is indispensable for their daily social activity. Similarly, formalized patterns of institutional behaviour is mainly based on knowledge-about, but no institution can properly work without a diffuse knowledge-of-acquaintance pertaining to its basic social roles and norms. In fact, the very core of an institution's values are acknowledged and transmitted through personal acquaintance. It is this knowledge-of-acquaintance that conveys the authoritative cogency of a social institution.

Perhaps, the critical criterium that distinguishes the two types of knowledge is that the one based on acquaintance is mostly contextual, while

knowledge-about is predominantly coded in the means used to express and convey the specific content of knowing. The current distinction made in socio-linguistics between contextual and coded meanings of a message fits particularly well what I think is the crucial difference between these two types of knowledge.

**Knowledge-why And Knowledge-how**

The cognitive structure we term "knowledge" is a system of thought whose content are essentially ideas and beliefs. Within a cognitive structure, we may distinguish those ideas and beliefs which are mainly concerning the interpretation, justification and rationalization of the natural and social worlds - usually called Weltanschauungen or world-views - and those ideas and beliefs concerning the explanation of the functioning of these worlds as well as the proper, right or best ways of dealing with them. We should not confuse these last ideas and beliefs with values, norms or judgements, because the former have a cognitive content, while the latter have an evaluating one.

The part of the cognitive structure which is essentially a "world-view" may be termed "knowledge-why"; the part, instead, concerning procedures and manners of dealing with objects, persons or symbols is usually called "knowledge-how". Within knowledge-of-acquaintance as well as within knowledge-about we may distinguish these two components of a cognitive structure. Therefore, from this analytical point of view, we have four types of knowledge, according to the two different distinctions that we have made. The lack of single words in the English language for the first distinction makes the terminology quite burdensome; but we have to differentiate knowledge-of-acquaintance-why from knowledge-of-acquaintance-how, and knowledge-about-why from knowledge-about-how.

Although such a fourfold distinction has never been made in the literature of sociology of knowledge, most of the discussion and theoretical debate had as subject matter one or the other of these types of knowledge, and some misunderstandings could have been avoided if these distinctions had been clearly made. The interpretation of Weltanschauung ("world-view") and some commentary on the work of Karl Mannheim would have profited from it.

While it would be of some importance to point out the sociological characteristics and peculiarities of these four types of knowledge, I have to restrict this presentation to a few comments, namely to those which are theoretically useful for an understanding of technological impact on society and culture.

Knowledge-why is a cognition of the relationship between oneself and the outer world, natural as well as social. A view of the world, in other terms, which is fundamental to the definition of the existential and social situation of a person or a nation. It is a very general outlook and a very persisting one. When we consider knowledge-why at the level of knowledge-about, we are concerned with the whole complex of speculative and theoretically articulated thought - religious, moral, political, economical and social - which constitutes the evident and observable bulk of a cultural heritage. When we consider it, instead, at the knowledge-of-acquaintance level, it is the core of that pervasive cognitive structure which is fundamental for grasping the identity of a cultural tradition. Let me anticipate that no technological transfer, by itself, can alter this basic cultural anchorage.

Knowledge-how, on the other side, is a way of considering objects, persons and symbolic creations as means to dominate the outer world. This instrumental view of the world may be more or less developed within the cultural patterns of a given society, but it is inevitably present. At the knowledge-of-acquaintance level, we find the contextual and never explicitly expressed rules to deal with people, the notions of a trade which can be learned only by observing skilled craftmen, the procedures to use in handling symbolic data which can be apprehended only through the assiduous scrutiny of the intellectual work which is considered exemplar. This is the case even in the most technologically advanced societies: there are rules of interactions which are never spelled out in detail or encoded in standard communicable messages, there are trade-tricks to be learned by apprenticeship even in the most advanced computer soft-ware production, there are procedures for a lawyer's argumentation, for literary mastership, for artistic top level performance, all of which have to be discovered through the attentive observation of the most admired personalities in these fields.

Only when the know-how is knowledge-about, it is easy to be encoded in messages which can be transmitted by formal education and instruction, communicated by verbal teaching, and easily standardized in textbooks. In fact, the prevailing part of the development of science, and in particular of applied science, has been a purposively made effort to elaborate and to transform know-how-of-acquaintance into know-how-about. Formal establishment of new scientific disciplines and the opening of new courses in schools or universities are typical instances of this process, which becomes predominant in those cultures whose "knowledge-why" is particularly oriented toward an instrumental world-view.

**Technological Transfer And Its Impact on Society**

Technologies are constituted of both know-how-about and know-how-of-acquaintance. The former is the body of technical notions and rules for procedures which are encoded in communicable messages and which can be transferred and learned. Instruction manuals for operating technical equipment are prototypical instances of know-how-about. The latter, instead, is the technical knowledge which represents the cognitive content of specific abilities or skills, which require personal experience by apprenticeship or through a sufficiently long on-the-job training. Know-how-of-acquaintance is the most difficult component of a technology to be transferred within a society and across societies. The current way of facing this difficulty is to include in a technological transfer planning, a program of long-term technical "assistance", which is mainly devoted to on-the-job training of personnel. In fact, given that know-how-of-acquaintance is so much rooted in the societal context and in the net of social interactions in which a particular technology was developed, the training program will prove the decisive factor in the success of the technological transfer project.

In a certain sense, it seems paradoxical that the most difficult aspect to be transferred is not the more culturally elaborated know-how-about, but the elementary socially rooted know-how-of-acquaintance. Moreover, when the technological transfer project is successful, the greatest impact is not on a cultural level but on that of primary social interaction. Of course, the extent

of the social impact will depend on the type of technology itself. A major distinction, in this respect, is one seldom made, and that is if the object of the technological process to be implemented are essentially material products, services or organizational structures, or data informational systems. Know-how-of acquaintance is of a kind substantially different when it concerns material objects, relations among people, or symbolic forms.

However, a decisive aspect concerns the kind of correspondence between the know-how-of-acquaintance of the implemented technology with the one which pre-exists in the economic or social context to be innovated. Experts on technological innovation in agricultural production know very well the difficulties which stem from the pre-existing know-how: most of the problems arise from the contextual traditional knowledge-of-acquaintance with which new practices are put into actual use. And rural sociologists who have studied successful planning have recorded a definite change in the personal and social relationships and, with time, of the local community structure.

Technological acceptance does not necessarily mean technological adaptation. Acceptance of a technological process might mean that the know-how-about is received with interest, but adaptation implies that old ways of familiar know-how-of-acquaintance have to be modified and often discarded. The two cognitive structures are definitely different and we need carefully designed studies to reach an adequate understanding of the complex relationships which link the pre-existing know-how with the one requested by a new technological process, on both levels of knowledge-of-acquaintance and knowledge-about.

To sum up the main tenets of this paper, I shall advance some hypotheses which I think should be put to test in this kind of studies. The least relevant impact of technological innovation and transfer on social life and structure will be detected on a know-how-about level of cognitive structures. Changes at this level will affect neither basic social relations nor the core of a culture, which rests on a world-view based on a knowledge-why-of-acquaintance. However, if the know-how-of-acquaintance is little compatible with the one requested by the new technology, its implementation will seldom be successful. In order to change this know-how-of-acquaintance, social interactions have to be modified

and primary social relationships may be substantially modified. Then the overall impact on society and culture will depend on the existing structural relationship between knowledge-how and knowledge-why in the cognitive structure of-acquaintance predominant in a given culture. If this relationship is weak, the introduction of new know-how-of-acquaintance will not affect the fundamental cultural patterns. If this relationship is strong - as it has been the case in western European countries, whose cultures tended to subsume under the knowledge-why any kind of knowledge-how - a fundamental change of know-how-of-acquaintance will have great repercussions on the knowledge-why-of-acquaintance, and therefore on the basic cultural "world-view".

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# SOME CONSIDERATIONS ON TECHNOLOGY TRANSFER

by

Shuhei Aida*

## Eco-technology

Man is master of his environment in all directions. When we look at the long history of man from this view-point, we find that there are essential differences between Japan and Malaysia because of their respective geographical, climatic, cultural and religious conditions.

While the orientals live close to nature, the Europeans tend to add artificiality to nature and come into contact with nature only in this way, then conquer nature itself. In other words, to the Europeans nature is an object of conquest rather than an object of mutual existence.

This contrast can well be understood when we read the history of buildings, which form the environment closest to man. In Europe, the mainstream has been stone and brick structures, while the Japanese and Malaysian traditionally stick to wooden buildings. At the root of the mind of the European peoples lies the desire to add substantial artificiality to the products of nature and extend their living environment in nature; in short, the desire to conquer nature.

It is not too much to say that modern technology has progressed on the basis of the methodology established by Galileo Galilei. Modern technology developed and was disseminated in accordance with Galileo's methods. And today, the intention to initiate a new leap forward is being pursued. In other words, there is an increasing need to expand Galileo's methodology in our civilization.

Up to the present, technology has been the only runner. In considering what technology should be in the future in a dialectical method, we should identify the opposite concept to technology, that is, the ecology inherent in nature. To prepare ourselves for the 21st century, we need a new kind of

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technology that is able to enter into a symbiosis with ecology, that is the essence of nature and human activities and technology. Such a technological process is called "eco-technology", which is the essential concept of the movement of Honda Foundation. In this kind of sense, I will speak about technology transfer.

Technology transfer has become an internationally recognized term; but its objectives and methods are yet to be defined in the world today. My interest in this subject was first aroused during my one-year stay at the Laboratory of Cybernetics, located in the suburbs of Naples in 1970. The Laboratory was founded by Prof. Eduardo Caianiello, and aimed at conducting research on an international scale in the fields of systems engineering.

The research project in southern Italy, in a rural setting, was an experience that I had not expected. Since then, I read papers on technology transfer and appropriate technology, and attended international conferences. In particular, the IFAC (International Federation of Automatic Control)-sponsored symposium, concerning appropriate technology, held in Italy in 1977 was a success, from which I have had much to learn, and it helped my study on technology transfer.

Appropriate technology, in short, is a type of technology with which a country, developed or developing, creates a technology based on the culture, by means of accumulating technological potential. For this reason, the goal for the intellectuals, all of us here today, in the 1980's is the development of appropriate technology in this age of dynamic diversity in ASEAN countries.

In the midst of diversification in the international society, it has become imperative to develop a technological system that harmonizes with the culture, society, and governmental structure. Needless to say, it has to be one that has the support of the people of the area or country and brings prosperity to them through their participation, rather than the mere acquisition of technology from an advanced country for the sake of convenience and profit. In this connection, there are numerous problems, in addition to the inter-cultural communication,

that must be solved. The first step towards the goal begins with the social and cultural aspects and the identification of its scope.

**Discontent And Complaints From Both Parties**

Now, technology transfer will be considered focusing attention on our country. For the Japanese, the counterpart involved is usually the countries in Southeast Asia, Africa, or Latin America. Technology transfer is in principle a bilateral effort; and for this reason, a one-way affair, in which assistance is simply offered, and this rarely produces a lasting effect. Japan's aid to ASEAN countries has been extended only upon request of the counterpart and, hence, has been unilateral and lopsided.

In light of this background, it is very often the case that the greatest impediment to technology transfer lies within the structural framework in Japan. From the outset, our technological assistance overseas has not been done on its own initiative but as reparations in the postwar period. In the initial stages, aid to ASEAN countries, in particular, strongly has such implications. In these countries, modernization had usually been held back by devastation - material or spiritual - of the land and the people, caused by colonial exploitation by European countries, as well as by the scars left over from the last War. Of course, the losses that these countries experienced during the war cannot be ignored, especially for me as a Japanese. The point that I would like to propose is to have an unbiased view of the reality of ASEAN countries as the basis, and to identify these problems as the first step to better relations.

Because of the lack of such understanding, Japan's technological cooperation with ASEAN countries has in the past been quite negligible, with programs providing help only on sporadic and separate occasions, without extending to the high policy-making and academic levels. This indicates the lack of sufficient consultation between Japan and the country involved in dispensing aid, thus stirring discontent and criticism on both sides as cooperation expands in scale.

## Principles Of Development

Recently, I had the opportunity to visit one of the ASEAN countries on a study tour through my association with JICA (Japan International Cooperation Agency). I was greatly impressed by the rapid modernization that was going on in the city, Kuala Lumpur; and saw many buildings that were under construction. The government was actively promoting several projects, enthusiastically campaigning for the needs of the people, as well as showing practical applications on radio and TV through the use of information technology.

Generally speaking, developing countries are seeking help in various social aspects, such as education, medicine, labor and population problems, aside from economic aid in resource development and promotion of industry and agriculture. In addition, expectations are high for aid in the fields of government administration, academia, science and technology. In such a multi-faceted assistance program, the most important thing is the comprehensive agreement of interests of the two parties - the benefactor and the beneficiary. To recognize and understand each other's position paves the way to better relationships.

Until now, Japan's aid to ASEAN countries had been comparable to those of other advanced countries in both quantity and quality, but because of this lack of attentiveness, mistrust on both sides has grown to a regretable state, as it is now. Quite naturally, there are cultural and social differences; and to blindly seek cost and effect for projects simply stirs dissatisfaction and complaints without accomplishing the original objective. Frank discussion of the real intentions of both sides is necessary.

Furthermore, in many instances, Japanese aid programs are designed and drafted in the offices of the administrative government, ignoring the opinions of the field experts sent to the project site. For any aid project - regardless of its size - decisions are made from above. The vertical line of authority is built into the administrative framework, and all plans must follow this line without exception. In other words, there is no horizontal decision-making. The horizontal form reflects the culture of the beneficiary, best. It is very unfortunate that because of this lack, troubles occur in the process of

technology transfer, and discussions to seek solution to problems are limited to the theoretical level.

Basically, technology transfer must begin with a comprehension of the true intentions that lie behind what is upheld as the principle. It should be noted that even if family planning is set as a national goal, what the country really wishes to obtain is development projects based on it. In this manner, every country has to have its "development principles", and the identification of these principles helps to define the problems and to promote candid talks between the two parties. Technology transfer requires a philosophy of its own, a comprehensive administrative framework, a preparatory survey conducted beforehand, a drafting of a general plan and well-thought-out strategies. In other words, the official title of the project is not important. Interpretation of the project is easy as long as it appeals to world opinion. Herein lies the difficulties that accompany technology transfer.

In the flow of operation such as in our government, particularly in the thin, frail line of authority that exists, the administrative government in Japan tends to ignore the culture of the countries concerned, and attempts to control the project from afar, that is from Japan, thus creating anti-Japanese sentiments among the educated in the recipient country, who had gained a knowledge of the Japanese without the respect due to a nation offering development assistance. Making assumptions and creating fixed images, as well as making judgements based on preferences, are complete nonsense, as Machiavelli wrote in his work, "The Prince (il principi)".

## The Specialists

When technological cooperation is given, an important factor is the qualifications of the specialists dispatched abroad. Due to insufficiencies existing within the organizational structure in Japan, the specialist abroad is burdened with disadvantages from the start. Moreover, there are unique problems that stem from the characteristics of the Japanese.

Japanese specialists generally fail to view things in a broad perspective, and tend to make pessimistic observations erroneously when making forecasts of technological development. Specialists from Western countries tend to have a wider outlook and show leadership qualities. This difference probably is based on culture and is the result of our education system, which emphasized the training of specialists and researchers who focus attention on a narrow field of discipline.

There are examples of failures due to this. The construction of an irrigation dam led to the spread of schistosomiasis. In another, a technological breakthrough in heart surgery was allowed to dissipate after a few years to virtually nothing. The fact that the expansion of water channels contributes to the spread of epidemics and parasites has been proven when the Aswan Dam was built in Egypt. Also, the transfer of medical technology piecemeal to developing countries may surely follow the example of Dr. Schweitzer's Lambalene Medical Clinic, which was left to fall in ruin. The relentless effort of the experts sent overseas deserve admiration, and the fruit of their work must be preserved. For that purpose, one must bear in mind the true intentions, and personnel with organizational capabilities are necessary. In short, adjustments must be made for all projects on site from a systematic point of view.

To achieve this goal, the ability to organize data must be nurtured. This involves a reassessment of the effects of technological aid, as well as data gathering on site. At present, attachés specialized in various fields of study are appointed to most embassies and legations overseas. As the first step, they should be trained to acquire expertise to collate data acquired from the right sources. Information that is pertinent can be collated in meaningful ways only by people. Data collected within the framework of a specialized discipline cannot be valuable to human society unless an expert intervenes.

Data gathering, competent personnel, and the ability to transform data into information with relevance and value are indispensable for technological cooperation. Compared to Japan, attachés sent from other countries have demonstrated such abilities as generalists. More weight should be placed on the

training of generalists with skills in handling data and securing talent in this field.

Historically, our country has had little contact with the outside world, and our efforts to understand others have very often been futile. Yet, to understand others, their history, religion and customs and to respect their social structures and public sentiments are important for achieving success in drafting and executing a project.

American aid to ASEAN countries, from transfer of its technological knowledge to assistance in administration of the central government; German aid in the form of project priority analyses, comprehensive project aid, and promotion of labor-intensive agriculture; the French respect for intellectual order and integrated cultural aid from chanson to Concorde; and the Chinese examination of the eight principles of aid are valuable hints on the improvement of our form of aid and training of specialists.

**Emphasis Of The Human Factor Rather Than The Material**

When examining the process of technology transfer, the cultures, such as the concept of royalty, of the countries involved can be discerned clearly. The present form of requests for cooperation still emphasized the material aspect, therefore brushing aside the role of the specialist, however competent he may be. In Japan as well, money is spent on equipment, but human involvement is considered only as ancillary to machinery, though it is indispensable for instruction on the use of equipment and the equivalent as in computer software. The lack of consideration of royalty, for example, only makes the job unattractive to talented people. Worse, the social climate in Japan does not evaluate experience in developing countries - particularly in technology - and discourages people from taking such jobs. This general problem must be given sufficient attention by both parties. I am not the only one who advocates the importance of the human factor, including royalty in cooperation. this may also be true for the beneficiary country. For technology transfer to take roots and mature, the existence of a similarity in cultural characteristics and common technological seeds are essential. The effectiveness of technological

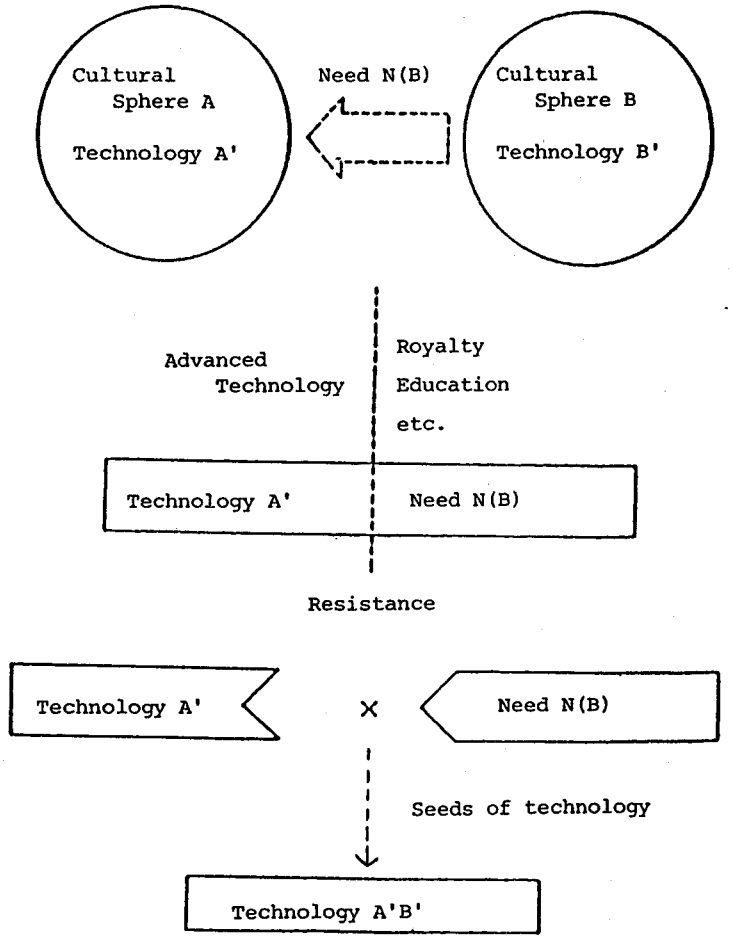
cooperation relies on this premise, even if the country receiving aid asks for sophisticated technology, assistance is bound to fail at modernization if technological seeds do not exist among the people and the request originates from administrative authorities only.

**Beyond The Cultural Gaps**

So far, we have discussed the basic philosophy of technology transfer. In what fields shall we utilize the concepts of eco-technology? In considering dialogues on technology, culture and society, we will need to find ways to link the results of research on, for example, atomism at the molecular level, with the study of holism. In particular, the concept of eco-technology is indispensable when we promote international exchanges. Figure I illustrates schematically the process of forming appropriate technology as in the "Look East" Policy in Malaysia; this theme has been widely discussed in connection with technology transfer.

For example, we assume that cultural sphere A has an advanced technology A', and that a country in cultural sphere B having technology B' wants to transfer the technology A' to the cultural sphere B in accordance with the needs N(B). In other words, the country tries to satisfy the needs N(B) of the cultural sphere B with the technology A'. Great differences will occur if these needs stem from the people or the authorities. Suppose a developing country, in an attempt to accelerate her modernization, wants technical exchanges with advanced countries. In this case, according to the normal scenario, technology A' will create a new technology A'B' from the needs of cultural sphere B, N(B). According to the economic principle, the new technology A'B' ought to be developed in the country with the cultural sphere B so long as the country pays royalties. Royalty is a very important concept to realize in technology transfer. For example, in Japan, we have paid a lot of royalties to the U.S.A. and European countries, and we have made the advanced industrialization as you know. But in reality, things will not go so smoothly. In virtually every case, there will be resistance to the introduction of a new technology. This resistance will emanate from the culture of people.

FIGURE I: "LOOK EAST POLICY"




The Process of Appropriate Technology

Source:

**ARMSTRONG, J.H.** Cultural discontinuities - their effect on technology and development. Proceedings of IFAC Symposium on Criteria for Selecting Appropriate Technologies under Different Cultural Technical and Social Conditions. Italy, May 1979.

Even though the needs of a developing country are great, modernization will face many difficulties if the need is only perceived among the ruling class. This is evident from the recent case in Iran. Therefore, we will find a lot of charts illustrating international relations similar to that referred to above. When there is something essential related to technology common to the giving and receiving countries, especially when the receiving country already has the seeds of technology, technical exchange will become possible between the two countries irregardless of cultural barriers through the development of these seeds. I said "irregardless of cultural barriers" but in fact such exchanges ultimately lead to cultural exchanges. We should, therefore, look for some core technology arising from the culture of the receiving country. We should then design a mechanism or a system for a technological society that will satisfy the needs of the receiving country. This will be required in international relations in the future.

As Figure I shows, Technology A'B' faces cultural resistance. But when there exists an essential seed "S" which will generate Technology A'B' in the receiving country, the seed will reduce resistance or lead to the birth, growth and establishment of a new technology, Technology A'B' then is the appropriate technology for "each culture each technology". This is the meaning of international exchanges taking culture or a dialogue with culture into consideration, and is the foundation of an eco-technology-based scenario of international technology transfer.

Thus the focus is on the training of personnel along with technology transfer. If the other party requests education for its people, it denotes that the country is seriously tackling the task of modernization through technology transfer. Japan in the past promoted education of specialists and acquisition of skills after the Meiji Restoration by paying a lot of tuition, and inviting numerous teachers from the West with lucrative incentives and by sending students abroad. That was the "Look West" policy in Japan.

As mentioned above, the problems relating to technology transfer exist in a variety of levels, but in essence, the emphasis must be laid on the education of

professionals and mastery of technological capacity at the individual and group levels - both of which I believe make up the first step to improvement in the situation.

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# ITALIAN TECHNOLOGICAL DEVELOPMENT AND ITS CONTRIBUTION TO INTERNATIONAL COOPERATION

by

Bruno Grassetti*

The implications of this topic are far more involved than what I can present in a quarter of an hour. However, I will concentrate on those aspects that I consider more relevant to the message I would like to transmit to you here. The core of my presentation falls around the statement that the approach adopted till now, in Italy, for the management of the development process, is no more valid. The development process is more complex than the simple assumption of a dualistic nature, considered till now as a policy basis for the design of public and private action. Some new guidelines and recommendations will be provided for situations similar to the Italian, especially as far as the role played by science and technology in a more effective approach to development problems is concerned.

But let me now inform you briefly about the type of problems we are facing in Italy, in order to make clear the contents of my statement.

Italy is an independent republic since 1870, with a total population of 57.1 million inhabitants in a territory of 301.245 square kilometers, and a per capita income of approximately 5.500 U.S. dollars. It is poor in natural resources but rich in manpower and cultural life.

Italy is also one of the ten partners within the European Economic Community. As far as the subject of our meeting is concerned I would like to remember that Italy is now leading quite an effort towards international cooperation, with a total budget of 1.6 billion U.S. dollars, and with considerably high growth rates in recent years (0.5% of the GNP, and with the political commitment of reaching 1.0% of the GNP in 1990).

During the 1960's, Italy was experiencing an important social and economic progress known as the "Italian miracle". The pillars of the Italian miracle

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were four factors, connected with each other by a circular flow of namely:

(i) "cheap" labour;

(ii) high rates of exports;

(iii) favourable terms of trade for manufactured products; and

(iv) behaviour of market operators convergent to and consistent with the needs of economic development.

Under the pressure of different terms of trade and behaviour of international market operators, Italy is now the object of a generalized change. Italian manufactured exports require an orientation towards products with an increased value added in order to contrast international competition. This change calls for a commitment to technological research and large investments, and requires increased quotas of the available resources for capital accumulation with a reduction of consumption. These changes would obviously bring about several social difficulties.

Special attention was devoted to the so-called: "Applications-Oriented Projects", financed by the National Research Council. Following the general policy guidelines laid down by the Interministerial Committee for Economic Planning, the National Research Council, with the contribution of Universities, public and private Research Centers, undertook a selective research activity in applied sciences and special projects in scientific and technological fields of national economic and social importance.

An "Applications-Oriented Project" is a planned group of activities set up with the intention of applying knowledge, already acquired or which may be acquired rapidly, to concrete problems, and making the results readily available to suit national requirements.

The first attempt on the part of the CNR to organize and promote scientific solutions to economic and social problems, dates back to 1964 when seven "Special Projects" were launched. These were concerned with: water supplies (especially desalination), industrialization of the building industry,

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mechanization of agriculture, marine resources development, automation of the engineering industry, and development of national energy resources.

Apart from the importance of the technological results obtained, at least one other objective has been reached in that scientists and technicians are now more aware of the problems which have a direct bearing on national needs. This has made the establishment of new organizations and the training of young scientists possible.

Given the nature and the magnitude of the problems dealt with, the first "special project", other positive "fall-out" ensued; there was an improvement in collaboration and coordination between scientific establishments and the setting up of a more rationally planned long-term scientific research structure with an interdisciplinary approach.

The total amount of financial effort for the "Applications-Oriented Project" may be evaluated as much as 120 million U.S. dollars in five years.

The main fields were:

(i) food resources and technologies;
(ii) human health;
(iii) environment;
(iv) advanced technologies; and
(v) energy.

Given these technological and social transformations, Italy today accounts for:

(i) the most advanced labour legislation in the world;
(ii) preventive and curative medical assistance (free for all);
(iii) the most extensive pension legislation; and
(iv) compulsory education for all up to university degree.

Such outcomes are not reached without mistakes and conflicts, but the democratic maturity of our institutions have been able to overcome the difficulties.

Together with the commitment of a new technological policy at the national level, Italy continues to face the development problem of Southern Italy. After 30 years of a special effort of 30 billion U.S. dollars (that is 1.0 billion U.S. dollars each year), many aspects of social and economic development are still waiting for an effective solution, and the distances between the northern part of Italy and the developing southern one are still there.

The total population of the "Mezzogiorno" is 19 million inhabitants (33% of the total population) on a surface of 123.045 square kilometers (41% of the national territory) with a per capita income equal to 65% of the national figure. In this area you can find several highly populated centers like Naples, Palermo, Catania, Bari, etc.

As pointed out earlier, the special disbursement through the specialized agency called "Cassa per il Mezzogiorno", amounted to 30 billion U.S. dollars in 30 years, which is 30% of the total capital expenditure in the area. The investments of the "Cassa" in the industrial sectors were in the range of 35% to 75% each year in the 30 year period, while the investments in infrastructures were in the range of 0.75% to 1.15%; while referring to the gross product of the area, it was in the range of 3.5% to 4.5%.

During the period 1950-1980, the main policy guidelines of the development of Southern Italy were the following:

(i) financial support of agricultural activities and infrastructures connected with soil defense and water supply (with a share decreasing in that period from 60% to 32% of the total resources involved);

(ii) financial incentives for the location of manufacturing plants (with an important increase from 8% to 35% in the period);

(iii) redistribution of income with a financial support through the channel of public administration.

It is worthwhile to remember that the role of state-owned enterprises was as great as 30% of the total capital expenditures in Southern Italy, versus a range of 10% to 18% in the rest of the country.

The main effects of the development policy of the Southern Italy Development Fund may be summarized as follows:

(i) priority to chemical as well as to metallurgical industries not following a "development policy" as such, but rather an "availability approach" based on technological fragmentation (this simply means "poor planning");

(ii) increase in the share of public funds, given "a posteriori" more for redistribution purposes than for productive purposes; and

(iii) location of plants as subsidiaries of firms located in the Northern part, instead of location of enterprises with a local management responsible for decision making.

The main issues resulting from the Italian experience may be summarized as follows:

(i) the development process needs a global approach more than a sectorial one, and a diffused process more than a concentrated one;

(ii) agricultural and natural resources sectors are playing a primary role in sustaining all aspects of the development process;

(iii) capital expenditure in the manufacturing activities needs an effort in associated investments (for infrastructure, housing, education, etc.) approximately 3 to 3.5 times greater than the present one; and

(iv) investment in technology must be understood as an investment in human resources (i.e. in know-how) more than simply in machinery and equipment.

While apologizing again for such a concise description of the Italian situation on the basis of the picture outlined above, let me point out some indications concerning the new type of approach towards development problems that we are adopting in Italy. Now, I will briefly indicate why science and

technology is playing such a central role in this new approach, and finally how this experience may be offered to other countries with similar problems.

I suggest we consider three words, namely:

(i) catalytic;
(ii) monitoring; and
(iii) network;

as a description of the proposed approach.

**Catalytic** is a term indicating that the managing behaviour promoting the active and direct participation of the parts involved in the development process, is more effective than a guided "top-down" type of policy (even if it is difficult to put it into practice). With a jargon familiar within our computerized environment, we may say that attention must be given to software more than to hardware. At any rate, "hardware" must be understood again as an investment in human resources (i.e. in know-how) more than simply in machinery and equipment.

**Monitoring** is a term that indicates the necessity of a continuous measurement of the economic and social behaviour of the development process, adopting an information system that must be tailored and up-dated according to the characteristics of the system taken into consideration.

**Network** means remembering the fact that a diffused distributed structure of productive units connected with a network for the exchange of materials, information and energy, is more effective than a "concentration type" of policy with a single-line of communication connections.

As far as the Italian experience is concerned we are assigning the following meaning to the three terms above mentioned. First, as far as the "catalytic function", the Special Fund (Cassa per il Mezzogiorno) is reducing its financing role, moving to a "consulting" type of activity, directed to the local administration and to single grouped firms (consortium). The promoting agency (IASM) is transforming its role toward a technological agency similar to ANVAR in France.

The "monitoring function" is in progress, with an effort to a more disaggregated type of periodical surveys. A contribution from computerized information system, specialized in the Mezzogiorno problems, is also expected to improve the effectiveness of the decision-making process at the policy level.

The "networking function" is also in progress with the promotion of new local universities and of special programs of discussion meetings for consultative purposes among the various actors of the development process. The importance of human resources improvement is particularly stressed by the networking function.

Also, special attention is given to the connections with the "finalized projects" of the National Research Council, which is an important R and D effort at the national level, for a total amount of 4.0 billion U.S. dollars in 1983. This action is showing the importance given to science and technology in the approach presently adopted in Italy for development problems. The role given to science and technology in managing the development process is following the invitation of the United Nations since the Vienna Conference in 1979, assigning priority to science and technology in the Third Decade of Development.

Often, this action is included in a framework of "interdependence", in order to emphasize the "global village" type of approach. In this case it may be worthwhile to remember the exercise done by a research team within the ENI Group (the State-owned financial holding for petroleum-connected activities). The positive effects of interdependence between OECD and OAPEC communities are shown in the following table:

| | GROWTH RATES 1980 - 1990 | |
|---|---|---|
| | SCENARIO NIC | SCENARIO CIC |
| GNP OAPEC | 4.4 | 7.2 |
| GNP OCDE | 2.4 | 3.2 |
| INVESTMENT OAPEC | 6.4 | 11.1 |
| INVESTMENT OCDE | 2.4 | 3.8 |
| EMPLOYMENT OAPEC | 2.1 | 3.5 |
| EMPLOYMENT OCDE | 1.1 | 1.5 |
| PETR. PRODUCTION OAPEC | 0.3 | 1.4 |
| WORLD COMMERCE | 3.3 | 4.5 |

Note:

NIC - NEUTRAL INTERDEPENDENT COOPERATION
CIC - COOPERATIVE INTERDEPENDENT COOPERATION

In conclusion, we are convinced that the experience we are having in Italy may be of interest for many other countries.

As far as the action is under our responsibility, we are adopting the guidelines indicated above. We are making reference to the action of the Italian Committee on Science and Technology for Development, an agency created by the Ministry of Science and Technology in agreement with the Ministry of Foreign Affairs, with the aim to promote and coordinate the Italian effort on science and technology development.

The main concept of our action is the promotion of endogenous capacity of absorption of developing areas as far as technology is concerned, devoting special attention to the cultural and environmental condition of the area concerned. As far as the management of our intervention, we are giving priority to financial organizational and managerial aspects, avoiding conflicts with sectorial interventions carried out by specialized agencies. Our programs are mainly developed in connection with the activities of the Financial System of the United Nations for Science and Technology for Development. We are aware of the fact that this challenge is calling for a long path. As the poet is

remembering and as the nature around us here in Kuala Lumpur is showing, the beauty of a flower is the final event of a process beginning with a good preparation of the ground. This is why we are optimistic.

# INTERNATIONAL TRANSFER OF MANUFACTURING TECHNOLOGIES AND CORPORATE CULTURE

by

Yoshihiro Tsurumi*

## The Japanese Paradox

From semi-conductors to machine tools and robots, and from automobiles to color television sets, American manufacturing firms are fleeing the U.S. And yet, their Japanese competitors are increasingly opening their own new manufacturing operations in the U.S. Other Japanese firms have already turned around successfully the unionized factories in the U.S. which their former American owners abandoned as uneconomical. All these examples belie American executives' popular excuses that high wages and rigid union rules make manufacturing operations uneconomical in the U.S. How can we explain then, this Japanese paradox? With essentially the same product and production process technologies, Japanese competitors are succeeding at what their American competitors failed in the U.S. (Tsurumi, 1983b).

For over two decades, at the first sign of intensifying price competition even in the growing U.S. market, one American manufacturer after another closed down their plants in the U.S. and moved their production operations to lower wage countries like Hong Kong, Taiwan, Mexico, Malaysia, and Korea. For example, from 1970 to 1980, General Electric alone has created about 30,000 jobs outside the U.S. and laid off permanently about 25,000 American workers, engineers, and managers. At the same time, for about a decade, Japanese and European manufacturing firms have also been expanding their manufacturing operations in Southeast and Northeast Asia and Latin America. And these manufacturing operations of Japanese firms outside Japan are increasingly being linked up with one another through diverse arrangements of cross-hauling of goods, technologies, trained man-power, and services among their networks of parent-subsidiary units.

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All these investing and trading activities of Japanese, European, and American multinational firms have confronted many developing host-nations not only with the problem of selecting only those foreign direct investments which are beneficial to the economic development of the host-nations, but with the problem of selecting the useful corporate culture which the modern corporations of the host-countries could emulate. In other words, the developing host-nation must now screen foreign direct investments not only on the basis of their products and proposed ownership patterns, but more importantly on the basis of foreign multinationals corporate culture. Without flexible and human resource-oriented corporate systems, many firms in the developing countries may well find themselves saddled with dead-end operations that have little prospect for technological and economic growth.

**Flexible Manufacturing Systems (FMS)**

In order to avoid being saddled with dead-end operations, corporations must develop flexible internal structures which can adjust themselves quickly to dynamic changes in their technological and marketing environment at home and abroad. Many American firms have failed to develop such flexible corporate and manufacturing systems while many Japanese firms have fortunately succeeded. The FMS corporate culture and its proprietary institutional skill have produced the Japanese paradox mentioned in the preceding section. And the rigid corporate systems of many American firms have been found as the single most important cause of the declining international competitiveness of the U.S. industries (Reich, 1983).

The FMS corporate system can best be illustrated with Japanese and American comparisons of the automobile production. For example, the Suzuka Plant of Honda Motors of Japan is just as modern and automated as the Lordstown Plant of General Motors in the U.S. And both plants are producing subcompacts on a comparable scale of production. The similarity ends here, however. While Honda's Suzuka Plant in Japan easily tops over 110 cars per hour with impeccable workmanship, General Motors' Lordstown Plant in the U.S. barely completes 75 cars per hour, many of which had to be recalled for their defects (Tsurumi, 1983a).

## CORPORATE CULTURE

Table I summarizes the U.S.-Japan comparison of automobile manufacturing systems. It is a well-known fact that the manufacturing systems of Japanese firms have attained superior productivity simultaneously with quality (Deming, 1967). This systemic difference between American and Japanese corporate culture is captured in Table I. The Japanese production systems are more capital-intensive (because of a greater degree of automation) than their American counterparts. More importantly, the length of machine set-up time of American factories is adjusted to the length of production runs, while the Japanese have developed a manufacturing system that strives to minimize the machine set-up time regardless of the length of production runs.

While American factories separate quality control functions from actual production, as evidenced by the ubiquitous presence of quality inspectors, Japanese factories have almost eliminated their quality inspectors by holding production workers responsible for product quality. As shown by General Motors' inventory level, the firm uses inventories to cushion the uncertainties of market demands and uncertainties of delivery and product quality of over 3,000 suppliers. Toyota, Honda and other Japanese auto firms have almost eliminated their inventory by using the flexibility of their own production scheduling and by developing an organic support network of far fewer suppliers who are trained and rewarded to produce zero-defect parts. This flexible manufacturing system (FMS) has been developed by now to become Japan's distinct institutional technology. Naturally, this FMS can be sustained only when factories manage to keep their employees' daily absenteeism and annual turnover rates to a bare minimum and only when rank-and-file employees in factories and offices do not resist any technological innovation such as robots, new quality control methods and customer services (Baranson 1983). The FMS-based system does not, therefore, threaten the job security of corporate personnel from top to bottom. And in Japan, the corporate culture that is a prerequisite for the FMS has developed rather recently after World War II (R. Tsurumi, 1983).

Unfortunately, however, many executives, government policy makers and academics in the U.S., Europe and developing countries mistakenly equate the FMS with mechanical automation (a mere substitution of robots and machines for human labor). It is true that even today over three quarters of industrial robots in use in the world are found in Japan. But this fact should be interpreted to mean that the firm must develop its FMS-based corporate culture before it introduces the first robot. In other words, robots and other machines will be

TABLE I: U.S.-JAPAN COMPARISON OF AUTO MANUFACTURING SYSTEMS, 1981

| | U.S. | JAPAN |
|---|---|---|
| 1. Parts stamped per hour | 325 | 550 |
| 2. Manpower per press line | 7-13 | 1 |
| 3. Time needed to change dies | 4-6 hours | 5 minutes |
| 4. Average production run | 10 days | 2 days |
| 5. Time needed per small car | 59.9 hours | 30.8 hours |
| 6. Average daily absentee rate | 11.8% | 3.5% |
| 7. Average annual employee turnover | 15-20% | 2% |
| 8. No. of quality inspectors | 1 per 7 workers | 1 per 30 workers |
| 9. Inventory/gross sales | 16.6% (GM) | 1.5% (Toyota) |
| 10. No. of suppliers | Over 3,000 (GM) | 300 (Toyota) |

Source:

Items 1-5 and 8 from Reports of Harbour & Associates, Detroit, 1982.

Items 6, 7, 9 and 10 were computed by the author on the basis of industry data.

best utilized when they are applied to the existing FMS corporate culture. And the FMS corporate culture encourages even the lowest ranked employees to participate in managing and designing their own work place. In this regard, I find the comments of Soichiro Honda, the founder of Honda Motors in Japan, to be particularly informative. Honda was heard to observe after a visit to an automobile plant in Detroit about two decades ago:

> "... One thing that struck me was how the worst workers were in jobs like casting. Casting shops have poor working conditions. They are hot and dusty, so none of the better workers wanted to go near them. Traditionally, only workers who had no other choice, such as disadvantaged blacks, would take these jobs. But metal castings and other basic materials are really the most important elements. If these materials are poorly made, there is no way that you can produce a good product. Take engine blocks, for example. If the metal isn't cast properly, you have to add another process for drilling holes or filing. And that means you have to buy another expensive machine. Then, after that you discover that they still have pinholes and can't be used..."(Sakiya, 1979).

In order to solve this problem at his own plant, Honda collected many ideas on casting and welding from his workers. As a result of this participative management, Honda equipped his welding and casting shops with machine tools. This arrangement permitted Honda workers to proceed directly to the next process of machining operations as soon as the fittings were welded or cast. This scheme was a real challenge to common practice at the time, since the sand used in the casting shops leaked out of the machines. And sand is the greatest enemy of precision machine tools. Eventually, Honda and his workers developed a method for preventing the sand from escaping from casting and forging machines.

Table II shows the superiority of the FMS by pinpointing major sources of the much talked-about cost difference between Japanese and American subcompacts. In Table II, we should see that 49 percent of the net cost difference came from the difference in the production process yields and that the next most important factor, 34% was the human resource factor. All told, 83% of the unit production cost difference between Ford and Mazda were due to the institution-related technology of Japan's FMS management. On the other hand, the automation and

TABLE II: SOURCES OF PRODUCTION COST DIFFERENCES: A COMPARISON OF MADZA (TOYO KOGYO) AND FORD MOTORS COMPANY, 1981.

| | | | |
|---|---|---|---|
| Labor per Vehicle | 47.0 (Mazda) Hrs. | | 112.5 (Ford) Hrs. |
| Cost Difference per Vehicle | | $1,304[a] | |
| Sources of Cost Difference | | | |
| Plant Engineering | | 49% | |
| Process yield | 40 | | |
| Quality control | 9 | | |
| Technologies | | 17% | |
| Automation | 10 | | |
| Product engineering | 7 | | |
| Human Resources | | 34% | |
| Absenteeism | 12 | | |
| Broader job categories and lesser supervision | 18 | | |
| Production rates | 4 | | |
| Total | | 100% | |

[a] This was computed when the yen/U.S. dollar rate was ¥210/$1.00 in 1981.

product engineering merely contributed 17% of the total cost difference. And the factors called "Plant Engineering" are nothing but the cumulative results of widespread participation by rank-and-file workers in their own production decisions.

## Corporate Culture Of The FMS

Corporate culture and its internal structure of modern corporations worldwide can be classified essentially into two models: Models A and J (Richardson and Ueda, 1981: pp. 5-13; Tsurumi, 1979). Model J type firms are found predominantly among Japanese and American manufacturers whose business environment is characterized by high technology, global competition, and rapid market growth. Unlike Model A type firms, which include many American firms involved in mature technologies and markets, Model J firms share such internal characteristics as follows :

(i) management is committed to the job security of employees;

(ii) corporate goals are shared throughout the firm;

(iii) lateral and informal communication is more free across divisional or functional boundaries of the organization;

(iv) longer time horizons are common at all levels of the firm; and

(v) management promotion from within is normal. The famed Quality Control Circles and other Quality First practices of Japanese firms are natural outgrowths of their postwar management philosophies.

Another important attribute of the Japanese manufacturing system is the minute division of tasks among the firm's support groups. In addition to the keiretsu groupings of postwar Japan, each large firm has created around it hundreds of related support firms and subcontractors. It is not uncommon for large manufacturing firms like Nippon Steel, Hitachi, Toyota, Honda, Matsushita, and NEC to have from 80 to 200 related firms that comprise organic support systems. These related firms or cooperating firms are not necessarily subsidiaries of a core large firm. However, over the years, each large core

manufacturing firm has developed a cluster of related supplier-firms so that the division of tasks can be exploited to the greatest advantage of the group. By sharing long-term production goals and necessary technical know-how between supplier-plants and customer-plants, the group synchronizes production schedulings for support-member firms. This system lies behind the famed "just-in-time delivery system" where supplier-plants deliver necessary supplies to appropriate sections of the customer-plant's production processes "just in time" for production. Rather than the unit prices of supplies, zero-defect quality and timely delivery are the two overriding variables which are considered by industrial customers in their selection of supplies.

In fact, this kind of industrial group approach to economic growth is found effective in the U.S., Japan and throughout the world. Industrial groupings function as effective internal markets of capital, technology, trained manpower, and management skill. In particular, the domestic diffusion of all three kinds of technologies, product, production process and institutional skill, is facilitated by keen competition at home and abroad between different industrial groupings (Tsurumi, 1982a).

As the market competition intensified in Japan among seven auto firms throughout the 1970s, Japanese auto firms invented and perfected flexible manufacturing systems (H. Tsurumi and Y. Tsurumi, 1983). And these technological innovations of both production processes and corporate management skill spread to such other batch-system production operations as consumer appliances, IC chips, machine tools, and electronics and precision equipments. These innovations enabled many Japanese firms to attain two goals simultaneously - high productivity and zero-defect production that permit the firms to cope quickly with whimsical shifts in market demand at home and abroad without losing production efficiency.

The superiority of the Japanese FMS underlies the Japanese paradox in the U.S. market that I discussed earlier. In addition, in 1980, the American IC chip industry was shocked into changing its own manufacturing system when the worst Japanese IC chips of 16K RAM were still found six times more reliable than the best American products (Hadley, 1981: pp. 55-56). In 1982, the American IC chips makers learned that their Japanese competitors have twice better product yield rates (The Wall Street Journal, 1982). Furthermore, from 1981 to 1983, as the American demand for 64K RAM IC chips unexpectedly soared, American firms'

rigid manufacturing systems ran into production bottlenecks and product defects. The resultant market void was filled by Japanese IC chips. In 1983, American air conditioners were found to show about 70 times more failure rates than the comparable Japanese makes (Garvin, 1983). The widening merchandise trade gap between the U.S. and Japan in favor of Japan merely reflects inferior manufacturing system and obsolete corporate culture of many American firms.

**Multinational Firms As Agents Of Technology Transfer**

Unlike discrete product and production process-related technologies, the institutional technology of FMS-based corporate system and culture can best be transferred across national boundaries by the proprietary developers of such institutional technology, namely, many Japanese multinational firms and a selected few American and European multinational firms (Vernon, 1980; Tsurumi, 1976).

Once the FMS-based manufacturing system and its accompanying corporate culture are transplanted in a developing country by a multinational firm, the host-nation needs to expand the secondary diffusion of the FMS-based corporate culture into the local industrial sectors. Again, this secondary diffusion can best be attained through organic supplier-customer networks. In other words, either through joint venture partners or through independent local suppliers, the host-nation must promote the fundamental management mind-sets of the FMS-based corporate culture that are devoted to the long-term growth of their business through technological innovations and participation in the international trade.

Model A type of corporate culture that dominates many American firms reward executives who, at the first sign of business difficulty, ditch their employees and salvage their equipment. In contrast, Model J type of corporate culture that characterizes many Japanese firms demands executives to save their human resources. If they must immediately lower personnel costs, many Japanese executives cut their own salaries first rather than lay-off their employees. They strive to lower costs and improve their product quality by building more flexibility into their production systems through automation and worker retraining. In other words, Model A type of corporate culture treats human labor as disposable costs while Model J type of corporate culture treat human

labor as the most renewable human resource. And this human resource-based approach of firms has been found effective in aiding the economic development of any nation.

**Conclusion: Appropriate Government Policies**

Once we recognize the importance of Model J type of corporate culture for the economic development of any nation, we must outline basic framework of appropriate government policies that nudge firms away from Model A type of behavior toward Model J type of behavior. The experience of Japan and the U.S. again, offer useful guides to this policy formulation.

First, throughout the educational systems from primary to graduate school training, pupils and students must be taught the importance of getting their hands dirty in actual works with their own hands including daily cleaning of their class rooms and even school toilets. In social studies, business, economics and engineering training, pupils and students must be encouraged to think that they do not join businesses to make money but to contribute to make products and services like steel, motorcycles, retail, banking and international trade. Naturally, from primary school to high school, an increased skill and knowledge of mathematics, sciences, world history, world geography, foreign languages, reading and writing must be imparted to students. Pupils and students must be encouraged to think for themselves. In this regard, the developing nations can ill afford to imitate the dreadful American invention of pedagogy, namely, multiple choice type of examinations. Instead, pupils and students must be taught to think out their own answer in a complete sentence and logic in their own way.

Second, tax cuts, export assistance, government procurements, and other forms of industry and firm-specific assistances of the government must be explicitly linked to such proven behavior of firms as :

(i) increased R & D investments and plant modernization;

(ii) stable employment level and continuous retraining of the workforce; and

(iii) export performance.

Third, the government must involve business, labor, mass media and academic sectors in discussing and formulating the economic goals of the nation. Unless business and labor sectors participate meaningfully in formulating broad framework of their own national goals, they will not be motivated to develop a long-term view of their own business ventures. Without such long-term view of business venture, Model J type of corporate culture will not develop.

Fourth, to the extent that a developing economy chooses to encourage foreign multinational firms' investments, their corporate culture must also be evaluated on the basis of whether or not these multinational firms are transferring their dead-end-jobs. One acid test of such corporate culture would be to see how eager a given multinational firm is to train its local managers and employees and its local suppliers.

Fifth, an exposure to the global market competition provides an incentive for firms to keep their organizational structure flexible enough to cope with dynamic shifts in foreign demand. Accordingly, the developing countries will have to aid the emergence of their own general trading firms patterned after Japan's sogoshosha. Even the U.S. has belatedly recognized this need and enacted the Export Trading Company Act in 1982 (Tsurumi, 1980). And the success of general trading firms depends on their ability to develop Model J type of corporate culture.

In short, without proper Model J type of executive mind-sets guiding important industrial and mercantile activities of the nation, no amount of government's economic and technological policies would aid the social and economic development of the nation. Policy makers of both business and government circles must clearly understand how important it is for them to promote appropriate corporate culture. Once Model J type of corporate culture is in place, the rest - the emergence of international competitive operations - follows.

Unfortunately, government, academic and business sectors of the U.S. have let their institutions drift toward rigid systems of Model A style. The declining industrial strength of the U.S. today should serve as the warning to all of us.

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# THE TRANSFER OF TECHNOLOGY IN THE IRON AND STEEL INDUSTRY OF MALAYSIA[1]

by

Mohamed Ariff*

## Introduction

The iron and steel industry has long been regarded as a strategic industry because of the vital role it could play in the industrialisation process. Indeed, Japan and Brazil have considered iron and steel as the "motor of industrialisation". Even in Malaysia, where the iron and steel industry is a relatively newcomer, the economic importance of the industry is already being manifested as a major input into the manufacturing industry, directly or indirectly. The strategic importance of the iron and steel industry is reflected in the public policy towards the industry in many countries, including Japan, Brazil and Malaysia. It is evident that the Japanese iron and steel industry could not have reached the present supreme position without the government support especially in the 1950s and 1960s.[2] In Brazil, the involvement of the government in the development of the iron and steel industry

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2 In a conscious effort to promote the steel industry, Japan first nationalised the industry between 1951-1955, closing obsolete plants in the process. In the second phase (1956-60), new large scale coastal plants were built. The government-owned banks provided soft loans, while the industry was also assisted by favourable tax treatments and generous allocation of foreign exchange.

was even more direct and active.[1] Malaysia is no exception in this regard, as shown by the government promotion measures including fiscal and infrastructural incentives offered to the industry in general and government equity participation in the case of the largest integrated steel mill, i.e. the Malayawata Steel in particular, although the degree of government involvement pales somewhat in comparison to both Japan and Brazil.

The iron and steel industry in Malaysia may be classified into :

(i) the production of basic iron and steel products; and

(ii) the manufacture of fabricated metal products. The former accounts for about nearly one-half of the total gross value of the output of the industry in Malaysia. Ingots constitute about 75% of the output of crude steel products. The main fabricated metal products are structured metal products, tin cans and metal boxes, and wire products. It is of interest to note that about 65% of the fixed assets in the industry consists of machinery and equipment. This proportion is as high as 73% in the basic iron and steel industries.

The industry has performed fairly well in terms of growth of output and employment. It is of relevance to note that a part of the industry output is exported. During the period 1970-1980, exports grew at the annual rates of 14% in terms of volume, and 55% in value terms, although Malaysia continues to remain a large net importer of iron and steel products. It is, therefore, not surprising that the bulk of the industry output is marketed locally.

The industry owes its existence in Malaysia not only to the generous government support but also to the successful transfer of technology. Technology transfers have been effected mainly through foreign equity participation in the industry, although "unbundling" of technology has also been

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[1] In addition to indirect support through the provision of physical infrastructure facilities and fiscal incentives, the Brazilian government has also had direct equity participation in the industry.

resorted to. The present paper focuses on the transfer of technology, both hardware and software, in the iron and steel industry in Malaysia.

There are 7 rolling mills in Malaysia with a total rolling capacity of about 500,000 tons per annum. Three large mills, namely Malayawata Steel Bhd. (MSB), Amalgamated Steel Mills Sdn. Bhd. (ASM) and Antara Steel Mills Sdn. Bhd. (ASMSB) account for nearly 87% of the total capacity. The other four mills are relatively small with plant capacity ranging from 18,000 to 30,000 tons per annum. All these mills concentrate on the production of non-flat products which are used mainly in the construction industry in Malaysia.

The iron and steel technology has been sourced mainly from Japan, West Germany and Italy. During the 1970s, a total of 26 technical agreements were signed by the steel mills in Malaysia with 8 countries viz Japan, the United Kingdom, West Germany, Italy, India, Australia, Hong Kong and Canada. It is of interest to note that Japan accounted for 9 of these agreements.

**Hardware Technology**

The plant capacity of even the largest integrated iron and steel mill in Malaysia, MSB, is somewhat small by modern international standards. Its planned capacity of 180,000 tons per annum pales in comparison to the Japanes mills which produce one to two million tons of output per year, and the largest iron and steel mill in Brazil (USIMINAS) which has a capacity of 2.4 million tons a year and which plans to increase its capacity to 3.5 million tons a year.

The construction of MSB's mill at Prai was carried out in 2 phases. The first phase was completed in August 1967. Equipment for the first phase was supplied by the Japanese at the estimated cost of M$40.5 million and consisted of a D.L. Sintering plant, a 170 T/D blast furnace, two 12 T/C L.D. converters[1]

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1 The L.D. process, which is known for the short tap-to-tap heat cycle, uses a larger amount of hot pig iron than does the open hearth method, while the scrap content is limited to about 10% to 30% of the charge. The capital cost of an LD furnace is, much lower than an open hearth furnace, with capital savings ranging from one-third to more than one-half depending on the capacity.

for steel making, a reheating furnace, a roughing and finishing rolling mill and an oxygen plant. In addition, auxiliary service facilities such as maintenance, power, water, transportation, analysis and testing were also built in the first phase.

The second phase expansion, which began in 1969 and ended in 1972, included the construction of the No. 2 Blast Furnace, modification of the rolling mill, No. 2 oxygen plant, installation of an Electric-arc Furnace,[1] a continuous casting plant,[2] a slitter line, a cold forming line, a slit bar line and additional auxiliary service facilities. Under the modification programme which commenced in 1973 and aided in 1975, No. 1 Blast Furnace was enlarged and relined and the rolling mill was modified to increase its capacity. Reference may also be made to the pollution control devices which have been installed at MSB at the cost of a few million dollars.

It is pertinent to note that all these were done with Japanese machinery and equipment and with the direct involvement of Japanese personnel. It is interesting to observe that the second rolling mill which is currently being installed at MSB, unlike the first one, is carried out by MSB's own personnel, with Nippon Steel Corporation (NSC) acting only as a consultant. The second rolling mill is designed to have greater automation and larger capacity than the first mill. With the installation of the second rolling mill the total capacity of MSB would rise to 500,000 metric tons a year.

That Japan has played a key role in the technology transfer in the case of MSB is not surprising in view of the fact that Japan has accounted for 39% of its equity. The above transfer of the Japanese iron and steel technology was not effected without due regard to the local needs and resource endowments. On the contrary, it was adapted to rely almost entirely on local raw materials,

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1 In Brazil, Electric-arc Furnaces are found in many semi-integrated steel mills. Some integrated steel mills also use them in the production of certain lines of special steel products. Electric furnaces are usually charged almost exclusively with scrap.

2 The continuous casting system represents a significant labour-saving introduction, as it bypasses the ingot preparation and casting stage in the steel shop and the initial blooming process in the rolling mill.

except for the ferro alloys (ferro-manganese and ferro-silicon) which are imported from India and Japan. All the iron ore, a high-grade haematite, comes from the mines in Kedah, Perak, Johore and Pahang, while limestone is supplied from the quarries in Perak. Charcoal for the mill is manufactured from waste rubber wood in the six charcoal kiln centres built within a radius of 50 miles from the steel mill.[1] It is of interest to note that charcoal is seldom used in the Japanese iron and steel mills. The use of charcoal instead of imported cooking coal made economic sense,[2] since the price of cooking coal had increased three times.

The hardware technology for the second largest iron and steel mill in Malaysia, ASM, which is located in Kelang, came from multiple sources. The hardware for this mill, (which is a joint venture with Malaysian, Singapore and Hong Kong capital) in the initial phase was supplied by Danieli C.S. p. A of Italy. By 1980, in the second year of production, it was already producing 124,000 tons of wire rods which amounted to 83% of its installed capacity. Encouraged by the success of its first rolling mill, ASM is in the process of implementing its expansion programme. ASM has set up a steel meltshop comprising an electric arc-furnace (with water-cooled panels) and a continuous casting machine to produce steel billets from scrap, entailing an investment of M$50.5 million in fixed assets. The mechanical works for the steel meltshop was supplied by Danieli of Italy while the complete electrical works including a sub-station came from Switzerland. It is of interest to note that the 70-ton electric arc furnace in the steel meltshop represents one of the largest single unit steel-making vessels in Southeast Asia incorporating the latest developments in arc-furnace technology. The other special features of this meltshop include a six-strand continuous casting machine capable of producing billets of 100-160 m square, a scrap baling press for compressing light scrap,

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1 An efficient kiln converts 7 tons of rubber wood into 1 ton of charcoal.

2 A study undertken by Japanese experts had considered various processes such as the combined rotary kiln-electric smelting processes, the blast furnace process using imported coal and the blast furnace process using charcoal. The experts concluded that the last named process was the most economical. The success of the blast furnace operations in Brazil using charcoal from Eucalyptus wood provided confidence on the outcome of the study.

and an electrical substation with Flicker Compensation Equipment which prevents fluctuations in power supply. It is of interest to note that ASM is the first steel mill in Malaysia to install an environmental protection system for the extraction of fume.

The above iron and steel technology has rendered ASM one of the largest consumers of electricity and water in Malaysia. Steel scrap and sponge iron are the raw materials for the electric arc-furnace, and ASM imports about 70% of steel scrap as the local supplies are inadequate.

ASM is installing a second rolling mill with a production capacity of 150,000 tons per annum for 5.5 mm diameter rods, involving an investment of M$40 million, under the second phase of its expansion programme. It is of interest to note that the hardware technology for this second rolling mill is being secured from a variety of sources, namely, Danieli C.S. p. A of Italy, Moeller & Neumann GmbH of the Federal Republic of Germany, BBC Brown Boveri & Co. Ltd. of Switzerland and Sunds Defibrator S.A. of France. The second rolling mill which represents a more modern tandem mill equipped with programmable logic controls, is the first of its kind in Southeast Asia, capable of running at a final speed of 75 meters per second for 5.5 mm diameter rods. Another salient feature of the second rolling mill is that it is very versatile as it can produce various grades of steel with a carbon content ranging from low to high.

The third largest iron and steel mill in Malaysia, ASMSB, is a joint venture with a 40% foreign equity participation. The Kloeckner Industrie-Anlagen of West Germany and the Islamic Development of Jeddah, Saudi Arabia, have taken up 20% of the equity each. ASMSB's M$35 million plant, located in Pasir Gudang, Johore, began commercial production in April 1981. Its rolling mill, which is one of the smallest in the world, is designed to produce 50,000 - 80,000 tons per annum. All machinery for this mill were supplied from Italy with the exception of a billet cutter which was imported from West Germany. The burners came from Forni Combustione of Geneva, Switzerland, while the control equipment for the rolling mill have been sourced from CEDA Spa of Italy. Billets, imported from Japan, Taiwan and China, are converted into wire rods in the oil-fired furnace at ASMSB. It is of interest to note that ASMSB's rolling mill is less automated and relatively more labour-intensive than the larger ones. ASMSB has plans to set up a second rolling mill although it has no similar plans to produce billets.

## Technical Know-how

MSB employs more than 1800 workers, 90% of whom work in the technical department related to production activities. There are 80 engineers and 120 technicians at MSB which has received full technical assistance from NSC of Japan which agreed to provide technical knowledge and technical guidance. The technical assistance agreement between MSB and NSC, signed in 1962 effective for a period of ten years, was renewed once. The agreement gave MSB access to the software technology of NSC with certain qualifications. Under this agreement Japanese technical experts came to MSB to provide training while MSB personnel also received training in NSC in Japan. At present MSB has a five-year agreement with NSC to secure training and access to NSC'S technology. In April 1979, two additional agreements were signed between MSB and NSC to get technical services for MSB's second rolling mill at the cost of more than US$1 million. In addition, equipment suppliers for the second rolling mill have agreed to provide training for the workers of MSB.

The number of NSC personnel at MSB increased from 14 in May 1966 to a maximum of 92 by August 1967. This does not include other Japanese experts sent by machinery and equipment manufacturers and construction agencies. The breakdown of the 92 NSC personnel at MSB was as follows: 17 for roll mills, 16 for maintenance, 31 for management and blast furnaces, 20 for charcoal and L.D. convertors, 5 for power and 3 for construction. It is of interest to note that the number of Japanese staff at MSB declined from 92 in August 1967 to 20 by January 1971, and finally to just 2 by April 1978. By 1973 the role of the Japanese engineers at MSB had been reduced to the advisory level, and by 1975 all the top managerial positions had been filled by Malaysians.

The experience of ASM in the acquisition of technical know-how was quite different from that of MSB. As in the case of the hardware technology, ASM obtained the technical know-how from several sources. In 1980, ASM signed a technical agreement with Funabashi Steel Works of Japan which is one of the leading steel mills in the world in electric-arc furnace technology. Under this agreement Funabashi Steel Works provided :

(i) training for ASM's technical and production personnel; and

(ii) technical advice on the operation of the steel meltshop and the rolling mill. In addition, ASM has developed a close working relationship with several other Asian steel mills with respect to staff training and technology exchange. It is of relevance to note that by 1982 more than 40 engineers and technicians had been sent by ASM to Japan, Taiwan and Europe for training in various aspects of steel-making, involving a total of 9,000 man-hours and a cost of more than M$1 million. The training of ASM's workers for its second rolling mill has been secured by sending workers to Italy and Switzerland for technical training and to Japan and Taiwan for production training.

ASM employs more than 500 workers, but only supervisors and executives are sent for overseas training while the rest are given on-the-job local training. In addition to sending workers for training, ASM has also bought the services of foreign personnel who came to ASM to train its workers. Training assistance was also given by the machinery suppliers including Danieli of Italy, BBC Brown Boveri of Switzerland and Nikko of Japan. Besides, some "friendly" steel mills such as China Steel Corporation, Chin Tai and Tung Ho of Taiwan, SAM of France and Korf Engineering of West Germany also provided training assistance and technology interchange.

By 1981, ASM had built up its own expertise and became "self-reliant" without any more need for expatriates on its payroll. The production technology of ASM is now sufficiently advanced for producing SWRM-8, a very low carbon steel. This has been achieved by adopting Funanbashi's technique.

It is of interest to note that expertise at ASM is sophisticated enough to permit "unbundling" of the technology package for its second rolling mill. As it was seen earlier, the first rolling mill was purchased as a complete package from Danieli of Italy. But since some of the machinery and equipment in the complete package are sourced from a third party indirectly, there is a danger of delivery time being longer and services provided by the suppliers being less satisfactory. Unfortunately, ASM did not have the technical expertise to "unbundle" the package when its first rolling mill was installed. But by the time it purchased its second rolling mill, ASM had acquired sufficient technical knowledge and expertise for the identification of the best machinery and equipment that would make up the rolling mill. Thus, ASM has resorted to

a consortium of 4 different suppliers in Italy, West Germany, Switzerland and France for installing its second rolling mill.

The experience of ASMSB with respect to the acquisition of technical know how was different from that of both MSB and AMS, mainly due to differences in the scale of operation and the composition of output. ASMSB employs more than 200 workers including 3 expatriates on loan from Kloeckner Steel of West Germany. These foreigners who occupy the top positions as General Manager, Chief Engineer and Technical Manager are contracted to be with ASMSB until 1984 during which time they would train the local personnel to take over the plant.

ASMSB's workforce includes 35 skilled workers, 8 of whom were sent to Italy and West Germany for on-the-job training in rolling mills. It is of interest to note that ASMSB has attracted some workers from other mills in the country, including 4 from MSB and 4 from ASM.

**Problems And Prospects**

It is not the concern of this paper to evaluate the costs and benefits of the iron and steel industry or the economic viability of the different iron and steel mills operating in Malaysia. Nevertheless, insofar as the transfer of technology is concerned, there is evidence to show that technology transfers have been quite smooth and fairly successful.

In particular, there have been deliberate attemps to adapt the foreign technology to suit the country's resource endowments. But, the industry seems to face some problems in this respect. One serious problem in the future will be the shortage of local iron ore unless new commercially exploitable deposits are discovered soon. Besides, the Fe content of the local iron ore at present is very low. Shortages in the supply of charcoal also presents a formidable problem. It was easy and cheap to convert rubber wood into charcoal when there was no alternative commercial use for rubber wood. But the situation has changed considerably and rubber wood has become a raw material for a number of industries including furniture manufacturing. Consequently, the cost of charcoal has risen considerably. Alternatively, the industry may have to rely on imported charcoal, imported coke, and coal from East Malaysia. Other alternatives include the use of heavy oil in steel making and a higher grade of iron ore. But, none of these alternatives offers much hope, as they are no

less costly than the charcoal produced from rubber wood. There is also a shortage of local scrap for the electric arc furnaces. Steel making is an extremely energy-intensive industry and the cost of energy especially electricity is quite high in Malaysia, although natural gas offers an alternative source of cheaper energy.

The importance of training to the iron and steel industry is readily obvious. For, it represents the main vehicle of transfer of technology, both hard and soft. The success of these training programmes is manifested by the speed and smoothness with which foreign personnel have been replaced by Malaysians. Even so, there is still scope for technical assistance to play an important role, as the transfer of technology is indeed a continuing process in the face of the development of new products, new methods, new applications and new technology. However, the acquisition of technical skill is beset to some extent by the high rate of turnover of workers, which makes training a rather expensive affair. This problem is completely alien to the Japanese culture where the workers' loyalty to their firms is absolute. By contrast, in Malaysia labour turnover is a serious problem, so much so that some firms find it economical sometimes "to pinch" trained workers from other firms rather than to train their own workers.

The iron and steel industry is known for its externalities, on account of the important position it occupies in the industrial network and the lumpiness of the investment it entails. The linkage effects, both forward and backward are likely to be substantial especially where industrialisation has gone beyond the infant stage. The impact of the technology transfers on the economy as a whole through the diffusion of technology depends on the extent of such industrial linkages. In Malaysia, however, the externalities of the iron and steel industry are not readily visible, owing partly to the smallness of the scale of the operation and partly to the fact that the industrial pattern in Malaysia has not reached the degree of sophistication found in Japan or even Brazil. Nevertheless, externalities of the industry are indeed present as shown by the emergence of a number of ancillary and user industries in recent years. Externalities are also manifested in the form of sub-contracting, a practice which is widely practised in Japan. However, in Malaysia sub-contracting is seldom seen in the iron and steel industry, although some foundaries are known to be involved. This is mainly due to the narrow industrial base which does not permit scale economies in sub-contracting activities to be exploited.

The iron and steel industry all over the world is affected by a general decline in demand. This is exacerbated by structural changes which have been taking place in the industry. For example, technical development in the form of blast furnace/oxygen blown steel (BF/BOF) and continuous casting processes have increased the minimum economic scale of production. Meanwhile, competitive investment in new plant, combined with tighter export markets, increasing import substitution and protection in many countries have resulted in over-capacity. Owing to the economies of scale, integrated steel works with output below a minimum economic scale of about 4-5 million tons per annum appear to be at a comparative disadvantage compared to the large producers.

No doubt, Malaysia has the advantage of being a newcomer insofar as the iron and steel industry is concerned, although there are constraints which seriously limit the extent to which these advantages could be exploited. Unlike Japan where the reconstruction and modernization of the iron and steel industry was facilitated by the rising demand for steel products in the post-war era, and unlike Brazil which has had many decades of industrial experience and a large domestic market with huge raw material resources, Malaysia suffers from a narrow industrial base that could not provide the impetus for a rapid expansion of the iron and steel industry. The steel products manufactured in Malaysia are largely absorbed by the construction sector, while the machinery and automobile and related industries are not in a position to generate adequate demand for high value added specialised steel. As mentioned earlier, there are supply constraints such as the shortage of charcoal, and the scarce supply of domestic coal resources. Yet, there are plans to set up two new steel mills in Malaysia. The tender for the first mill to be located in Labuan, Sabah, has been given to First Alpin of Austria. The mill will make use of natural gas and have a production capacity of 680,000 tons per annum. The second mill to be sited in Telok Kalong, Trengganu, will be a direct reduction billet plant with a capacity of 600,000 tons of sponge iron and 555,000 tons of steel billet per year. The plant will be built by a consortium of Japanese steel mills led by Nippon Steel Corporation. The economics of the two new steel plants to be located in Trengganu and Sabah may well be questioned, notwithstanding the abundant supplies of natural gas in these two locations, unless these plants can be worked to their full capacity -- which would call for wider markets, regional or international.

Apart from the pertinent question regarding the opportunity costs of such massive investments, there are two other relevant questions concerning the area of technology and skilled manpower which are scarce and underdeveloped in Malaysia. There is no clear-cut national policy on technology development, and the Malaysian government has not created incentives to stimulate technology transfers. The incentives for industrial development have been designed to attract foreign capital and infant industries. But, there is no incentive scheme aimed specially at technology transfer.

In any case, technology transfers require more than the role of the investors and foreign companies, as they call for a reservoir of skilled labour which could absorb new technologies. This aspect of manpower-development has not received serious attention. At best, the transfer of technology appears to be an ad hoc affair.

There is a need for the government to reexamine the whole structure of incentives so as to encourage the diffusion of appropriate technology from advanced foreign firms. The use of various fiscal incentives, the establishment of a skill development fund, and the formation of bilateral government-to-government agencies for technology transfer represent some directions for the government to consider.

It cannot be denied that there has been a substantial transfer of iron and steel making technology to Malaysia. About twenty years ago the workers would not have been able to differentiate a chimney from a blast furnace. Today, the two large iron and steel mills in Malaysia are run almost entirely by Malaysians. These modern mills have acquired sufficient expertise to handle the installation of additions to the rolling mills and to "unbundle" the package so as to select the best machinery and equipment for steel making. Had there been no such technology transfers, these mills would have to rely on turnkey projects and packaged deals for their expansion programmes.

Be that as it may, one should not overlook the fact that the transfer of such technology has been quite limited. The older mills have not been able to generate a surplus cadre of steel engineers and technicians who can help develop new steel mills in the country. This is not, however, to deny that there has been some diffusion of technology from the larger and older mills to the smaller and newer ones as revealed by the empirical enquiry.

Technology transfer should not be left to the whims and fancies of private companies, which are guided mainly by private cost and return considerations. The transfer and the diffusion of technology have far reaching implications for the economy as a whole, far beyond the immediate interests of private companies which are directly involved, as there are considerable externalities which confer enormous social returns or benefits. Thus, for instance, a high turnover of staff would discourage the firms from investing in the development of skill, although such a high turnover tends to expedite the diffusion of technology. It would, therefore, make a lot of economic sense for the government to provide incentives for the private companies to undertake extensive training activities through either tax concessions or financial subsidies. There is also a need for the government to closely monitor the licensing agreements between the suppliers and the recipients of technology so as to ensure that the agreements are fully implemented.

# AN IMPORTANT VIEWPOINT REGARDING THE TECHNOLOGY TRANSFER IN THE TRANSPORT FIELD BETWEEN THE TEMPERATE ZONES AND THE TROPICS

by

Namiki Oka*

First of all, I would like to thank you for giving me an opportunity to set forth my view on technology transfer in the transport field.

There has been a lot of proposals for Southeast Asian countries on the introduction of urban transit systems and motorways from Europe, North America, and Japan.

Many of them have surely been already carried out, and have affected a great part of the lives of the people of those countries.

However, we have come to wonder if we have forgotten something important when we offered our systems to them, and as a result, some systems probably did not function as they should. So, we have started a project on Southeast Asia, aimed at discovering matters which should not be overlooked, and at suggesting the findings to the people related to consultation for Southeast Asia. This has been one of the research projects of the International Association of Traffic and Safety Sciences, which is commonly called IATSS.

One of the blind spots which we were aware of, in the first place, was that the persons concerned might not have considered the following fact, namely that the cities of Southeast Asia are located in the tropics, whereas most of the cities of Europe, North America and Japan are in the temperate zone.

For instance, in Japan, there are only two weeks or so in a year when the average temperature of a day rises to 28 degrees centigrade. On the other hand, in the cities in Southeast Asia, for a large part of the year, the average daily temperature is as high as around 28 degrees centigrade. This difference in temperature must have a significant influence on the behavior patterns of the people.

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Since the beginning of the 1960's, the pattern studies on pedestrian behavior have made progress. These studies have resulted in a concept or scale called "Pedestrian Refusal Distance". Pedestrian refusal distance indicates the distance where more than 50% of pedestrians unconciously begin to dislike walking. In European cities, usually, the refusal distance is about 400 meters. However, the report also reveals that when temperatures are below minus 5 degrees centigrade or when it rains more than 1 millimeter per hour, the distance reduces to half, that is 200 meters. Also, the distance reduces to 150 meters, under the condition of walking in crowded places. On the other hand, it has been verified that when the pedestrian environment improves and becomes more comfortable, the distance increases by 50% to 600 meters. The study also shows that each pedestrian refusal distance is doubled during commutation time.

According to research by the Japan Transport Economics Research Center, the pedestrian refusal distance in Tokyo is 300 meters, which is 100 meters shorter than that of Europe. The reasons appear to be Tokyo's specific conditions. That is to say, too many traffic lights stop pedestrians too many times; sidewalks are too narrow to walk; and pedestrians get sick of going up and down the pedestrian crossing bridges.

As you can see, pedestrian refusal distances are different according to various conditions in each city.

What is the most characteristic condition of the cities of Southeast Asia? Without doubt, it is the fact that the cities are located in the tropics and not in the temperate zones. I already told you that in Europe, pedestrian refusal distance reduces to half when the temperature is below minus 5 degrees centigrade. Then very hot weather, in the cities of Southeast Asia, namely that the average daily temperature being about 28 degrees, should shorten the pedestrian refusal distance too.

Actually, the refusal distance in those cities is estimated at between 100 meters and 200 meters, based on the description of specialists and our observations. For example, in Djakarta, we saw a housewife ride a Betcha to go to the market which was about 250 meters from her home. Or in Manila, we learned of a maid of a middle class family going to the market, 300 meters from the home by a jeepny every day.

Among the transport planning specialists in Europe, North America and Japan, there are some who are indifferent to these subtle aspects of the physiology and psychology of pedestrians. They do not think about why the common transport modes such as jeepny, betcha or samro, are attractive to peoples in these cities. On the contrary, they urge abolishment of these common transport modes only because they interrupt traffic, and urge the construction of subways, monorails and LRT, or Light Rail Transit, in the same way as they are planned and operated in the cities of the temperate zones.

For instance, the distance between one subway station or monorail station and the next in the temperate zone is generally from 800 meters to 1 kilometer. Is it appropriate to keep the distance between stations in the tropics that far? If shortening the distance causes any trouble in maintaining low cost and high average speed per hour, then the transport means for access to the stations should be given more serious consideration in tropical cities than in the temperate zones. If the planners are not sensitive to this point, then the new system will be not be used by the people. We must not forget that the pedestrian refusal distance is outstandingly short compared with those of the temperate zone cities.

Once, a leading member of the Belgian Ministry of Transport and Communication commented that in Brussels, commuters who live more than 500 meters from stations are not expected to be customers of the subways.

The report of SEATAC, Southeast Asia Agency for Regional Transport and Communications Development, observes that the rate of increase in automobiles (including motorcycles) in Southeast Asian cities is higher than that of Japan. Does this not indicate a natural feature of Southeast Asian cities that the peoples are not eager to walk?

If the characteristics of pedestrian behaviors in the cities of Southeast Asia are neglected by both transferring and receiving countries in technical transfer, plans for public transportation facilities and measures for automobiles will not be successful.

Recently, the number of pedestrian crossing bridges in Southeast Asian cities has increased as in Japanese cities. Even among young Japanese in the temperate zone, the crossing of bridges is unpopular. I am afraid that

increasing pedestrian bridges and their compulsive use in tropical cities, may cause problems.

Last May, IATSS made a study at a pedestrian crossing bridge along the belt way, EDSA in Manila. According to the study, 59 people out of 219 crossed the road without using the bridge within 15 minutes. They walked across the busy traffic flow and crept through the wire of the median strip. Scenes like this happen everywhere in Manila. Some Japanese experts on transport planning describe it as bad pedestrian manners. However, I cannot agree with such a viewpoint.

In Kuala Lumpur, there are also a number of streets awkward to cross. I think the city governments in Southeast Asia should increase the number of crosswalks, and educate and enforce severely so that drivers stop when seeing pedestrians on the crosswalk, instead of forcing people to use pedestrian crossing bridges. We must not forget that pedestrian bridges, and automobiles which disregard pedestrians, are responsible for shortening the pedestrian refusal distance.

In Singapore, shady sidewalks have been constructed, since several years ago, for the purpose of lengthening the pedestrian refusal distance to 400 meters. In Japan, to my regret, there has not been enough improvement of road circumstances aimed at lengthening pedestrian refusal distance.

New technology is not always accepted by everyone. And also, even though the new technology is advanced, it does not always mean an advantage in daily life if it is not introduced appropriately. The new technology may or may not bring expected changes in customs and behaviors.

What aspects of the new technology are accepted or rejected? And why? Or what kinds of changes are brought into the lives of the people by the technology? Or doesn't it cause any change? What are the reasons? If we can answer these questions, we will be able to derive hints for improving the method of technology transfer in the transport field to the Southeast Asian countries. These questions have led us, the members of IATSS, to study the influence on people produced by the opening of the LRT in Manila. The studies are done twice, before and after the opening of the LRT, to see the changes from the views of cultural anthropology. The first study, before the opening, was

conducted from May to August, 1983. Methods of the study were observation, interview, picture frustration (PF) test, semantic differential (SD) test and questionnaire to 1,300 people by the random sampling technique. After the opening, the study will be done using the same methods.

I regret that I cannot tell you about the research in detail because analysis has not been finished. However, the summary of the questionnaires reveal that 65% of the people answered that they would take the LRT, and 60% of them consider that the passengers of the LRT would be from the upper and lower middle classes. Only 15.4% thought that they would not take the LRT. Forty-five percent of them gave as a reason not to take LRT "routes are too limited"; 14.9% thought they "live too far from stations"; and about 14% answered they "hate to walk up stairs". As to the changes which would occur after the opening, 22% of the people thought that the LRT would foster a habit of punctuality in their daily life; and 10% of the people expected that they would go out more often and farther.

In the PF test, the subjects were shown in picture. In the picture, there was a LRT, stopping at a guideway station of an elevated railway, and a jeepny on the ground. We allowed them to write down the conversation which occurred freely between the passenger of the LRT and the driver of the jeepny. General analysis shows that 85.8% of the words of the LRT passengers were positive to the LRT; and 56.5% of the words of the jeepny driver were with good intentions. Among the words of the LRT passengers which were against the LRT, not a few indicated that the distance to the station and stairs were the source of the problems.

It has been reported that the construction of the LRT and Aero bus systems are being planned in Kuala Lumpur. I hope that the system will truly be accepted by the people.

# RESEARCH AND DEVELOPMENT IN COMPUTER APPLICATIONS IN UNIVERSITI SAINS MALAYSIA

by

Kamal Salih*

## Introduction

The aim of this paper is to describe the research and development work that have been done and are being undertaken at Universiti Sains Malaysia (USM) in the area of computer applications. The projects involved, except in one case, were undertaken to meet internal university educational and managerial needs. The systems which had been developed, and are being improved further, are of course transportable, with suitable modifications, and can be made available to outside users and researchers. The one exception to this is the pilot project to develop a National Integrated Data System (NIDAS Project), which was commissioned by the Malaysian Government.

The purpose of describing these R & D activities in this conference is to demonstrate the capacity of local researchers, and the local universities, to undertake innovative and highly technical work to the same level as the best in the developed countries. It shows also that whatever level and type of technology transfer, consistent with the perceived needs and relevant to the aspirations of the local situation, can be achieved if the right environment and encouragement can be given to local researchers.

This paper will present in turn the R & D efforts in the field of computer applications undertaken in USM in the area of integrated information systems for public adminstration (Project NIDAS and the family of operational data systems it has spawned), the work of the Computer-Aided Translation Group, the activities concerning the development and implementation of mediated instructional design systems, in particular computer-aided instructional (CAI) systems, and finally the project to develop a university management information system (Project SISMAP).

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## NIDAS Project: Development Of A National Integrated Data System

The NIDAS project was commissioned by the Malaysian Government in 1976 as part of the government's attempt to modernize its planning, implementation and monitoring machinery; and incorporated into the Third Malaysia Plan (1976-1980). The three-year pilot project was undertaken by a team from the University's Centre for Policy Research (CPR).

The idea for NIDAS was developed in the CPR in the last quarter of 1975, arising from discussions concerning the enormous amount of data generated in various CPR projects then being conducted, namely the MADA/USM Land Tenure Study and the USM/UDA Urban Land Ownership Study. The initial push to mobilize this experience, and to devise an information system for planning and monitoring purposes, came from consideration of data requirements of the project on Evaluation of Regional Policy in Malaysia. The whole idea, encouraged by discussions with the then Minintry of General Planning and Socio-economic Research, culminated in a proposal submitted to the Ministry for the development of a National Integrated Data System (Kamal Salih and K.J. Ratnam, 1975). The proposal was accepted and incorporated into the Third Malaysia Plan. Initial work on NIDAS took the form of a pre-pilot test, undertaken in cooperation with the Statistics Department in Butterworth (NIDAS Mid-term Report, N-MTR-7(78)). The material and prototype computer system was presented to a briefing in Penang in June 1976, at which point the NIDAS Pilot Project was officially launched.

As a result of the pre-pilot briefing, interest was generated among a number of agencies in participating in the NIDAS Project. The Penang State Government took special interest in the Land File component of the NIDAS Project, and independently sponsored a Land Data Bank Project for Penang, which was dovetailed into NIDAS. The Seberang Perai Municipal Council took the initiative to support a separate study aimed at the revaluation of properties to improve its local tax base and the creation of a Property Information System (Project REPIS - see REPIS Project Final Report, CPR, 1981), which provided for NIDAS an opportunity to test a data system for local government needs. The Statistics Department participated from the beginning, not only because it was at first planned to be the eventual recipient of the NIDAS System, but also it wanted to use the NIDAS census as a pre-test for its own 1980 Census. The final NIDAS Project workplan incorporated a considerable number of government agencies, as shown in Table I.

TABLE I: GOVERNMENT DEPARTMENTS AND AGENCIES PARTICIPATING IN NIDAS PILOT STUDY

| File Development | Cooperating Government Agency |
|---|---|
| Land Data System | Ministry of Land and Regional Development; Penang, Perak and Kedah State Governments; MAMPU |
| Census and Population Register | Department of Statistics (Census Division) |
| Property Information System | Majlis Perbandaran Seberang Perai |
| Health | Ministry of Health (Maternal and Child Health Division) |
| Education | Ministry of Education (EPRD) |
| Labour and Manpower | Penang Labour Office |
| DEVPRIS | Penang State Government; EPU; ICU |
| Business | Department of Statistics (Industries Division) |
| Geocoding System | National Directorate of Mapping (Survey Department); Penang State Survey Department |
| Liaison Work | Socio-economic Research and General Planning Unit; Implementation Coordinating Unit; Economic Planning Unit of the Prime Minister's Department |

## COMPUTER APPLICATIONS

The basic aim of the NIDAS Project was to demonstrate the technical, administrative and financial feasibility of an information system for public administration at various levels of government, as well as of a computerized integrated data network for use by the central and operating agencies involved in the implementation of Malaysia's development plans under the New Economic Policy. In particular, the increasing complexity of managing and monitoring development projects, added to the traditional roles of civil administration, had strained financial and manpower resources to levels which require new and ingenious innovations in institutional structure, such as the replacing of the Red Book System by the Directive No.1 System. Given the disparate data resources (censuses, special surveys, and ordinance survey data etc.), the different regulations, conventions and methods of administratively-generated data, the objectives and strategy of a national integrated data system were two-fold:

(i) mobilization and rationalization of existing procedures of collecting, storing and processing data resources in the country, in particular the horizontal integration of current information structures into a functionally-oriented system; and

(ii) provision of a computer-based data banking system tailored to the needs of planning, monitoring, control, and evaluation of public sector activities in development.

Within this context, a host of side payoffs to an integrated data system capability may be identified, including the modernization of land registration, rationalization of programme planning at all levels of government, monitoring of social impacts of public and private sector activities on a small area basis through provision of "quality of life" indicators, provision of intercensal process data geared to physical planning on a local area basis, and providing an array of modern electronic data processing methods of collecting, storing, retrieving, processing and displaying information for particular purposes in a routine and tailor-made manner.

An integrated data system is a well articulated network of data registers or banks which are linked together by an information (or data) management suprasystem incorporating the collection of data from various sources, their

processing, storing, analysis and transmission to eventual users. Conceptually, the system is of two parts: the user-environment and the hardware-software system.

The user-environment is characterized by the definition of required data and their utilization by various agencies, planning groups, researchers, administrators and decision-makers, the last mentioned being the work critical in defining what types of data are required and, therefore, merit incorporation into the system. The hardware-software system on the other hand consists of:

(i) the input system: translating the raw input data into coded machine records, giving location references to phenomena and activities (geocoding) and other input conversion of areal and other structural data in machine-readable forms;

(ii) the data files: non-aggregate data items classified according to areal units, time period labels and topical (characteristic) categories in a manner consistent with user information needs on the problems associated with the "dimensions of data" and aggregation problems; and

(iii) the output system: taking many forms from statistical tables, the computer graphics including machine-produced maps, graphs and other forms of visual display. An important requirement of any information system capability is that processed data must be presented in as comprehensible a manner to decision-makers as possible, and that this be done in a straight forward and routine fashion to meet any contingent needs.

The exploitation of recent advances in computer technology is, therefore, essential in data system development. An integral part of the system is in fact an Information Management System (IMS) consisting of computer programs for the storing, updating and maintenance of files and for the analysis and display of data, including computer graphics.

The information bases of an integrated data system comprise several registers, which may be classified into two groups: basic registers and special registers. Three registers may be defined in the first class, namely the

population (household) registers, the land or property register, and the business register. The special registers, for example of motor vehicle owners, voters (the electoral roll), tax-payers, etc., are subsets of these basic registers, and are built from these primary sources of data. In the unorganized data "system", many of these registers are under the jurisdiction of different collecting agencies, with different coding procedures, classifications and references. Even in the same register, say the land register, there may be alternative parcel identifiers, especially when as in our country land is a state matter. One of the basic tasks of building an integrated data system is that of linking these registers; of particular importance is the question of integrating socio-economic data obtained from the decennial censuses and other surveys with land data in one data system.

The basic integration procedure involves identification of several integration keys. These range from using street addresses to the more general coordinate referencing method. A whole field of expertise has developed which addresses itself to this problem of locational referencing which serves not only as an integration key of separate registers, but also as a basis for the computer graphics component of the integrated data system, especially in physical planning applications and for display purposes. What we are now talking about is the so-called geocoding problem. This problem consists of choosing a geographical unit (functional - for example a census enumeration block (EB) or a mukim - or arbitrary - for example a land lot), encoding and identifying the units so as to compute some portion of the geometric structure of the map in a machine-readable data file. These geographic base files are then the basic directory for cross referencing and retrieval of information from the various registers for planning and analytical purposes.

The substantive work of the Pilot Study can be divided into three basic aspects: the development of data files which are to be used as demonstration models; the development of a geocoding system; and the development of an information management system for NIDAS. The detailed results of this work are too voluminous to report with any justice here (full reports are listed in the bibliography). The tasks involved and the work schedule are shown in Table II.

TABLE II: NIDAS EXPENDITURE - COSTS OF FILE DEVELOPMNET

| Files | Staff & Salaries | Computer System | Capital Equipment | Materials and other Consumables | Total |
|---|---|---|---|---|---|
| Prefieldwork Concepts and tests | 27,600 | - | - | 3,668 | 31,268 |
| Census Register Stage 1 | 512,725 | 2,500 | 8,520 | 38,665 | 562,410 |
| Stage 2 | 306,549 | 1,900 | 7,406 | 59,160 | 375,015 |
| Land File | 352,850 | 2,000 | - | 35,708 | 390,558 |
| Geocoding | 87,242 | 5,276 | 158,788 | 67,799 | 319,085 |
| Systems | 437,400 | 131,435 | 50,990 | 1,000 | 620,825 |
| Health | 52,552 | - | - | 2,509 | 55,601 |
| Office and Administration | 59,518 | - | 2,295 | 3,881 | 65,694 |
| Total | 1,836,436 | 143,111 | 227,999 | 212,370 | 2,419,916 |

* Figures are in Malaysian dollars: US$1.00=M$2.22 approximately

## COMPUTER APPLICATIONS

The steps in data base development consist of:

(i) identification of existing data;

(ii) conduct of a NIDAS Census, to update the 1970 statistical base, with the aim of filling in the gaps in the existing data required to create the prototype data bases; and

(iii) rationalization and data base implementation, by merging and matching available departmental data with the NIDAS Census data, and distributed to prototype files which then form the basis for operational data systems which simulate the task environment of various agencies responsible for the maintenance, updating and utilization of the information according to their respective responsibilities.

Seven prototype data bases were developed: a land data base; a property/building data base; a population data base; a business file; a health file; an educational and manpower file; and a development projects file. These data bases can then be linked into an integrated data structure as shown schematically in Figure I, where the integration keys, appropriately coded, are also indicated. These data bases are, however, linked only at the extract phase of the system processing stage. This and other information system management functions are the task of the NIDAS System.

The task of building a geographic base file (GBF) is a crucial step in the entire project. This special data base provides the basic integration keys for linking the other data in the distributed data base system. The GBF is basically made up of a number of directories, consisting of geographic data such as street and network segments, point and polygon data, which are coded (i.e. geocoded) in such a way as to make them machine readable. When organized according to some data file structure such as that developed for NIDAS (Figure II), these georeferences (essentially coordinate references to various geographic entities) serve as input for the integration of other data for processing purposes.

FIGURE I: NIDAS INTEGRATED DATA STRUCTURE

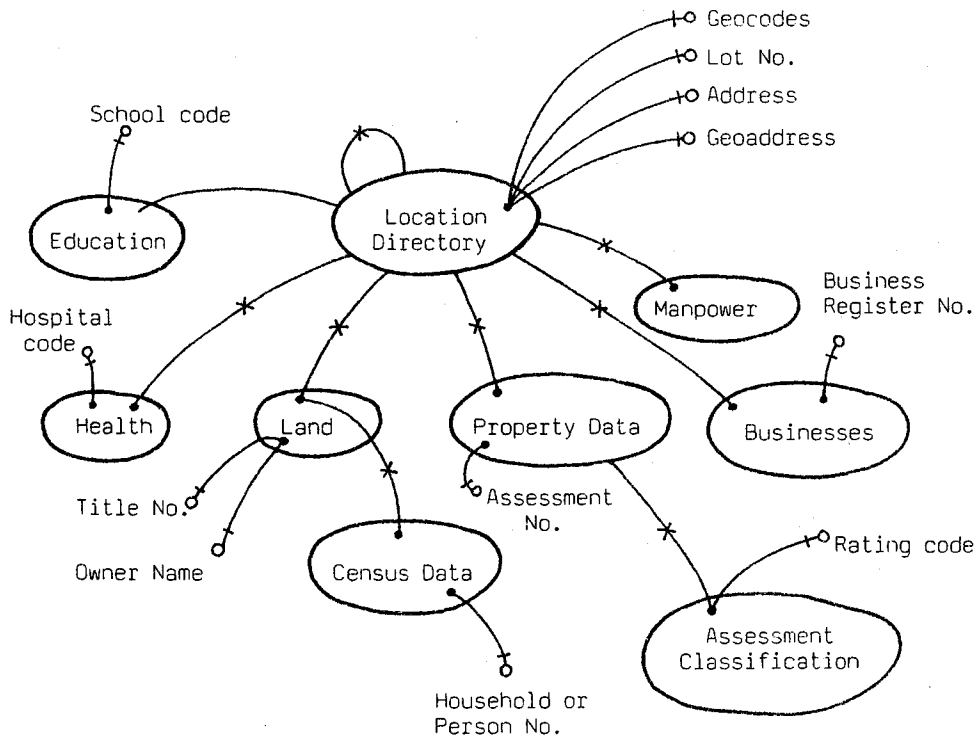
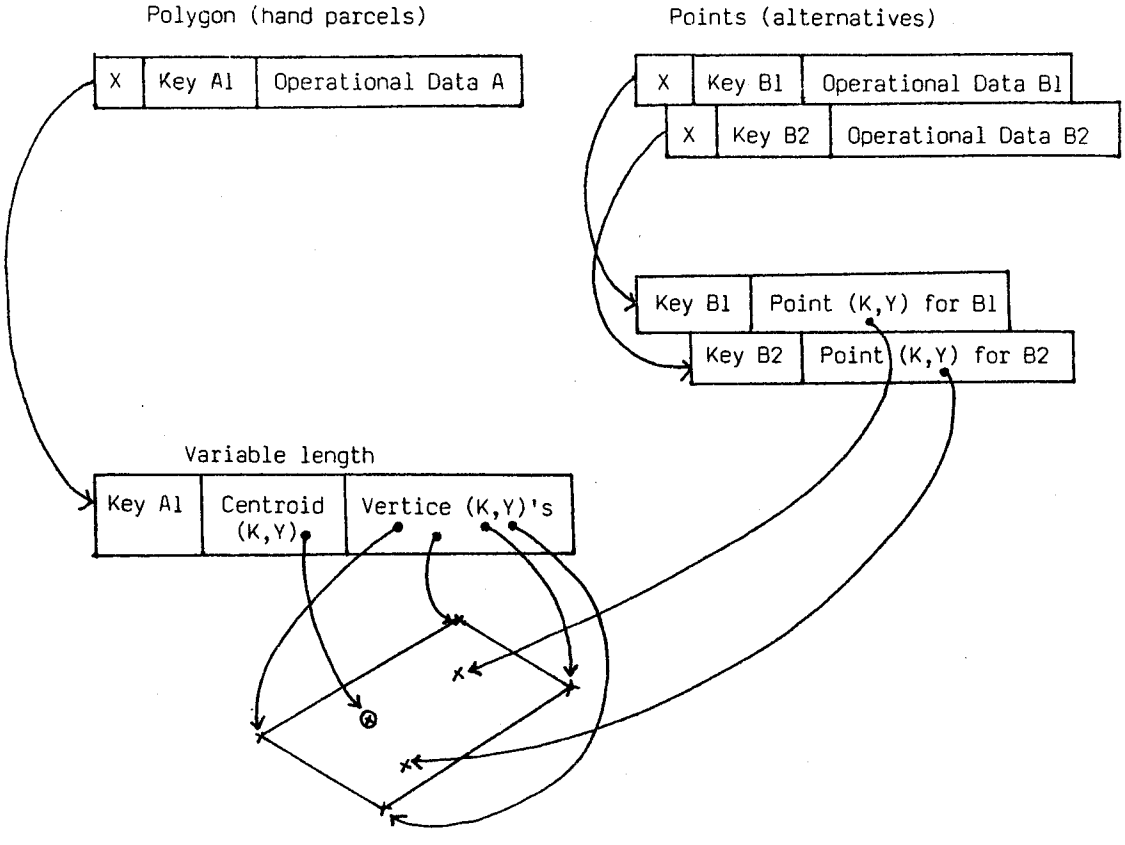


FIGURE II: GBF DIRECTORY FILE



The task of geocoding the relevant geographic entities, e.g. streets, land lots, administrative boundaries, land-use zones, addressed units such as houses, involve digitizing them from mapped sources. These geocodes are then used as input for data retrieval by user specified areas, or for cross-referencing non-geocoded data from the other operational files for processing, as well as for use as data in computer mapping. These utilities are made possible through the NIDAS Geoprocessing System.

The development of the NIDAS data management system involves creating computer programs for storing, updating, and maintenance of files or data bases, and for the retrieval, analysis and display of the data. Its components and operations may be categorised under five broad headings:

(i) data storage and data documentation capabilities;

(ii) data manipulation capabilities, particularly those associated with file processing and matrix manipulation;

(iii) data inspection and analysis capabilities, covering descriptive statistics, spatial statistics, statistical analyses and operation research methods; and

(iv) system modelling capabilities, and data presentation capabilities, including report generation and computer graphics.

The NIDAS System is a geoprocessing system in that the basic integration mechanism, capable of linking the various data bases in the network, is based on a locational referencing system built from various geographic or locational data, as described above. The NIDAS Geoprocessing System is depicted in Figure III; and has three phases: a build/maintain phase; an extract phase; and a processing phase. The build/maintain phase has the function of constructing, editing and updating the geographic base file. The extract phase performs the function of selecting the appropriate locational data from the geographic base file, and linking it with data in the other data files appropriate to the problem at hand. The extract phase of the NIDAS Geoprocessing System is shown in Figure IV. The processing phase organises the data into the desired format, performs the appropriate analysis and displays the results. These may be in the form of tabulated data, sophisticated statistical calculations, or in the form

FIGURE III: THE NIDAS GEOPROCESSING SCHEMA

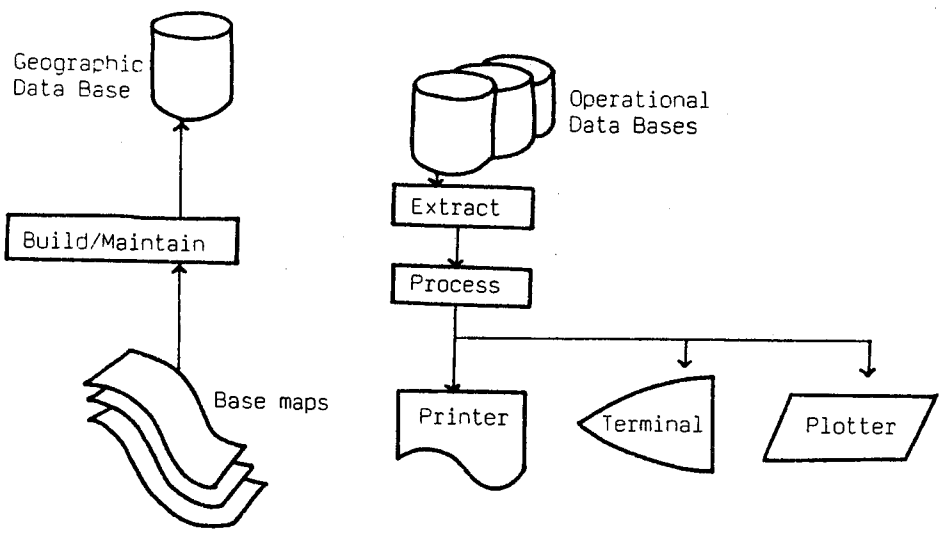
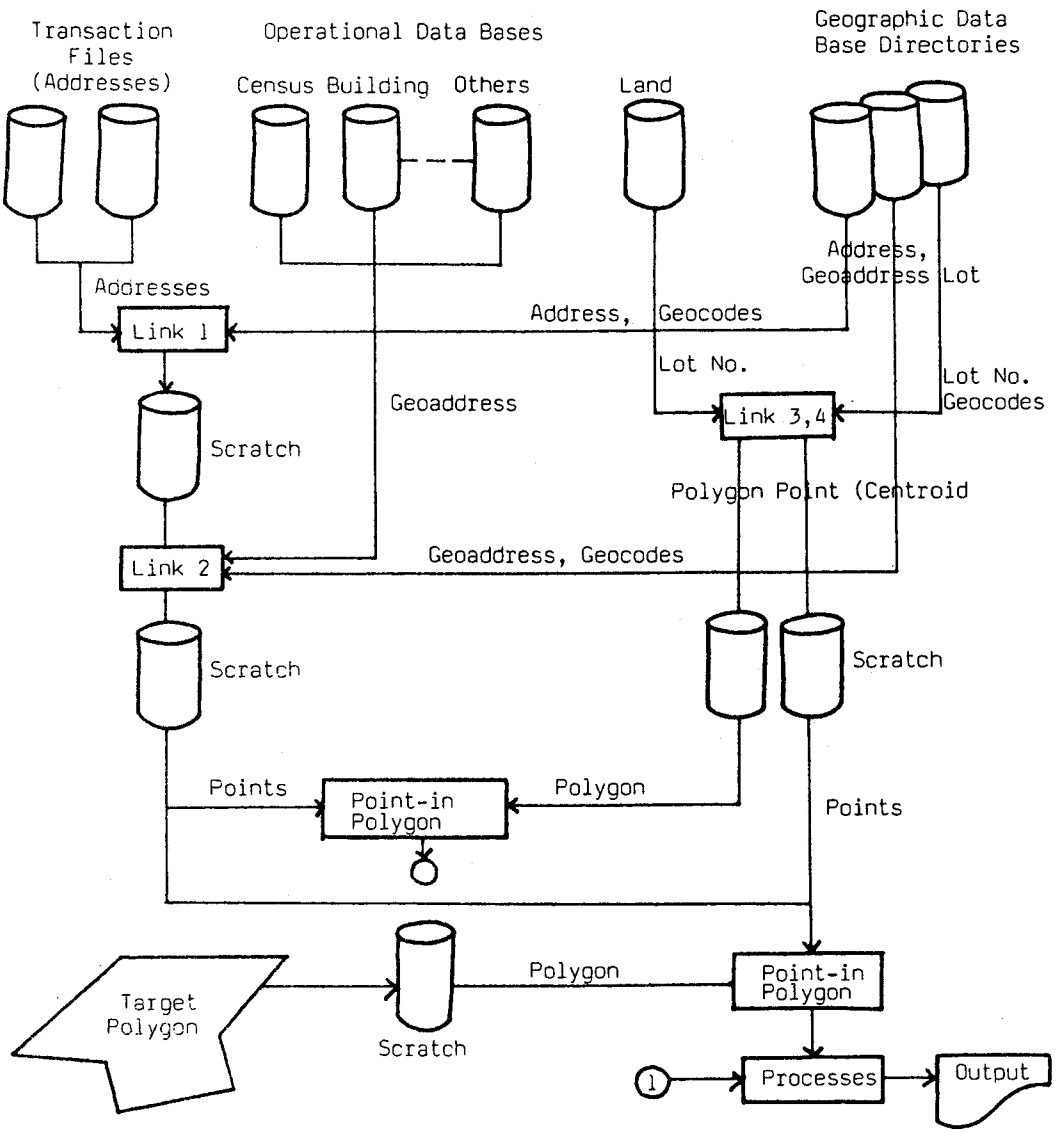


FIGURE IV: IMPLEMENTATION OF THE NIDAS GEOPROCESSING EXTRACT PHASE



of mapped data and other graphics. The system performs all these functions in a routine and automated manner. The full structure and capability of the NIDAS System is depicted in Figure V. The system configuration for the NIDAS Geoprocessing System Version I, shown in Figure VI, which was handed over to the Government, is the final version evolved first from a DOS/VS environment, through a VM/CMS-MARK IV environment, and eventually to the OS/VSI-IMS/VS-MARK IV version depicted.

As a user-oriented system, NIDAS may be accessed by different types of users, as depicted in Figure VII. There is first the geodata user, who enters the system via the geocoding routines in order to produce computerized maps of his own data or that of other data bases, if authorized to do so. A second user are the analysts seeking to use the NIDAS data bases directly in order to analyse and produce tabulations, reports and to conduct more sophisticated analyses. A third group are those who came with their own data files, which are not part of the NIDAS system (which are, therefore, designated external files), which they want to integrate with NIDAS data files through the geocoding system, and thus expand their data base. A fourth group of users are those agencies who themselves maintain their own operating data systems as part of NIDAS. All user groups, those linked as well as those not having priviledged access to NIDAS may, if authorized, use the system via a simple statistical request form. With this form, and having referred to the NIDAS Data Directory and the Area Reference Directory, they will be able to obtain any desired reports or analysis quite simply and directly.

The payoff from the development of a system such as NIDAS, can in one sense, be seen in terms of its applications. Several exercises were undertaken in the Project to demonstrate these uses and applications. The list of possible applications include: development of a socio-economic indicator system; applications to village classification; creation of district data banks; development impact analysis (one application here was the study of the impacted area of the Penang Bridge Project); census update on a sampling basis; and other planning applications.

Completed at a total cost of M$2.56 million (Table II), the NIDAS project had successfully demonstrated the technical and financial feasibility of such a national integrated data system. The report has been accepted by the Malaysian

FIGURE V: NIDAS GEOPROCESSING SYSTEM (VERSION 1)

FIGURE VI: SYSTEM CONFIGURATION OF NIDAS

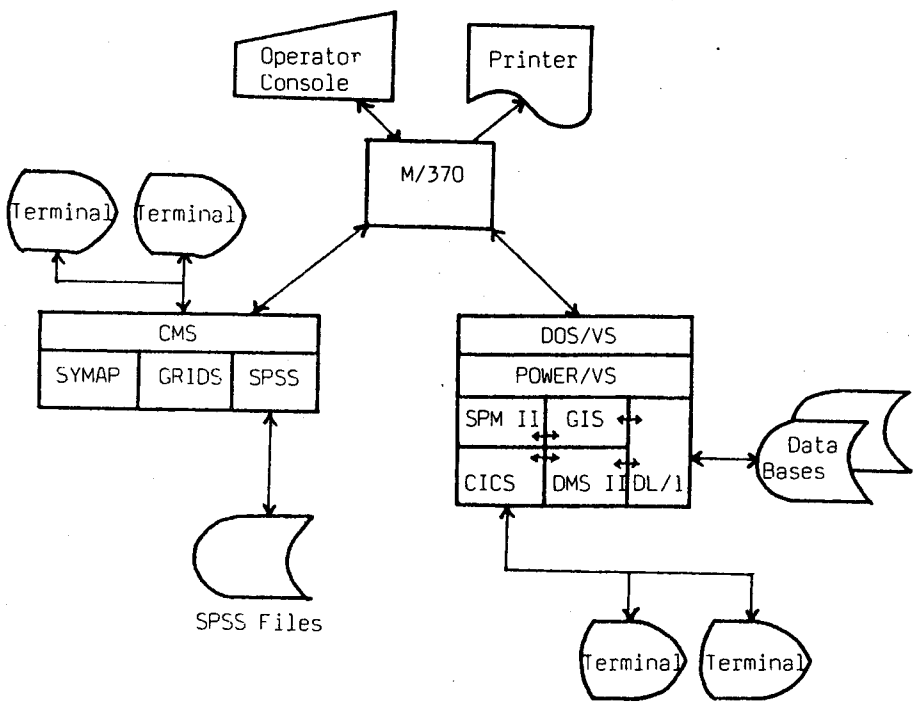
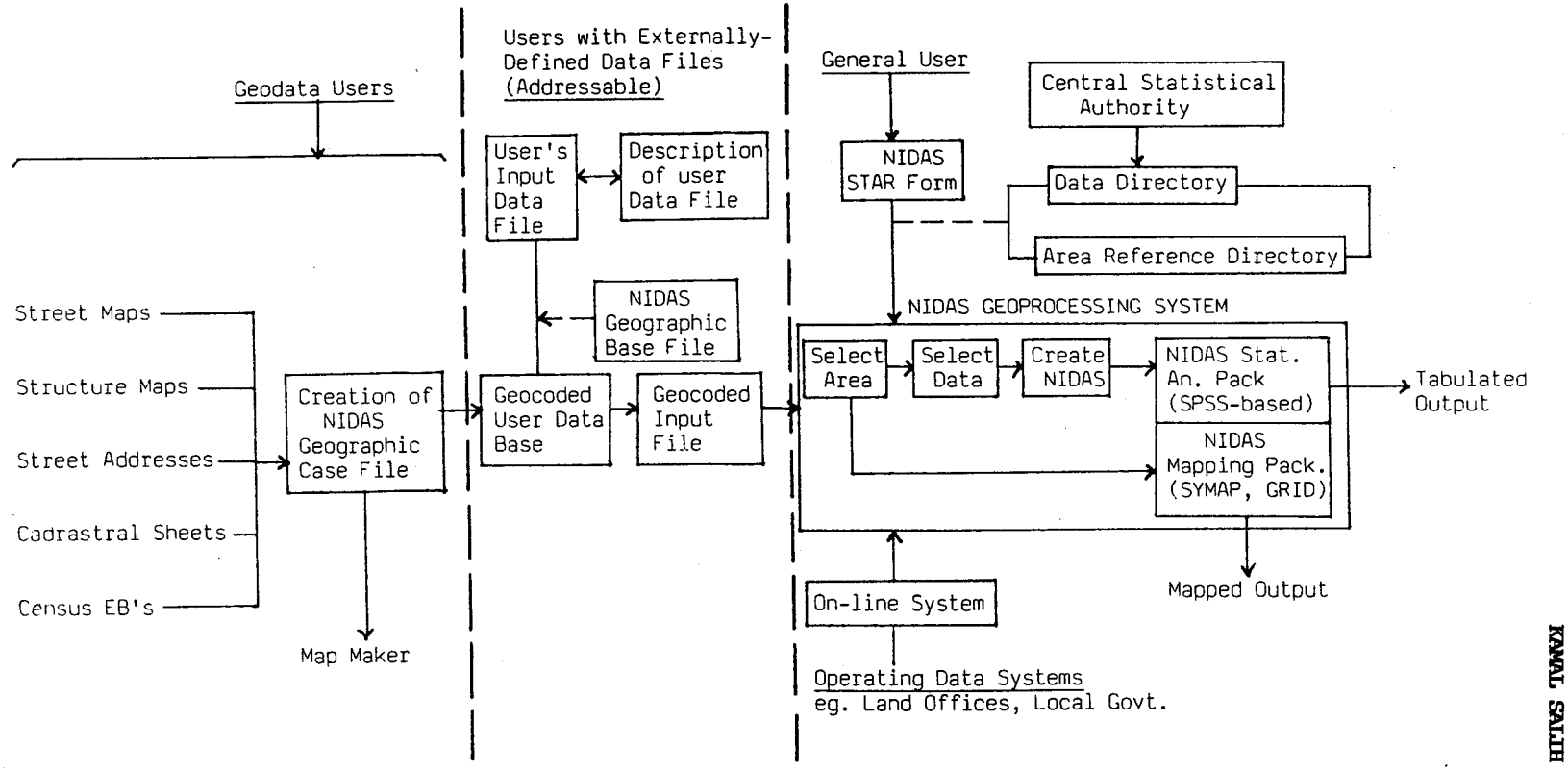


FIGURE VII: ACCESS INTO NIDAS GEOPROCESSING SYSTEM



Government and is being implemented in stages in the Fourth Malaysia Plan (1981-85). A Penang State Land Data System has been operational for some time; just as the REPIS System in Seberang Perai; a report on a Local Authority Planning Information System was prepared for the Penang Island Municipal Council (see Project LAPIS); a feasibility study for an integrated data system a la NIDAS had also been conducted for the Klang Valley Development Authority (see SISMAK Report); and initial work on a National Land Data System originally proposed by the NIDAS team is now being pursued via a micro-computer based system to be developed for State and District Land Offices by the Ministry of Land and Regional Development.

One of the most pleasing aspects of the work on NIDAS is not just that it has spawned these various activities, but that it has also contributed to accelerating the interest in computer applications and computerization in the public sector. This interest is, however, not without its dangers. The all too eager acceptance without adequate preparation in terms of trained personnel, administrative reorganizations to accept the new system, and the phased adoption and rationalization of procedures in order not to disrupt on-going functions during and after conversion, can lead to much waste. But carefully planned and implemented, it can contribute to greater efficiency and productivity in the public sector.

**Computer-Aided Translation Project:**
**Development Of An English-Bahasa Malaysia Grammar Model**

Since 1980, a research group made up of members from the School of Mathematics and the Language Unit at USM has been engaged in a project to develop a computer model for the automatic translation of English texts into Bahasa Malaysia. This project has been carried out in cooperation with the Automatic Translation Study Group (GETA) based in the University of Grenoble, France. The project is now in its second phase, beginning in 1983. The first phase had successfully demonstrated the possibility of automatic translation of a foreign language, in this case English, into Bahasa Malaysia. The second phase will go into the development of a research prototype to end in 1985, but given the importance of the project, the university has urged that the project be accelerated so as to achieve an operational industrial prototype as early as possible.

The development of an English-Bahasa Malaysia grammar model for automatic translation is based on the ARIANE-78 System developed by GETA for the automatic translation of English into French and Russian into French. ARIANE-78 is part of the second generation machine translation systems, which were built on entirely different principles than the systems first introduced in the early 50's and 60's, and which later collapsed.

The early enthusiasm associated with the IBM-Georgetown University Project in 1954 foundered owing to theoretical and technological grounds, and for not being able to deliver on its promise. In 1962 Y. Bar-Hillel wrote about the impossibility of high-quality fully automatic translation (the famous "Time flies like an arrow" problem). The 1966 ALPAC Report finally put an end to the machine translation movement, the money to support it dried up, and such activity came to be considered a hopeless exercise.

Fortunately for automatic translation research, the search for viable systems was continued by a few die-hards groups, such as at the University of Montreal, Stanford University, and the University of Grenoble. In 1972 new projects emerged; Y. Bar-Hillel himself wrote a more hopeful paper. The second generation models are less ambitious, and are based on a completely different and more fruitful approach and methodology. A commercial system, SYSTRAN, based on improvements to the Georgetown model, was adopted by the EEC, and limited purpose systems came on-stream in Canada, Russia, and the United States (such as the US Air Force Russian Translation Project).

The new interest in automatic translation, or the more modest term for it now - computer-aided translation - is due to two factors: first, the growth in the demand for translation; and second, improvements in computer technology which allow for more powerful models at cheaper cost. The demand for translated work is not only felt in the developed countries arising from the information explosion, but also in the developing countries where access to scientific and technological knowledge is possible through the medium of a limited number of foreign languages. The need to generate as much material in the national language as quickly as possible is therefore great. This is no less dramatically felt in Malaysia, with the conversion of the medium of instruction in schools and institutes of higher learning to Bahasa Malaysia, and the national thrust toward science and technology.

The first generation machine-aided translation systems were based on a large bilingual dictionary, a word-for-word translation approach, and contextual exploration in order to solve some ambiguities and subroutines to rearrange the word order. This approach was greatly limited by the need to add more and more new subroutines to accommodate an increasing number of particular cases, and semantic features have to be augmented for each item in the dictionary for different fields of application.

The second generation approach is based on entirely different principles. The first generation systems were limited by the complexity of programming so many topics due to the absence of a structured linguistic and logical model. The second generation systems, on the other hand, are based on three principles:

(i) the principle of the detection of "structural descriptors" for the representation of every sentence in the natural language. This means the analysis of each sentence of the source language in order to replace it by a suitable structural descriptor; then the transformation of the structural descriptor related to the source language into another one corresponding to the target language; and in the third phase, the generation of a sentence in the target language from the latest structural descriptor.

(ii) the principle of modelling by levels, is related to the question of transfer level above. In the initial phase of the Grenoble model, three levels were recognized, namely the morphological level, the surface syntax level, and the deep syntax level.

(iii) the principle of partition between linguistic data and programming. According to this principle, aimed at a consistent organization of the models, the concepts which occur in the grammar description and dictionaries are clearly separated from the translation algorithms. In this way, instead of programming a translation algorithm for a definite oriented pair of languages, a set of programs are written to which the linguist gives linguistic data formalized in some external artificial

language related to these programs. Then, the products obtained by these programs are other programs which realize a (language) model. By assembling these generated programs in a suitable sequence we obtain a translation system.

The GETA group had utilized these principles in the development of the ARIANE-78 System. It has been done in several phases, learning from the experience of other groups, and pioneering in some areas of its own, such as in the new concept of transducers and incorporating the principles of transformational grammars discovered by Chomsky. The complete system, called ARIANE-78, shown in Figure VIII, consists of the following components:

(i) A conventional monitor which is a guide for all operations prescribed by the linguist - the operations may include:

- opening or updating grammars and dictionaries in any phase of analysis, transfer or generation of declared languages,

- preparing texts for new experiments,

- execution of some phases (or complete translation process) for some experimental texts, with or without tracers for debugging,

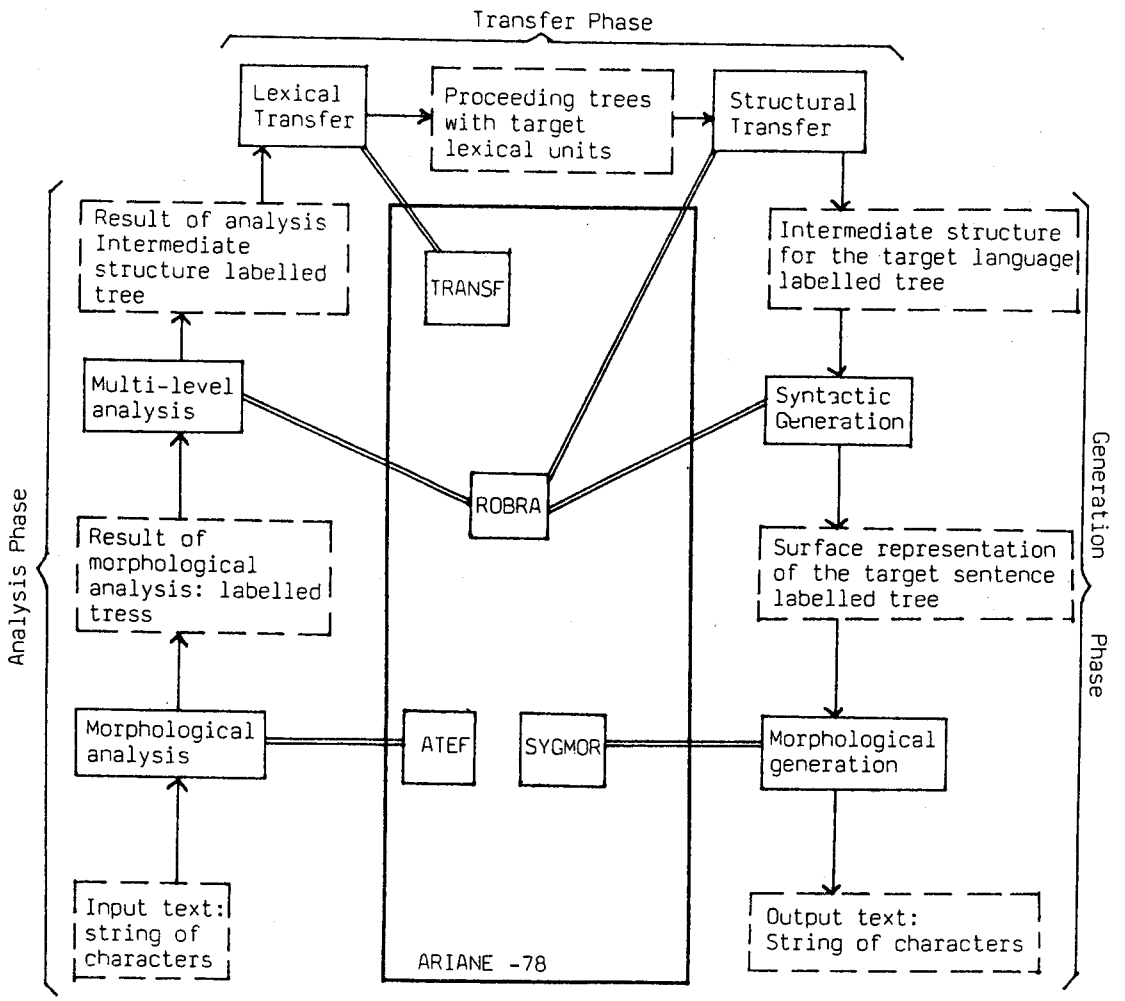
- print-out of any file, etc.

(ii) Different algorithmic components:

- ATEF is a non-determinate finite state transducer. This component is the programming tool which generates programs for the morphological analysis,

- ROBRA is a tree to tree transducer. This component is used for the multilevel analysis (syntax and partial semantics), second, for the structural transfer, and third for the syntactic generation in the target language,

FIGURE VIII: ARIANE - 78 SYSTEM



- TRANSF is a system for bi-lingual dictionaries look-up. It is used for the lexical transfer,

- SYGMOR is a deterministic finite-state transducer used for morphological generation.

Each algorithmic component is characterized by an external language, a compiler, an algorithmic program, and programs for traces. The external is the means by which the linguist describes the dictionaries, the grammars and the control of dynamic processing.

The entire system is quite complex (see GETA publications in the bibliography), but holds out much promise for successful implementation in the Malaysian case. The USM-GETA cooperation in computer-aided translation is supported by the French Government through the provision of experts from the University of Grenoble, and the exchange and training of USM research staff.

The computer translation model so far developed in USM as a test of the ARIANE System's applicability in the English-Bahasa Malaysia pair is aimed at a specific type of text; a secondary school level chemistry book is being used as the first experimental text. In terms of the quality of translation, the project only hopes to achieve, at this stage, a level of translation which is 'understandable'. Another consideration is the percentage of translation which can be achieved for a particular input text, and at the moment this is targeted at about 70% understandable translation.

Some examples from the experiment using the grammar model and the limited dictionary (consisting only of 700 items) developed so far might illustrate the feasibility of computer-aided English-Bahasa Malaysia translation:

**COMPUTER APPLICATIONS**

Example 1.

English Text:

"THE ONLY IMPORTANT SOURCE OF ALKANES IS CRUDE OIL. OIL ALSO GIVES MANY OTHER HYDROCARBONS. SINCE THE INTERNAL COMBUSTION ENGINE WAS INVENTED, AT THE END OF THE LAST CENTURY, OIL HAS HAD AN INCREASING IMPORTANCE AS A SOURCE OF PETROL".

Bahasa Malaysia Text:

"SUMBER ALKANA-ALKANA YANG PENTING SEKALI ADALAH MINYAK MENTAH. MINYAK JUGA MEMBERI BANYAK HIDROKARBON YANG LAIN. SEJAK ENJIN PEMBAKARAN DALAM DI REKA, PADA AKHIR ABAD YANG LALU, MINYAK TELAH MEMPUNYAI SATU KEPENTINGAN YANG BERTAMBAH < MENINGKAT > SEBAGAI SUATU SUMBER PETROL".

Example 2.

English Text:

"MATHANE, THE SIMPLEST OF THE ALKANES, IS A GAS AND ALMOST ALWAYS OCCURS WITH LIQUID OIL DEPOSITS. TO A LESSER EXTENT THE OTHER VOLATILE ALKANES (ETHANE, PROPANE, AND BUTANE) ARE MIXED WITH IT. THE MIXTURE IS KNOWN AS NATURAL GAS".

Bahasa Malaysia Text:

"< INCOMPLETE ANALYSIS > METANA, PALING MUDAH ALKANA-ALKANA ADALAH SUATU GAS < INCOMPLETE ANALYSIS > DAN HAMPIR-HAMPIR SENTIASA TERDAPAT DENGAN ENAPAN-ENAPAN MINYAK CECAIR. <INCOMPLETE ANALYSIS > UNTUK SUATU SETAKAT YANG KURANG LAIN ALKANA-ALKANA MERUAP < UNKNOWN TARGET LU > ETANA, PROPANA DAN BUTANA < INCOMPLETE ANALYSIS > DICAMPUR DENGANNYA. CAMPURAN DIKENALI SEBAGAI GAS ASLI".

While the first text is acceptable, the second example shows clearly the limitations of the present grammar model, and in particular the associated dictionary.

It is hoped in the second phase (1984-1986) that further improvements to this model can be made in terms of the percentage of translatable text and the quality of the translation. Large scale dictionary work is expected to be carried out, and at least one other type of text will be investigated. The development of an industrial prototype depends very much on the availability of resources, including a dedicated computer of sufficient size and power, and the involvement of a large number of specially-trained linguistic assistants and subject specialists.

Possible directions of research and development work in this area, besides the enlargement of the grammar models, would be in the area of pre-edit text processing, including large scale text storage for mass input into the translation modules (see Mohammad Ghazie, 1983) developing man-machine interface systems for post-editing activities, and exploring the possibility of implementing the computer-aided translation system on microcomputers for specialized text types. These efforts will be enhanced by the University's recent decision to create a task force for the Computer-Aided Translation Project.

**Computer Aided Instruction (CAI) Activities In USM.**

The role of computers in its academic programmes has been recognized quite early at the University. Besides the obvious involvement in computer science degree programmes, and research in computer science and computer applications, the University has since the last three to four years taken definite steps to introduce the use of computers as a teaching tool on a wide scale, mainly through the development of computer aided learning and instruction. The pace of CAI and related activities in the application of advanced educational technology has since increased. These activities are not merely aimed at its adoption within the teaching schools in the university, but also are projected towards its promotion to targets outside the university through the University's teacher education programme and a school's computer literacy project. This section reports the various research and development activities in computer aided instruction carried out at USM.

## COMPUTER APPLICATIONS

Since 1975, the School of Mathematical Sciences is offering both major and minor programmes in Computer Science in order to meet the manpower requirements of the country in the computer field. The work on CAI was started during 1980 when a research project on "CAI in Teaching and Learning - A Feasibility Study" was sanctioned. The main aims of the research work carried out at this School are as follows:

(i) To study the cost effectiveness of CAI system over conventional methods;

(ii) To identify computer hardware suitable for CAI activities;

(iii) To develop necessary hardware and software necessary to integrate the conventional CAI systems with other audiovisual equipment;

(iv) To study the effect of speech input and output in a CAI environment;

(v) To create computer awareness among the educators and students both at the University and school level;

(vi) To develop management information system packages suitable for local schools and colleges;

(vii) To develop more user-friendly authoring languages and authoring systems;

(viii) To promote CAI activities at different Centres and Schools in the Universities, through development of suitable packages using authoring languages and systems; and

(ix) To develop suitable simulation packages for teaching Computer Science subjects.

In the direction of user-friendly languages, the School has developed two new languages "BAHASA PENGATURCARAAN SALING TINDAK (BAHASA PESAT)" AND "S.P.P.K. system" for PDP-11 and Apple II, and IBM 370 respectively. After realizing the reluctance of the instructors in learning even such simple languages, an authoring system "Computer Aided Instruction Courseware Authoring System (CAICAS)" has been developed for Zilog and Vector-3 microcomputers (Figure IX). CAICAS is an interactive authoring system consisting of a set of software tools for the fast production of interactive CAIware packages using Microsoft Basic as the programming language (see Rao et al., 1982). The CAICAS System is user-friendly to the extent that the user will find it CAImatic in terms of operational procedure. Presently, the Matriculation Centre is using CAICAS for creating a number of CAI courseware packages.

In a joint project with the School of Applied Sciences and the Educational Technology Unit, the School has developed both hardware and software for interconnecting VCR with the Apple Computer (see ETU following). Presently, the School is planning to develop more sophisticated interfacers for other audiovisual equipment.

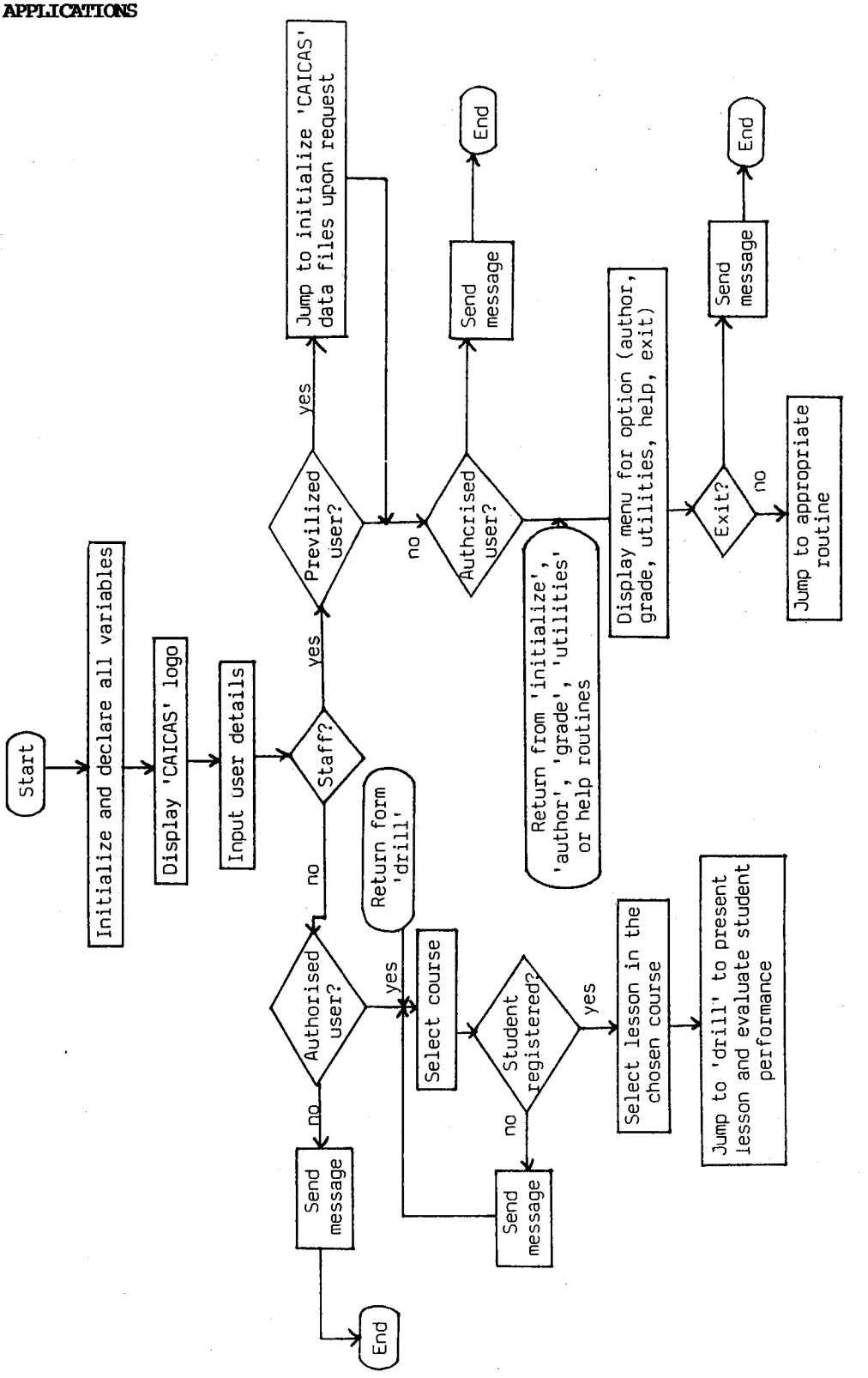
Recently, the School has developed a simple keyboard to enable handicapped children to communicate with the computer either for CAI purposed or other textual information presentation. A speech synthesis system is also interfaced with the above system. The speech system was found to have a greater impact on the students where the messages are spoken rather than displayed on the screen.

The School has also developed simulation packages to illustrate the basic working principles of computer organization and assembly instructions execution. Tutorial packages required to teach the working principles of microcomputers are developed and tested with practising engineers.

The computer science minor programme is designed to cater to the needs of non-computer majors. The courses like Computers and Society (MAK 257), Computers and Systems (MAK 258), etc., deal with some of the important topics that are useful for those who would like to have a career in CAI.

A number of official lectures have been given by the lecturers of the school at different secondary schools in Penang on the use of computers in education.

FIGURE IX: CAICAS 'MAIN' PROGRAMME



In the new School of Computer Science a separate CAI Laboratory is provided for CAI activities. Physical facilities are provided for sixteen terminals along with discussion and film projection facilities. The School is also actively considering using the student computer power for developing CAI packages.

The Educational Technology Unit (ETU) is actively taking part in the development of computer aided instruction, since microcomputers are considered an extension of audiovisual devices. It is believed that the success of the CAI program is mainly dependent upon the design of the instruction and learning strategies applied.

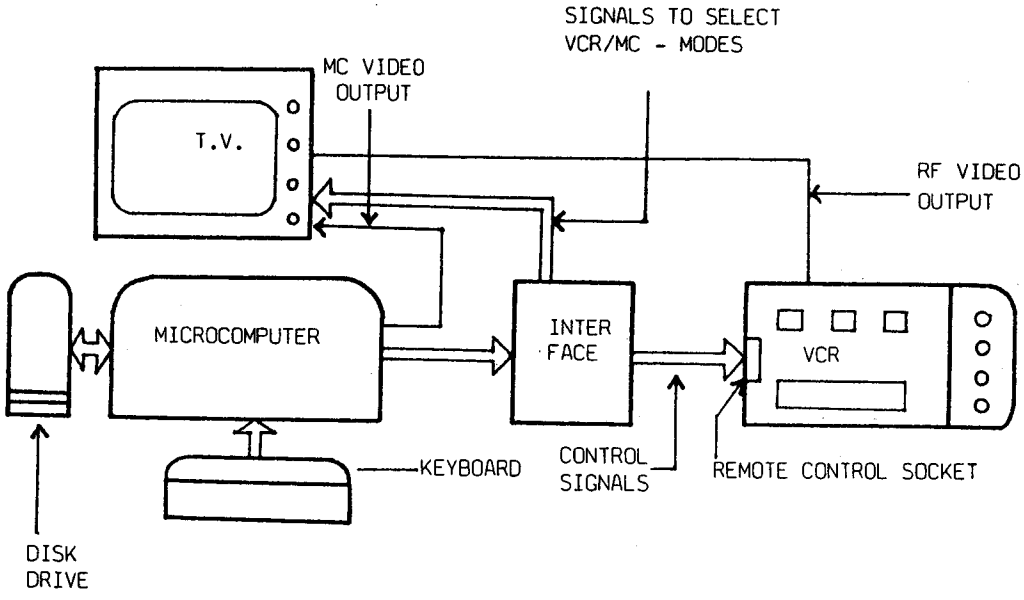
The ETU is in a strong position to offer support in the growing fields of computer assisted learning and computer assisted teaching in terms of research, software development, teacher training and learning resources, from several points of view:

(i) Microcomputer as a control device can be effectively used to combine with other audiovisual devices. A research project, conducted jointly with the School of Applied Sciences and the School of Mathematical Sciences as mentioned earlier, has been successfully conducted to interface microcomputer with video recorder and developed courseware material (Figure X). It is found that the potential of using such medium is enormous and further improvement to the system is in progress.

(ii) In developing prototype instructional materials for teaching, proper application of instructional design procedures, instructional psychology based upon learner differences, content differences and level of expected learner performance are always considered. A taxonomy of instructional strategies is to be derived from the analysis of student's study process in computer-aided learning materials, which is at present being carried out.

(iii) A computer literacy course has been offered in the teacher training program at the School of Educational Studies. The

FIGURE X: BLOCK DIAGRAM OF COMPUTER AUGMENTED VIDEO SYSTEM



input to the course from the educational technology point of view is in the design procedure of educational courseware, application of learning psychology and criteria for evaluation of CAI programmes.

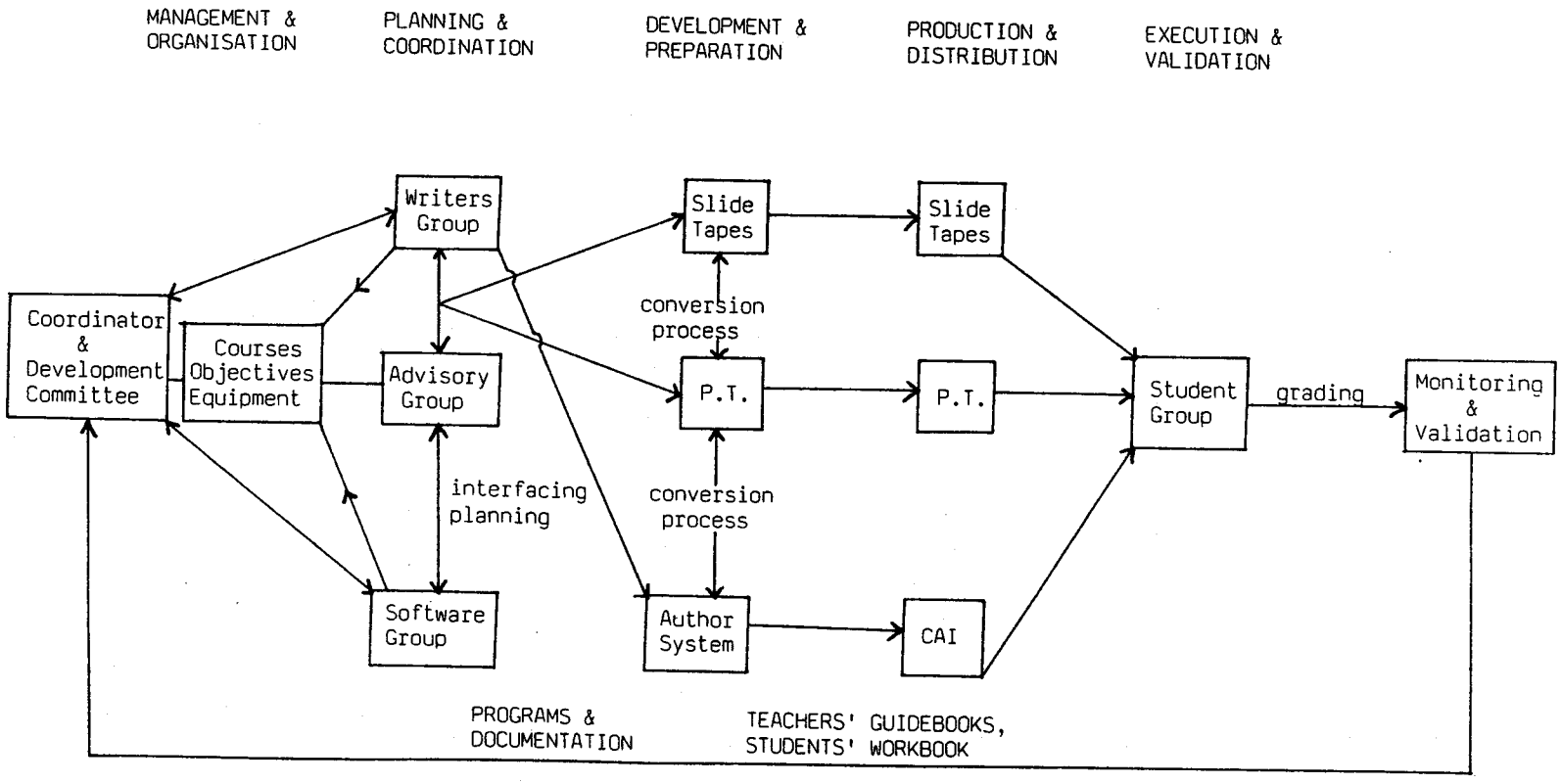
(iv) The media library of ETU plays a role in providing learning resources support for CAI activities. At present, two microcomputers are placed in the library and students can use them with the supervision of the staff. Acquisition, collection and organization of software and related references have also been in progress. All the reference manuals, books and diskettes are made available to the students.

Presently, the Unit is in the process of acquiring four more micro-computers to expedite the activities mentioned above. The development of the above mentioned range of activities is expected to be expanded when the ETU is upgraded, as currently being planned, to a Centre for Educational Technology and Media, and in collaboration with other interested groups within the University.

The Teaching-Learning Advisory Unit (TLAU), responsible for the improvement of the teaching-learning process and for the professional development of the teaching staff, has been given approval to implement plans for the development of self-paced individualised learning as a supplement to the traditional lecture-tutorial system at present being practised in university instruction. From the beginning the TLAU has adopted the view that individualized and bridging courses are potentially an effective long-term strategy to overcome the existing teaching-learning problems in science education among academically-disadvantaged student groups. Towards this end it had initiated the CAI programme for Matriculation Science courses in 1982 as one of the three modes of programmed instruction, namely Paper Programmed Instruction (PPI), Computer Assisted Instruction (CAI) and Slide-Tape Instruction (STI).

The TLAU strategy has been developed in the form of a system which incorporates PPI within a scheme called SPICES (Self-paced Programmed Individualized Computerized Education Strategy) where the use of computer assisted instruction and other audiovisual aids (including a prototype Audio-Tutorial System) is prevalent (Figure XI). The implementation of this scheme

FIGURE XI: FLOW CHART FOR THE DEVELOPMENT OF CAI, PT & ST



has been made possible by the successful development of the Courseware Authoring System (CAICAS), mentioned earlier, for the Vector-2600 microcomputer system at the Unversity.

The material developed in the TLAU is highly structured and is principally based on programmed instruction texts written by tutorial staff of the Matriculation Science Centre in cooperation with the Unit. The programme benefited directly from the pioneering work involved with the production of prototype PPI units by TLAU in collaboration with a few interested academic staff.

Much of the experimentation and implementation of CAI systems has been carried out with groups of students in the Matriculation Science Centre. In keeping with the national manpower needs of Malaysia in the fields of science and technology, as well as to reflect the ethnic balance in institutions of higher learning, a Universiti Sains Malaysia Matriculation Science Programme was launched in 1977, which last year was upgraded to a centre. This programme aims to prepare Bumiputra candidates for science degree courses at the university level.

In the effort to achieve the above target, this programme is so designed as to provide guidance as well as wide and suitable background to candidates in the fields of science. In-depth studies on the teaching-learning problems of pre-university students from the Matriculation Science Programme of Universiti Sains Malaysia have indicated that viable individualised programmed teaching-learning systems should be actively pursued as a priority programme. CAI is one of the modes of self-paced, programmed, individualised learning that has been identified. Presently, modular packages for the CAI mode of learning have been developed for the Matriculation Science Programme as well as 1st Year Pure Science courses taught at the various Science Faculties as a supplementary effort in enrichment and remediation to provide a much stronger background in the formative years of university education.

With the installation of five Vector microcomputers in its premises in June 1982, informal orientation and sessions for 25 of its tutorial staff were held for 12 weeks. Every instructor was given one hour per week to study the PPI prototype materials and to use the computer in converting those materials into CAI units under the supervision of an advisory panel of four academic staff,

(one each from TLAU, Pusat Pengajian Sains Fizik, Pusat Pengajian Sains Matematik and Pusat Pengajian Sains Gunaan). A follow-up workshop was held for all the instructors involved in the Computer Laboratory of the School of Mathematical Sciences in November 1982. The objective was for the instructors to use the microcomputers to key in their CAI lessons onto the diskettes from the PPI drafts they had written prior to the workshop.

This on-the-job training experience was productive as six PPI lessons on certain topics for each of the three subjects, Mathematics, Physics and Chemistry were produced by the instructors. These were also converted into appropriate CAI units in time for a trial run during the last six weeks of the following semester of 1982/83.

Twenty selected students for each of the three subjects were given one hour per week to use the microcomputer in learning a difficult topic that has been covered in lectures that they had attended. The outcome of the trial run was positive and encouraging. The feedback from the questionnaire given to a random sample of the students concerned at the end of the six week course was considered highly satisfactory.

As a result of the positive feedback from another trial run of the CAI programme conducted from February to March, 1983, the Matriculation Centre decided to continue the development and consolidation of the project for the full academic session, 1983/84. The academic staff of the Centre will develop new PPI materials for selected topics prescribed for Semester One in each of the four subjects, Mathematics, Physics, Chemistry and Biology for eventual conversion to CAI lessons. It is proposed to have at least 12 lessons for each of the four subjects, i.e. one lesson per week for twelve weeks of Semester One. This plan is under implementation. The PPI materials are in the process of getting converted into CAI lessons.

It is also proposed to modify the present CAICAS System for Vector computer system so that it can be available for use in future with any microcomputer system that is compatible with the Apple II system for reason of economy in costing. A compatible system costs two and half times less than an Apple II and such costing should be taken into account when purchasing micros for use at the Matriculation level.

The School of Educational Studies has, beginning with the 1982/83 Session, offered a CAI-related course known as Computers and Education (PLG452) in its B.Sc. and B.A. with Education programme. This course is an elective for fourth-year Education students. Its main aim is to examine the present and potential uses of computers in the educational process through sample courseware and also personal experience in developing some mode of computer courseware using Apple II PILOT. Student response to this is overwhelming. A group of current fourth year students has petitioned early this year to the Dean of the School to offer this course in both semesters. However, because of the constraints of manpower and facilities, the School can offer this course in one semester only.

Beginning from the second semester of this academic year, the School will start implementing a new teacher education programme known as Bachelor of Education for practising college-trained teachers. This programme has a number of areas of concentration or specialization. One of these is Computers and Education which consists of a package of courses with the aim of producing specialists in CAI for Malaysian schools. The School is currently working out the package of courses.

In early 1981, the School submitted to the University, a proposal to carry out a study for a period of five years on the uses of computers in education. The objectives of the study are:

(i) To develop software and CAIware for the training of teachers in the School of Educational Studies and teacher's training colleges;

(ii) To develop software and CAIware for instruction in languages and mathematics at Forms 4 and 5 with special emphasis on remediation;

(iii) To develop software and CAIware for use in school administration and instructional management in collaboration with State Educational Resource Centres;

(iv) To develop software and CAIware for in-service training of practising teachers and Ministry personnel;

(v) To study the capabilities and suitability of the various types of microcomputers available for use in schools; and

(vi) To formulate guidelines for optimum utilization of computer facilities in schools.

With the forthcoming implementation of the B.Ed. programme which has Computers and Education as an area of specialization, the proposal might be reviewed and possibly be launched soon.

The School of Medical Sciences intended to use microcomputers for teaching-learning purpose with special emphasis on CAI. CAI will be used as a supplementary teaching mode, but not as a main medium of instruction. There are two aspects of CAI implementation for use as supplementary instruction in the Medical School:

(i) Programmes for slow learners - to provide drill and practice and tutorial programme on particular concepts, practice of Multiple Choice Questions (MCQ), and to inform the learner on his performance.

(ii) Clinical simulations - to provide clinical simulation programmes for application of medicine, history taking, case studies and clinical problem solving especially for clinical years.

At the moment, the Medical School has three batches of students. The school has recently acquired two Vector-2600 microcomputers. To accommodate all the students, it will require at least four microcomputers. It is envisaged that the school can introduce CAI for all batches in 1986.

There is an increasing demand for CAI materials and CAI training not only from the university staff but also from outside bodies. USM is the first university in South East Asia to employ microcomputers and back-up educational technological media extensively for individualised learning in science subjects as supplementary efforts to its traditional lecturing system of teaching. It seems, therefore, that the infra-structure for the introduction of CAI is already present, and that we need only to step up efforts to realise the computer's pedagogic potential. Thus, there is need for further research work

particularly in the areas of effective CAIware programmes and effective training methods suited for local conditions. A plan was recently approved by the University to set up a central CAI Resource and Service Bureau to look into some of the functions indicated in the project proposals. The proposed Bureau would look into the following:

(i) To assist in software developmnet, like:

  (a) new and effective authoring languages,
  (b) educationally sound authoring systems,
  (c) graphic editors and simulation languages, and
  (d) statistical evaluation programmes;

(ii) To assist in CAIware development;

(iii) To train lecturers/instructors in using and maintaining CAI hardware, software and courseware;

(iv) To evaluate hardware and software available from educational and commercial bodies;

(v) To coordinate in software exchange programme with other CAI establishments;

(vi) To disseminate CAI related information; and

(vii) To build up a library of CAI programmes and related materials.

Under current plans the activities of the Bureau will be restricted to development and research of software and CAIware only. The departmental coordinators must develop their own educational methods in consultation with TLAU and ETU where necessary.

The various activities described in this section reflect the University's determination to introduce innovative instructional and learning systems to overcome some of the problems in the teaching-learning process in USM. These in CAI and related activities are being incorporated into an overall programme of

research and development concerning the implementation of instructional systems design for science and technology education. These efforts might later provide useful new approaches and experience for implementation in other universities.

**Project SISMAP: Development Of A University Management Information System**

The large scale usage of computer technology for USM administrative applications has been undertaken for about three years. Some of these applications use system designs and data structure which were developed by the USM computer analysts and professionals, such as the payroll and student information systems. Other administrative applications use software packages which were acquired through purchase, lease or through donation such as the Local Government Financial System (LGFS) and the SISMAKOM (USM Library Sistem Maklumat Komputer).

However, all these computerized administrative systems were designed primarily, if not exclusively, for scheduled production of predefined information, such as the production of paychecks, student transcripts or list of newly acquired books. That is, these administrative systems are basically what are called operations systems and are not particularly useful for management at the level of the departmental heads.

The senior executives of the USM require a computer technology which can provide facilities to:

(i) monitor and improve the **efficiency** in performing the many tasks required by the university; and

(ii) to enhance the effectiveness in making decisions for operational control as well as strategic planning purposes.

In the coming years, when the USM will be facing the adverse implications and consequences of the global economic recession, it is almost certain that the environment for decision-making processes is and will be unstable. Under this condition, the USM leadership must not only try to maximize the efficiency in the use of its limited economic resources but also to ensure that the utilization is based on effective decision-making. In this regard, the call by the Vice-Chancellor to implement a management information system (MIS) in the USM as soon as possible is timely. It is likely that a modest and sensible investment in developing a customized management tool will have large payoffs in the near future.

To develop an MIS for the university within a limited time frame and budget and expertise is, to say the least, a difficult task. The system was developed under the auspices of a project management team rather than under an existing administrative mechanism, for two main reasons:

(i) Firstly, the tasks required for developing such a system are not only new and onerous; more importantly, in order to ensure its satisfactory completion on schedule, there must be flexibility in work administration (recruitment, disciplinary action, work pattern, etc.) and the project participants are to be governed by different motivations.

(ii) Secondly, the development of the MIS must not impair or impede the existing work routines in the university. In this regard, current administrative and technical personnel from existing routine tasks are not incorporated as active members of the projects.

The objective of this project is to conceptualize, design and implement a type of computer-based Management Information System for the university administration, within the period of about six months with a modest project funding. In order to achieve the above objective, the following strategies were proposed:

(i) Conduct further in-depth analysis and evaluation of administrative files which have been computerized or to be

computerized, with the intention of rationalizing all such activities towards the development of an MIS, which may be based on a data base design.

(ii) Conceptualize, design and implement a database information system for the university administration, in which, either at least a prototype of such a system would be developed and evaluated; or, an existing educational information system package would be evaluated and tested.

(iii) Coordinate the purchases/leases and subsequent utilization of software and hardware in the Unit Komputer and other relevant departments in the USM with the purpose of making a transition from the existing data processing environment to that of an information processing environment.

(iv) Utilize the in-house expertise among the academic and professional personnel within the USM who have participated in administrative file and/or data base development, or who have the necessary technical skill.

(v) Integrate the proposed programme activities of the International Institute of Education (IIE) with the aim of incorporating certain methodologies and technical features with Projek SISMAP (USM).

The major activities under Projek SISMAP are threefold:

(i) The systematic and rapid development of new administrative applications and conversion of existing applications in which an adequate set of operational files would be computerized.

(ii) The development of a data base (or data bases) in which the requirements for operational system and information system can be adequately and efficiently met. Given the constraints of

this project, only a prototype of this data base design can be expected to be completed. Nevertheless, it is expected that this prototype design, if successful, will form a firm basis for later implementation of a comprehensive data base(s).

(iii) The development of a set of decision support system for certain areas of strategic planning in general; the development of a monitoring and evaluative system of the internal efficiency of the USM operations in particular.

There are four main types of data files - students files, academic and general staff personnel files, building and classroom files and financial files. The student files consist of the basic characteristics or biodata of the students, the courses taken for each semester and their performances in these courses. The academic and general staff personnel files consist of the basic personal characteristics of the university employees and their work achievement. The physical structure files consist of the location, dimension, usage and availability of facilities/amenities of all the rooms and buildings in the campus. The financial files consist of the employee salaries file, the annual operating expenditure file and the development expenditure files for all departments in the USM.

The computerization of certain administrative records in the USM in the form of data files is adequate for specific operational application such as the monthly payroll production or production of transcript every semester. However, this type of computerized data storage is rather unsatisfactory for usage at management level, for the following reasons:

(i) executives often need information which spans across departments, schools and other administrative units; and

(ii) executives often need information through ad hoc query or through some semi-structured request in which the information is not produced on a scheduled basis.

For these reasons, a management information system should be designed in which data bases are developed in addition to data files. Under this project, a prototype data base(s) will be developed in which some or all of the operational data files will be involved.

It is envisaged that this prototype data base design will provide a sound basis for future implementation of a full data base system. However, a viable MIS will be developed within the period of the project with or without a database system since there exist a few alternatives in developing a computerized MIS, using the available software in the Unit Komputer.

The tasks and the stages of work of Projek SISMAP are designed to integrate with the activities of the International Institute of Education. It is assumed that the IIE project with the USM will be finalized in time for such an integration of the joint activities. Basically, the objective of the IIE project is to develop a set of computer-based methodology to monitor and evaluate the internal efficiency of the USM administration. The nature of the integration of the two project activities are as follows:

(i) Most if not all the data requirements for the IIE project are likely to be met from the data file and data base development under Projek SISMAP.

(ii) The conceptual design and the methodology for the development of a monitoring and evaluation system under project IIE can be usefully incorporated as an important component of a set of decision-support technique for managerial use, as stated earlier in the strategies for Projek SISMAP.

The first phase of this project will terminate by the end of 1983, and a series of technical and administrative reports will be submitted in early 1984. However, in order to implement successfully the computerized system which has been developed and tested, a considerable amount of organizational and technical resources is required in the next two years. Under these circumstances, an organizational review of Projek SISMAP activities is called for, so that the transition from project management to a formal administration (under Unit SISMAP) can be made without undue difficulties.

The major activities which have been planned for 1984 are:

(i) To continue the existing effort in developing new computerized files which are required for operational and managerial functions;

(ii) To implement the existing structure of the computerized Managegement Information System which has been developed and demonstrated in 1983; and

(iii) To formulate a new design for integrating the data files which are kept in the mainframe computer using the new data base software and a more powerful mainframe computer.

The major files which have been developed by 1983 are:

(i) Student-Course file
(ii) Student Staff file
(iii) Course Staff file
(iv) Academic Staff file
(v) General Staff file, and
(vi) Operating financial file

The academic staff file has been edited and a verification process by the individual staff members has been done. The response rate for this verification exercise is about 70%, and it is proposed that a further attempt would be made to obtain a 100% reponse rate from the academic staff in 1984.

The administrative staff file has been edited but no verification has been made to these records. It is envisaged that in early 1984, a major effort to get these records verified would be launched.

Amendments of these verified records would be made through an on-line editing system with pre-formatted screens. This is to ensure that the records would be corrected quickly and accurately. This feature would also serve as a non-line query facility for administrative and managerial use.

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The financial file which has been developed consists of the monthly operating expenditure of the schools, departments and units in the University. This file is being developed at the microcomputer level using an integrated software. The file and the associated financial models have been developed and are ready for operational use. Further financial files would be considered for development in 1984.

The students' and the course files have been developed prior to Projek SISMAP but these files have been restructured as MARK IV files so that on-line query facility may be made available and the capability to generate reports can be easily expedited.

It is proposed that further rationalization be undertaken for these files so that a truly integrated database could be developed using a powerful database management software and a faster performance mainframe computer in the second half of 1984.

In 1984, the new files to be developed have been idenfitied as follows:

(i) Fixed asset files which include building, fixtures, equipment, machinery, and vehicles; and

(ii) Project and research files.

When Unit SISMAP is constituted as a unit under the Chancellory in 1985, it will have the following objectives:

(i) To create and maintain a distributed microcomputer-based data base for the exclusive use by the Vice-Chancellor office and other senior administrators of the University; and

(ii) To create and maintain a decision-support system (DSS) so as to increase the effectiveness in the decision-making processes by the University management.

The proposed major activities for the Unit SISMAP in 1985 are as follows:

(i) To create new data files (if necessary) and to maintain/improve existing data files (or databases);

(ii) To initiate ad hoc projects/studies for conceptualization and development of decision support models and other analytical tools for financial, student, personnel and physical asset management (academic staff might be asked to participate); and

(iii) To plan and implement conversion tasks for the SISMAP system using the new database software and new mainframe capabilities.

**Conclusion**

In this paper, we had described some of the work being undertaken at the Universiti Sains Malaysia in the area of computer applications. These activities in public sector information systems, in automatic translation, in computer-aided instruction, and in the development of a university management information system, were all motivated by needs felt as a result of experience and aimed at solving local problems. It is thus, an example of the transfer of technology, one of the most powerful and far-reaching technology yet, that has been evaluated according to local criteria of relevance and adapted to the appropriate conditions of the country.

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# MODIFIED FORMS OF NATURAL RUBBER AND THEIR CONTRIBUTION TO INDUSTRIAL DEVELOPMENT IN MALAYSIA

by

Sekaran Nair*

## Introduction

Natural rubber like most agricultural products with industrial applications has suffered the trauma of being relegated from the status of being a "unique" material to one where it is intensely competing with a whole host of synthetic substitutes. While the synthetics have taken the major share of the increasing market for elastomers (synthetic rubbers now command 67% of the world market), natural rubber production has also increased through the years albeit at a slower rate than the synthetics. A major defensive action taken by those involved in the R & D aspects (largely confined to Malaysian institutions) of the NR industry is that of modifying NR in any way possible to match the synthetics. These modifications range from the simple imposition of quality control procedures to those involving a basic change of the NR molecule. Generally, the modifications could be classified into physical or chemical changes.

Two examples of how modifications to NR have helped Malaysia maintain its premier position (as the major supplier of NR) are described in detail. One of these involves the modification of processing methods, the evolvement of an elaborate system of quality control measures and the modernisation of marketing techniques/channels. In this example, the changes are largely physical. The other example is a more recent breakthrough in chemical modification of natural rubber whereby the behaviour and characteristics of this modified form (epoxidized NR or ENR in short) are significantly different.

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The SMR scheme was initiated in 1965 and the SMR type of rubbers now constitute the major type of Malaysian rubber exported; SMR - 51%; RSS - 30%; latex concentrate - 19%. Epoxidized natural rubber (ENR) is still in the stage of semi-commercial production and all indications point to this modified form greatly enhancing the competitive position of NR in the elastomeric markets.

## Epoxidized Natural Rubber (ENR)

**Grades And Properties Of ENR:** The technique for the epoxidation of natural rubber has been known for several years and under general reaction conditions, a number of side products (e.g. through furanisation or otherwise) would also be obtained in addition to the epoxidized natural rubber. The presence of these side reactions had detracted from any serious consideration of epoxidation as a technically or economically viable proposition for modifying NR. Under the new reaction conditions devised, the formation of side products is minimized giving rise to a "clean reaction". The production of ENR to any desired level of modification of up to 90% is achievable. Furthermore, the chemicals involved are relatively simple and easily obtainable; finally and most important, the reaction can be carried out in the latex stage. This is in contrast to most other modification reactions which can only be effected in the solvent phase.

The versatility of the reaction enabling different levels of epoxidation to be achieved results in a wide spectrum of modified NR with an equally wide spread of special properties. To prevent undue proliferation of ENR grades, it has been decided to confine the semi-commercial production of ENR to 3 basic grades. These would be:

ENR 10 - 10% mole epoxidation level

ENR 25 - 25% mole epoxidation level

ENR 50 - 50% mole epoxidation level

The damping characteristics of ENR 10 combined with the inherent basic properties of NR (e.g. high strength, good fatigue resistance, high tear strength, low stress relaxation and the ability to strain-crystallize) would make this an even better material for engineering applications.

ENR 25 in certain formulations has a useful combination of "wet grip" or traction and a low rolling resistance (improved fuel economy in tyres). This combination of characteristics (Figure I) is of particular importance in the treads of passenger car tyres which have hitherto been largely of synthetic polymers (OESBR)

At 50% epoxidation level (ENR 50) the modified NR is difficult to process like some of the specialty synthetics i.e. halobutyl and nitrile rubbers. Similarly ENR 50 has good air impermeability characteristics, like the halo butyl rubbers (Table I); and good oil resistance, like nitrile rubber (Table II). ENR 50 is expected to suit applications such as oil resistance hoses and seals, milking inflations, printer's blankets, connectors, tubes and as inner liner for tubeless tyres.

**Production of ENR:** The production process of ENR has been scaled up from a laboratory process through a 80 kg batch process into the current 1 tonne pilot plant. At the various stages of the scaling-up process, improvements to the temperature controls, coagulation and processing techniques were instituted. Modifications to the reaction conditions and the use of additives enabled these ENR grades to largely meet property criteria considered important for elastomers. Adapting the material for processing through the use of conventional machinery used in SMR processing was an additional challenge. A simplified flow-chart of the current process is depicted in Figure II.

Samples produced from the laboratory scale equipment and the 80 kg batch reactor were utilized to generate initial data both at the RRIM and in consumer laboratories on its specialised properties. The tonnage quantities of materials now being produced would be adequate for probing factory evaluations. Final acceptance of grades such as ENR 25 in tyres is a very elaborate procedure involving large quantities of the rubbers and thorough testing by the tyre manufacturers. The 1 tonne pilot plant at the RRIES factory has produced to-date some 13 tonnes of ENR 50 which is being evaluated on factory scale equipment at various locations and for a variety of applications. Each lot of ENR 50 when sent for factory evaluation is accompanied by a booklet describing compounding recipes and typical vulcanisate properties (Malaysian Rubber Research & Development Board, 1983).

FIGURE I: WET GRIP AND ROLLING RESISTANCE OF SOME RUBBERS

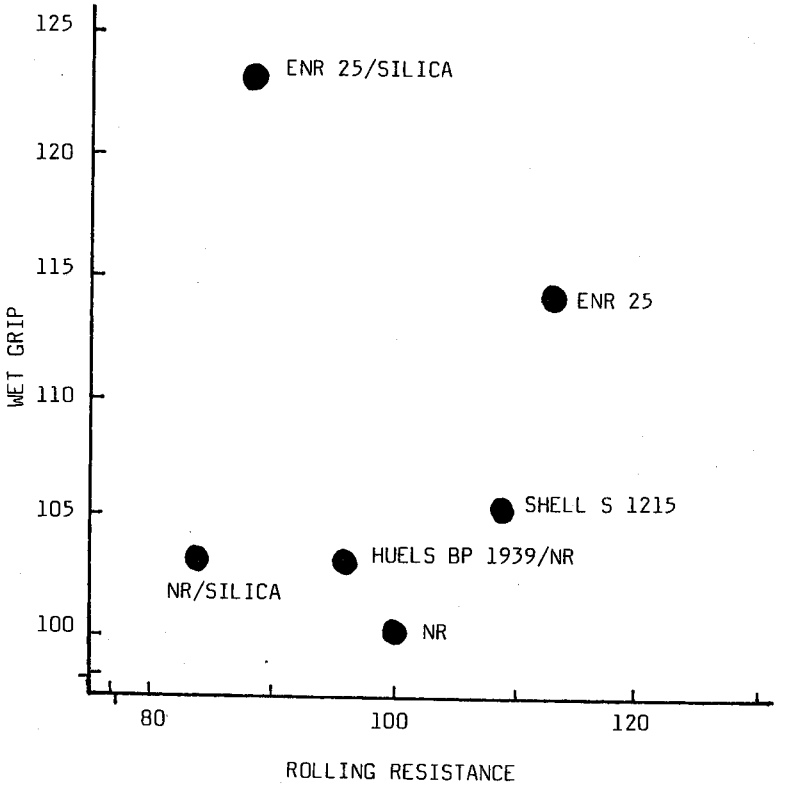


TABLE I: RELATIVE AIR PERMEABILITIES*

| Elastomer | 24°C | 40°C | 60°C |
|---|---|---|---|
| NR | 100 | 156 | 281 |
| ENR 25 | 28 | 54 | 142 |
| ENR 50 | 9 | 18 | 58 |
| ENR 68 | 1.5 | 5 | 32 |
| Butyl (IIR) | 5 | 12 | 43 |

* Data obtained by MRPRA using Rubber 100; ZnO 5; stearic acid 2; sulphur 0.33; MOR 3.0; TMTD 2.0; Flectol H 2.0; cured to optimum at 150°C.

**TABLE II: OIL RESISTANCE OF NR, ENR 50 AND NBR* VULCANISATES****

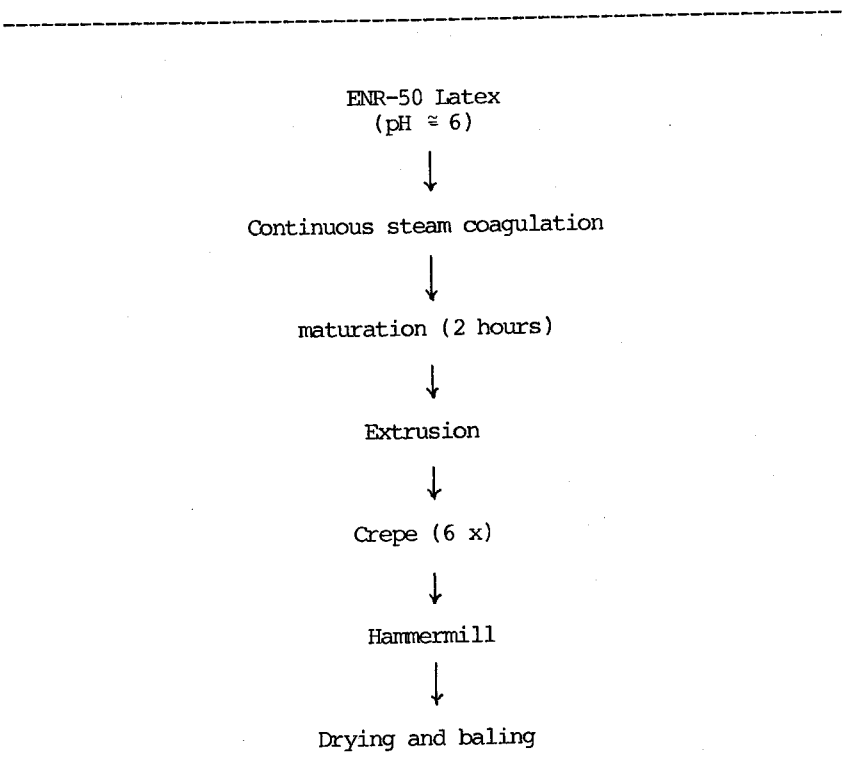
**- % Volume Change After 4 Days At 23°C**

| Oil | NR | ENR 50 | NBR* |
|---|---|---|---|
| ASTM No. 1 | + 15 | + 0.1 | + 0.2 |
| ASTM No. 2 | + 28 | + 0.6 | + 0.3 |
| ASTM No. 3 | + 78 | + 1.1 | + 0.7 |

* NBR - nitrile rubber

** All the rubbers contain 30 phr N220 black

**FIGURE II: SIMPLIFIED FLOW-LINE FOR ENR 50 USING CONTINUOUS COAGULATOR**



The pilot plant is now in the process of producing and accumulating some 10-12 tonnes of ENR 25 for consumer factory evaluations. It is likely that each of these ENR grades may not be used on their own but in blends with unmodified NR or other elastomers. Such blends would not only be easier to process but would also result in cheaper compound costs.

The incorporation of about 10% ENR 50 in motor cycle tyre treads in place of certain synthetics at no increase in compound costs but with similar or improved "traction" is one such example of utilisation of blends.

The developmental price for ENR grades has been pegged at premiums of 280, 210 and 180 Malaysian cents above that of RSS 1 for ENR 50, ENR 25 and ENR 10 respectively. The use of RSS 1 as a base for pricing ENR would lead to fluctuations in the ENR prices and this may not be entirely desirable from a consumer's viewpoint. At current prices of RSS 1, these ENR grades are slightly overpriced in comparison to the equivalent synthetic rubbers. However, there are a number of areas in which cost reductions to the process could be made, namely through the use of field latex in place of latex concentrate as a starting material; reductions in prices of chemicals when larger quantities are used and their local manufacture becomes feasible; and improvements to the process. The potential markets for ENR can be assessed from the total world consumption of halo butyl and nitrile rubbers. The consumption of these two specialty rubbers is now in excess of 1 million tonnes annually.

In view of the large markets and the range of variations in properties achievable either through epoxidation or blending, the development of ENR is a priority project within the programme of both the RRIM and MRPRA laboratories. When the trials with ENR have been concluded and the production details finalised, the production of this material would be farmed out to the Malaysian producing industry for full commerical exploitation.

**New Process Rubbers And SMR Scheme**

The new or block rubber process factories have grown in tandem with the SMR scheme since 1965 (Rubber Research Institute of Malaysia, 1965 a & b). These block rubber factories utilize modern methods of coagulation, size-reduction, precleaning and treatment (where necessary), high temperature air circulation

driers and unitized packaging concepts. The conventional primary processing techniques for producing ribbed smoked sheets (RSS) and brown/compo crepes require long drying times and, hence, throughput is generally low.

The SMR scheme which involves grading certification according to certain technical criteria does not exclude conventional grades from being so classified, but is generally associated with block rubbers which are not amenable to visual classification.

It must be admitted that the pressures to devise new and modernised methods of processing, grading and packaging of NR arose out of the leads set and competition by the synthetic industry. Although some of the processing methods used in the NR industry have similarities with those used by the synthetic manufacturers there are significant differences of detail.

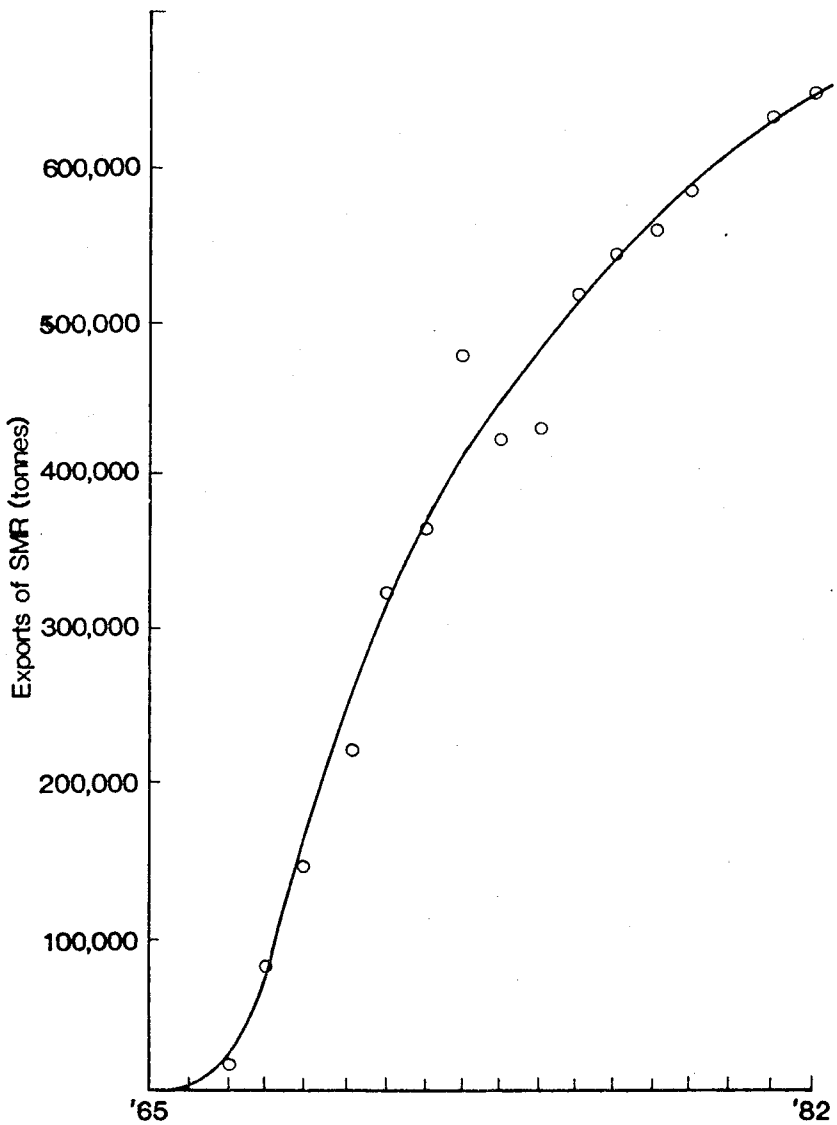
**Growth And Controls:** SMR has been dubbed the fastest growing polymer and this recognition against a whole host of synthetic polymers which have all been trying to capture an increasing share of the elastomeric market is really laudable (Figure III). The growth of these new forms of NR in Malaysia has been emulated in the other NR producing countries and each country has its own version of technically specified rubber e.g. Standard Indonesian Rubber (SIR), Thai Tested Rubber (TTR), Standard Singapore Rubber (SSR) etc.

Although the growth of SMR has been dramatic, the production is strictly monitored and the quality guaranteed through (Nair et al, 1972):

(i) System of registration of all producers together with the assignment of identifying code letters wherein every block of SMR can be traced back to the producer;

(ii) An advisory service to assist in choice of machinery, factory layout and start-up problems to enable a high level of quality SMR to be produced;

FIGURE III: EXPORTS OF SMR (1965 TO 1982)



(iii) A network of authorised laboratorites numbering some 45 throughout the country to test and grade the total Malaysian SMR production. All these laboratories come under the jurisdiction of the RRIM Standards Laboratory, which organises regular crosschecks and maintains an instrument servicing unit. Additionally, a copy of every test certificate issued is deposited with the Standards Laboratory;

(iv) The operations of an inspectorate/quality control unit, wherein spot checks are conducted and the shipment of every consignment recorded through the submission of monthly statements from each producer;

(v) The utilisation of the overseas MRRDB technical advisory officers to channel complaints and provide feedback on requirements of consumers. This feedback results in the SMR scheme being periodically modified and revamped (Rubber Research Institute of Malaysia, 1966 a & b; 1970 a, b & c; 1979; 1981) to suit the needs of consumers but tempered by the ability of producers and cost considerations.

**Sectorial Benefits:** The pioneering lead set by the RRIM in introducing new processing methods and the SMR scheme has provided the following benefits to the different sectors of the NR industry.

The remiller sector of the NR industry had previous to the introduction of SMR been the major processors of cuplump, treelace and other field coagula material into various brown and compo grades. On switching to the SMR scheme wherein these field coagula material was processed mainly into the SMR 20 grade, they enjoyed significant price increases. Within a few years of the introduction of the SMR scheme, Malaysian remillers ceased producing traditional grades arising from field coagula material. The SMR 20 grade is the most popular grade and accounts for some 54% of total SMR production.

The estate sector has benefited from the premium latex grades (CV, L grades which command a premium of 20 cts/kg over RSS 1) and also through the processing of their field coagula into SMR 10.

The central factories established primarily to process smallholders' material are able to produce the premium latex grades and also the SMR 10 and 20 grades in addition to the newer SMR GP grade. Mardec which is the largest of these corporations processing smallholders' rubbers is also the largest producer of SMR.

The premiums that SMR type rubbers attract over other types of TSR produced by the other countries is largely because of the strict system of supervision and controls exercised.

**Impact On Industry:** The changes introduced through the establishment of 180 new process block rubber factories and over 45 testing laboratories throughout the country has introduced to the general workers a sense of importance for industrial practices and the need to ensure quality through the use of testing equipment. This painless introduction through the medium of a well-known agricultural product to a large segment of the rural population of Malaysia (it is estimated that some 2.5 million people are connected in one way or another to the rubber industry) is one reason for the success of the rapid progress of industrialisation in Malaysia (industrial sector is currently the largest contributor to GDP). Among the successful industrial sectors, the rubber based industry also ranks as a success story. From two surveys done by the RRIM, the rubber based industrial sector had an average growth of 14% per year growth during the period 1972 to 1980 (Table III). Within this area of rubber based products, the manufacture of products from liquid latex concentrate has registered an even more impressive growth rate of over 20% per year. It may be pertinent to mention that Malaysia is now the world's leading exporter in a number of such products made directly from latex in gloves, catheters, latex thread.

**New Process Block vs Conventional Rubbers:** RRS type rubbers still constitute an important proportion of Malaysian NR as there are consumers who are used to these types and have already invested in equipment to handle and process these grades. There are certain consumers who claim marginal superiority in certain physical properties of compounds made from either of the two types of rubbers but protracted laboratory investigations both by consumers and the RRIM have failed to confirm these suggestions.

TABLE III: GROWTH OF DIFFERENT RUBBER PRODUCT SECTORS

(1972 TO 1980)

| Product Groupings | Tonnes rubber consumed 1972 | 1980 | Average Annual growth rate % |
|---|---|---|---|
| Latex products | 3,000 | 13,500 | 21 |
| Tyres | 8,800 | 23,000 | 13 |
| Retreads | 3,600 | 12,150 | 16 |
| Footwear GRG | 6,400 | 19,350 | 15 |
| Total | 21,800 | 68,000 | 15 |

## Other Types Of Modified NR

Over the years a number of chemically modified forms of NR, namely cyclized, methylmethacrylate, superior processing, physically modified (powdered rubbers, powdered carbon black masterbatch) and mixed forms (thermoplastic NR, powdered rubber treated with chlorine/bromine to modify surface) have been produced. While many of these have achieved limited commerical success, none of them has accounted for any significant proportion of Malaysian NR. It is also pertinent to point out that some of the above mentioned forms are comparatively recent e.g. carbon black masterbatch powder and thermoplastic NR (TPNR) and, hence, the question of them having any significant production volume is premature.

In most applications, NR is used together with other materials e.g. fibres, steel, fillers and these composites may sometimes be loosely defined as modified forms of natural rubber. This, however, is a complex area and one that should be discussed under individual applications.

## Conclusions

The three major prongs of research into natural rubber are:

(i) increase tree productivity and lower cost of production;

(ii) incorporate modifications or improvements in the primary processing stage to make NR as competitive in all elastromeric applications; and

(iii) encourage further manufacture of rubber products in Malaysia to ensure maximum utilisation of NR in products.

The second objective has been the subject of this paper and from the instances quoted, it would appear that research efforts and concepts have been productive. The translation of these into commerical realities especially in the case of ENR should make NR an even more competitive raw elastomeric material in world markets.

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# AN OVERVIEW OF URBAN TRAFFIC MANAGEMENT

by

Masaki Koshi*

## The Background Of Urban Traffic Management

Population concentration in urban areas, industrialization, an increase in income and the growth of motor vehicle ownership are more or less common phenomena in the post-war world. Urban traffic problems such as congestion, accidents and environmental deterioration have been the consequences of these phenomena and are also common in the cities of the world. Another important issue for non-oil producing countries is the increasing consumption of energy. Large cities in developing countries are suffering more severely from these problems than those in the developed part of the world due to the higher density of inhabitants and to lower levels of existing transportation infrastructure stock.

The term "Urban Traffic Management" became popular in the late 1970's as people realized that these problems could not be solved only through infrastructure investments. The expansion of infrastructure tends to take a long time and many cities cannot afford the large costs that are necessary. Moreover, economic recessions in many areas after the oil crisis has made it difficult to spend large amounts of money in short periods although the problems are immediate and pressing. Even if a city can afford the expenditure, it is sometimes physically impossible to do so in the older towns without destroying the town itself.

Urban Traffic Management (UTM) is a concept of comprehensive and coordinated application of the conventional measures for traffic operation. The objectives of UTM are the improvement of the movement of people and goods in a city with less harmful side effects through better and more efficient use of existing facilities. In the application of UTM, the concern is for more efficient movement of people and goods rather than the movement of a larger number of vehicles that conventional traffic operation tends to examine.

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**Problems Related To Urban Traffic**

There exists a variety of problems related to or caused by urban traffic. They may be categorized into five groups as follows:

(i) Problems of mobility-accessibility, relative to:

- private car users: delay, insufficient parking spaces;
- public transport users: unreliable operation, too long headway, delay, congestion, improper location of bus stops, lack of park-and-ride facilities, too high cost, limited service network (too far to walk);
- pedestrians and cyclists: delay, threat to safety by turning vehicles, lack of safe crossing facilities;
- urban goods movement: poor loading and off-loading conditions, delay of goods movements, lack of direct access (due to contra-flow bus lanes);
- public transport operators: too high operating cost, need for more buses (due to delays).

(ii) Problems of environment, such as:

- noise and vibration in city centers and residential areas and gas, fumes, smoke, dust and dirt;
- severances - by traffic and structures;
- visual impact - of traffic and structures.

(iii) Problems of safety, related to:

- vehicles, pedestrians and cyclists;
- city centers, residential areas;
- intersections (signalized and non-signalized), non-intersection;
- daytime and nighttime.

(iv) Problems of energy conservation - increasing motorization and undue delay due to too frequent stops and starts.

(v) Problems of finance and public transport caused by:

- increase in operation costs due to growing labor costs and road congestion; and
- decrease in revenues due to less passengers.

**UTM Measures**

UTM measures include not only traffic regulations and signal control, but also any other short-term measures which affect traffic such as taxation, fare system and staggered work hours. UTM measures may be clustered into the following eight groups (OECD, 1977):

(i) measures influencing the **time and place of trip generation** (e.g. staggering of work hours, approval of land use changes, road pricing, etc.);

(ii) measures influencing the **choice of mode** (e.g. systems of park and ride, car pool, parking controls, public transport network development, characteristics of the public transport system; schedule adherence, regulatory controls, stop location, provision of pedestrian and cycle facilities, etc.);

(iii) measures influencing the **choice of route** (e.g. ramp metering, motorway incident detection and management, route guidance, etc.);

(iv) **street usage allocation** (e.g. one-way systems, reversible lanes for public transport, truck routes, restrictions of certain classes of users, traffic cells, pedestrian precincts, etc.);

(v) **intersection control** (e.g. choice of type of control, signal timing, signal coordination, etc.);

(vi) **parking control** (e.g. supply of parking, fee schedules, time restrictions, guidance to car parks);

(vii) measures directly influencing **safety** (e.g. speed control, segregation of road user classes, pedestrian crossing, intersection control, etc.);

(viii) measures aimed directly at **environmental problems.**

**Measures Influencing The Time And Place Of Trip Generation**

Since the major aim of UTM is to secure mobility of people and goods, UTM should not be a means to restrict the total trip demand. However, UTM is an acceptable means of altering trip generation in terms of time and space.

**Land Use Control:** Large-scale changes in the land use pattern of a city is obviously out of the scope of UTM. It is still valuable for traffic managers, however, that they influence land use changes through routine administrative approval such as building permits, determination of parking provisions and land access and location of bus/truck terminals. A study on UTM for Metropolitan Tokyo revealed that the relocation of truck terminals will result in an estimated reduction of five per cent of goods moving vehicle kilometers.

Parking control is probably another tool for influencing land use and will be discussed later in detail.

**Staggering Work Hours And Flexible Work Hours:** Commuter trips are concentrated in short periods of the day and cause morning and evening traffic peaks. Smoothing these peaks by distributing the flow of commuters for a longer period will enable transportation networks and facilities to carry more people in a more comfortable manner without additional investments.

**Staggering work hours** in which different offices have different hours for starting and finishing work has long been a widespread practice among many cities of the world. In many medium-sized cities in Japan, this practice may provide a larger margin of congestion relief. **Flexible work hour** programs have also been introduced in cities in Europe and North America. In these systems, an employee is permitted to choose, within limits, the times he/she starts and finishes his/her work day on an individual basis. The flex-time system is not popular in Japan because collaborative activities among employees in an office may be hindered by this system.

**Flexible work days** are conceptually possible as an expansion of flexible work hours. In this system, employees or whole offices may choose a day off other than a Sunday or a Saturday. If this system is adopted, not only transportation facilities, but also other facilities such as the telephone and sewage systems in cities to recreational facilities in the countryside will be utilized more efficiently.

A study of UTM for Metropolitan Tokyo showed that 21% of the offices in central Tokyo would agree to the introduction of flexible work days if governmental offices and banks would also adopt it.

**Fare Surcharge:** Surcharges of public transport fares during peak periods has been in practice in Washington, D.C. in the United States. The above-mentioned UTM study for Metropolitan Tokyo showed that 23% of the offices answered that they would alter their work hours if the public fare surcharge is introduced. The study estimated that peak passenger volumes of commuter trains in Tokyo would decrease by 12%.

**Measures Influencing Choice Of Mode Of Travel**

Many transport-related urban problems stem from the preference of people for private modes of travel such as the automobile. Therefore, the idea of influencing choice in travel mode usually implies reduction in the use of private automobiles.

**Improvements To Public Transport Services: Bus lanes** are already very common all over the world. One problem that face bus lanes in Japan is that shops, offices and other facilities alongside of the bus lanes cannot have direct

access to the roadway because bus lanes are implemented along the curb lanes through strict prohibition of curb parking. For this reason, bus lanes are limited to only the peak commuting periods of the day. The lack of an exclusive bus lane that is not congested and thus less subject to delay is partly the reason why buses cannot attract many passengers during off-peak hours.

One-way schemes usually bring about disadvantages to bus users due to longer walking and/or riding distances. Contra-flow bus lanes on one-way streets are implemented in many cities to solve this problem, but it creates two adverse effects. One problem is the lack of direct access to roadways for premises facing bus lanes. The other is the problem of accidents which may take place because pedestrians as well as drivers tend to pay attention to only the main flow of traffic and overlook buses.

**Park-and-ride facilities** have usually been in use at railroad stations in suburban areas in order to ease access to public transportation. In Japan, however, park-and-ride facilities are used only in exceptional cases due to the high cost of land. **Kiss-and-ride** (the wife drives her husband to the nearby station) seems more popular than park-and-ride in Japan.

**Bus priority signals** have been implemented for reducing intersection stopping times of buses caused by red lights. Measurements of the effectiveness of bus priority signals in Tokyo revealed that the signal stop times were reduced considerably in the under-saturated conditions, but the reduction of the total bus travel times were not substantial because the ratios of the signal stop times to the total travel times were not very high. It was concluded that the over-saturation of general traffic should be solved first, and other measures such as developing buses with lower floor bodies, larger doors and improved fare collection systems would also be effective and necessary in order to shorten the overall travel times of buses.

**Shorter headways, longer hours of operation, escalators at railway stations** and **better information services** are obviously effective in attracting more passengers.

**Discouragement Of Private Car Use: Fuel price surcharge** through gasoline taxation was once examined as one of the UTM measures for Metropolitan Tokyo. It was estimated that private auto trips generated in the area would decrease by

twenty per cent if the fuel price was doubled. However, it was also concluded that this policy would be impractical. A major problem would be that users in rural areas would suffer adverse effects because an automobile may be indispensable outside of metropolitan areas. Automobiles also create less social problems in rural areas. If the policy is adopted only in the urban areas, urban auto users would make gasoline purchase trips to rural areas.

**Road pricing and supplementary licences** have been discussed as measures for limiting auto use. Singapore is the only city in the world which practices this type of policy. Single occupant cars are not allowed to come into the city center during predetermined times of the day without having bought special tickets issued by the Singapore government.

The current concept of road pricing utilizes electronic devices that are installed in the car and on the road. A system called the automatic vehicle identification (AVI) is the core component of the system. The equipment within the vehicle transmits the identification number of the car whenever the vehicle passes over roadside detection devices which are usually embedded in the pavement at strategic locations over the entire road network. The computer sums up the charges of each vehicle and fees are mailed out to the owners of the cars. There are several other ways of charging users as well. To date, road pricing has not been introduced in any city although technological advances have been made to implement such a system. The major reason for not implementing road pricing is probably for equity reasons. The general public reaction to this type of fee system for auto use is that wealthy groups in society will not be as adversely affected as poorer users.

**Discouragement of private car ownership** seems to have been, though implicitly, a consistent policy of the Japanese government. The garage regulation which requires a car owner to prove that a proper off-street space has been secured at the time of registration was first introduced in the early 1960's in order to clear the roadway. This regulation has been quite effective in keeping car ownership in urban areas low and to discourage multi-car ownership even in suburban areas.

The introduction of residents' permit for on-street parking which is rather common in European countries is absolutely out of the range of policies in Japan.

**Driver licensing policy** has been stringent in Japan and many potential would-be owner-drivers have given up entrance into the driving population. At present, however, most young people hold driving licences, therefore, the influence of this policy will fade away in the near future.

**Promotion of collective use of motor vehicles** is popular in the United States. **Car pooling schemes** are subsidized by the federal government. Two or more people share the ride in a single car for home-work trips. Information services to match the car poolers are provided by the local governments. Cars with several passengers are permitted to use priority lanes which are otherwise reserved for buses (e.g. Shirley Highway in Washington, D.C.) or exempted from the bridge toll (e.g. Oakland Bary Bridge in California).

There is no systematic and/or government-promoted applications of car pooling schemes in Japan although in some medium to small-sized cities some commuters practice pooling schemes in order to save the expense of city parking fees.

**Van pooling** is also an American practice and is similar to car pooling except that vans are used instead of cars.

**Subscription bus schemes** have been introduced in a few U.S. cities (Washington, D.C., St. Louis and San Francisco). A bus together with a driver is hired on a contract basis for transporting the subscribers every day between predetermined locations. This measure is said to suit relatively long distance commuting.

**Measures Influencing Choice Of Route**

**Motorway Ramp Control: Ramp metering** is used widely in U.S. and rather exceptionally in Europe. A traffic signal installed on an on-ramp regulates the rate of the ramp traffic flow. The rate of flow is determined by the computerized traffic surveillance and control system based on the traffic conditions of the motorway. When the queue at the signal becomes long, those who arrive at the ramp may change their route to alternative surface roads.

In Japan, **ramp closure** has long been practised on Tokyo expressways. Several on-ramps are closed for a half hour period when the expressway traffic

becomes over-saturated. When one half hour period of ramp closure is not enough to ease the expressway congestion, several other on-ramps are closed for another half hour period. Selection of the on-ramps to be closed is made by the computer of the surveillance and control system. Variable message signs installed along the major approaching streets to the on-ramps indicate if the ramps ahead are closed so that drivers can choose alternative routes in advance. Traffic news programs on the radio also inform drivers about the ramps which are currently closed as well as those which are scheduled to be closed in the coming half hour period.

**Information Service: Variable message signs** installed at the entrance of on-ramps of Tokyo expressways display the location and the level of traffic congestion of the expressways so that drivers can have a choice of using or not using the expressways and variable messages are also displayed along the main lines of the expressways and inform drivers about the congestion ahead so that they can decide what off-ramps they should take.

**Traffic news programs** in radio broadcasting is a common media for drivers to receive information. **Roadside radio** has an advantage over conventional radio broadcasting because the receiving range of the former is extremely limited compared to the latter, enabling information which is broadcasted over roadside radios to be more localized and detailed. Japan has been late in introducing roadside radios, and the first application will start in early December, 1983.

**A dynamic route guidance system** was developed and experimented in Tokyo in the late 1970's. A driver inputs his destination code number into his on-vehicle equipment. The direction he should take for the shortest route, in terms of time, is displayed on the on-vehicle equipment located on the instrument panel whenever he approaches the intersections in the network. The traffic conditions over the network are continuously surveyed and the shortest routes to any of the destinations are sought dynamically by the central computer. However, the practical use of this system is deterred by the high investment required for on-vehicle and on-road equipment.

**Street Usage Allocation**

Streets serve many purposes. UTM schemes may regulate the way in which they serve to benefit the community.

**Traffic Cells:** There has been an increasing tendency to alter street connection patterns through UTM schemes so that streets serve preferred purposes. The aim of traffic cells is to arrange streets in a hierarchy so that:

(i) arterial streets carry heavy through traffic;
(ii) distributor streets carry local traffic; and
(iii) access streets serve homes, shops and places of work.

Local distributor and access streets are connected with each other so as to form traffic cells. Intersection directional regulations and median strips are so arranged that there are no direct through routes between adjacent cells. Thus, within a traffic cell, the environment is expected to improve due to the absence of through-traffic. It is clear, however, that this scheme may increase the total vehicle distance travelled. Further, the reduction of traffic on some streets may increase the flow along other streets, and the overall impacts of such management measures may be complex and hard to predict.

The practice that is common in Japan is not exactly the same as traffic cells in the sense that direct connection between adjacent cells are usually provided. Instead, one-way and turn regulations within a cell are so arranged that through-traffic is virtually avoided. This method has been highly successful in improving the environment and the prevention of accidents.

**One-Way System:** One-way systems are a widely used UTM technique. Among the advantages are:

(i) intersection control can be simplified and efficiency improved due to the reduced number of conflicting traffic movements;

(ii) coordination of traffic signals can be greatly improved; and

(iii) the "frictional" resistance imposed by the street on the flow of traffic is reduced.

One-way systems are generally believed to reduce congestion and increase average speed but traffic will usually have to travel greater distances. In most cases, however, travel times are reduced in spite of the increase in distance travelled but there is a possibility that in some one-way systems, the

benefit of the congestion reduction may not be sufficient to justify the travel distance increase.

It is important at the stage of planning one-way systems that methods for traffic control and capacity of the terminal intersections of the one-way streets must be carefully examined.

One-way systems usually result in higher speeds of traffic. This may cause problems of safety and traffic noise. As far as the experience in Osaka, Japan, however, accidents were even reduced after the introduction of the artery one-way scheme.

Bus users may be adversely affected by one-way systems as mentioned earlier.

**Reversible Lanes:** The direction of flow along one or more lanes of multi-lane roads may be reversed during the day to meet highly directional traffic demands. The technique is usually used on arterial radial roads which carry heavy inbound flows during the morning peak and heavy outbound flow during the evening peak. The use of this technique is of particular value on bridges and in tunnels where the high cost of road construction requires maximum use of existing roadways.

The direction of use of lanes is usually indicated by remote-controlled variable signs which are mounted on gantries above the lanes.

Reversible lane schemes are not suitable when right turn lanes in left side traffic are needed at the intersections.

**Pedestrian Precincts (Vehicle-Free Zones):** In recent years, many cities have converted streets from vehicle to pedestrian use. Typical examples of pedestrian precincts can be found in Stockholm, Bremen, Lyon and Minneapolis. The reports that are available of pedestrian precincts indicate that both pedestrians and local businessmen are generally in favor of the schemes. The full range of impacts caused by the redistribution of vehicular traffic is rarely reported. In some cases, use is restricted to pedestrians, but in other cases buses and service vehicles have full or partial access.

Sometimes, pedestrian precinct schemes require large investments such as additional roads to redistribute vehicular traffic, car parks for shoppers and

service roads for transporting goods. The Japanese practices of "pedestrian heavens", "lunch promenades" and "shopping promenades" are measures which have been developed because the cost of allowing complete restriction of streets for use by pedestrians is too expensive. In these schemes, vehicular traffic is prohibited by traffic police regulations during fixed days of the week or fixed hours of the day in a given area. "Pedestrian heaven" schemes are used in major commercial centers on Sundays, "lunch promenade" schemes occur in business areas during lunch hours on weekdays and "shopping promenades" occur in community shopping areas during the early evening hours.

**Intersection Control**

Efficient control of intersections is of vital importance for the effective use of the existing street network. Almost all daily traffic congestion is caused by heavily used intersections and a substantial portion (approximately a half in Japan) of accidents take place at intersections. In a sense, it is fortunate that modern intersection control techniques have not yet been fully utilized particularly in many developing countries because large potential gains in promoting safety and efficiency are still possible by a large application of intersection control techniques.

**Intersection Channelization:** The technique of intersection channelization is already well established. The impact on safety and capacity is significant while costs are relatively small in most cases. The combination of these measures with signalization often mutually reinforces the effects of both measures.

**Local Signal Control:** It is doubtless that properly operated modern signal control is more efficient than manual control by skilled traffic officers. Traffic officers have been regarded as better than machines in coping with traffic demand fluctuations. However, any human brain is not capable of optimizing the operation of intersection controls on an on-line real time basis as well as modern electronic equipment.

Recent developments in microelectronics have made it possible to operate traffic signals in a highly flexible and traffic-responsive manner so that fluctuations in traffic demand can be handled automatically. A microprocessor which serves as the "brain" of a local controller with deliberately composed

programs can decide the optimum timing of the signal based on vehicle detector pulses.

**Artery Coordination Of Signals:** Linking two or more adjacent signals along an artery is highly effective for reducing delay and traffic stops. When adjacent signals are too close to each other relative to the cycle time and the traffic demand, linking is indispensable in order to maintain the traffic capacity of the section of the artery and to avoid congestion. Accidents, noise and emissions are generally reduced as well through linking.

The common cycle times and offsets for coordination are usually controlled by the master controller either on fixed time-of-day plans or in a traffic-responsive manner.

**Area Control Of Signals:** Conventional area control systems use a digital computer to operate signals over an entire urban area. There are seventy cities in Japan which use this type of area control system. The computer selects one of the preset signal control programs (a program is a set of signal timings) depending on the prevailing traffic demands over the area. The effectiveness of area control thus depends totally on the manner in which the program selection is made as well as the extent to which the selected program reflects actual traffic conditions. In reality, however, optimization of the preset programs has not been carried out satisfactorily because it is tedious and expensive to do so. Moreover, the method of program selection has not been improved greatly probably due to theoretical difficulties.

The use of microprocessors in local controllers make it possible to decentralize intelligence in order for local controllers to handle local situations in a traffic-responsive manner. This decentralization allows the central computer to concentrate more on the strategic optimization of the system as a whole. Thus, program formation instead of program selection becomes possible. In program formation, no preset programs are needed and the system is optimized by itself without tedious work on the part of signal engineers.

**Parking Control**

Parking control has been regarded as probably the most important management measure for regulating the use of the private car. The main objectives of

parking control are to reduce congestion, improve the environment and to increase safety. Parking control can be imposed by the following means:

(i) restricting the number and location of parking spaces;
(ii) limiting the duration of parking;
(iii) varying the scale of charges with the time of use; and
(iv) reserving parking for use by selected classes of users.

The integrated use of these measures permits a great deal of flexibility in the application of parking control. Car park control is generally believed to reduce congestion because uncontrolled on-street parking can obstruct the free movement of traffic, particularly at intersections. Also, commercial vehicles may be denied access to premises, buses are obstructed at stops and in bus lanes, and there is an increased risk of accidents. However, three factors act to limit the effectiveness of parking control: private non-residential parking, through traffic and the problems associated with enforcement.

For parking controls to be effective, the majority of parking spaces in an urban area must be subject to controls. This is often not the case where many parking spaces may be on private premises, and there may be legal difficulties for local governments to control private parking spaces.

Where parking controls can reduce congestion by limiting the amount of traffic that terminates in the controlled area, then, it may become possible for more traffic to travel through the area. In such cases, an integrated approach to UTM can be adopted whereby streets are connected so as to form traffic cells.

Enforcement is undoubtedly necessary to secure effective parking controls. Enforcement is labor-intensive and costly resulting in a large number of illegally parked vehicles in most of the cities of the world.

**Measures For Safety**

Almost all of the UTM measures that have been mentioned have an important impact on safety. In addition to these, there are a number of measures which are directly aimed at increasing safety. Important measures include speed limits, segregation of road user classes, pedestrian crossings, street lighting, vehicle design and inspection, enforcement and penalties, licensing and

education. Traffic safety is a topic of a separate paper prepared by Mr. M. Kobayashi for this Symposium and will be discussed in detail there.

## Measures For Environment Protection

Many of the UTM measures that have been discussed earlier have an impact on the environment to some extent. Therefore, UTM measures should be examined at a stage of planning from the environmental point of view. Measures which are directly aimed at the environment include pavement surface maintenance, truck bans, noise insulation of roadside buildings and speed limits. However, according to the Japanese experience, speed limits which are established from an environment protection point of view are not observed by most drivers when the limits are too low from a safety point of view.

## Concluding Remarks

Closer attention should be paid to Urban Traffic Management than it is now. UTM provides remedies that may solve disastrous traffic situations for many cities and particularly the cities of the developing world.

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# TOWARD THE ESTABLISHMENT OF TRAFFIC SAFETY PROGRAM

by

Minoru Kobayashi*

## Introduction

Road transport in South-East Asia including Malaysia has come relatively late resulting in a greater impact of urban problems, especially in view of the rapid rate of growth and resource development. Such a rapid increase in motor vehicle ownership has created increasingly greater demands for better road and traffic management schemes, including traffic safety programs. The magnitude of time and capital investment required by the infrastructure deficit had led to an alarming disparity between the needs of the transport system and the observed ability of the existing system to meet the demands. Congested roads, at the very least, lead to untold losses in the individual's time and material resources.

In almost all the capital cities in South-East Asia including Kuala Lumpur, "Urban Explosion" is occurring as a common and rather serious problem. For example, the population density in Kuala Lumpur indicates such a high figure as 3,844 persons per square kilometer in 1980, compared with 85 persons in Peninsular Malaysia. Particularly, the rate of motorization in Kuala Lumpur and Selangor State is 26.6% which is significantly higher than other ASEAN capitals except Singapore.

In Kuala Lumpur and Selangor State, the number of motor vehicle registration reached almost three times within these ten years, e.g. 251,532 motor vehicles and 305,694 motor cycles (39.2% and 47.7% respectively). As a result, a huge number of motor vehicles and motor cycles flooded the streets and highways where feasible safety infrastructures are not well provided. Lack of driver's safety consciousness and attitudes are other problems (Figure I).

As a direct impact, traffic accidents are naturally increasing. Around 200 persons are killed by traffic accidents every year in Kuala Lumpur, and the

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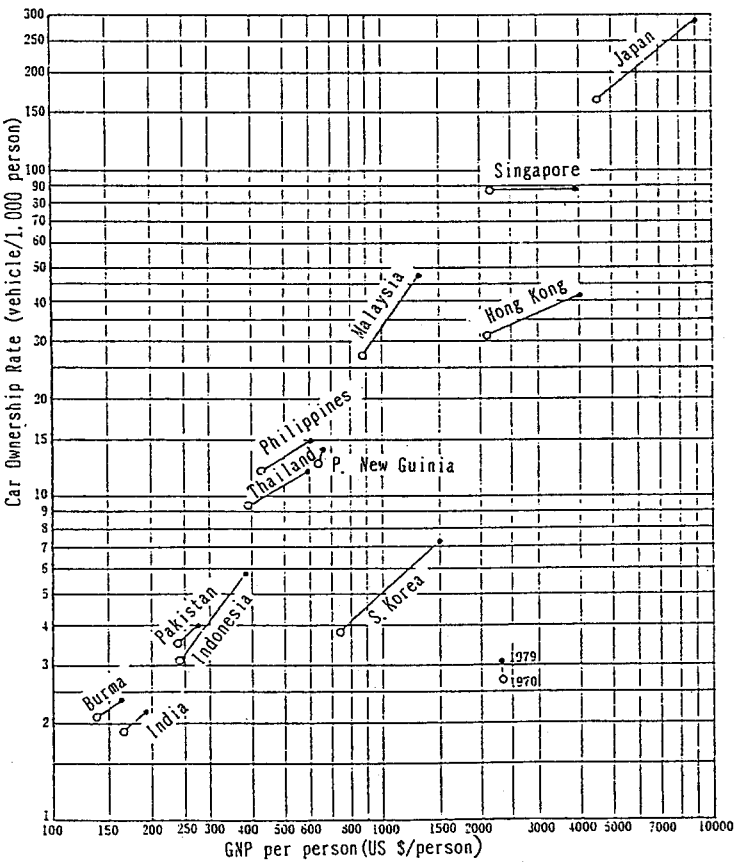
FIGURE I: TRANSITION OF CAR OWNERSHIP RATE PER GNP AMONG ASIAN COUNTRIES (1970-1979)



number of fatalities per 100,000 population indicates almost 20, which is significantly high compared with other capitals including Tokyo (Table I).

According to the projection of traffic fatalities in 1990 and 2000, based on certain limited data covering the past population trend, registered vehicles and of traffic fatalities, forecasted fatalities in Kuala Lumpur will reach between 300 to 400 persons per year, and the fatality rate per 100,000 population will be 30 to 35. In other words, unless safety counter measures are successfully conducted, traffic fatalities in Kuala Lumpur will increase.

The results of such traffic accidents caused by human errors and reckless behaviours are miserable not only for persons who are involved but also for the families and communities since the major victims are young males. We have to realize that the improvement of the traffic situation would directly be connected with GNP growth.

It is time to aim for the reduction of human loss caused by human errors. This should be on a national basis because comprehensive safety programs can solve this problem.

**Characteristics Of Traffic Accidents In Malaysia**

**Rapid Increase of Traffic Accidents:** Due to the rapid pace of motorization in Malaysia, particularly in Peninsular Malaysia, the number of fatalities increased almost three times compared with 1970, namely 579 in 1970 to 2001 in 1980. Thus, the accident index in Peninsular Malaysia is rather high compared with Singapore or Japan as shown in Table I and Table II.

The growth rate of fatalities and serious injuries is almost the same as the growth rate of registered vehicles. Accordingly, the death rate per 10,000 vehicles was only 8.7 in 1970 and increased to 21 in 1980.

In other words, traffic fatalities have been spreading all over Peninsular Malaysia. Particularly, the younger age victims are more often involved in accidents on the rural roads in sparsely populated areas.

TABLE I: TRAFFIC ACCIDENT INDEX, 1980

| Capital City and Country | Fatality rate per 100,000 persons | Fatality rate per 10,000 vehicles | |
|---|---|---|---|
| | | excl. motorcycles | all vehicles |
| Kuala Lumpur | 19.72 | 34.40 | 22.27 |
| Penin. Malaysia | 17.97 | 21.14 | 8.56 |
| Jakarta | 7.00 | 13.96 | 6.03 |
| Indonesia | 7.77 | 94.68 | 29.18 |
| Metro Manila | 8.49 | 12.43 | 11.23 |
| Philippines | 3.12 | 17.16 | 13.45 |
| Bangkok | 12.11 | 14.51 | 10.37 |
| Thailand | 11.13 | 56.65 | 29.55 |
| Tokyo | 3.93 | 1.45 | 1.21 |
| Japan | 9.72 | 2.94 | 2.29 |
| Singapore | 10.73 | 10.28 | 6.98 |

TABLE II: COMPARISON OF FATALITY DISTRIBUTION ON VEHICLE TYPE

| | Japan (1981) % | Malaysia (1980) % |
|---|---|---|
| Pedestrian | 30.8 | 21.7 |
| Bicycle | 11.2 | 14.6 |
| Moped | 9.7 | 6.3 |
| Motorcycle | 8.7 | 28.5 |
| Motor vehicle | 25.2 | 17.4 |
| Passenger | 14.4 | 10.9 |

## TRAFFIC SAFETY PROGRAM

**Situation in Kuala Lumpur:** Although the average growth rate of the number of traffic accidents and of fatalities is not so high in the capital city, the relative risks are comparatively high due to the large number of high speeders.

**Major Victims by Age:** Major age groups involved in traffic accidents are between 16 to 30 years old. These are young workers and students. The distribution of fatalities by age group is almost similar to that of Japan, except for the older age group.

**Pedestrians:** Of the pedestrians, 47% are over the age of 55, and 26% are school children.

**Helmet Wearing:** The casuality rate of motorcyclists is the highest among all the types of road users (33.5%), followed by pedestrians. At the same time, growth in the number of casualties in the group is also the highest.

The Crash Helmet Law introduced in Feb. 1975 claims to have reduced the accident rate for riders and pillion passengers by 35%. However, many riders seemed to be wearing helmets without the straps fastened.

**Accident Rates of Buses and Taxis:** Buses and taxis which handle passengers indicate a rather higher involvement rate in traffic accidents, e.g. for buses 73.8%, and for taxis 27.7%. These are extremely high causing the public to regard them as unreliable.

### How Japan Tackled Road Accident Problems

In 1971 when our traffic death toll reached its peak, namely 17,000 were killed including 6,000 pedestrians and 1,000,000 injured, the Japanese Government concentrated her efforts on how to reduce the total number of victims to half within the coming ten years. Accordingly, the problem was addressed at the nationwide level. First Fundamental Traffic Safety Programs for both the national and local government level were drawn up for the period 1971 and 1975. Based on these programs, great efforts have been made to implement powerful and comprehensive traffic safety strategies in each region. Moreover, hand in hand with this new objective to reduce to half the number of accident victims, people at large made great efforts to do what they could by cooperating positively and pursuing the goals through their voluntary activities. Particularly those

activities sponsored by the Traffic Safety Association, Parent-Teacher's Association, Children's Traffic Safety Clubs and Safe Riding Promotion Activities were indispensable (Figure II).

In the Second Fundamental Traffic Safety Program from 1976 to 1980, while taking pride in the accomplishments of the previous program, the new goal was set to prevent an upturn in traffic accidents; and in order to make permanent the decreasing traffic accident trends of recent years, the program provides for further overall and integrated strengthening of future traffic safety policies and counter measures (Figure III).

**Current Safety Problems In Malaysia**

**Needs for Objective Data Acquisition:** To find out current urgent problems, data acquisition and analysis on traffic phenomena, including accidents, is a prerequisite since safety counter measures particularly those found in the infrastructure should be based on quantitative data. Few data are available on the extent to which road traffic accidents contribute to incapacity in the community. Thus, insufficient attention is paid to the correction of inadequate roads which are unable to cope with a heavy volume of traffic demands. For example, a variety of roadside obstacles would greatly increase risks. Both macro analysis (statistical analysis) and micro analysis (case studies) are necessary in accident studies. Although, massive accidents are televised or reported in newspapers, people are rather indifferent to accident prevention.

**Necessity for Basic Quantitative Data:** Not only accident analysis, as mentioned earlier, but OD survey and person trip survey are needed. They closely reflect human mobility. Government agencies should set up programs to obtain such information.

**Necessity for Long Range Programs:** After setting up a Master Plan, both short range and long range programs should be set up. From our previous experience, particularly with the police agency, their interest is mainly focused on how many deaths will be reduced. This is a rather limited viewpoint. We may have to put emphasis on instant remedies for a while. In this country, the major target for accident reduction will be directed at the two wheel riders. Strong enforcement and safety campaigns (particularly wearing helmet with straps) are needed.

FIGURE II: CHANGES IN THE NUMBER OF VEHICLES OWNED AND THE NUMBER OF PERSONS KILLED OR INJURED IN TRAFFIC ACCIDENTS (1968 = 100)

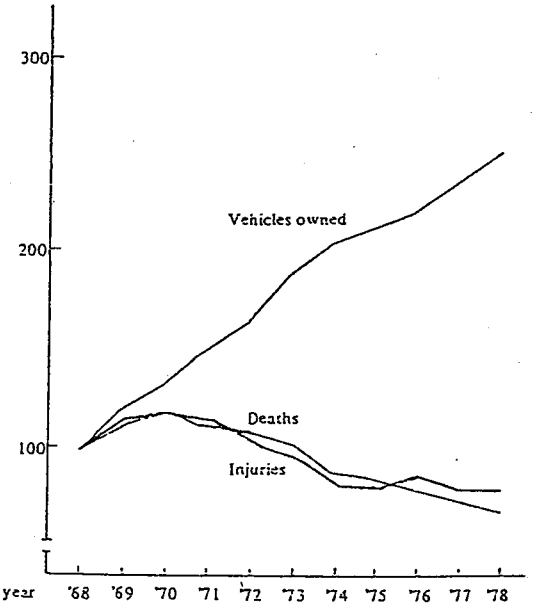
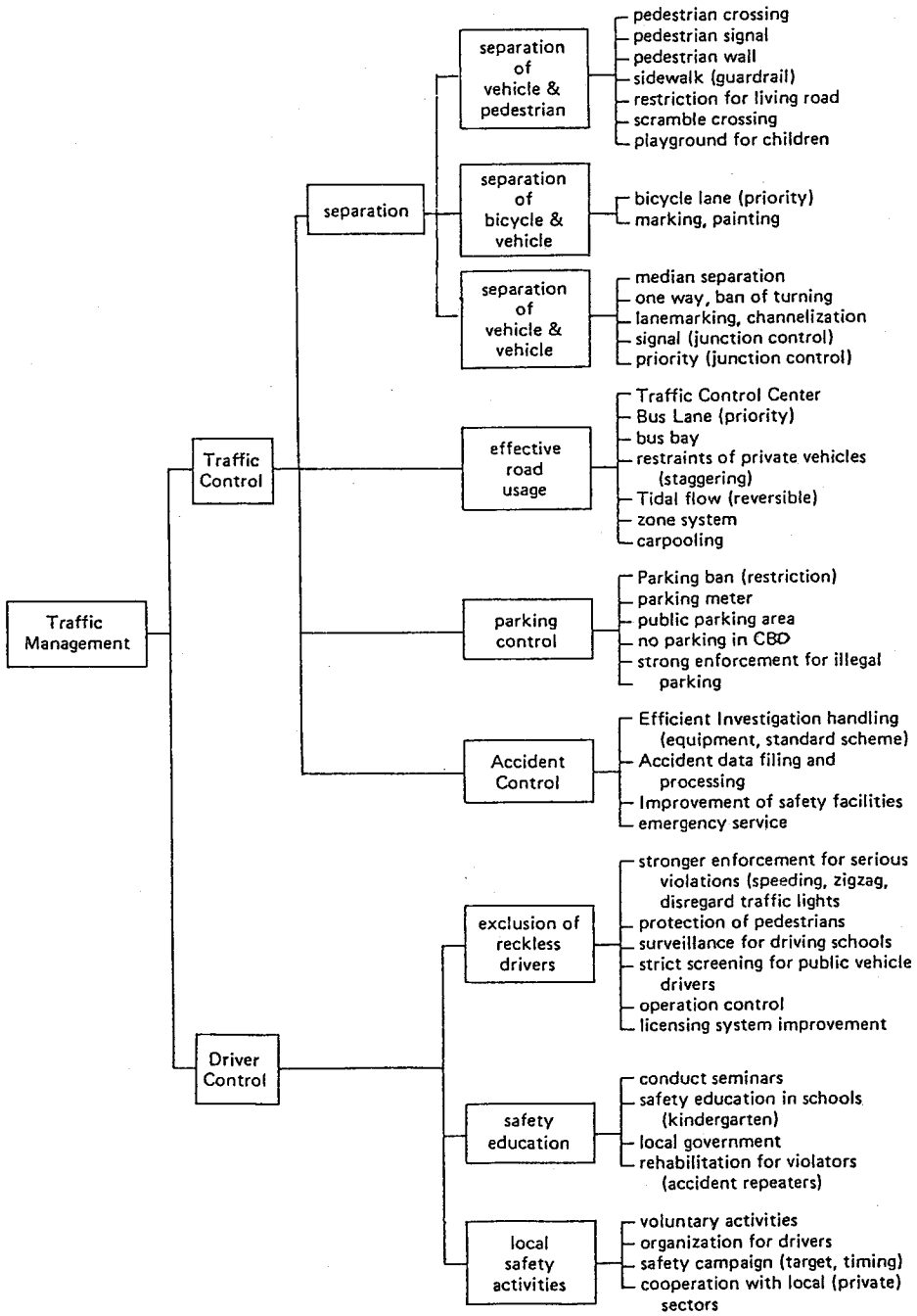


FIGURE III: URBAN TRAFFIC MANAGEMENT SCHEME



Secondly, measures to improve the habits of young and new riders who are reckless in driving are needed. At the first stage of driving, risk is highest.

**Coordination with Safety Infrastructure:** The driver's behavior is partly and also closely related with the infrastructure. We cannot enforce drivers by just saying "Keep your lane" where no reliable lane markings are available. Insufficient attention is paid to correction. Besides, awareness about safety should be accompanied by technical knowledge (skill) about how to improve safety (courtesy) in a given situation. Common sense and good intentions are sometimes not sufficient by themselves to prevent accidents.

**Public Indifference:** In our experience in promoting safety programs, people are gradually realising that safety is costly and not free of charge. Generally, the public has little idea of the economic loss due to death and incapacity from road accidents. People rather accept accidents as unpreventable or unavoidable, and they do not feel that they can do or they should do something.

**Need for Local Educational Materials:** In Malaysia, the Road Safety Council was established in 1963, and has been conducting safety campaigns with the limited resources available. The Council seems to work very effectively. However, locally made audio visual aids are scarcely available.

The attitudes of audiences are strongly influenced by such media since local scenes in the film will be more effective than foreign scenes, which are naturally different from local daily driving situations.

**Need for Specialists on Traffic Safety:** Likewise in traffic engineering or planning, highly qualified experts on safety programs are lacking. It is also notable that Malaysian Universities offer no specialized course in transportation. Training such personnel is essential for safety promotion in the long term. Recently, the Government of Thailand made a proposal for the development of the National Traffic Safety Center under the National Safety Council.

## International Cooperation

From our point of view, continuous efforts to set up traffic safety programs could be utilized with minor modification in this country since motorization in

Malaysia is growing so fast. Naturally, this technology transfer may be viewed as software-oriented. Our technology transfer has usually been started with monetary assistance, such as in the form of equipment or construction of roads, etc. These are rather hardware-oriented. Software-oriented cooperation like in our framework is rather new.

There is another view that transportation or traffic problems are rather local and national matters. Thus, technical aid from other advanced countries should be focused merely on road construction and assistance for equipment operation. Actual traffic operation itself should be entrusted to locals and regarded national matters. As a result, proposals made by foreign firms and consultants would not be applied in practical situations.

Naturally, we have to consider many factors from our point of view. Japanese uniformity such as one tribe, one language and one religion is quite different from your manifoldness. We sometimes forget these complexities which cause some kind of friction between us. It is quite true that programs for traffic safety for developing countries should be adjusted to the actual situation, and considerable readjustment may be needed to the local conditions including climate and attitudes.

Very fortunately enough, we, Japanese, have been tackling safety problems in almost similar backgrounds like you have now. I believe that our programs can be easily adopted with minor modifications in this country.

**Some Recommendations**

**Safety Campaigns:** Safety campaigns **per se** are not so effective unless they are well coordinated with engineering fabrication, police enforcement and safety education.

In Singapore, once the safety campaign for wearing of helmets ended, the motorcyclists reverted to the old habit of driving bare headed. Finally, they appealed to the Government to make it a law for all motorcyclists to use crash helmets, and the number of deaths for motorcyclists fell by as much as 50%. The same phenomenon is true in Malaysia for the inappropriate use of helmets. Firm persuasion for all motorcyclists to wear helmets with straps fastened tight is necessary to save lives. Appropriate police supervision is needed.

Establishment of "Safety Week" is another technique to promote safety consciousness for road users. Prior to this event, government agencies, the Safety Council and other interested private sector bodies should discuss and decide the theme, procedure and target. The theme should be a more practical one, like "Let's wear seatbelts", "Stay in your own lane", or "Save your life with saving your gas"; and avoid spiritual persuasion like "Drive carefully" because the general public is not willing to follow the guidance unless specified actions to be followed are indicated.

Unfortunately, many motorists on the road leave their good manners at home. Discourteous driving or riding takes many forms where the right of way of other motorists are ignored. These behaviors on the road create a general atmosphere of anger and frustration among other motorists because they are rather selfish. This may even result in accidents. Most of the drivers do not feel they are the cause. Thus, most accidents can be prevented with proper attitudes towards safety and the use of safety precautions. Very importantly is the fact that safety awareness cannot be treated like a cost to be taken on and off.

Ideally, such risky behaviors can be corrected through campaigns, enforcement and good training.

We must be reminded that the modification of human behavior or attitude will take a long time. I would say, formulation of good driving habits will take almost ten years along with painstaking and continuous efforts. The police should assist the public to observe good driving manners (Figure IV).

**Driving Control Scheme:** Studies have proven that a large number of motorcyclists and drivers who are responsible for accidents are those who have secured their driving licences within one year. In this country, approximately 40 to 60% of the driving population have been trained in the ordinary driving school. In other words, the rest of the new drivers are not trained in a systematic manner. Skills and knowledge necessary for good driving habits should be formulated in the early stages of the driving experience.

Careful studies and supervision of the curriculum in driving schools should be conducted on a nationwide basis. Strict screening for professional drivers should be taken as the first priority. Figure V shows a tentative flow of

FIGURE IV: DRIVER'S HABIT FORMULATION

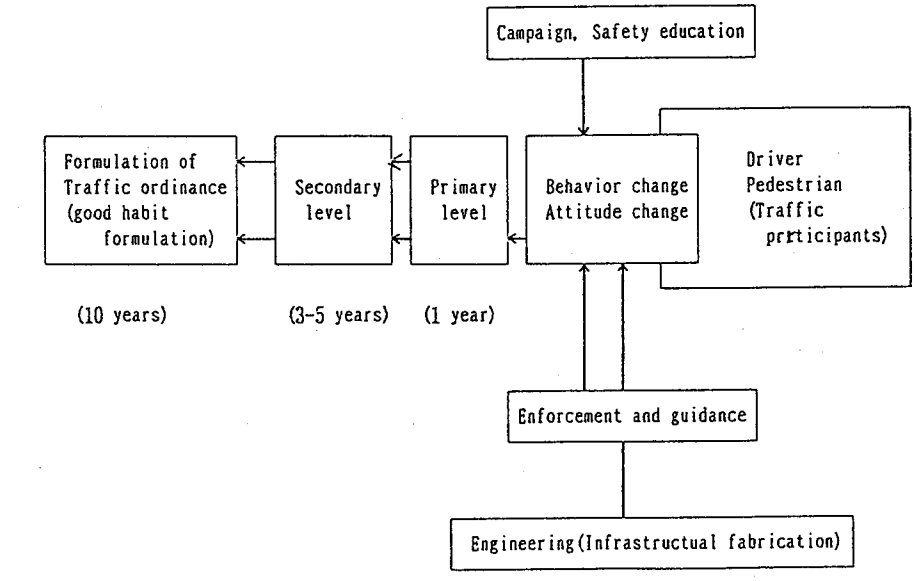
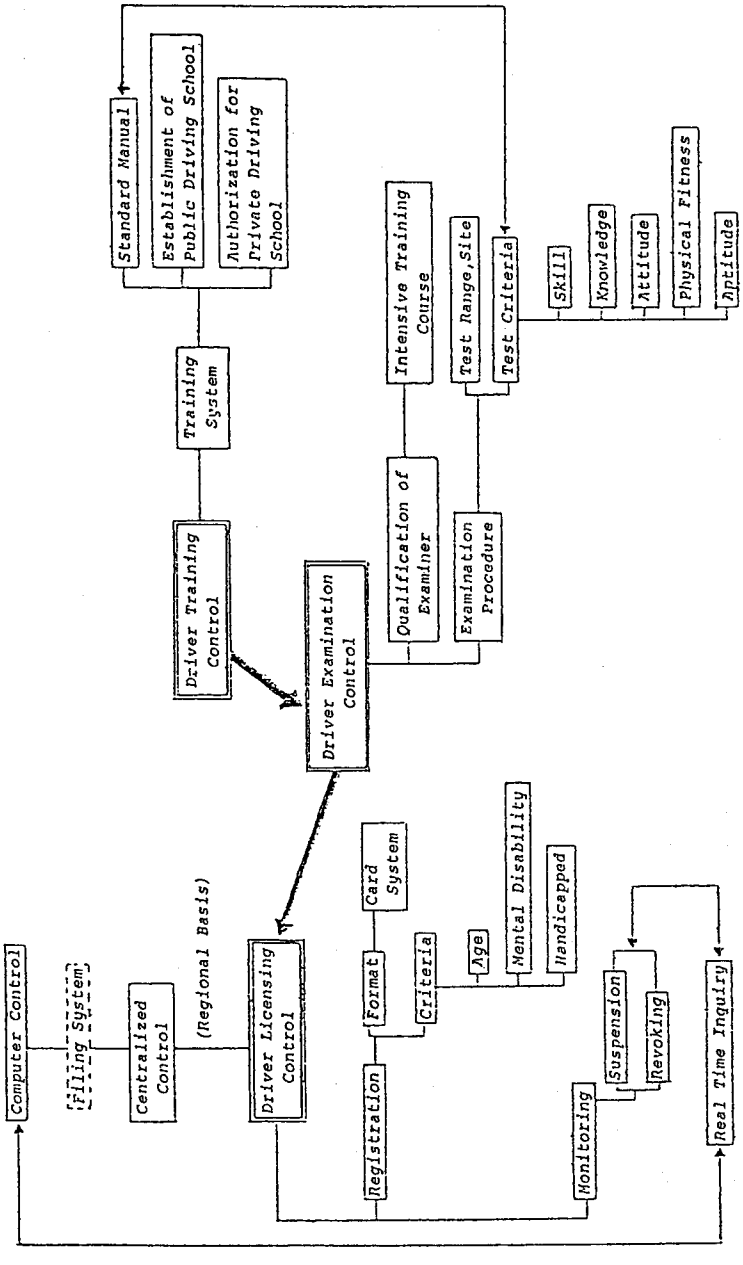


FIGURE V: FUTURE DRIVER CONTROL SCHEME



driver control scheme where computerization in the system is quite a prerequisite.

**Child Education:** An extensive traffic education (not simply safety education) program should be considered carefully because these young people should grow up with sufficient safety awareness as they are the road users for tomorrow. Safety Club activities will promote for these young people, attitudes of road safety. Establishment of a traffic park will be a useful tool to familiarize children with various simulated traffic situations, and they learn how to react to the real situation by themselves. The Road Safety Park in Singapore is a good example where all school children can use the park in a series of road safety competition.

Traffic education should be considered as a part of the ordinary school curriculum, and necessary steps could be taken to provide training for school teachers. At the same time, necessary information at home should be given to mothers since they are most responsible for the habit formulation of children.

**Conclusion**

In order to establish comprehensive traffic safety programs, we must bear in mind that the seriousness of the losses due to traffic deaths is something which cannot be quantified, and the problem of traffic safety cannot be overstated. Since we know that the incidence of traffic deaths cannot be reduced to zero, measures should be aimed at organizing and controlling traffic safety problems relying on solutions arrived at by scientific means.

Support from both the public and private sectors is important because traffic safety can only be fostered through the cooperation and safety consciousness of the public.

Whether you would succeed or fail depends a great deal on the measure of support from safety minded Malaysians.

Technology transfer, especially those which are software-oriented including traffic education, is the hardest problem since modification of human behavior is unpredictable. We understand that traffic problems here in this country

are peculiar to you, and as one of the ASEAN countries we are willing to cooperate with you for the accomplishment of mutual goals.

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# EFFECTS OF ROAD CONSTRUCTION ON THE ENVIRONMENT

by

Low Kwai Sim*

## Effects On The National Space-Economy

Transportation studies have in recent years become increasingly concerned with the broader issues of impacts on the environment rather than in the movement of vehicles. Thus according to Isard (1960), it is imperative to think of transport input as a spatial concept if one is to comprehend fully the significance of space in actuality, and he likened the road system to exertions of efforts required to overcome the friction of distance encountered in movement through space. The importance of road and highway development in this case could be said to lie in the functional role of serving other economic sectors in order to achieve an efficient space-economy.

Roads and highways can also be regarded as agents of change and catalysts of development. This impact is based on the belief that roads will accelerate economic development by opening new areas and providing new opportunities for the population. Thus the road pattern in 1911 in Peninsular Malaysia for example, clearly corresponded with the mining activities in Perak and Selangor (Leinbach, 1975a).

By 1930, rapid expansion of the road system shifted in response to the rubber industry and other economic exploration. The completion of a trunk road between Johore and Province Wellesley, the cross-Peninsular link to Kuantan and the expansion to the northern frontier to Thailand, all highlighted a phase of vigorous transport expansion which was tied to spatial socio-economic development and political integration between the various states in the Peninsula. After 1950, the expansion of the road system is related to the national development strategy aimed at rural modernisation and regional development. Many feeder roads were constructed to provide access to new agriculture lands, medical clinics, schools and markets. The landuse pattern slowly but perceptibly transformed itself from forest areas to agricultural landuse mostly under rubber, oil palm and padi with many new villages being up-

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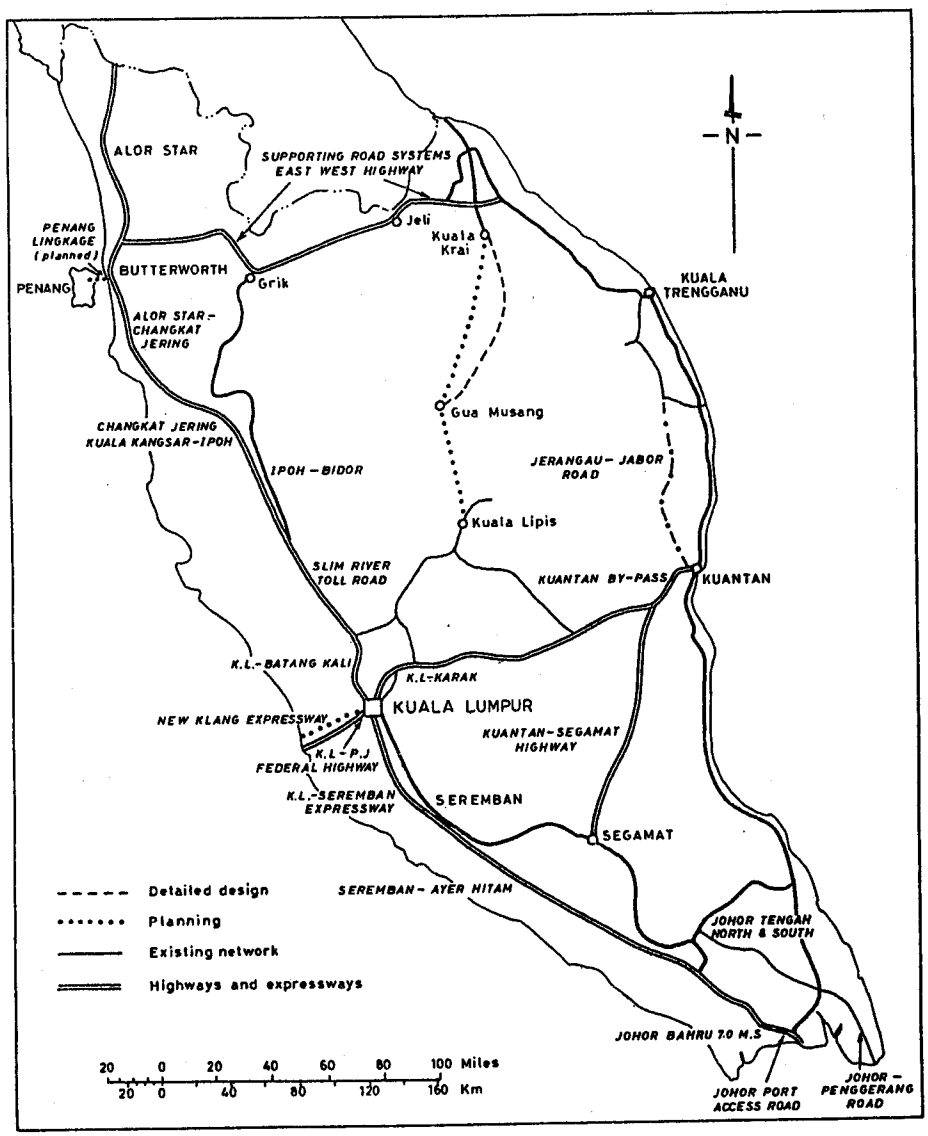
graded to small towns, and small towns to large urban centres, many of which have industrial estates attached to their development. The road transport network is efficient with respect to access to economic activities. However, the rapid pace of economic development has generally outpaced the development of roads, creating capacity problems in the 1970's. Thus, in 1977 for example, improvements and up-grading of the road network are undertaken as part of the infrastructure development, and as shown in Figure I, there have been major qualitative improvements to Route I (North-South Trunk Road) and Route II (Cross-Peninsula Road), and many Highways were also completed. These included the East-West Highway, Kuala Lumpur-Karak Highway, Kuala Lumpur-Seremban Highway, Ipoh/Bidor-Butterworth Highway and the Kuala Lumpur-Batang Kali Highway. Others such as the Seremban-Johor Highway, Segamat-Kuantan Highway, Kejora Highway, Kuantan-Trengganu Highway, Kuala Lipis-Kuala Krai Highway and Kuala Lumpur-Klang Expressway are in various stages of planning, all of which attempt to accelerate socio-economic development.

**Effects On The Physical Environment**

The expansion of the road network in relation to the processes of socio-economic and political growth as discussed above, has great impacts on the physical environment too, in terms of environmental modification. In particular, the opening up of extensive areas for settlements and economic activities causes rapid depletion of forest areas which is in turn linked to soil erosion, leaching, loss of nutrients and, therefore , soil fertility, low regeneration rates of vegetation, loss of original qualities and quantities of timber species, siltation in rivers and streams, flooding, dislocation of fauna species and changes in micro-climates. Many roads are also constructed with a general disregard to topography, slopes and geology. These factors are often neglected in transportation studies, and it is the aim of this paper to illustrate with specific case studies the magnitude of destruction on the environment resulting from road construction. The first case study shows the impact of forest logging road construction, and the second, the construction of highways in Peninsular Malaysia. The environmental effects are then synthesised into an Environmental Impact Assessment matrix to show the cause-effect and affected relationships.

**Impact Of Forest Logging Road Construction:** The effects of forest logging road construction on the environment in terms of soil erosion are very serious on

FIGURE I: MAJOR ROAD SYSTEM IN PENINSULAR MALAYSIA



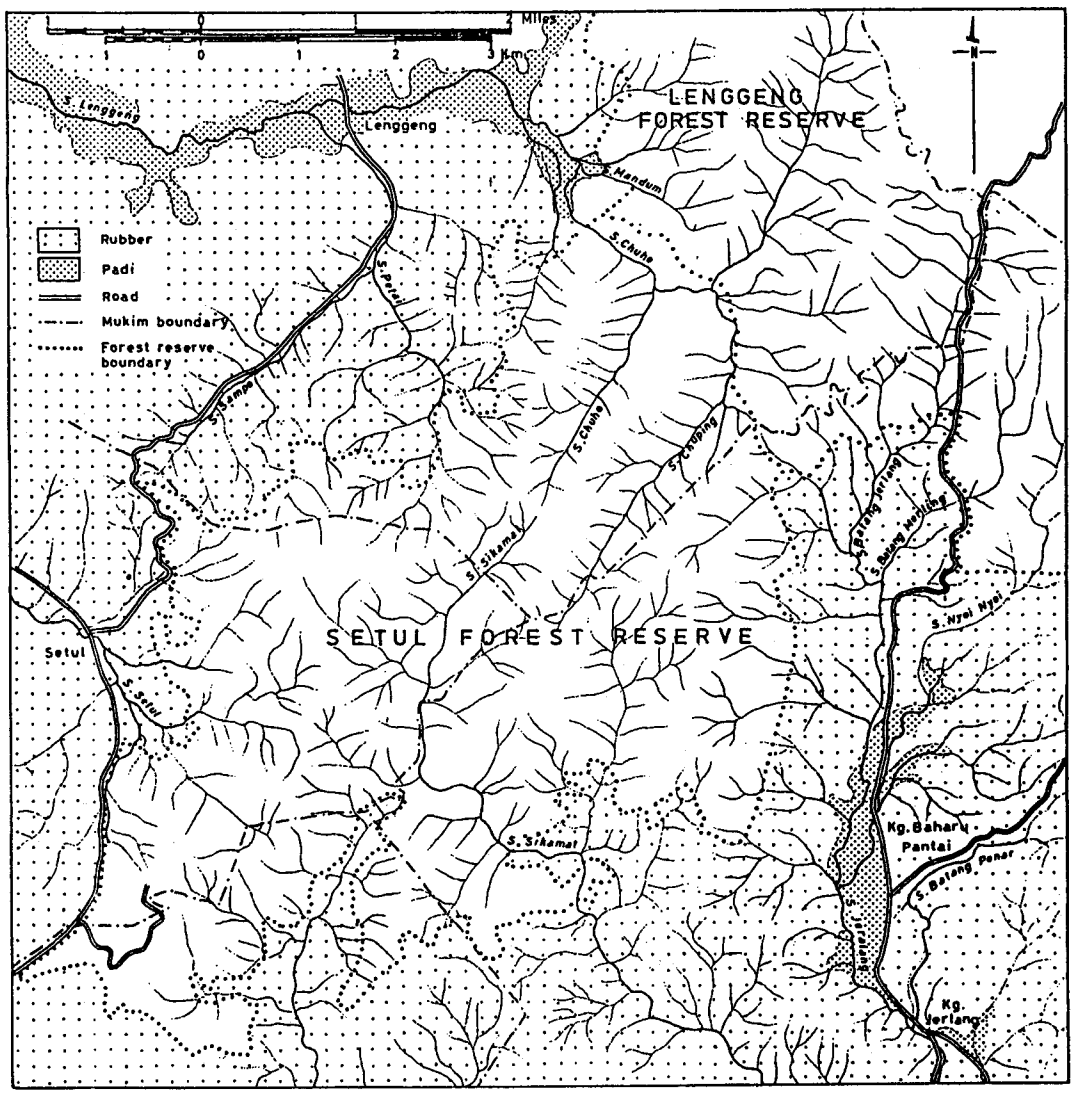
account of the deeply weathered soil profiles encountered. Generally, forest vegetation stabilises the upper layers of the soil profile with its root fabric, while the vegetation canopy shields the ground from the direct intensity of the rain. The forest leaf and duff layer also inhibits overland flow and, hence, erosion. Forest areas that have not been logged for the past twenty years rarely show signs of active erosion. Even on very steep slopes, the litter layer often shows very little evidence of disturbance by overland flow which strongly suggests that infiltration rates exceed rainfall intensities.

However, to sustain the timber industry, and to open up more land for agriculture, housing and industrial development, many low to montane forest areas are progressively logged. The dangers inherent in logging such areas are already noted as early as the 1950s when Berry (1956) in his account of the construction of a logging track to the summit of Bukit Barkar in Kelantan highlighted the disturbances when several landslides occurred immediately below the road, and erosion was so severe that it was visible from the main Kota Bahru road as large, red scrapes on the once green forested hillsides.

Field investigations were carried out in September, 1983, in Hutan Simpan Setul, Kuala Pilah Area (Negri Sembilan) to verify some of the environmental damages such as erosion that are likely to occur with construction of logging tracks during timber extraction. Hutan Simpan Setul, although a forest reserve area, has recently been converted to agricultural landuse (Figure II). It consisted of 2834 ha. of mixed lowland Dipterocarp species which were progressively logged over a period of six months. After the logging of saleable timber, the whole area was clearfelled, burnt and replanted with oil palm and rubber.

Three types of logging roads are discernible in the study area. The first one is the main road which cuts through the area following approximately the 15 m. contour height. This main road is 9 m. wide, untarred, unsurfaced and ends at the logging camp site. The second type of roads is only 3 m. wide and consisted of cut tracks over very steep gradients. They normally traverse through, to as near as possible areas of good timber species where the third type of logging roads are constructed to cut and haul the timber out. This third type of logging roads are known as skid tracks because they are constructed for the logs to slide to the hauling lorries waiting at the end of the skid tracks.

FIGURE II: SETUL FOREST RESERVE AREA, NEGRI SEMBILAN



The skid tracks are less than 2 m. wide, but because of the nature of their function, their impacts on the environment are most severe in terms of soil erosion. The skidding of logs often gorges deep, trough-like furrows in soil mantle, which are ideal for concentrating run-off and initiating deep gully formation. Some of the gullies are 15 m. long and more than 1 m. deep while gullies of up to 5 m. depth are also found at the curbs of most secondary logging roads. Although no estimates are made of the total amount of sediments removed from this form of erosion, studies conducted earlier on gullies in the University of Malaya Campus showed that as much as 118,000 tonnes of sediments were carried away by the Sungei Anak Ayer Batu as a result of roads and housing construction in the Damansara and Kiara Estate adjacent to the Campus ground (Leigh, 1982).

Although the main road to the area follows the alignment of the Sungei Sikamat, many of the secondary roads or winch-lorry roads and skid tracks cut across the tributaries of the main river. No culverts are constructed and many of these tributaries become obliterated. Others are blocked and waterlogging occurs above the crossings. Where the roads cut into the hillsides following the contours to gain height to reach the spurs and ridges where the best timber stands are located, considerable quantities of earth are excavated and deposited immediately below the road or pushed over the slopes at the sides of the roads, often destroying all the vegetation in its path and adding considerable sediments to the stream channels below.

Related to these are landslides and slumping which occur along logging roads in the steep terrain. However, in the study area, very few landslides are observed even though many slope gradients are over $30^{o}$. This may be due to the relatively low rainfall received, and the very recent disturbance to the regolith. This is in contrast to the Genting Highlands area where upgrading of the 20 km. highland road caused many landslides and slumping to occur. The steeper gradient, higher rainfall received, very deep weathered profiles on granitic rocks, and man and machine bulldozing across the ridges may have contributed to the larger number of landslides compared to the Hutan Simpan Setul Area. Along the whole stretch of the Genting road, 30 minor and 7 major landslides were observed. Many of the minor landslides which averaged between 3 m. to 30 m. in length, are mostly in the form of slumping from the freshly cut hill slopes that have been left exposed without vegetation. This spontaneous slumping of the soil not only add considerable amount of sediments on to the

road itself thus blocking traffic, but those that occurred at the valley sides of the road often damage the vegetation along its sliding path and eventually lower the stocking rates of vegetation and its growth in these valley slope areas. This latter form of damage is often associated with the major landslides of more than 30 m. Although aerial photographs show that many major landslides have been recolonised by natural vegetation, these later vegetation stocks are often inferior to the primary ones, which partly explained why, in general, fewer good species are now obtainable in the mid valley areas.

Disturbances to wild life and its habitat in both the Hutan Simpan Setul and Genting areas could not be ascertained, but the impacts could be considerable. The disturbances to the nesting grounds, sources of food and water supply chains, and ecology, all contribute to lower the wildlife numbers. Although many of the affected animal species could successfully re-establish themselves in neighbouring forest areas, there are many, particularly elephants, which may be unable to do so because of pre-existing animal densities in the adjoining forest areas or not enough suitable sources of food supply. There have been cases reported where these animals migrate for more than 100 km. in search of a new habitat they could adapt to, and in the course of their migration cause considerable damage to oil palm trees in FELDA estates. It is also doubtful whether the small animal species such as the slow loris, wild hogs, deer and birds could also successfully adapt to the disturbed forest environments.

Clearly stricter controls over roads and skid track construction in forest areas could do much to reduce the damage to vegetation and to minimise erosion. Although the National Forestry Council in 1971 has in fact recommended that companies with concessions should rehabilitate their concessions once logging has been completed, many have not done so. There are also very few specifications for constructing logging roads and seldom is there any official supervision during the construction. The State Forestry Department incorporates clauses concerning road construction into their logging licences, but in practice the alignment and construction of roads is carried out by loggers as they see fit. Little attempt is made to plan the location of roads in the study area so that the maximum of timber is extracted with the minimum amount of disturbance. As observed, terrain, slopes and the drainage of the area are neglected. Altogether there are about 10 km. per 1 sq. km. of roads and tracks constructed, representing 8% of the total land area. The total area disturbed

was found to be as high as 15 per cent if the landing depot, log camps, and extraction areas are considered.

**Impacts of Highway Construction:** In this section, the Federal Highway project is taken as an example for analysing the physical impacts as a result of its construction. It is not possible to state its impact before or during construction as it has already been built but, retrospectively, it makes a very good case study for comparative purposes to the construction of forest roads described earlier, and the magnitude of the direct and indirect effects on the urban environment in which it passes through.

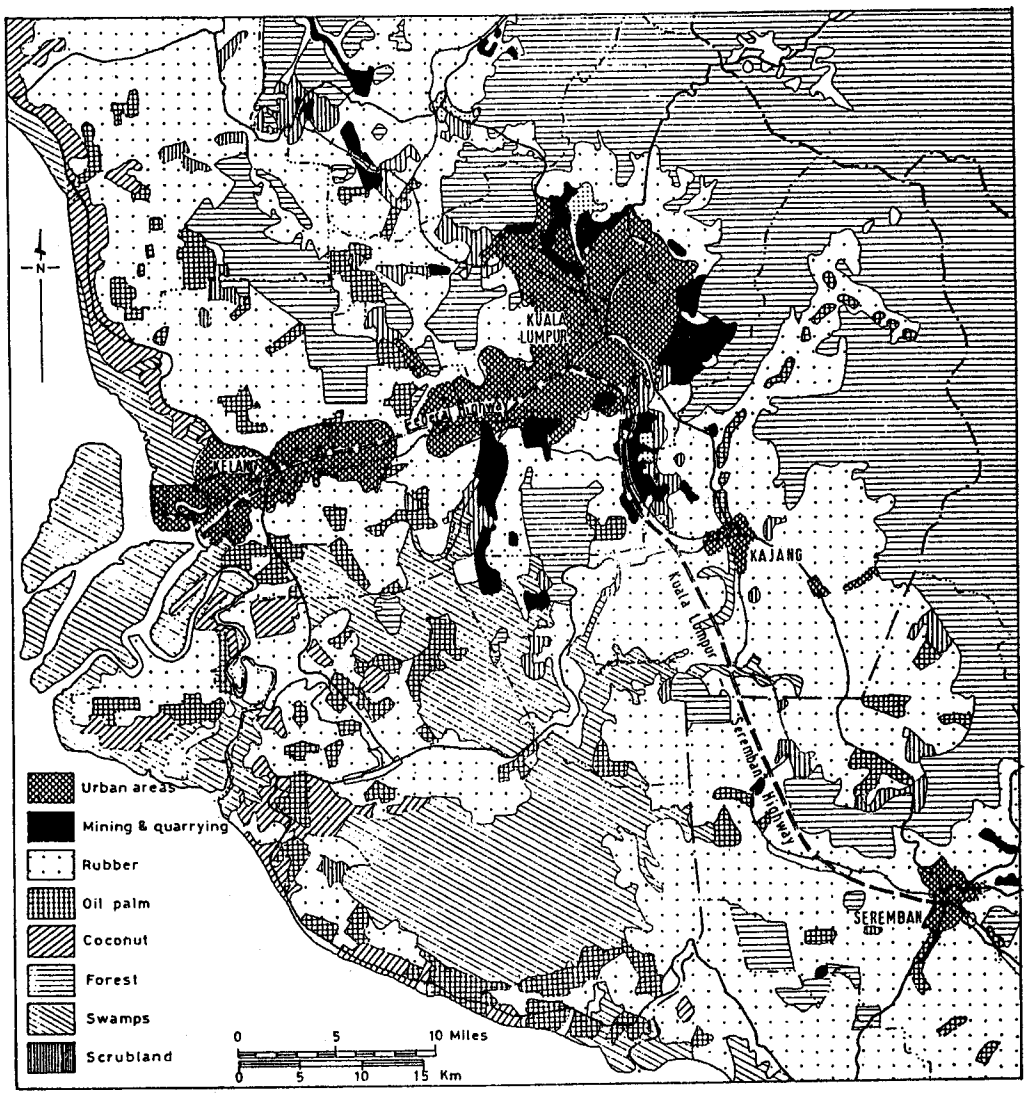
The Federal Highway connects the Federal Territory of Kuala Lumpur to Klang, the former capital city of the State of Selangor. This 40 km. four-lane dual Carriage Highway (certain sections have six lanes) passes through the most densely populated and industrialised area in the country, known as the Klang Valley conurbation (Figure III), following the northeast to southwest alignment of Sungei Klang.

Although the Federal Highway serves an estimated population of no less than 1.5 million, in terms of landuse, the corridor on either side of the Highway is "filled in" very rapidly with housing and industrial development. These include Petaling Jaya; Subang Jaya; Shah Alam, the Capital City of Selangor; Batu Tiga the Industrial Estate; the rapidly growing Centres of Klang and Port Klang, with many smaller housing estates interspersed among them. Thus, following the classical 'with and without' analysis, there is no doubt that in terms of economic and social impacts, the Highway has brought about considerable changes and benefits to the population.

The Federal Highway also brought about considerable environmental problems which lead to a steady deterioration in the quality of the adjacent urban environment. This deterioration is caused by the noise, vibrations, air pollutants, dirt, changes in the amount of light, increase in day and night temperatures, visual intrusions and alterations of landuses all of which are direct and indirect consequences of the Highway.

Traffic noise is one of the most serious problems generated by the Highway. At present there is a total of 223,849 vehicles comprising of 124,650 motorcars, 94,390 motor cycles, 3,606 taxis, 803 stage buses and 400 mini buses in the

FIGURE III: KUALA LUMPUR-KLANG VALLEY CONURBATION



Kuala Lumpur-Klang Valley Conurbation. This does not include the 20,000 trucks and lorries of various tonnage using the road. The vehicle density is about 2000 vehicles per square kilometre and the noise these vehicles generate especially during daylight hours is tremendous. The noise offenders are usually the heavy transports (lorries, buses and trucks), two-wheeled vehicles (motorcycles and scooters) and sports and passenger cars in decreasing order. During the daytime, the minimum noise levels seldom reach below 80 decibels at even 25 m. away from the Highway and the maximum levels are about 10 to 15 decibels higher than 80 decibels. These levels are consistently higher than the accepted maximum of 60 decibels for traffic noise. The high average speeds (usually over 80 km/hr) of the vehicles and the large numbers of heavy vehicles using the Highway contributed significantly to the high average noise levels (Yeow, et al., 1972). Side effects of the traffic noise levels are psychological in nature, such as nervousness, arousal of annoyance and tempers, interference with speech, communication, sleep and rest.

The high traffic volume also generates serious air pollution problems. Emissions from the motor vehicles and from the industrial premises which have been located adjacent to the Highway to take advantage of the easy access, are major causes of haze and smog in the early mornings. According to the 1977 Department of Environment survey, an estimated 680,121 tonnes of air pollutants from fuel combustion were emitted along the Kuala Lumpur-Klang Conurbation, and of this amount, transportation by motor vehicles accounted for more than 60%. Of this, analysis shows that 80.2% are carbon monoxide, 10.3% hydro carbons, 7.8% oxides of nitrogen, 0.6% oxides of sulphur and the remainder being particulate emissions of lead and carbon. The stable weather conditions and the physiographic setting of the Conurbation located in a slight hollow surrounded by hills in Kuala Lumpur which tapers to a very flat low-lying valley in Klang, hinder the dispersion of the pollutants. Since the mean daily ventilation values (the product of the depth of the atmospheric mixing layer and the windspeed through the atmosphere layer) are also very low as compared to New York, Pittsburg or Los Angeles (Sani, 1976a), the pollutants are often suspended in the air for a considerable period of time. Fears of lead pollution are, therefore, not unfounded, particularly in specific places where the Highway runs close to schools and residential houses. Although there are no studies conducted in relation to specific health problems, such as dizziness, headaches, infestation and skin diseases, they should not be under-estimated because the incidences of these diseases may not have been traced directly to air pollution

at present. It has generally been accepted that Highways are potential carriers of diseases. The building of the Darien Gap Highway from Panama City to Rio Leon Bridge in Colombia for example, facilitated the northward movement of aftosa or foot-and-mouth diseases from the endemic areas in Colombia and other parts of South America (Weck, 1977).

The temperature surrounding the Highway is also higher than in the surrounding areas chiefly arising from the greater expanse of concrete and asphalt surfaces, absence of trees and the heat generated by the vehicles. The heat-island effect of Kuala Lumpur is thus sucked along as a continuous heat flow along the Federal Highway to the coast with the maximum temperature in Kuala Lumpur decreasing slightly to Klang and the surrounding areas causing general thermal discomfort.

Frequent floodings in various sections of the Highway are also common. These arise from surface detention of run-off after a storm where the drains are either blocked or too shallow to permit flows through them. In sections where there are no drains, flooding is a recurring problem. This is especially so in the adjacent sections near Klang and many sections of the Kuala Lumpur-Seremban Highway. The construction of large roundabout loops at intersection points although permitting an easy flow of traffic, leaves much to be desired in landuse planning. These roundabout loops, for example the one at the Sungei Besi-Seremban Intersection, is over 1 ha. in size and because its elevation is 1 m. below the road surface, it has become a receptor of the run-off from the Highway. As a result, it has imperceptibly been converted to a small fresh water swamp with its own aquatic habitat of water weeds, mosquitos and fishes.

Other environmental effects of the Highway are vibrations, visual disruptions especially to those houses and factories located adjacent to the Highway, and dust which often pose considerable problems in terms of cleaning and maintenance. The dust is derived mostly from the excavations on either side of the Highway in the process of upgrading it from 4 lanes to 6 lanes. These excavated materials are often dumped at the sides of the Highway which are blown away bit by bit with the passing of the vehicles. Although disposal regulations are strict, the many remnants of these materials along the Highway suggest that there is very little enforcement.

## Synthesis of the Environmental Impacts

It is common in environmental impact studies to present a summary of impacts, usually adverse, which have been identified as a result of investigations of the project. Matrices are often employed to direct attention graphically to the type and magnitude of impacts in one compact format.

Although different environmental assessment techniques are used, the most straightforward impact summary usually consists of a 4-point scale ranging from ascending order 'no effects', 'little effect', 'moderate effect' to 'very serious effect'. In this type of matrix, each environmental parameter (such as air quality, flooding, noise etc.) is assessed on its own merits and not in relation to other parameters. This type of matrix is useful for comparing different case studies on the same subject such as effects of road construction on the environment. A synthesis of the impacts which shows the cause-effect and affected relationship from the two case studies is summarised together in Table I, for easy comparisons. The impacts from Case Study One (1) on the forest area and Case Study Two (2) on the Federal Highway are shown at the bottom and top triangular boxes in the matrix respectively.

From the matrix it can be seen that while construction of roads in the forest area has little to moderate effects on the air/climate component, Highways which are completed have tremendous impacts in terms of noise, air pollution and temperature on the surrounding areas. On the other hand, during the construction of roads, very serious impacts on the soils and terrain are encountered as shown in Component Two. Also, the drainage system is disturbed during the construction causing changes in depths of water table, siltation and development of freshwater swamps due to ponding effect of the streams by the fallen vegetation. Highways which are already built generally have no such effects although occasionally flooding occurs in sections which are poorly drained. In terms of landscape damage, it depends on the area of study. The Federal Highway has moderate effects on the visual disfiguration of the Kuala Lumpur-Klang Conurbation compared to construction of roads in forest areas which generally leaves exposed scars on the landscape devoid of vegetation. In the case of the Highway, all natural vegetation is depleted as shown in Component Five.

TABLE I: ENVIRONMENTAL IMPACT MATRIX

| Environmental factors affected by road construction & traffic | | | Degree of impacts: No Effect | Little Effect | Moderate Effect | Very Serious Effect |
|---|---|---|---|---|---|---|
| Air/Climate | Noise | | | 1 | | 2 |
| | Air pollution – | dust | | | 1 | 2 |
| | | chemicals | | 1 | | |
| | Temperature | | | | 1 | 2 |
| | Rainfall | | | 1 2 | | |
| Soils/terrain | Erosion | | | 2 | | 1 |
| | Landslides/slumping | | 2 | | | 1 |
| | Leaching/loss of soil fertility | | 2 | | | 1 |
| | Gullys development | | | 2 | | 1 |
| Water | Surfaces runoff floods | | | | 2 | 1 |
| | Changes in depth of water table | | 2 | | 1 | |
| | Pollution of surface water | | 2 | | 1 | |
| | Development of swamps | | | | 1 2 | |
| Landscape damage | Visual disfiguration | | | | 1 2 | |
| | Scars on landscape | | 2 | | | 1 |
| | Decrease in visual complexity | | 1 | | 2 | |
| Vege-tation | Loss in natural vegetation | | | | | 1 2 |
| | Low regeneration rate | | 2 | | | 1 |

## Conclusion

As shown in the Environmental Impact Matrix, road projects have profound impacts on the physical environment. Where severe adverse impacts have been identified, it is usually possible to reduce them through mitigation measures and measures such as legislations and proper enforcement by the Highway Authorities. Often these measures add significantly to the cost of the project, but the long term effects are generally more costly to mitigate than the short term ones. Therefore, it is important that impact studies be conducted during the planning of any road projects to anticipate the impacts so as to minimise costs. The technique as shown above is but one example of a wide range of Environmental Impact Assessment techniques employed to study the cause-effect-affected relationships in road construction. It is used to delineate the environmental stress caused by road construction in two very different environments and the resultant environmental damages caused by the construction.

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# CULTURAL IMPACT OF TECHNOLOGICAL CHANGE IN ITALY: REFLECTIONS ON THREE CASE STUDIES

by

Alfonso Alfonsi*

Italy, from the end of the Second World War, and particularly in the 50's and 60's has undergone major technological transformation, which, from an economic point of view, has found expression in an intense industrialization of the Country, whose workforce has moved in an impressive manner from the countryside to towns.

One must consider that up to 1950 those working in agriculture consisted of about 47% of the total workforce; while from the beginning of the 60's up to the present, the agricultural sector accounts for a little more than 10% of the workforce. In 1981, 12% of the workforce was employed in agriculture; 37% in industry; 37% in services; and 14% in public administration.

In the same period huge development of consumption has taken place, confirming the fact that Italy was adopting the Keynes' neo-capitalist model.

It is important to understand that Italy has therefore produced, during and after the famous "economic miracle" of the second half of the 50's, an economic model of its own, which had cultural repercussions giving rise to an Italian model of the socio-cultural kind.

The characteristics of this model can be summarized in a few items, such as the following:

(i) the development of mass society and communications;

(ii) the enhancement of private consumption;

(iii) the development of individualism and the break with traditional communities, joint family included;

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(iv) the growth and assertion of the nuclear family; and

(v) the ever widening affirmation of a radical and libertarian mentality, notwithstanding the presence of two forces such as catholicism and communism, which we could define as anti-liberal (in the European sense).

It is easy to understand how the Italian model is almost the opposite of the Japanese model of corporate culture, since it presupposes the individual to be completely untrammelled by others, or if at all tied to them by merciful relationships or values such as friendship, understood above all in its accidental and temporary aspects.

Naturally also, the great cultural traditions, namely the catholic and the communist ones, are part of the model. These traditions somehow have opposed the model, but sooner or later they had to integrate.

Thus we had the clamorous case of the catholic updating, which has been concretized in the acceptance of the culture of modernization and the case of the liberalization of the Italian Communist Party, which has not only broken its ties with the Soviet Union, but has also become a promoter of a cultural policy aimed at the assertion of the individual and of values which only a decade ago would have been inconceivable to attribute to Italian communism.

All of this happened as a consequence of and in concomitance with a technological transformation of enormous proportions, which overran not only production and distribution, but above all consumption, leading to the creation of profound changes in both personal and family life.

Between 1977 and 1982, the Centre for Research and Documentation February '74 has carried out, on the Italian case, five major researches, which I wish to utilize in this brief paper in order to stress what could have been the positive and negative aspects of a model such as the one I have briefly described. It is also the aim to show, at the same time, how cultural change and the dramatic problem of development that legitimately belong to the industrialized countries themselves, provided the processes of technological transformation to take place within those countries.

## CULTURAL IMPACT

Obviously, the purpose of this paper is to show the relevance of the inner and cultural aspects of technological change, which according to the point of view of our Institute, is never a mere technical fact, but always a process which is both material and cultural at one and the same time.

### Young People

The Centre's researches on young people have been two; one empirical-theoretical aiming at discovering youth's social role at the end of the 70's; and the other, mainly empirical, on the relationship between catholic youth and the processes of modernization.

I shall outline some of the data of these researches from which I shall then draw some conclusions.

In Italy, one witnesses a process of contraction of the working base. During the 60's, people with an occupation formed about 40% of the population; from the beginning of the 70's, the percentage has fallen to about 35% to 36%.

The number of the unemployed is, conversely, continuously increasing from 3.4% of the manpower in 1961 to 5% in 1971; and to 8.5% in 1981. In such a context, the phenomenon of youth unemployment is particularly enhanced. In 1966, 291,000 young people were looking for their first job; in 1976, these young people were 603,000; in 1981, 697,000 (Table I).

The data I presented have a value that is purely illustrative of a universally known fact. It also has to be said that the reduction of the work basis, and the increasing youth unemployment go hand in hand with the increase in industrial production and the available national income.

Something which I should like to dwell on and which represents the original research contribution of my Institute, is the fact that the structural situation I have recalled runs parallel to an anomalous functioning, we might say, of a true and proper crisis of the agencies which are expected to take care of the acculturation of young people. I shall briefly present some major data concerning such a crisis.

TABLE I: YOUNG PEOPLE IN SEARCH OF A JOB

(THOUSANDS)

| Year | Number (thousands) | Index number |
|---|---|---|
| 1966 | 291 | 100 |
| 1971 | 435 | 149 |
| 1976 | 603 | 207 |
| 1981 | 697 | 240 |

## CULTURAL IMPACT

### Family

As far as the family is concerned, it is noteworthy that what could have been considered as a common effect of industrialization, namely an increase in the independence of the young generations from parental control, due to new working opportunities and the weakening of traditional family ties, is by no means a mono-directional and irreversible process.

At a more advanced stage of industrialization, connected with phenomena such as the increase in the rate of youth unemployment or the rise in the average age in which young people are able to attain a first occupation, a trend somehow opposite to that described before can be detected. In this trend, a major role is played by the nuclear family that is affected by a model of development oriented toward private consumption. The nuclear family shows itself as scarcely able to give rise to effective processes of socialization also because, in such a context, the parental couple is driven to project on their children problems of identity crisis, aspirations, and frustrations.

Typical of the features of the socialization crisis related with the present stage of Italian industrialization are the following:

(i) the dependence of children on the parental couple increases instead of decreases;

(ii) as a consequence, young people at once have a less developed individual personality and a lower capacity of associate life;

(iii) this is mainly due to the excessive prolongation of parental care for young people who still live with their parents up to even the age of 30; and

(iv) moreover, and arising from this, the field of perception of young people becomes all the more restricted, vis-a-vis the social aspects and the dynamics external to the nuclear family.

**School**

Due to the efforts by the State and a strong popular demand, the educational sector has increased enormously its activities since the end of the war. Illiteracy, which was still a relevant problem prior to the 50's, has now almost completely disappeared. Compulsory school attendance is up to the age of 14; high school attendance has risen from 9.5% of the concerned age group of the population in 1951 to 56% in 1981; university attendance increasing from 3.5% to 18%.

Beyond these data, the real situation has certain strong problematic characteristics. I shall seek to outline some of them, namely:

(i) Mass school attendance has taken place within structures which are obsolete, designed for a conception of education which served only the elites. Due to an almost overnight change in the direction of mass school attendance, the general reaction has been the lowering of the quality of school performances, especially due to the inadequacy of the teaching personnel.

(ii) The motivation for attending school is oriented mainly in accordance with an individualistic model: either to reach a better social position, or to attain self-achievement, independent of social professionality.

(iii) In general, these motivations are frustrated since the Italian school system has failed in its relationship with the labour market, giving rise to an increasing gap between expectations concomitant with a high level of education and the need for concrete job opportunities.

A second aspect of the condition of the youth group that is to be taken into account is represented by the phenomenon of youth grouping. I will deal with it on the basis of the findings of a nation-wide research that was carried out by our Institute on a form of group life peculiar of the second stage of Italian post-war industrialization. This form of group life is associated with the local groups of young catholics.

**CULTURAL IMPACT**

Up to the early 60's, catholic associations in Italy were moulded according to a model typical of mass organizations (both socialist and catholic), developed in all Europe from the beginning of the last century in concomitance with the formation of the modern industrial society. Typical of this form of association was a very rigid organisational structure, centralised national leadership, written statutes, strictly coded value charts, and so on.

In the middle of the 60's, this kind of organisational form underwent a deep crisis. Traditional catholic associations (which counted in 1950 2,500,000 members, 1,800,000 of which were young people) from 1962 to 1978 witnessed a reduction of the number of their young adherents to 120,000.

Running parallel to this crisis, however, a new form of catholic aggregation has developed, no longer on a nation-wide basis, but on a local one. It is no longer strictly structured, but is produced on a quasi-spontaneous basis. Such a phenomenon is however very relevant.

By means of a thorough wide ranging census over the whole national territory which was the first step of a research carried out for three years, we have documented the existence of nearly 9,000 groups, corresponding to about 450,000 affiliated young people.

Forty percent of the groups live in urban areas, while 60% are in rural areas. Most of the groups, however, as the relevant point, are not tied to traditional catholicism, but they are found to embrace systems of values tied to that model of development I mentioned earlier that can be defined as "modern".

The four values which were obtained over a wide ranging sample of groups indicating maximal preferences, are:

(i) **friendship** (96% of the groups);
(ii) **community** (94% of the groups);
(iii) **self-achievement** (93% of the groups); and
(iv) **service to the Church** (92.3% of the groups).

It is of particular significance that of the four values only the last has an evident tie with the catholic system of values, while the first three came from the culture of modernization.

The four values which, instead, have recorded the lowest level of preferences, are related to the traditional catholic culture, namely: **humility, obedience, chastity,** and **political unity of catholics** (a pass-word of traditionally oriented political catholicism).

Furthermore, having built 4 groupings of values, we can observe that the groups have given their preference to:

(i) **values of modernity** (friendship, personal freedom, self-achievement) - 79.2% of the groups;

(ii) **values of ecclesiastical life** (service to the Church, community, unity of catholics in the faith) - 70.4% of the groups;

(iii) **social values** (democracy, peace) - 41.8%;

(iv) **traditional catholic values** (obedience, humility, chastity) - only 25.9%.

Preference for informal and horizontal values, and the consequent distancing from the typical organisational structure of the traditional catholic associations is also witnessed by the following data:

(i) 84.8% of the groups do not have a written statute; and

(ii) 85% of the groups refuse the idea that the animator of the group should have elements of authority.

But the most original data of the research derives from the comparison between 4 semantic blocks built by means of linguistic methodologies, both qualitative and quantitative, corresponding to 4 different forms of religious experience, which can be found within the groups, namely:

(i) modern post-conciliar catholicism[1];

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1 Between 1962 and 1965 took place the Oecumenic Concil Vatican 2nd, the major assembly of Catholic church, which gave rise to a deep updating and renewal of the Catholic church, including liturgy, theology, organization, which strongly affected Italian catholicism.

(ii) traditional Catholic religion;
(iii) extra-ecclesiastical religion of modernity; and
(iv) political and social religion.

Of the four blocks, again, two appear to stand out by far: extra ecclesiastical religion of modernity and the up-dated post-conciliar catholicism. What has been discovered, then, is that in the groups of young catholics an original form of syncretism has developed, undiscovered so far by any scholar, between a remarkably integrated system of secular values of modernity, experienced with a strong religious attitude, and up-dated catholicism.

Such syncretism is present in 88% of the groups we have studied.

I have to add that this is but just the tip of an iceberg, for we could calculate that the total number of youth groups with the characteristics which I have briefly outlined, should be about 15,000. This is a social area of great relevance due to the formative processes which take place within its interior.

**Some Conclusions**

As far as young people in general are concerned, it appears evident that the Italian model involves their progressive expulsion both from the world of work and the possibility of achieving family status.

In this way a vast sector of the population, in the 14 to 30 age group, which equals 13 million, finds itself in a situation of continuous anomy and uncertainty about the most important meanings of life and the very sense of existence.

The lay structures of Italian society have today very little to offer to young people.

Village communities or clubs are lacking; lay associationism is undergoing a crisis; the practice of sports is strongly individualized and private; ties within the family are felt as a burden; the authority of parents or other

ascendants is of little worth and is no longer capable of making itself felt; the crisis in the schools and universities is very strong.

Catholic reaction to such a state of affairs seems, instead, to have worked; thanks to the creation of a series of structures which have somehow performed therapeutic functions, such as the local youth groups in the 28,000 Italian parishes.

It is conversely evident that the Catholic Church has embraced the individualistic model, and has disaggregated the Catholic movement by accepting the supremacy of individual values, vis-a-vis community values.

In this way it has enacted a cultural system, which is very functional for horizontal mobility, and has contributed to favouring that which Gino Germani calls inner indicators of modernization, or those structures of consciousness which Peter Berger considers as constitutive of modernization.

**Elderly**

The elderly in Italy constitute about 20% of the population, and about a quarter of the active electorate.

The average life span in Italy, has risen from 65.5 to 72.8 in the last 30 years.

The increase in well-being, the improvement of the quality of life, the practice of preventive medicine, the fight against social illnesses, the progress in the field of medicine, have made it physically possible - like in all other industrialized countries - for the elderly to become a true and proper social area, which was not hitherto the case.

Certainly such an area would never have to come into existence without the concurrence of social factors leading to the progressive expulsion of the elderly from the nuclear family or the world of work with anticipated modes of retirement.

## CULTURAL IMPACT

It is clear that the Italian model, even with some resistance, has worked also in this sector of the elderly, as shown by the research carried out by the Centre February '74.

A society based on two status levels alone, namely work and family, encounters many difficulties in seeking to give rise to new forms of social existence which should find their legitimatisation in different status and institutional systems.

Let us now consider some data referring to this.

The research from which the data came from, had a national character and has been carried out in two stages: a qualitative stage comprising the gathering and the analysis of 380 life histories, and a quantitative stage carried out by means of the administration of a questionnaire according to a stratified sample representing the eleven million elderly in Italy.

On the basis of its results, we can assert that there exists a wide gap between the high self-image of the elderly (62.5% of those interviewed claimed to be very satisfied with their lives; 43% believed the elderly should have a very important position in society; and only 1 out of every 3 interviewed thinks of himself as being "old") and the low level of their actual condition of life (just consider that 67% of the elderly have an income less than US$3,000 per year). This is evident especially with regard to the above mentioned environments: work and family.

### Work

There is a constant aspiration to work: 70.4% of those interviewed consider the continuance of a working activity to be necessary; and over 80% placed work among the top values. Conversely, only 9% of the sample fulfilled a remunerative role, while more than a quarter of those interviewed had retired early, before reaching 60. Furthermore, the activities which showed the greatest increase after retirement were tied to daily trivialities such as watching television, carrying out little domestic chores and looking after the grandchildren. Very few of the elderly (only 6%) are engaged in social work activities.

**Family**

About 93.5% think it necessary to be surrounded by the love of the family; and the value "family" is that it received the maximum vote. Besides, according to 70.8% of those interviewed, the intervention of the elderly should be concentrated in the family domain.

In reality, the nuclear family tends to exclude the elderly. About 51% of them live alone or with their spouses, 23% with unmarried children, and only 12% with the married children. Further, one must consider that among those interviewed only 74% have married children.

The family condition of the elderly is furthermore characterised by a scarce independence (only 50% of those living with other relatives have exclusive use of a room); loss of authority (only a minority is regularly consulted on decisions concerning family life); isolation with reference to the circle of communication within the family.

**Socio-cultural Stress**

The situation of socio-cultural stress characteristic of the elderly can be furthermore evaluated on the basis of the following data:

(i) the high degree of anomy, which is present in 53.9% of the sample;

(ii) the scarce evaluation of social and political values, political opinions or activities;

(iii) the existence of a substantial and widely shared area of needs, centered on a very strong demand for individual autonomy (from the economic, physical and personal-choice points of view);

(iv) the existence of a strongly homogeneous system of aspirations tied mainly to rest and of the use of free time for themselves and tne family;

(v) the tendency to use mass-media especially for entertainment, which corresponds to a very intensive use of television and, conversely, to an almost non-existent habit of frequenting both the cinema or theatre;

(vi) a paucity of information concerning the existence of social services for the elderly, and a minimal tendency to use them. This corresponds to a remarkably insufficient structure of social services at the organisational level for the whole territory.

**Some Conclusions**

The Italian society, as has been mentioned, tends to give weight to subjectivity in evaluations concerning individuals, that is: it gives them a high sense of self.

Meanwhile, it abandons the individual to blind mechanisms such as those of the market, or administration, or the institutional games of a society which tend to have rules, goals, and institutional processes where only and always the individual is the protagonist. We, therefore, have an explanation of the elderly and their isolation and, above all, of their psychic suffering. They have somehow been given to high evaluations of subjectivity, and then frustrated in their expectations.

The great myths of the old age, which in practice are the myths of the Italian working masses, such as rest, or the possibility of finally doing something new, or of re-entering the family, are socially impractical and show their falseness. This in turn falsifies the Italian model itself.

Rest becomes one of the most etiologically relevant causes for the mortality of the elderly; the possibility of finally doing something new decays into the socially legitimatised practice of routine hobbies; re-entry into the family is frustrated by the snarling opposition of the nuclear family, which accepts the elderly only as baby-sitters.

**Health**

An interesting aspect of what I feel like calling the Italian crisis is the contradictory effect of development and technological change in the area of health and health care.

With reference to this, it is important to consider four variables.

The first variable is represented by the overall technological transformation which has developed those processes of giving the masses a sense of subjectivity, whose outlet has been, precisely, a culture strongly centered on the values of the individual.

The second variable is represented by the specific technological development which is proper to the field of health care, which in Italy has reached top levels, as has however, happened in other industrialised countries.

The third variable is represented by the fact that the health care infrastructures, i.e. services such as hospitals, bureaucracy, and so on, have remained from the technological point of view at pre-industrial levels.

The fourth variable is represented by the professional institution of doctors, nurses, auxiliary personnel, managers, in short of health personnel.

Professional institutions, professional conscience and professional practice have also remained at pre-industrial levels.

Two research projects carried out in the city of Rome and in a region of Central Italy, Umbria, have stressed - in considering these four variables and their interactions, and the very real institutional conflicts which have arisen - the social, cultural and technical characteristics of the health care service in Italy.

Beginning from the close of the 60's, a complete restructuring of health plants took place in Italy involving the introduction of sophisticated health technology. Nowadays, for instance, the bed-population relationship (11 for every 1,000 in 1972) is among the most favourable of highly developed countries

(in 1971 the USA had 8 for every 1,000, and England 9 for every 1,000). The per day cost of a hospital bed is about US$85 to $90.

The data in Tables II and III illustrate some of the problems in the health care service in Italy.

**Time Period Prior To Hospsital Entry**

To the factor of availability of hospital beds is to be contrasted the decline which manifests itself, for example, in slowness of admittance and in the commencement of treatment.

**Food And Services**

Notwithstanding the high cost of beds, the type of services provided is extremely lacking, to the point of causing frustration and a sense of loss in the patients.

This is shown in Table IV.

**Information**

As can be seen from the following data in Table V, the patient is marginal with regard to the informative circle of the hospital which does not consider him an obvious and legitimate recipient of information.

Finally, we can affirm that the patient has a subordinated role within the hospital system, the organization of which seems to him to be extraneous to his well-being to the extent that about a quarter of patients, both in Rome and in Umbria, regard the hospital's timetable to be inhuman and damaging. A good 6% of patients come even to the point of suspecting that they are being given somebody else's treatment.

Typical of the patient's condition are, therefore: the need to bargain with or implore the hospital personnel to carry out what should be accounted as professional duties; to be addressed in a familiar and childish way; to be publicly reprimanded, or to be made the object of other types of affirmations of inferiority; not to be recognized as the bearer of rights.

TABLE II: PERCENTAGES RELATIVE TO THE DAYS OF WAITING FOR ADMITTANCE

| Days | Rome | Umbria |
|---|---|---|
| | % | % |
| 1 day | 40.3 | 49.1 |
| 1 - 2 days | 20.8 | 20.0 |
| 3 - 4 days | 6.2 | 16.6 |
| 5 - 7 days | 10.1 | 6.3 |
| 8 - 14 days | 7.3 | 4.6 |
| more than 14 days | 15.3 | 3.4 |

**TABLE III: PERCENTAGES RELATIVE TO TIME SPENT IN HOSPITAL**

| Time Spent in Hospital | Rome % | Umbria % |
|---|---|---|
| Time Prior to Commencement of Analyses: | | |
| 1 day | 23.9 | 39.5 |
| 1 - 2 days | 62.8 | 54.8 |
| 3 days and more than 3 days | 7.9 | 5.7 |
| Time Prior to Commencement of Therapeutic Treatment: | | |
| 1 day | 16.8 | 33.2 |
| 1 - 2 days | 32.8 | 42.5 |
| 3 days and more than 3 days | 50.4 | 24.3 |

TABLE IV: RESPONSES (%) PERTAINING TO HOSPITAL SERVICES

| Hospital Services | Rome % | Umbria % |
|---|---|---|
| **Food:** | | |
| of poor quality | 19.98 | 6.30 |
| badly cooked | 29.08 | 10.60 |
| diet is not taken into account | 11.00 | 2.30 |
| no variation in the menu | 25.62 | 15.60 |
| loss of weight by the patient while in hospital | 30.36 | 23.30 |
| **Furnishings:** | | |
| lack of sheets | 22.25 | 10.00 |
| lack of blanket | 10.29 | 5.30 |
| lack of glasses | 28.49 | 38.30 |
| lack of cutlery | 25.91 | 33.00 |
| lack of wardrobes | 28.68 | 20.60 |
| **Structures:** | | |
| relatives are met in the wards | 37.49 | 84.00 |
| relatives are met in the corridors | 19.09 | 15.30 |
| relatives are met in the waiting room | 21.46 | 15.60 |

TABLE V: RESPONSES (%) CONCERNING INFORMATION IN THE HOSPITAL

| Information | Rome % | Umbria % |
|---|---|---|
| Could not see his medical chart | 69.93 | 76.33 |
| Was not informed of what kind of treatment he was going to undergo | 61.92 | 58.00 |
| There was no exchange of information between the personal doctor and the hospital doctor | 73.39 | 69.66 |
| Does not know the name of hospital doctor | 27.89 | 22.66 |
| Does not know the technical term of his illness | 30.36 | 40.66 |
| Does not know the treatment he is undergoing | 28.29 | 31.66 |

Such a situation is in a sharp contrast with the strong self consciousness which the sick person has in Italian society; and this makes the hospitals prime places of social conflict.

# PLANNING AND DEVELOPMENT OF SINGAPORE CHANGI AIRPORT

by

Peng Giok Beng*

## Introduction

I was asked to speak on the planning and development of Singapore Changi Airport with specific references to how the decision-making and project implementation were carried out on the basis of empirical studies and forward planning. With this theme in mind, I will trace through the various development phases of the airport starting from site selection, land reclamatiom etc. until the shift to the new airport, and try to give examples of empirical studies and forward planning done. It is not intended to give an exhaustive list of all studies made for each area. Also being a non-technical man, it is not my intention to go into in-depth or technical treatment of the sample empirical studies quoted. I will also like to share with you the kind of problems we encountered in the planning and development of the airport.

## Site Selection

The decision to build Changi Airport was studied in great detail by a Special Committee on Airport Development (SCAD) set up by the Government in early 1975. This Committee comprised top civil servants from various ministries concerned with planning and development matters and took about 3 months to collect empirical data and traffic statistics; interview user departments, airlines and ground agents; conduct site surveys and inspections etc. to assess the time-frame, cost and noise pollution aspects associated with the development of a new airport at Changi versus the continued expansion of the then existing Paya Lebar Airport.

After an in-depth feasibility study, SCAD concluded that the construction of a new airport at Changi could be done expeditiously as compared to the expansion of Paya Lebar Airport because there were more severe engineering difficulties and the squatter resettlement problem at Paya Lebar. Besides, the Changi site being foreshore is more superior insofar as noise pollution and safety hazards

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are concerned. There is also a bigger area for master planning, for sizing the facilities and for provision of better ground access to the airport. The Government accepted SCAD's recommendation and decided to develop Changi Airport in June 1975.

**Land Reclamation**

More than half of the land area at Changi Airport, namely 907 hectares (out of 1663 hectares) were reclaimed from the sea. Of this area, 200 hectares were reclaimed using earth obtained from hills outside the airport area while the remaining 707 hectares were created by using sand recovered from the seabed. Reclamation using sea-fill started in March 1976 and was completed in 29 months' time. Five cutter-suction dredgers worked round the clock with 2 more deployed to boost the output at peak period. A total of some 40 million cubic metres of sand were recovered from the seabed adjacent to the site.

Studies carried out in this area were more technical in nature. Some examples are given below:

(i) Various reclamation layouts were considered taking into consideration the tidal conditions, navigation safety, siltation etc. A hydraulic models study was conducted at Ponna to select the optimum configuration.

(ii) Prior to the commencement of the reclamation, bore-holes and seismic refraction surveys were carried out over the reclamation site and the sea-fill borrowed area to establish the soil conditions. A magnetic survey covering the whole of the borrowed area was also carried out. Some jettisoned bombs from World War 2 were found and several old sea mines were exploded by the Singapore Armed Forces.

(iii) Tests were carried out during the reclamation to check the relative density of the hydraulic fill which was found to vary widely between 40% and 80%. This would not be suitable for the design of aircraft pavements which require a subgrade with 90% relative density. The hydraulic fill was, therefore, densified

by a method involving the application of high energy impact known as dynamic consolidation.

(iv) The most serious problem from the engineering point of view is the long-term delayed settlement of the area underlain by the highly compressible soft marine clay. If this soft clay is not treated prior to the construction of aircraft pavements, substantial settlements causing uneveness and cracking of the pavements would render the airport unserviceable. To overcome this long-term settlement problem, two methods were used to consolidate the soft marine clay, namely sand drains and pre-fabricated drains.

**Demand Forecasting**

Forecasting is the key to the planning process. In view of the long lead-time to construct an airport, long term forecasting of traffic demand is critical. Such input is necessary to determine both the size of the facilities as well as when they are needed. Obviously, forecasting can in no way be precise; nonetheless, it serves as a valuable pointer for future planning and investments.

Various forecasting methods were used by us. These include trend projection, regressional model, market analysis, Delphi method, econometric modelling and judgmental method. In these methods, a detailed study and analysis of the past statistics on air traffic and economic parameters (such as GDPs of Singapore and other countries), aircraft load factors, seats availability per aircraft type, operating traffic pattern, seasonal statistical factors, air fare, efforts of our Tourist Promotion Board, availability of hotel rooms etc. were taken into account. The airline experts were asked to give their views on the possible future growth as well as their operating plans. Forecasts of our tourist Promotion Board on tourist arrivals were also solicited.

Since facilities in the airport (e.g. runway, passenger terminal, parking apron etc.) are most stretched during peak-hours, it is the peak demand rather than the annual demand that will determine the facilities required. The peak-hour figures are normally derived from the annual figures by applying various

seasonal statistical factors such as peak-month to average month ratio, peak-day adjustment factor, peak-hour traffic as a percentage of the peak-day traffic etc.

**Master Planning**

An airport master plan represents the planners' conception of the ultimate development of the airport. It should provide the required capacity to handle aircraft, passenger, cargo and vehicle movements with maximum convenience for the users and with minimum capital and operating costs. As an airport master plan has to cater for the requirements of the very distant future, flexibility and expandability should be the basic design criteria. This is especially so since the longer the time horizon, the less accurate the demand forecasts become.

Studies to conceptualise the master plan for Changi Airport were carried out by local airport officials based on their experience in planning and designing the facilities at Paya Lebar. Factors considered include meteorological conditions, availability of central core area for terminal development, landside facilities, need for separate access to cargo complex etc. In addition, two study teams were sent overseas to tap the experience and expertise of other airports. One team was sent to the Far East while the other team to Europe to discuss with their planners on the airport master planning aspect. A team of consultants were also engaged to give a second opinion on the master planning concept drawn up by the local officials.

**Facilities Planning**

In general, airport facilities can be broadly divided into 3 categories, namely:

(i) **Aircraft facilities** such as runways, taxiways, aircraft parking aprons, communication facilities, navigational aids, fire and rescue services facilities etc.;

(ii) **Passenger handling facilities,** namely the passenger terminals together with their various sub-systems such as check-in counters; Customs, Immigration and security facilities; baggage

handling system, travellators and aerobridges; shopping facilities and restaurants; carparks, taxi queues, rental car facilities and access roadway system etc.; and

(iii) **Cargo handling facilities** such as cargo terminals, cargo agents buildings, Customs warehouse, transit postal facilities, animal quarantine station etc.

Examples of the empirical studies carried out in this area are:

(i) **Surveys:**

(a) Surveys were conducted to determine the queueing and clearance times for check-in counters, Customs, Immigration and security counters to determine the number of counters that should be provided to meet the demand of the projected passenger traffic during the peak-hours.

(b) Surveys were also carried out to determine the waiting time of the arriving passengers for bags in order to compute the number and length of the conveyor belts to be provided.

(c) Surveys on the throughput rate of passengers to and from the aircraft were conducted to determine the number of aerobridges that should be provided with double heads taking into account the projected traffic mix.

(d) In order to ensure that the number of carparking lots, length of taxi queue, number of traffic lanes along main airport access road, length of kerbside space etc. are adequately provided, surveys on the travelling pattern of the passengers, greeters and well-wishers were carried out to ascertain the modal split of land transportation used by them to and from the airport, time before aircraft arrival/departure times that the greeters and well-wishers normally came to the airport, dwelling time of the passengers, greeters and well-wishers in the terminal etc.

(ii) **Empirical Statistics:** Extensive use of empirical statistics was made to complement the survey data to assist in the planning of the various facilities. For example, to determine the number of aircraft parking bays required, statistics on the number of aircraft on the ground in relation to the number of aircraft during the peak hour were kept for the past years. An average factor was obtained and this was applied to the projected number of peak hour aircraft movements to derive the number of parking bays required. Statistics are also used to determine the seasonal factors for planning of facilities that are critical during the peak-hour.

(iii) **User Requirements:** Airlines and other airport users were interviewed to advise on their requirements based on operational experience and expertise in the particular area e.g. the design concept for check-in counters, ticket sales counters, offices, shops, restaurants etc.

(iv) **Study Tours:** For planning of specialised systems or projects such as airfield lighting system, baggage handling system, interior design and finishing etc., specific overseas study tours were organised to visit the relevant airports to observe, study and discuss with their planners on the systems concerned, tapping their operational experience and expertise in those areas.

(v) **Use Of Mock-ups:** It is generally difficult to visualise plans or small samples. Because of this, mock-ups were put up before final implementation where possible e.g. the facade tiles of the passenger terminal, lighting within the terminal, counters, interior decoration and lighting of the lifts, floor tiling etc.

(vi) **Experimentation At Paya Lebar Airport:** Wherever possible, new procedures, concepts or systems proposed for Changi Airport were first tried out at Paya Lebar Airport to confirm their suitability. These include the taxi queue/pick-up system, housekeeping of the airport, policy and layout concept for

airport shops and restaurants, baggage conveyor system, sign-posting system etc.

(vii) **Other studies** carried out include:

(a) Soil testing for critical facilities such as aircraft pavements, aircraft maintenance hangar etc.

(b) Wind tunnel test for the 78-m high Control Tower to assess its ability to withstand the wind shear.

(c) Accoustic and sound reverberation tests in connection with the installation of public address system for passenger terminal.

(d) Computer simulation study to evaluate the light intensity level and distribution pattern for apron floodlighting system.

**Physical Construction**

During the physical construction stage, project control and monitoring aspects are critical. In our case, the highest level controlling the development of Changi Airport was the Executive Committee on Airport Development (ECAD) which made policy decisions relating to airport planning and construction on the basis of the various empirical studies done. The decisions were then filtered down to other committees, and down to the rank and file. The construction progress and financial position were reported regularly to ECAD. This clear-cut chain of commands enabled numerous problems to be resolved expeditiously as they arise.

To ensure that critical tasks for each stage of the construction were completed within their scheduled times, the progress of the project was monitored using a computer-based Project Evaluation Review Techniques (PERT) method. A master network showing the sequential relationship amongst some 4,000 activities and their estimated time duration was drawn up. This network was constantly reviewed and revised as the development of the airport progressed. Activities which were delayed and those which had to be completed in time to

avoid causing further delays to other activities were identified by the computer. This was followed by regular review and coordination meetings where corrective actions to recover the lost times were made, and contingency plans laid down for consequential future delays.

**Simulation Flights/Public Familiarisation**

When the airport was completed, and all the individual details concerning the operations were worked out, there was a need to test the airport operation system as a whole. That test was in the form of simulation flights. Sixteen flights in all were operated through Changi Airport in May and June 1981. There were 6 departure flights and 10 arrival flights all involving full jumbo loads of about 400 passengers each.

These 16 flights tested out actual operations of all systems ranging from check-in, baggage handling, flight information system, sign-posting system, Customs, Immigration and security clearance to air traffic control, airfield lighting, aerobridge operations, aircraft fuelling, flight catering, apron handling and engineering services; and they were quite indispensable to the successful operation of Changi Airport.

The proper handling of the public and press was another important element in the opening of the new airport. A series of press releases and briefings were made from the end of May 1981. News items about Changi Airport were released regularly to the press over the 1 1/2 month period prior to the opening so that there was maximum exposure regarding various aspects of Changi Airport.

Secondly, the public was invited to visit and walk around Changi Airport before it actually began operations on 1 July 1981. From 24 May to 31 May 1981, the public was permitted to drive up to the passenger terminal and to familiarise themselves with the airport roads and carparks. From 1 June to 21 June 1981, the public was invited to tour the terminal itself. During the three weeks in June, about 400,000 visitors came to see the new airport. Familiarisation tours of the passenger terminal were also organised for civil servants, community centres and airport users in May and June 1981.

The familiarisation tours and visits by the public served two main purposes. Firstly, it acquainted the public with the layout of the new airport so that

when the airport opened, they would not be confused. Secondly, the public's curiosity of the new airport was satisfied before actual operation started. In this way, congestion by huge crowds of visitors was avoided when Changi Airport opened on 1 July 1981. This was critical as despite the most detailed planning and preparation for operations, everything could be paralysed by visitors jamming the roads, carparks and terminal on the opening day.

**Shifting To Changi**

It was apparent from the outset that the physical shifting from Paya Lebar to Changi would be a major task because of the large number of pieces of equipment involved, and because the majority of this equipment would be required at Paya Lebar right until the eve of the opening of Changi Airport. The need to ferry empty aircraft between Paya Lebar and Changi Airport, and to minimise inconvenience to the air travellers were other major considerations. Forward planning was also exercised in carrying out this operation.

Planning for the airport shift began in May 1980, 14 months before Changi Airport commenced operations. A Committee known as the Changi Airport Shifting Coordination Committee was formed with the following 3 sub-committees to work out the various details:

(i) Operations Shifting Sub-Committee;

(ii) Apron Services Shifting Sub-Committee; and

(iii) Facilitation Shifting Sub-Committee.

Members of these committees included representatives from the various airlines, ground handling companies, oil refuellers, freight forwarders and other Government authorities such as Immigration, Customs, Police, Telecoms, Fire Brigade etc.

Various shifting scenarios were identified, namely whether:

(i) To have an uninterrupted airport operation during shifting;

(ii) Interrupted airport operation during shifting; or

(iii) Dual airport operation during shifting.

By the second half of 1980, a decision was taken to close Paya Lebar Airport at midnight on 30 June 1981, and to resume aircraft operation at 7 am on 1 July 1981 in Changi Airport. This surgical shift-over procedures as opposed to an extended shifting period was adopted to minimise public inconvenience. Passengers and visitors knew exactly which airport to go to. Similarly, taxis, buses and other supporting services will also have the same clear cut-off date. The 7-hour break in airport operations enabled the various airport organisations to concentrate their efforts on shifting their equipment without having to divert personnel and equipment to attend to aircraft operations.

Besides 'drawing board' planning, 'reconnaissance' and 'dry-runs' were made to ensure that the routes were clear of obstructions both on the ground and overhead. Road signs advising public of road closures, detours etc. were put up and trees obstructing high vehicle movements trimmed. Arrangements were also made to widen certain portions of the road along the routes and additional lights installed.

The shift was actually carried out over 3 nights:

(a) 10 pm 29 June 1981 to 6 am 30 June 1981;

(b) 10 pm 30 June 1981 to 6 am 1 July 1981; and

(c) 10 pm 1 July 1981 to 6 am 2 July 1981.

During the shift, some public roads were closed. The main bulk of the shift was carried out on the midnight of 30 June 1981 and the morning of 1 July 1981. There were about 2,200 pieces of equipment to be shifted. These equipment were identified and tagged, and were organised into 1,000 units and then moved in convoys of ten. These convoys were sent on selected routes at five minutes interval. To ensure their smooth movements, marshallers were placed at strategic road junctions along the routes. The police were present in large numbers to exercise general control. Communication links were set up between the main control headquarters at Paya Lebar Airport and predetermined monitoring points along the routes to track the convoy movements closely.

The shifting was carried out successfully. All equipment moved according to plan; and on the morning of 1 July 1981, both equipment and aircraft were ready for operations.

## Problems Encountered

The above are examples of the empirical studies and forward planning which I try to cover under the various stages of development of Changi Airport. As I stated earlier, I would like to share with you some of the problems we encountered during the planning and development of the airport. These are:

(i) **Siting Considerations And Users' Space Requirements:** There was a tendency for the various agencies providing services at the airport to compete for prime locations to build their facilities, and to request for larger space than necessary. The siting of various facilities at the airport was critical to the effective and efficient processing and clearance of passengers and cargo. Conversely, an optimal location for a particular facility may be sub-optimal from the overall airport viewpoint especially if it amplifies surge effects in the passenger and cargo flows. Often, the designed parameters and criteria used in supporting space requirements by these agencies were based on untested assumptions. This required the discipline of gathering data, subjecting them to rigorous analysis, and engaging in detailed discussion to determine the trade-offs between desirable but opposing sub-objectives.

(ii) **Facilities Planning:** The sizing of facilities is at the best of times a difficult exercise since either the forecast traffic or the rules of thumb applied may vary. Having the facilities too early is obviously wasteful but having them too late will create severe operational problems. The modular and flexible nature of the passenger terminal and cargo facilities at Changi Airport overcame this problem somewhat. Nonetheless, the sizing of certain facilities such as the baggage sorting area, the baggage reclaim area and the hold rooms were found to be inadequate relative to the capacity of other sub-systems, and steps had since been taken to enlarge these areas after the airport's opening.

(iii) **Changes:** Many changes and alterations were made during the planning and construction of the airport. These arose from the

changing operational and functional requirements or changes in personnel handling the project. Our experience on the Changi Airport project reveals the importance of weighing each change and improvement with the additional time needed to effect the change. Ultimately, we had to adopt a cut-off date for changes and alterations to meet the tight dateline for the airport's completion.

(iv) **Coordination Problems:** In view of the numerous implementation agencies and contractors/sub-contractors involved in the Changi Airport project, site coordination problems were inevitable. Understandably, each organization would try to take care of its own requirements, and minimize its costs, in the context of its contractual obligations. Constant supervision and regular coordination meetings were, therefore, necessary to keep up the momentum to execute the work. Moreover, interfacing of the various inter-related facilities was essential to overcome the problems of uncompleted works holding up the implementation of other works.

(v) **Relationship With Main Contractor And Sub-Contractors:** Our supervisory engineering and architectural staff worked with the main contractor as a team to resolve problems and to meet the common objective. The usual problems between a main contractor and its sub-contractors arose for the passenger terminal project. The main complaints of the main contractor were that their sub-contractors did not adhere to the agreed programme and that inadequate manpower was provided by the sub-contractors. On the other hand, the sub-contractors complained that the areas of work were not ready for them (and thus their works were held up), materials supplied were inadequate, temporary utilities services (electricity and water supplies) were often disrupted etc. Much time and efforts had to be spent to resolve these disputes. The situation was further compounded by the acute shortage of labour and materials such as sand, aggregate, cement and bricks as Singapore was then experiencing a construction boom. The workers were encouraged to work overtime, and we had

to assist the contractors by diverting construction materials from other Government projects.

(vi) **Cost Escalation:** With a higher than normal general inflation coupled with the second fuel oil increase in 1979, there was growing escalation in the cost of labour and materials. Most of the projects in Changi Airport were tendered out at a time when cost elements were low. As a result of the escalation, the contractors attempted to cut corners to reduce cost over-runs. In view of the circumstances, we had to obtain closer co-operation from the contractor and to evolve a package to induce them to complete in time.

(vii) **Problems With The Flight Information Display System:** There was insufficient time for the debugging of the complex Flight Information Display System (FIDS) and as a result, the system did not operate satisfactorily from the first day of the airport operation. This was a trying period for the airport staff and the suppliers (whose programmers worked around the clock rectifying the faults). Manual back-up facilities were quickly arranged, and the FIDS was brought up to the required level of reliability in less than a month.

# IMPACT OF MODERN ELECTRONICS TECHNOLOGY ON WOMEN WORKERS IN MALAYSIA: SOME SELECTED FINDINGS FROM THE HAWA SURVEY

by

Jamilah Ariffin*

## Introduction

Using some of the relevant findings from the HAWA survey, this paper attempts to examine the impact of modern electronics technology on various aspects of the electronics industry's labour force, namely the life-style, well-being, behavioral orientations and culture of its women workers. The paper is divided into three sections.

Section One provides an overview of the development of the electronics industry and its technology. This is viewed within the context of the internationalization of production and labour through the establishment of off-shore assembly plants.

Section Two analyses in detail the impact of the technological requirements on the structure and characteristics of the industry's labour force. This is also viewed in terms of its direct impact on the well-being and life-style of the women workers, and its indirect impact on the behavioral orientations and culture of the women as mediated through the management control systems.

Section Three discusses the implications of rapid technological changes in the electronics industry over the last decade for women workers in Malaysia.

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## SECTION ONE: OVERVIEW OF THE ELECTRONICS INDUSTRY AND TECHNOLOGICAL DEVELOPMENTS[1]

### Sectors And Components Of The Electronics Industry

The electronics industry is a relatively new phenomenon with the bulk of technological development occurring since the Second World War. The industry comprises two major sectors and several sub-sectors (Figure I). A major component in one of these sub-sectors is semi-conductors. These include diodes, rectifiers and transistors used as discrete devices or within integrated circuit, often in combination with passive and other components. The integrated circuit combines up to thousands of components in a single silicon chip.

### The Manufacturing Process And Technological Requirements Of The Semi-conductor Industry

Studies carried out in the late 1970's on the manufacturing process of the electronics semi-conductor industry has described it (Hancock, 1980; Grossman, 1978). The production process is divided into two distinct areas, first, the high technology, capital-intensive production which includes development design engineering and testing. This part of the production system involves mask making and wafer fabrication. In this process scientists and engineers design complicated multi-layered circuit patterns for each semi-conductor device drawing giant versions. Each design is then photographically reduced until it is virtually invisible to the naked eye. Skilled assembly workers then fabricate the initial stages of the semi-conductor based on the microscope negatives. At the initial stage, they treat paper-thin pieces of pure silicon with a variety of chemicals to create electrically conductive and non-conductive areas. Other workers then photograph the circuit pattern, etching the pattern into the wafer with acids and solvents. These wafers are then baked. For this process, assemblers must insert special gases into the oven to alter the electrical characteristics of each device in specified ways. Every step in this production process is extremely exact and must be performed with great precision

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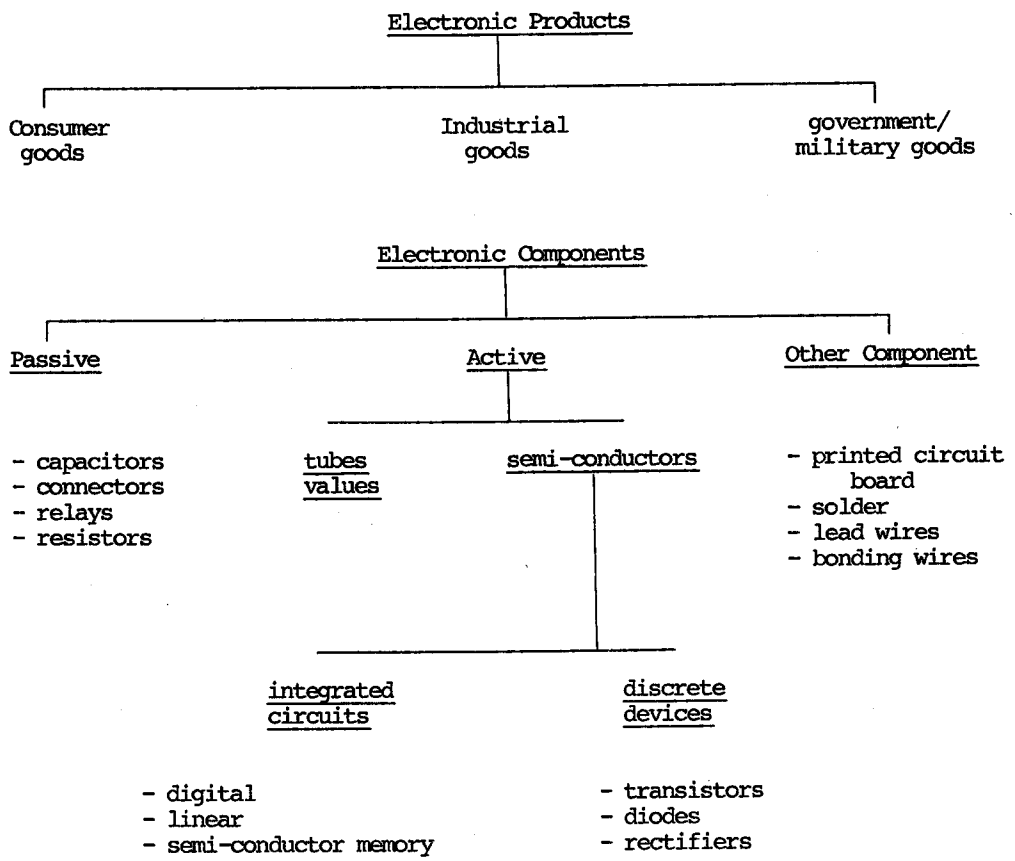
[1] This section draws heavily from the following sources:

Sciberras, E. Multinational electronics companies and national economic policies. Connecticut, JAI Press, 1977.

Grossman, R. Women's place in the integrated circuit. Pacific Research, 9, No. 5-6, 1978.

FIGURE I: MAJOR SECTORS OF THE ELECTRONICS INDUSTRY




Source:

HANCOCK, M.A. Electronics: the international industry. Honolulu, Hawaii, East-West Culture Learning Institute, 1980:1.

in a tightly controlled environment as any impurities introduced into the materials render the final product useless. Once the silicon wafer is fabricated, they are tested and then sorted into categories.

The second major area of production is the labour-intensive assembly and final testing process. In this process, the silicon wafer, about two to four inches in diameter are sliced into about 500 separate chips. Each individual chip is bonded with wire leads. In the early phase of the production technological process, this involves labour-intensive procedures where each assembler, peering through a microscope or highly-powered magnifying lens, attaches a variety of minuscule wires - each the size of a strand of human hair, on to the chip using fine soldering equipment. In the more advanced phase of the production technology, this process can be handled by sophisticated bonding machines. These phases in production technology especially in terms of its implications for women workers, will be discussed in further detail in Section Three. Each chip may be bonded with as many as 50 wires. The rest of the assembly process involves dipping the bonded chips into a protective coating of metal or ceramic, and then baked in ovens of 600$^{o}$F to 1000$^{o}$F to seal them. Once the manufacturing process is completed, the final stage involves testing each chip. Assembly workers must dip the chips into tanks of various liquids or chemicals and then test them with complicated and expensive equipments. Although the cost of these equipment in this stage of production in relation to labour costs is high, it does not have the same magnitude and technology-intensity as the first stage in the production process, that is, wafer fabrication.

Because of the nature of the production process, its physical demands on the workers, and the alternate capital and labour intensity of the different stages of manufacture, the semi-conductor industry requires two different types of labour force. The capital-intensive stage of production requires a large number of trained technicians, and the labour-intensive stage needs large numbers of assembly workers. In the second stage, workers must be malleable and easily disciplined to perform exacting work, dexterous and nimble-fingered. It is also beneficial for producers to have a labour force characterised by a high labour turnover and workers willing to work for only short periods. This is because experience has shown that semi-conductor assembly workers' productivity declines rapidly after a few years of scope work when their eyesight begins to deteriorate. The issue of training new unskilled workers for the assembly line

poses no problem since new entrants can learn their tasks and attain maximum productivity in a few weeks.

Aside from the nature of the production process and its requirements for a large unskilled labour force, the electronics industry has certain characteristics which compel electronics firms to seek cheaper and more expendable labour. This is a major motivation for the off-shore sourcing activities of electronics firms. Since the 1960's, several firms from the developed countries have relocated the assembly labour-intensive operations to Third World countries which can offer cheap and docile female labour. To understand the motivating reasons for this move, we must first delve into the structural characteristics of the semi-conductor electronics industry.

**Characteristics Of The Industry**

The semi-conductor industry has been characterised by intensive price and technology competition from early in its history. The fierce competition has led to rapid technical innovations and sharp decline in the prices of electronic products. The situation is reflected in the short life of electronic components and products. Rapid advance in semi-conductor technology over the past twenty years has been very evident. The industry which emerged in the early 1950's has passed through four distinct periods of growth and product development, firstly, in the early 1950's semi-conductor devices such as the transistor have been developed. Secondly, in the early 1960's various silicon integrated circuit (IC) often referred to as the 'chip' have emerged in the market. Integrated circuits are able to combine up to 100,000 transistors, resistors and other circuitry on a single chip of silicon which is about half the size of a fingernail. Thirdly, in the late 1960's large scale integrated circuits (LSI) have been developed. These circuits combine hundreds of silicon integrated circuit (CI) using metal oxide semi-conductors (MOS). Fourthly, in the mid-1970's the single chip micro-processors (MPU) which form the central processing unit of computers have emerged. Today, an integrated circuit is, therefore, a tiny silicon chip that can perform as many functions faster and cheaper than the original digital computer and every few years, most of the major manufacturers are capable of quadrupling the number of functions the last generation of chips can perform.

Due to the rapid periods of change and product development, the semi-conductor devices of different generations appear to have the introduction and growth period of about ten years before reaching their maturity. The comparable period for individual products would be even shorter, i.e. about five years. The shorter product life of electronic components and products is, therefore, a major aspect of the electronics industry. In this situation, research and development (R and D) activities is of vital importance to electronics companies since technologies and equipment are rapidly outmoded and replaced.

Other than the rapid rate of technological changes and development, the industry is also characterised by the rapidly growing demand for electronic products. For example, during the period 1963-1973, the growth rate for the US electronics market was 202%. The semi-conductor market expanded 331%, and within this sector the integrated circuit market has a growth rate of 5,406% (Scibberas, 1977). Similar rates of growth were recorded in the 1973-1978 period.

The rapid expansion in the electronic products' market is linked with the emergence and growth of several electronics firms. This is particularly evident in the semi-conductor industry where small but highly competitive firms have emerged. Competition among these firms is intense. If a new technology is not exploited quickly by one firm, another is bound to utilise it first. Firms that are slow to innovate or make mistakes in the direction of their research and development quickly find themselves shut out of the market by the more advanced (and often cheaper) products of their competitors. Rampant price competition on a national and international level (for example, between American and Japanese electronics firms) is speeding the drop in prices. For instance, active price and technology competition in the late 1970's has caused a drastic fall in the price of a single electronic function to about one hundred thousandth of its price in 1959 (Siegel, 1980).

In addition to the trend of price declines, the market for semi-conductors is also characterised by rapidly fluctuating demand. This volatility is most rapid since the 1974 recession. This situation affects producers' policy by recruiting and retrenching workers at short notice.

## The Global Production System And Factors Facilitating Off-shore Sourcing Activities

Off-shore production in electronics is a process in which companies, generally from the developed nations, particularly USA, Japan and those in Europe, establish subsidiaries in Third World Nations. These subsidiaries are assigned the labour-intensive stage of the production process. Components and products are assembled and then exported back to the home country or to other advanced capitalist markets. The capital intensive stage of the manufacturing process remains in the home country. In this manner a vertically integrated international division of production and labour has emerged.

Many factors have facilitated this transfer of labour-intensive assembly-line production to less developed countries. Three decisive factors taken together are responsible for this development. They are firstly, the presence of cheap labour in the developing countries; secondly, rising labour costs in the home countries of the multinational companies; and thirdly, technological advance in the production process and further development of transport and communication in the developed countries. We will now elaborate on the third factor.

Technological advance in the developed nations was clearly apparent after the Second World War. As mentioned earlier, the division and subdivision of the production process of the electronics industry is now so advanced that most of the fragmented operations can be carried out at different locations and with minimum levels of skills, which can be easily learnt within a short time. The development of a technology which frees industrial location and the control of production from the constraints of geographical distance has enabled electronics companies to shift labour-intensive operations to new sites where abundant cheap labour is available. Other technological advances which make off-shore sourcing possible include containerisation, telecommunication systems and electronic data processing systems.

The coincidence of these three factors (which are supplemented by other less important ones) has brought into existence a world market for labour together with a world market for production sites. The developing countries are competing among themselves to attract multi-national owned industries to their sites. In consonance with the demands of the electronics industry for easily

disciplined workers who can perform assembly-line tasks with dexterity, patience and nimbleness, electronics world market factories entail a distinctive labour force; the overwhelming majority of the workers in off-shore locations are young women (usually single) in the age group 16 to 25 years old.

A growing number of Third World countries are offering free trade zone facilities (such as water, electricity, suspension of customs duties and taxes, suspension of restriction on currency transfers) to foreign investors in an effort to develop export-oriented industries. For example in 1975, a total of 79 free trade zones were in operation in Third World Nations. In this regard, Malaysia has established 10 free trade zones by 1978 (Kreye, 1977:24). Malaysia has in fact become a favoured location for electronics firms. This is due to the stable political climate relative to other Asian countries, and the abundance of cheap and fairly educated female labour. Multinational electronics companies are also encouraged to base their assembly plants in Malaysia because of the willingness of the Malaysian government to cater to their needs (such as allowing night-shift work for women workers and discouraging the formation of electronics workers trade unions), and commitment to export-oriented industrialization since 1970.

## SECTION TWO: EXPORT-ORIENTED INDUSTRIALIZATION AND THE ELECTRONICS INDUSTRY IN MALAYSIA: ITS IMPACT ON WOMEN WORKERS

Promotion of labour-intensive export-oriented industrialization in Malaysia since 1970, has created unprecedented employment opportunities for women workers. In this regard, the electronics industry has become and remains the largest employer in the manufacturing sector with a total of 3,200 workers in 1970, 50,000 workers in 1977 and over 160,000 in 1981. Over 75% of the electronics industry workforce are women.

The electronics industry in Malaysia comprises four types of establishment - consumer products, components, industrial and communications equipment and others (Cheong, 1981). Of these, component establishments employ the largest number of workers and the largest proportion of female production operators. These companies which employ an average of 850 workers far exceed the averages of other types of electronics firms. Among the components establishment, the American-owned firms were the largest, their average of 1,240 workers per firm was two and a half times the average for all components firms in Malaysia. More

than 90% of the production assembly-line workers employed in component firms are females, most of them Malays from the rural areas. In terms of ownership, other than the American companies, the Japanese multinational companies employ the second largest number of women workers. The third group in this category is the European-owned electronics firms.

Given this situation where a sizeable proportion of Malaysian women workers are employed by the multinationals-owned electronics industry, and the majority of its workforce are women, it is important to study the implications of this development. It is pertinent to analyse the effects of the electronics industry and its technology on the women workers, particularly in terms of their well-being, life-style, behavioral orientations and culture. These issues form the focus of our deliberation in the following sub-sections. It is also important to note at the outset that although a few studies (locally and abroad) have addressed themselves to some of these issues, we will in this paper, concentrate on the findings of the HAWA Survey One (Grossman, 1978; Lim, 1978; Arrigo, 1980; Tse, 1981; Jamilah Ariffin, 1982). This survey was conducted in 1980 on factory women in export-oriented industries in the Kuala Lumpur area.[1] For the purpose of this paper we will refer to only some selected findings from the study on 774 female electronics workers.

## Impact And Implications: Some Selected Findings From The HAWA Survey I

The socio-economic characteristics of the HAWA survey respondents show that they are fairly representative of firstly, women workers in the electronics industry's workforce throughout the Third World; and secondly, women's labour force participation pattern in the export-oriented industries in Malaysia. We will elaborate on each of these aspects in turn.

**Socio-Economic Characteristics:** As is common among women workers in the off-shore sourcing electronics companies throughout the world, the majority of the HAWA respondents are young (87% are in the age group 16 to 25 years) and single. They are also mainly of rural origin. Many of them have migrated to the urban-industrial centres from a background of poverty and limited employment

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1 This survey forms the first portion of the HAWA nation-wide study on factory women in export-oriented industries.

opportunities. The majority of the respondents are fresh from school. For several of them, employment in the electronics industry signifies their initial encounter with the formal wage sector and migration from familiar village surroundings.

The characteristics of being young, single, relatively educated and Malay is largely determined by the employment preferences of the electronics industry. Electronics firms prefer to employ young unmarried women in the age-group 16 to 25 because they are believed to be docile, amenable to discipline and unlikely to burden the firm with maternity benefits. As most of the workers lack previous wage experience in the formal sector, the cost of their labour is low and their awareness of workers' rights is limited. Formal education is also emphasised in the recruitment of female assembly-line workers since basic literacy and ability to understand simple arithmetic calculations are required in unskilled electronics work. Educational attainment is also viewed as an indication of discipline and ability to withstand long hours of routine assembly work. The HAWA study shows that applicants whose educational qualifications exceed the requirements set by the firms are usually rejected because it is believed that they would become restless and seek job-opportunities elsewhere. In this regard, firms prefer to employ female workers with lower-secondary educational attainment. Fifty-eight percent of the HAWA respondents are Lower Certificate Education (LCE) holders or the Malay equivalent Sijil Rendah Pelajaran (SRP) certificate holders. Twenty percent have received Form Five education. Less than 1% have had no formal education. Electronics firms also emphasise recruitment of Malay females so as to comply with the New Economic Policy of the Malaysian government. Some studies have also asserted that the underlying reason for this preference is that these Malay girls are more docile and malleable to strict discipline than urbanised non-Malay girls (Lim, 1978). Additionally, non-Malay women are not attracted to factory work. In line with this reasoning, 98% of the HAWA respondents are Malay females of rural origin.

**Labour Force Characteristics:** Most of the HAWA responents are employed as unskilled production operators in American-owned firms. This characteristic is representative of the overall employment pattern for the majority of women in the electronics industry in Malaysia. **An important implication of this feature is that the women workers are particularly vulnerable to economic fluctuations in the United States' market for electronic products.** This is because as explained in Section One, the electronics industry has a rapidly fluctuating

demand pattern and retrenchment of workers at short notice is a common strategy adopted. Frequent shifts in technology, costs and cyclical fluctuations in the international industry also affects recruitment policies, and women workers face a precarious position and temporary work status.

Women workers in the electronics industry are concentrated in unskilled jobs with little opportunity for upward mobility and technical training. Among the HAWA respondents, these features are obvious. The majority (more than 75%) are employed as unskilled production operators and less than 1% hold technical or supervisory positions. As is common in the electronics industry, the managerial, technical, and supervisory positions are held by men. The HAWA study shows that educational qualification is not the criteria for the upward mobility of this small group of women. Rather, it is based on management's individual assessment of them. Generally, management is biased against promoting women to supervisory positions because they feel that men make better supervisors. Women workers in the electronics industry in Malaysia are also not encouraged by management to attain higher educational and technical training.[1] Given these views of management about women workers, it is reasonable to conclude that for the majority of female electronics workers, theirs is a dead-end job.

Additionally, their work participation in the assembly-line scope work is essentially short-term. This is because as discussed earlier in Section One, the technological requirements of the industry favour female labour with rapid labour turnover characteristics. It is also believed by management that the productivity of women workers will decline significantly after marriage and motherhood because of conflicting role-demands. As such it is profitable for firms to obtain a fresh crop of young single females every few years for assembly-line work. Firms select applicants on the basis of good health, perfect eyesight and the ability to pass tests of manual dexterity and spatial visualisation. These new entrants can also be easily trained in a short period of time. For example, the majority of the HAWA respondents cited no major adjustment difficulties in learning new tasks when they were accepted for

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1 Unlike the case for Korea and Taiwan, the electronics firms in Malaysia do not provide time off during work-hours for workers to pursue further education.

assembly-line jobs. About 33% of them were able to learn the skills required for the job within two weeks while the rest were able to do so after one month.

**Direct Impact Of The Production System**

In this part we will discuss the effects arising from firstly the nature of the job performed by the women workers and secondly the rotating shift work system and night shift.

**Nature Of Assembly-line Jobs:** As mentioned earlier on, the majority of the HAWA respondents are employed as production operators. About 75% of the respondents in this category are involved in scope work. This means that for 8 hours a day these women have to peer through the microscope in their assigned task of bonding the chips. On the average they are given a minimum work quota of 800 chips per day. Looking through the microscope and having to attach several wires, each as thin as a strand of hair, easily cause dizziness and backache. These are in fact common ailments reported by the respondents.

According to some studies on electronics workers, those who do scope work for more than five years develop eye defects (Grossman, 1978). In the case of the HAWA respondents, since most of them are recent entrants in the industry's workforce and have not yet served five years, the predicted ill-effects of scope work are not obvious.

About 15% of the HAWA respondents employed as production operators are testers. They deal with caustic chemicals in the 'tin-dip' section of the electronics plant. These caustic chemicals, all toxic and many suspected of being cancer-causing, exude fumes which are dangerous. They include TCE, Xylene, and MEX, all particularly dangerous acids and solvents. A United States study found the electronics industry to be the third most dangerous industry in terms of workers' exposure to harmful chemicals during the production process (Hancock, 1980). It is estimated by such studies that it will be 10 to 15 years before the possible carcinogenic effects of these chemicals begin to show up in the women who work with them now. As in the case of the scope workers, the effects on these HAWA respondents are not evident since they are recent employees in the industry.

The high and constantly increasing pace of production increases the possibility of accidents. This is particularly so when workers must handle acids and other abrasive substances quickly. A possibility of a high rate of accidents resulting in skin burns, rashes and loss of limbs has been predicted by other studies (Hancock, 1980). However, the HAWA Survey One shows that generally no serious accidents have ever occurred to any respondent.

The most obvious effects of the production process as shown by the survey are mainly feelings of boredom and fatigue among the women. As the jobs they are performing are basically tedious and monotonous, more than half of them complained that it is boring. The main reason cited by them for this feeling of boredom is that their job is simple and repetitive.

**Rotating Shift Work System And Night Shift:** The larger electronics firms in Malaysia generally operate on the basis of three rotating shifts: morning shift 7.30 a.m. to 3.30 p.m.; evening shift 3.30 p.m. to 11.30 p.m.; and night shift 11.30 p.m. to 7.30 a.m. Some of the smaller firms run only two shifts; morning and evening. Over 80% of the HAWA respondents are affected by the three-shift system. Rotating shifts provide a means for electronics firms to utilise their machinery at maximum capacity. Rotating shifts also mean that the production system is operating continuously 24 hours a day, and this ensures maximum productivity especially needed during the periods of peak demand. Studies have shown that the majority of women workers in the electronics industry disliked shift work particularly the night shift (Lim, 1978). This dislike for night shift seemed to prevail among the HAWA respondents because more than half preferred the morning shift, 29% the evening shift, while only 15% preferred the night shift. The research findings also show that some women workers are willing to forgo the higher starting wage and shift allowances offered by electronics firms as compensation for rotating shift, and instead would prefer to work in factories which do not impose shift-work.

Some studies have shown that shift work tends to disrupt the performance of family activities, extra-curricular social activities and time-oriented body functions such as sleeping, eating and elimination (Mott et al., 1965). Such studies have also shown that shift work results in poor health among workers. With reference to the HAWA survey data, while the majority of the respondents report that they do not suffer from insomnia, almost half of them complain of lethargy. About 25% complain of frequent headaches; 52% mention that they are

bothered by this ailment occasionally. Fifty percent of them are sometimes affected by fever usually after doing night shift work. On the whole, if the number of medical treatments during a three month period is taken as a rough indication of general health, it appears that the majority of the HAWA respondents do not have major medical complaints, but it must be borne in mind that these workers are recent participants in the manufacturing sector, and as such have not experienced the effects of shift work for over a prolonged period of time (five to ten years).

The rotating shift work system also has some effect on the life-style of the female workers. Because of night shift work, the HAWA respondents prefer to live near the factory. Thirty-six percent of them live within the vicinity, and 25% reside within a distance of 1 to 3 miles. Due to rotating shifts, they take turns in utilising their bed-spaces and cooking facilities at their crowded places of residence. Several of the HAWA respondents have at least one meal at the factory's canteen because of rotating shift time schedule.

**Indirect Impact Of The Technological Requirements**

**Centralised Control Over Workers' Behavioral Orientation:** Management in the electronics industry use highly refined techniques to retain control over workers and to induce them to conform to centrally determined standards. This is because the operations of a global assembly line is a complex process involving the need for sophisticated management coordination. In the semi-conductor industry this is a problematic issue due to rapid swings in demand. The key to coordination is centralised control. The complexity of the global assembly process is perhaps one of the main reasons for the anti-union stance taken by producers because control of the workers of the circumstances of their labour is directly contradictory to the needs of a global assembly system. The HAWA survey findings confirm the general trend of the non-existence of trade union membership among electronics factory women workers.

There are several methods, direct and indirect, utilised by the management of electronics companies to maintain control over their workers. A direct means is to discourage a sense of solidarity by keeping workers separate, alienated from each other and ignorant of common problems and issues. Strict regulations within the plant are often effective to control interaction and communication.

Rotating shift work system is another method of discouraging constant contact and solidarity among all the workers.

Because semi-conductor work is so exacting and requires discipline over minute physical activity, management has to impose strict supervision over the assembly-line workers. In this aspect indirect methods built around traditional sources of male authority are utilised because they are already legitimised and accepted by the women from a traditional background. Norms of traditional public behaviour require women to exhibit deference and obedience to male supervisors. Additionally, early socialization patterns in traditional communities have legitimised women's acceptance of tedious, monotonous tasks with forbearance and patience. In this regard, traditional expectations of female behaviour, are transplanted into the context of assembly-line work.

Management also strives to instill among workers a behavioral orientation of individualistic competitiveness. The underlying aim is to derive maximum productivity from the workers. Incentives and bonuses are frequently given on a competitive basis to individual workers and groups. Workers are exhorted to demonstrate their abilities and to out produce each other or other factories. Competition between workers in general also obstructs the development of solidarity and cooperation among workers. Women are also encouraged to compete on the basis of their feminine attractiveness as exemplified by the various beauty contests organised for workers by the electronics companies in the 1970's.

One other strategy used by management to ensure workers' commitment to their jobs and to hinder their realization about their precarious position in the industry is through fostering a sense of pride and loyalty to the company. This is done through providing them a better work environment (piped music, air-conditioning etc.) and a wider range of facilities (clean subsidised canteen food, subsidised excursion-trips, sporting activities, annual dinners etc.) than the other non-electronics companies. Workers are also introduced to forms of multinational company culture in the way of dressing, beauty-grooming, cooking and dance lessons. In the case of the HAWA respondents, since most of them are employed in American-owned firms they are introduced to westernised American culture (blue jeans and T-shirts, Western-style dancing and modern make-up classes). The HAWA findings show that more than half of the respondents had 9 basic amenities and provisions, namely canteen, clinic, medical facilities,

telephone, sports, locker, prayer room, uniforms and hand gloves. More than 75% of them enjoyed modern recreational activities such as dancing classes, picnics and excursions, annual dinners, sports, beauty contests and fashion shows.

**Cultural Effects:** The social and cultural environment of the factory is often segregated from the culture of the surrounding community and the home communities of the women workers. Being single and young, and as rural-urban migrants, the women become dependent on the factory for their social life and alienated from the surrounding community. Their sense of identity with the multinational culture and superiority to women in other industries increase their cultural isolation. Concurrently, the surrounding community regards women workers in the electronics companies with distaste and suspicion. The women's way of dressing and westernised behaviour is perceived as an indication of loose morals. Their participation in night shift work is often misconstrued as tendencies contradictory to traditional norms about seclusion and limited freedom for women. The demanding nature of assembly-line work and rotating shift system inhibits women workers' participation in community activities. The HAWA findings confirm this general pattern of lack of participation by factory women in non-factory activities. This situation further deepens the gulf of communiction and interaction between women workers and the surrounding community.

In conclusion, it can be said that the technological requirements of the electronics industry mediated through the management control strategies for women workers have an impact on changing the behavioural orientations and cultural norms of the women. These changes are made more obvious by the fact that the majority of them are Malay females from traditional rural backgrounds with established strict cultural standards of dressing and gender interaction.

## SECTION THREE: THE IMPLICATIONS OF TECHNOLOGICAL CHANGES IN THE ELECTRONICS INDUSTRY FOR WOMEN WORKERS

There has been rapid technological change in the electronics industry in this decade (1973-1983). Within the semi-conductor industry, the rapid pace of progress in making the micro-chips bigger, perform faster and cost cheaper, is especially evident. The technological development in this sphere has passed through four major phases. In the first phase, a major portion of the assembly-line production process involves manual tasks. These tasks have been described

in the earlier sections of this paper. Towards the end of the 1970's these tasks were slowly replaced by mechanical operations and then by capital-intensive automated devices. Nowadays electronics firms in Malaysia are introducing optics-mechanical and computer-assist technology in their production process.

The transformation of the assembly-line production system does not, however, mean that the production process is now technologically and capital intensive. When compared with the first stage of wafer-fabrication, this stage of production is still labour-intensive. The R and D and skilled unit-production part of the production process remain located in the home country of the multinational electronics companies. The only major change in the production structure in the off-shore assembly plants located in Malaysia, is that more automated machines are brought in to assist the assembly-line women workers. This change has been influenced by the interplay of two major factors; firstly, rapid progress in electronics technology which is motivated by fierce price competition and increasing demand, and secondly, increasing labour shortage. Given the current situation in Malaysia where firms are experiencing difficulties in obtaining cheap female labour for assembly-line work, the introduction of labour-saving automated machines into the plants is timely. In the present context, with the need for electronics firms to invest in expensive machines, the ratio of labour costs to total costs of production is declining steadily. Non-labour costs (such as costs on overheads, raw materials, power and electricity) now form a major proportion of total costs.

What are the major implications of this shift from labour-intensive technology to automated technology for women workers? We can analyse this issue in terms of two spheres; firstly, for women working in the industry, and secondly, in terms of employment opportunities for women in general.

In the first case, we can discuss the implications with reference to two aspects; firstly, the position of women workers in the industry, and secondly, their work conditions. With reference to women's position in the industry, we can deduce that with automation, several women workers in the assembly-line would be displaced and, therefore, retrenched. However, my preliminary investigation into this aspect reveals that several firms in Malaysia tend to retain their workers despite the shift to automation-technology. This is because there is a rapidly growing demand in the world market for their

products. Firms have to increase their production. They install more machines and mobilise their existing female assembly-line workers to mind these machines. Additionally, it must also be noted that despite automation, some parts of the production system still require manual tasks. It can be concluded that in the present context of increasing world demand for electronic products and increasing labour shortage for assembly-line work, electronics firms prefer to retain rather than retrench their female workers.

As regards work conditions of women workers in automated assembly line system, this is an issue which is worthy of detailed research. However, the problem of obtaining information (which is aggravated by the reluctance of most electronics firms to cooperate with academic researchers and to allow access to their factories) inhibits us from making definite conclusions on this issue. Based on my cursory analysis of the situation, it looks as though women's work conditions have in fact improved. With automation, their new task is to mind the machines rather than to perform tedious and tiring manual tasks. Contrary to Braverman's (1974) thesis[1], 'deskilling' seems to be beneficial for women assembly line workers in the electronics industry. For example, they are now spared from boring, tiresome scope-work which entails ailments like backache, dizziness and boredom. Although they are now dominated by the speed of the machines, they are no longer tied to one instrument on the factory bench, and have more room for movement. With the shift to higher technology production system, the electronics firms seem to provide better protection for women workers assigned to handle chemicals. On the whole, however, since this is a recent development which merits further research, we cannot provide final conclusions. This is especially so in relation to the management control system over women workers. At this juncture we do not know whether these systems have changed with the shift in production pattern and if so, whether these changes are beneficial for women workers.

With reference to the second sphere of employment opportunities for women, it is evident that with automation - technology in the assembly-line production process, the ratio of women to men workers in the electronics factory's

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1 Braverman asserts that deskilling leads to the degradation of manual skills and this is to the disadvantage of workers. For details see Braverman (1974), pp. 251-252.

workforce has declined.[1] This is because with the shift to higher technology and capital-intensive production system, more technicians rather than unskilled assembly-line workers are required. Even if we overlook the fact that several firms prefer to employ men for supervisory and technical positions, there are definitely more qualified male than female technicians in the Malaysian labour market for skilled positions in the electronics industry. As such, most of the new positions created in capital intensive, high technology electronics firms are occupied by men. It can, therefore, be concluded that unless there are significant changes to the present situation such as an increase of qualified, technically-skilled female job-seekers, no sexual bias in electronics industry's hiring policies, an expansion of support and ancillary industries to broaden the base of electronics industry in Malaysia, the shift to higher technology production process has reduced the employment opportunities for women's participation in the electronics industry.

**Summary And Conclusion**

The main conclusions in this paper can be summarised as follows:

First, the technology of the electronics industry is changing rapidly. This is due to rapid progress in technological knowledge, changing demand for electronic products and stiff competition among electronics firms. Because of the rapid rate of product development and obsolescence, there is need for the industry to retain some parts of the labour-intensive production process.

Second, labour-intensive tasks in the industry are usually performed by women because of their gender attributes. In several of the off-shore sourcing locations, women workers who are young, single, relatively educated and from a rural origin form the majority of the industry's labour force. This characteristic of the assembly-line labour force is pre-determined by the needs of the production process.

Third, women's participation in the labour intensive portion of the production system in the electronics industry is essentially short-term. This

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[1] As personally communicated to the author by Dr. Linda Lim, this is definitely the case for high-technology electronics firms in Singapore. Dr. Linda Lim's constructive comments and ideas on this matter and related aspects are gratefully acknowledged.

is because the nature of the production process requires a fresh supply of assembly-line workers every few years. Additionally, maximum productivity and output can also be obtained from new workers after a short training period.

Fourth, while being employed in the factories, women workers are affected by the technology of the industry directly and indirectly. The direct impact can be gauged in terms of their physical ailments, life-style and living arrangements. Indirectly, the technological requirements, mediated through the management control systems are affecting the women workers' behavioral and cultural orientations. The changes in their behaviour and cultural norms in the direction of "multinational-company culture" and "Westernization" serve to alienate them from the surrounding and home communities.

Lastly, rapid technological changes are occurring in the electronics firms in Malaysia as reflected by the shift from labour-intensive assembly production to automated technology. The changes affect women workers in considerable ways. For women workers retained in the industry, they seem to experience an improvement in their work-conditions. However, for women in general, the change in the technological structure has led to a reduction in employment opportunities, particularly for unskilled women workers.

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# AN EPIDEMIOLOGIC SURVEY ON THE HEALTH STATUS OF 100 FEMALE FACTORY WORKERS

by

Rokiah Ismail*

## Introduction

With industrialisation, urban development and the process of seeking jobs, there is a substantial migration of the working population from the rural areas to the cities. A majority of them previously being farmers and leading a rather less hectic country life, now on migration to the cities, have to change their life style and possibly their values to try to adapt to city life. As such, problems both physical and psychological and possibly those socioeconomic in nature may be encountered.

The aim of this survey was to look at the general health status of the Malay female factory workers. In an attempt to look at both the social and psychological adaptation to a totally different way of life, a survey on a sample of 100 Malay female factory workers from the age group 17-38 years was undertaken in August 1982.

## Material And Methods

To facilitate ease of getting the participants, 2 squatter areas in Kuala Lumpur were selected for this survey - Sungei Way and Kampong Kerinci. The youth leaders of both areas were briefed as to the aims of the study and their help requested to get the participants.

Each morning a batch of 10 girls was briefed before transporting them to the University Hospital for the health survey. At the hospital each of the girls were separately interviewed on their socioeconomic background. Then each one of them was sent in to the examination room. To avoid problems, only female doctors participated in this project.

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The protocol was divided into 4 parts :

(i) symptomatology;
(ii) family history;
(iii) physical examination; and
(iv) investigations.

Each of the participants were asked questions on the various symptoms listed in the protocol (Table I). A detailed family history was also taken. The participants' past medical history, particularly pertaining to immunisations during their childhood period was also included.

A full physical examination, including height and weight and blood pressure recordings was carried out routinely on all the participants (Table II).

Certain relevant specific investigations were done. As a routine, blood hemoglobin to look for anaemia, urine tests for screening of diabetes and kidney disease, and stool examination to look for worm infestations were done.

Because tuberculosis of the lungs is still prevalent in this country, chest x-rays were done routinely for all the participants who have not had chest x-rays in the last three months before the survey (Table III).

**Results**

The majority of the girls (50%) had suffered from period pains (dysmenorrhoea) at some time of their reproductive life. 33.3% of the participants had a history of headache. 5.1% had epigastric pain (Table IV). Table V shows that child health care with particular reference to immunisations was fairly satisfactory. The survey showed that 97% of the girls had their BCG vaccinations during their childhood; 90.9% had small pox vaccination; 38.4% had polio vaccines; 30.3% had DPT.

## TABLE I: SYMPTOMATOLOGY

| | |
|---|---|
| Present History | |
| Headache | Constipation |
| Visual Disturbance | Diarrhoea |
| Generalised malaise | Insomnia |
| Loss of appetite | Dysmenorrhoea |
| Loss of weight | Skin disease |
| Fever | Dysuria |
| Palpitations | Pruritus |
| Cough | Vaginal discharge |
| Epigastric pain | Problems at work |
| | Depression/Neurosis |
| Detailed Family History | |
| Past Medical History | |
| Immunisations | |

**TABLE II: SIGNS**

| SIGNS |
| --- |
| Height and weight |
| Blood pressure |
| Pulse rate |
| Cardiovascular system |
| Respiratory system |
| Abdominal Examination |
| Lymphnodes |
| Central Nervous system examination |
| Neck |

**TABLE III: INVESTIGATIONS**

| |
|---|
| Blood - Full Blood Count |
| - Urea/electrolytes |
| - Blood serology |
| Urinalysis |
| Stools |
| Chest x-ray |
| Electrocardiogram |
| Vaginal examination (where relevant) |

TABLE IV: SYMPTOMATOLOGY*

| Symptoms | Percentage (No. of cases) |
|---|---|
| Period pains (dysmenorrhoea) | 50 (50) |
| Headache | 33.3 (33) |
| Cough | 10.1 (10) |
| Itching | 9.1 (9) |
| Visual disturbance | 9.1 (9) |
| Skin disease | 7.1 (7) |
| Epigastric pain | 5.1 (5) |
| Lethargy | 3 (3) |
| Loss of appetite | 2 (2) |
| Loss of weight | 2 (2) |
| Painful urination | 2 (2) |
| Constipation | 1 (1) |
| Insomnia | 1 (1) |
| Fever | 1 (1) |
| Palpitations | 1 (1) |
| Problems at work | 27 (27) |
| Depression/Neurosis | 10.1 (10) |

Note:

* What the patient complains of

TABLE V: EVIDENCE OF CHILD HEALTH CARE

| Immunisations | Percentage of girls who were immunised |
|---|---|
| BCG | 97 |
| Smallpox | 90.9 |
| Polio | 38.4 |
| DPT (triple antigen) | 30.3 |

Table VI shows that nearly one-third of the girls had a family history of hypertension, however a family history of diabetes only occurs in 8.4%. From the inquiry into the family history, tuberculosis is still quite prevalent in the country - accounting for about 5.3% of the participants' family.

A family history of cancer is pretty low (2.1%) in our sample of 100 participants. The incidence of psychiatric illness in the family is also low (1.1%).

In our survey, we found that one girl resorted to taking tranquillisers to help her sleep after every night shift. Table VII shows that 27% of the participants had problems at work - this is mainly related to interpersonal relations with colleagues and supervisors. Depression and/or neurosis occur in 10.1% of cases. The more severe forms of mental illness were not noted in our survey.

In an attempt to identify psychosomatic problems among the female factory workers, we looked at the relationship between problems at work and headache, depression and neurosis and asthma. This is shown in Table VIII. Table IX shows a relationship between depression and/or neurosis with period pains and generalised malaise. We also cross tabulated the symptom of headache with visual disturbance and epigastric pain. This is shown in Table X.

Table XI shows the percentages of the participants taking either patent western medicine or traditional herbs for various ailments. We found that there is no significant difference in those taking both types of medicine. This accounts for about one third of the total number of girls surveyed.

**Physical Examination**

A full physical examination was done on all the 100 girls, and the positive findings are shown in Table XII. The mean height of the girls was 155.33 cm (range 140-163 cm), and the mean weight was 48.17 kg (range 39-61 kg). We found that the majority of the girls were healthy; 2 girls (2%) had thyroid swelling which was clinically noted to be benign; 3.1% had breast lumps - they were

TABLE VI: FAMILY HISTORY OF DISEASE

| Family history | Percentage |
|---|---|
| Hypertension | 29.5 |
| Allergies | 12.1 |
| Heart disease | 11.6 |
| Asthma | 9.5 |
| Diabetes | 8.4 |
| Tuberculosis | 5.3 |
| Cancer | 2.1 |
| Eczema | 1.1 |
| Psychiatric illness | 1.1 |

TABLE VII: PSYCHIATRIC HISTORY

| Psychiatric history | Percentage |
|---|---|
| Problems at work | 27 |
| Depression/Neurosis | 10.1 |
| Mental illness | 0 |
| Schizophrenia | 0 |
| History of attempted suicide | 0 |

TABLE VIII: PROBLEMS AT WORK VERSUS HEADACHE, DEPRESSION AND/OR NEUROSIS AND ASTHMA: PERCENTAGES IN SAMPLE

| | | Problems at work | | |
|---|---|---|---|---|
| | | Yes | No | Total Cases |
| Headache | Yes | 11.1 (11) | 22.2 (22) | 33 |
| | No | 16.2 (16) | 50.5 (50) | 66 |
| Depression and/or Neurosis | Yes | 5.0 (5) | 5.0 (5) | 10 |
| | No | 21.0 (21) | 68.7 (68) | 89 |
| Asthma | Yes | 6.3 (6) | 3.2 (3) | 9 |
| | No | 18.9 (18) | 71.6 (68) | 86 |

Note:

Statistics within brackets are frequencies.

**TABLE IX: DEPRESSION AND/OR NEUROSIS VERSUS PERIOD PAINS AND GENERALISED MALAISE: PERCENTAGES IN SAMPLE**

| | | Depression and/or Neurosis | | |
|---|---|---|---|---|
| | | Yes | No | Total Cases |
| Period pains | Yes | 6.1 (6) | 44.9 (44) | 50 |
| | No | 4.1 (4) | 44.9 (44) | 48 |
| Generalised malaise | Yes | 2 (2) | 1 (1) | 3 |
| | No | 8.2 (8) | 88.9 (87) | 95 |

Note:

Statistics within brackets are frequencies.

**TABLE X: HEADACHE VERSUS VISUAL DISTURBANCE & EPIGASTRIC PAIN: PERCENTAGES IN SAMPLE**

| | | Headache | | |
|---|---|---|---|---|
| | | Yes | No | Total Cases |
| Visual Disturbance | Yes | 18.2 (6) | 33.3 (3) | 9 |
| | No | 81.8 (27) | 70.0 (63) | 90 |
| Epigastric pain | Yes | 9.1 (3) | 40.0 (12) | 5 |
| | No | 90.9 (30) | 68.1 (64) | 94 |

Note:

Statistics within brackets are frequencies.

TABLE XI: PERCENTAGES OF GIRLS TAKING PATENT WESTERN MEDICINE VERSUS THOSE TAKING TRADITIONAL HERBAL MEDICINE

| Symptoms | Percentages (Frequencies) | |
|---|---|---|
| | Taking patent western medicine | Taking traditional herbal medicine |
| Headache | 11.5 (11) | 11.3 (11) |
| Visual disturbance | 4.2 (4) | 4.1 (4) |
| Epigastric pain | 1 (1) | 3.1 (3) |
| Pruritus | 3.1 (3) | 0 |
| Generalised malaise | 1 (1) | 1 (1) |
| Constipation | 0 | 1 (1) |
| Vaginal discharge | 13.7 (13) | 16.7 (16) |
| Total percentage taking self medication | 30.9 | 29.6 |

**TABLE XII: PHYSICAL EXAMINATION: FINDINGS**

| | | |
|---|---|---|
| Mean Height | = | 155.33 cm (range 140-163 cm) |
| Mean Weight | = | 48.17 kg (range 39-61 kg) |
| Thyroid swelling | = | 2% |
| Breast lump | = | 3.1% |
| Hypertension | = | 2% |

subsequently sent to various special clinics for further investigations. Two participants were noted to have high blood pressure. They were in the age group 31-40 years.

**Investigations**

Investigations showed that the mean hemoglobin concentration of the girls was 11.87 gm/100 ml (range 10 -15 gm%) which is within the normal range (Table XIII). It was also found that there was no relationship between the 3 girls with generalised malaise and anaemia - all of them had hemoglobin concentration of 12 gm% and above.

Out of the 63 girls who had chest x-rays done - only 1 case showed changes suggestive of pulmonary tuberculosis - she was further investigated. 64 blood serologies were done, out of which 2 showed positive results and both of them were treated.

**Conclusion**

In this preliminary report on the health survey of 100 female factory workers, who previously came from the rural areas and now live in the city, we found that a majority of them are healthy. However, studying the data obtained, a few questions come to our minds :

(i) What is the effect of urban migration with all its accompanying problems of overcrowding, lack of parental supervision, etc, on the work productivity of these girls?

(ii) Do the symptoms of headache, visual disturbance and problems at work, leave any effect on work productivity?

In this aspect, psychological, cultural and other social adjustments have to be looked into.

## TABLE XIII: INVESTIGATIONS

| | |
|---|---|
| **Blood** | |
| Mean hemoglobin | 11.87 gm% (range 10-15 gm%) |
| Serology positive | 3.1% (2 cases) |
| **Urine** | |
| Protein positive | 6% |
| Sugar | 4% |
| Casts | 10% |
| **Stools** | |
| Ova | 10.5% (2 cases) |
| Cysts | 15.8% (3 cases) |
| Trichuris | 21.1% (4 cases) |
| Abnormal Chest xray | 1.6% (1 case) |
| ECG - normal | |

With these questions in mind, an on-going indepth study in the effect of "social adjustments" of these factory workers and productivity have to be looked into.

**ACKNOWLEDGEMENT**

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# INDUSTRIALISATION AND THE SQUATTER PHENOMENON IN THE KELANG VALLEY: CASE STUDIES OF MALAY WOMEN FACTORY WORKERS' LIVING CONDITIONS

by

Susan Lee*

## Introduction

This study is concerned with the growth of the squatter problem in the Kelang Valley, an area which includes Kuala Lumpur, Petaling Jaya, Shah Alam and Kelang, as a concomitant of industrial development. The emphasis of this study is on the involvement of migrant Malay female workers in the occupation of illegally built dwellings. The majority of the women workers are employed by multinational electronics firms which attempt to provide accommodation for only a limited number of the migrant workers. Left to fend for themselves, the workers usually solve their housing problem by crowding into squatter huts occupied by relatives or friends who migrated earlier to the Kelang Valley.

The relationship between factory employment and squatting raises two crucial issues to be examined in this study:

(i) To what extent do the earlier waves of migrants settled in squatter areas, subsidize the accommodation needs of female factory workers?

(ii) Under circumstances which compel the overwhelming majority of female factory workers to become squatters, what are their prospects for raising their living standards and quality of life?

The scope of the present study includes both survey and case study data. Five detailed case studies of women factory workers residing in squatter settlements have been selected from a sample of 100 in-depth interviews, to illuminate the survey findings with respect to the issues that have been set forth above. The in-depth interviews were conducted during 1980-81 for the purpose of obtaining detailed data on the actual living conditions of women

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factory workers. This research was intended to supplement the broader, more general data obtained from HAWA Survey I, an extensive study of 1,066 Malay women workers, carried out in 1980. The in-depth interviews represent a non-random sample of semi-structured interviews based on open-ended questions designed to elicit more specific information than that allowed by the tightly structured, pre-coded questionnaire employed in HAWA Survey I. The semi-structured nature of the interviews enabled the respondents to spontaneously offer information on important topics and issues which could not be included on the Survey I questionnaire. The in-depth interview sample, from which the case studies to be presented in this study are drawn, and HAWA Survey I both cover the same field sites. The field sites include squatter settlements in Ampang, the Jalan Kelang Lama, and Federal Highway areas of Petaling Jaya and Kuala Lumpur, Shah Alam and Kelang, and were selected in accordance with information obtained from personnel managers of multinational firms in the Free Trade Zones, regarding the location of the workers' homes. Residents in these areas assisted in directing the researchers to the workers' huts.

This study is divided into five sections. The first section describes the background and scope of the squatter problem in the Kelang Valley. The housing alternatives available to female factory workers are examined in the second section. The third through fifth sections present case studies examining the process of becoming a squatter, the quality of life in squatter settlements and the values and aspirations of the migrant female workers. The policy implications of this study are discussed in the conclusion.

**Industrialisation, Migration And Squatting In The Kelang Valley**

Rapid industrialisation and expansion of job opportunities in factories throughout the Kelang Valley have stimulated large scale rural-urban migration for more than a decade. These developments have unfortunately not been accompanied by systematic provision of housing and transportation for factory workers. Malay female factory workers encounter major difficulties with respect to decent housing and reliable public transportation. These workers, along with other rural migrants attracted to factory jobs in the Kelang Valley, contribute to the proliferation of squatter settlements in the vicinity of Free Trade Zones and industrial estates, and to severe overcrowding in other available low cost housing.

## SQUATTER PHENOMENON

Few manufacturing firms in Malaysia take more than token responsibility for providing migrant workers with accommodation, unlike factories in such countries as Korea and Taiwan. Multinational firms are not required as a condition of operation in Malaysia, to house their workforce. The absence of hostel facilities at many electronics factories, compels female migrant workers to rely on their own friendship and kinship networks to find accommodation. The housing obtained through the workers' personal networks is usually located in squatter settlements.

It will be useful to digress briefly to examine the squatter problem in its historical context. Squatting, that is occupying land without possession of a legal title, developed as a response to economic conditions during British Colonial rule (Friel-Simon and Khoo, 1976). Until the outbreak of World War II, the number of urban squatters was relatively low. The Japanese advance through Asia threatened imports of required food supplies, which were not produced in sufficient quantities in Malaya. The British then encouraged intensive food production throughout the country, even by squatters in urban areas such as Kuala Lumpur. The deterioration of the urban economy and food shortages resulting from the Japanese occupation, gave rise to large numbers of squatters.

Squatters increased rapidly after the British returned to Malaya in 1945. British policy towards squatters oscillated between tacit encouragement and eviction (Friel-Simon and Khoo, 1976). At various times squatters were alternately viewed as obstructions to urban development, threats to internal security or necessary food producers.

It is important to note that the squatter situation during the colonial period involved mainly working class Chinese. Since Merdeka, however, urban and rural squatters increasingly came to comprise Malays. This trend became particularly evident during the late 1960s. The adoption of the New Economic Policy in the aftermath of the 13 May 1969 crisis which aimed at promoting Malay participation in commerce and industry, accelerated the influx of Malay squatters into Kuala Lumpur and elsewhere in the Kelang Valley.

The new urban Malay working class, similar to its Chinese and Indian counterparts, has resorted to squatting as a solution to the problem of lack of low cost housing. Most squatter areas are highly homogenous in ethnic composition. These areas are often exclusively Malay, Chinese or Indian. Only

10% of Kuala Lumpur's squatters live in ethnically mixed areas (Wehbring, 1976). Predominantly Chinese squatter areas contain 45% of the Federal Territory's squatter population, while the Malay settlements account for 41%, which far exceeds the proportion of Malays, 29%, residing in the city (Wehbring, 1976). Even in mixed squatter areas, ethnic exclusiveness is observed. The various ethnic communities tend to occupy distinct sections of the squatter settlements, usually grouping their huts around a symbol of ethnic identity such as a surau, Hindu temple or a Chinese school. This type of internal ethnic segregation within an ostensibly mixed area is exemplified by the Petaling Tin squatter settlement, located off Jalan Kelang Lama in Petaling Jaya.

According to information obtained from personnel managers of electronics firms located in the Sungai Way Free Trade Zone, about 80% of the women workers employed in the zone reside in squatter areas along the Federal Highway and Jalan Kelang Lama. It is likely that a similar proportion of women workers employed in the Ulu Kelang Free Trade Zone are also living in the numerous, densely populated squatter areas that surround the zone. These estimates are plausible in view of a 1981 study conducted by the National Institute of Public Administration (INTAN) together with a United Nations Development Programme Consultant, which reported that "the number of squatters in Kuala Lumpur has reached a crisis level of 25% of the city's population" (Natarajan, 1981). An earlier United Nations Consultant who carried out research on squatters in the Federal Territory in 1976 for the Urban Development Authority, found that one-fifth of the population could be classified as squatters (Wehbring, 1976). Within the period of five years between 1976 and 1981 studies of Kuala Lumpur, the squatter situation had become even more urgent.

In view of the situation as described above, this study will emphasize that migrant female factory workers' accommodation problems are for the most part, inseparable from the squatter phenomenon. Efforts on the part of the State and Federal governments to eradicate squatting have not proved equal to the task. The urban squatter population, a large proportion of which includes factory workers, continues to increase rapidly.[1] The next section will examine the various housing alternatives available and the reasons for the relative attractiveness of squatting.

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[1] A survey carried out in Shah Alam by the Socio-economic Research and General Planning Unit found that two-thirds of the workers employed on the new industrial estates reside in squatter areas (Undated report).

**Housing Alternatives Available To Female Workers**

A limited supply of non-squatter, low cost housing located near to the Free Trade Zones and industrial estates exists. The Selangor State Development Corporation (PKNS) has constructed terrace houses and blocks of flats in these areas which, according to the personnel managers in the Free Trade Zones, meet the accommodation needs of an estimated 20% of the female factory workers. The workers can gain access to PKNS housing through any of the following three channels:

(i) factory managements allocated flats by PKNS;
(ii) relatives living in PKNS housing; and
(iii) PKNS residents who rent out rooms.

The personnel managers of two large electronics firms in the Sungai Way Free Trade Zone explained that since PKNS allocates only a small number of flats to the factories, managements have decided to limit eligibility for flats to workers with at least one year of seniority. Thus factory managements do not attempt to meet the housing needs of newly arrived migrant workers, but rather have adopted the policy of utilizing the flats to reward senior workers, and to encourage a limited degree of worker commitment to the firm. The availability of PKNS flats to factories located in the Free Trade Zones does not contribute to solving the problem of initial accommodation for migrant workers. To alleviate this situation, some of the electronics factories in the Sungai Way Free Trade Zone rent hostels in nearby Sungai Way Village. However, the provision of hostel accommodation is the exception rather than the rule.

Migrant workers whose relatives reside in PKNS flats or terrace houses adjacent to the Ulu Kelang or Sungai Way Free Trade Zones, or Shah Alam Industrial Estate are among the fortunate minority with access to decent, low cost housing near to the factories. Electricity, piped water, and flush toilets are standard features of all PKNS housing units. Workers residing in PKNS housing generally do not complain of problems relating to security, sanitation, difficulties in obtaining water, and transportation to work. The female workers staying with relatives either receive free room and board or contribute a nominal amount of cash to the household. Their domestic labour contributions, however, are usually considerable. They spend most of their non-working hours

helping out in the house with cooking, laundry, cleaning and childcare, finding little time for recreation.

Despite the obvious advantages of living with relatives in PKNS housing, some female workers eventually choose to move out and share rented accommodations often in squatter settlements, with their friends in order to enjoy more leisure time and personal freedom. In-depth interviews and observations of female workers' living situations with their relatives revealed that they assume an exhausting double burden of domestic and factory labour. Under such conditions, participation in sports, cultural activities or continuing their education is inhibited. The girls' desire for freedom from the restrictions imposed by domestic duties is not surprising. It is not difficult to understand why some workers, seeking to maximize their leisure time, are willing to accept physically less comfortable accommodations with their friends in squatter areas, rather than to continue living with their relatives in PKNS housing.

Workers without relatives in PKNS housing can also gain access by renting rooms from PKNS residents. The findings of in-depth interviews with workers in PKNS flats indicate that exploitative practices among landlords are common. From one of the interviews, it was learned that the respondent and two other female factory workers rent a room from a family in a PKNS flat in Shah Alam and are charged more for the room than PKNS charges for an entire flat. The family charges M$105.00 per month for the room which they rent out to the girls, but pay only M$55.00 per month to PKNS for the entire flat.[1] PKNS housing located near to the Ulu Kelang and Sungai Way Free Trade Zones is in great demand among production operators who want to live within walking distance of work, and do not want to resort to squatter-type housing. Families living in PKNS housing are acutely aware of this situation and are eager to profit from it. The going-rate in 1980-81 for a room in a PKNS flat next to either of the two Free Trade Zones in the Kelang Valley, was over M$100.00 per month, an amount which represents approximately 50% of an average production operator's monthly earnings.

The excessive rents noted above are consistent with the Malaysian Center for Development Studies' (MCDS) findings in Penang. The MCDS survey of factory

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[1] All amounts of money refer to the Malaysian Ringgit

girls employed in the Bayan Lepas Free Trade Zone in Penang found rents in that area to be "very flexible to the disadvantage of the tenants" (MCDS, undated mimeo). A case in point concerns the sudden increases in rent that coincide with production operators receiving salary increments or bonuses from the factories. Most Bayan Lepas landlords, according to the MCDS study team, do not hesitate to take advantage of any financial gains made by the factory girls.

The housing shortage affecting migrant female workers in the Kelang Valley has encouraged other forms of the pursuit of profit among landlords. The construction of huts and longhouses resembling squatter housing on Malay reserve land for rent to factory workers has become a popular enterprise in some kampungs near to industrial estates. These zinc roofed, wooden structures on Malay reserve land without piped water, electricity, plumbing or drainage provide living conditions equivalent to squatter settlements. Sanitation facilities in this type of housing consist of bucket or pit latrines outside the house which are shared by two or more households. Flooding, stagnant pools of water breeding mosquitos and absence of rubbish disposal are characteristic of 'squatter like' housing on Malay reserve land. In 1980-81, landlords in Kampung Padang Jawa in Shah Alam demanded rents of M$35.00 for a one room unit of a longhouse, and M$40.00 - $60.00 for a detached one room hut. These rents are similar to rents in squatter areas. The housing units for factory workers constructed by Malay reserve landowners differ from bona fide squatter housing only in a formal, legal sense.

Another form of non-squatter living arrangements involves groups of 10-20 factory girls joining together to rent PKNS two and three room terrace houses. The going rent for this type of housing in 1980-81 was M$250.00 per month, and each girl's share ranged from M$15.00 - $25.00, depending on the size of the group. Rotating work shifts allow the girls to intensively utilize space by forming large co-residential groups within a small dwelling unit, since only some members of the group are home at the same time. Though only a small proportion of factory girls live in such groups, this life-style is highly visible and attracts much adverse attention from the surrounding community. Aside from public complaints of immoral behaviour on the part of female workers living with their colleagues in unsupervised settings of this type, such arrangements entail excessive overcrowding that cancels out the improved living conditions offered by PKNS housing.

As the cost of squatter huts is much lower, M$35.00 - $60.00 per month, the co-residential groups which share the huts are considerably smaller, usually two to six girls, and more space per person is available. The high cost of non-squatter housing promotes higher density occupation where female factory workers are concerned, resulting in deterioration of living conditions.

**Squatting As An Adaptive Strategy**

The individual decision to occupy squatter housing is influenced by rational economic calculation and by friendship and kinship networks. Non-squatter low cost housing, as noted above is in shorter supply, is more expensive and entails a greater degree of crowding than the alternative of squatter housing. Migrant workers' friends and relatives are more likely to be found residing in squatter settlements rather than in PKNS or other non-squatter housing. For this reason, seeking accommodation with friends or relatives often implies becoming a squatter.

The importance of social networks in finding housing and the effectiveness of squatting as a strategy of adaptation to urban life as a low income wage earner is examined in the following case.

Case 1: J. who is 18 years old and unmarried, was born and raised in Batu Pahat, Johore. She is the eldest child in a large, poor family. Her six younger siblings are still in school; J. is the only child in the family who is working. Although J.'s parents own a small amount of land, they depend on wage labour rather than agricultural production to maintain the family. J.'s mother has been working in a palm oil factory for the past year, while her father works as a labourer. Together, her parents earn a monthly income of M$260.00. J. completed Form Five and decided to migrate to Kuala Lumpur after hearing about the attractions of urban life from her friends who had already migrated. She obtained her present job as a production operator at Motorola in the Sungai Way Free Trade Zone through the recommendations of a friend from her Kampung. Despite her parents' misgivings, J. migrated to Kuala Lumpur with a friend. She initially found accommodation with her relatives living in Kpg. Jawa, Kelang. J. soon decided to shift from her relatives'

home to the squatter hut in Kpg. Melor, where she now lives, after quarrelling with her cousin's wife and, moreover, encountering transportation difficulties. Although Motorola provides subsidized bus service for the workers, J. found the bus fare high in relation to her income; M$20.50 was deducted monthly from her salary for the bus fare. The bus was crowded and J. usually had to stand up, which she disliked. J.'s decision to share a squatter hut with a friend in Kpg. Melor, a settlement on abandoned mining land off the Federal Highway, has enabled J. to reduce her living expenses enough to both remit money back to her parents and to accumulate personal savings. Although her income is very low, J. manages to send her parents M$50.00 every month as well as to save M$20.00 monthly in her postal savings account. J. has been employed for the past six months as a quality control worker in the wire bond section at Motorola and earns M$156.00 per month. Her monthly living expenses consist of the following: M$17.50 for her share of rent, M$50.00 for food, and M$19.50 for miscellaneous expenses. She has no transport expenses since she walks to work. The one room squatter hut which J. rents was obtained through a friend, who is staying in another squatter hut in Kpg. Melor. J. and a friend share the hut and divide the rent of M$35.00 per month. She and her friend also cook and share food together. J. cooks and eats two meals a day at home and purchases only snacks in the canteen at Motorola, spending 50 cents per day at the canteen. Through frugal living she is able to manage on her small salary. J. is dissatisfied with the lack of electricity and piped water in Kpg. Melor. Water is available only at a standpipe located far from the hut. She tolerates squatter conditions as a means of survival until she can find a better job.

This case shows the economic rationality of squatting for low income factory workers. The respondent earns less than M$200.00 per month, yet she is able to maintain herself and set aside 44% of her salary as remittances to her parents and personal savings. Squatting has proved to be an effective strategy for the respondent to avoid tensions with her relatives, solve transportation difficulties and moreover to manage on a small income.

In Case 2, the respondent who comes from an economically better-off family, lowers rather than improves her standard of living after migrating to the Kelang Valley. For this respondent, squatting is a means of accumulating sufficient cash to acquire consumer goods.

Case 2: N., a migrant from Tampin, Melaka, is 23 years old and newly married. She is the eldest of nine children and the daughter of a policeman. Her father's income exceeds M$400.00 monthly. N.'s parents own one-half acre of house land planted with fruit trees and their house is equipped with electricity, piped water, a T.V. set and radio. Employed as a production operator at Motorola for the past one year, N. presently earns M$200.00 per month on the average. Although N. does not consider her salary sufficient for her needs, she has not resorted to borrowing money as she reduced her living expenses by moving into a one room squatter hut occupied by her husband's brother and his family. Since N.'s husband is in the army, she is temporarily living with his brother in Kpg. Bakti at 8 3/4 mile, Jalan Kelang Lama a squatter settlement located within walking distance of the Sungai Way Free Trade Zone. N.'s brother-in-law who works as a driver at Kontena Nasional, does not charge her any rent. Previously N. stayed in a PKNS flat in Kpg. Kerinci. When N. lived in Kpg. Kerinci, she had to travel to work by bus and spent M$10.00 monthly on bus fare. She is now able to save on both bus fare and rent. N.'s monthly expenditures include M$60.00 for food and M$30.00 for her parents. She puts aside about one-half of her salary into her postal savings account. Once every two months N. buys clothing on which she spends about M$30.00. During the past year she has purchased a cabinet costing M$100.00, a wardrobe costing M$20.00 and a set of dishes costing over M$100.00. She paid cash for the cabinet and wardrobe. The set of dishes was obtained through a Kutu arrangement (rotating credit association) organized by one of her friends. N. manages her budget cautiously and is able to buy occasional luxuries. To live in reasonable comfort though, according to N., would require an income of somewhat more than M$300.00 per month. Despite shifting from a PKNS flat to a squatter hut, N. does not regard her present living conditions

as significantly worse. Her brother-in-law's well furnished squatter hut is equipped with a T.V. set, stereo, acquarium, floor lamp, cane furniture and electricity. The walls are decorated with woven handicrafts, paintings, posters of popular entertainers and Quranic verses. These household luxuries and attractive decorations making squatting more acceptable to N., who enjoyed a more comfortable standard of living in Melaka with her parents.

It can be seen in Case 2 that migration to Kuala Lumpur for factory employment makes possible cash savings, remittances to parents and acquisition of consumer goods. However, the attainment of these objectives entailed a lower standard of living than what the respondent had been accustomed to before migrating to Kuala Lumpur. The respondent initially lived in non-squatter low cost housing when she first came to Kuala Lumpur but later became a squatter when she moved in with her husband's relatives. Squatting has also enabled the respondent's brother-in-law to provide his family with consumer luxuries, despite being a low income wage earner.

The significance of kinship ties in migration, in obtaining factory employment and in becoming a squatter, as shown in Case 3, elucidates the social process underlying the growth of squatter settlements in the Kelang Valley.

Case 3: H., who is 18 years old and unmarried, recently migrated from Muar, Johore to Kpg. Kerinci in Kuala Lumpur. She is the fourth of eight children. Two of her elder sisters are working as electronics production operators in Kuala Lumpur. H.'s parents own no land. Her father earns a living as a taxi driver and her mother is a housewife. Her parents' house in Muar is supplied with electricity and piped water. H.'s parents also own a T.V. set, radio and cassette tape recorder. H., who completed Form Three, obtained a job as a production operator at General Instrument, an electronics firm located in the Sungai Way Free Trade Zone, recently through one of her elder sisters. She presently earns M$230.00 per month and spends money on necessities only, of which food is the major item. H. has been employed for only one month, and has not yet sent any money to her parents. However, she intends to send them M$50.00 per

month as well as to save money herself in a postal account. Her first month of expenses includes the following: M$40.00 for food, M$10.00 for busfare, M$50.00 for clothing, and M$16.00 for contribution to rent. H. is living with her two elder sisters in a one room squatter hut in Kpg. Kerinci that is partitioned with low dividers into cooking, sleeping and guest areas. Aside from a bed in the sleeping area, there is no other furniture in the hut. Mats are spread out for guests to sit on. The hut lacks electricity, piped water and plumbing. H. and her sisters together pay M$50.00 in rent. Each sister pays an equal share of the rent. H.'s sisters occupied the hut for two years. H. is dissatisfied with her present living conditions, as she enjoyed a higher standard of living in Muar at her parents' home. H.'s elder sisters, brother and aunt were already living in Kuala Lumpur before she migrated. The presence of her relatives in Kuala Lumpur was an important factor in her decision to migrate. One of her elder sisters accompanied her to Kuala Lumpur. H. first stayed with her aunt upon arrival at Kpg. Kerinci and then shifted in with her elder sisters who live nearby.

The three cases presented above typify the sample of in-depth interviews as a whole in that the respondents are migrant electronics workers who became squatters in the course of living with friends or relatives. As in the case studies above, the general trend among migrant female workers residing in squatter settlements is to rent huts built by earlier occupants of the settlement or to live with others who own or rent a hut. Rarely do unmarried female migrants build their own huts. Those who are married want to secure more permanent accommodation by purchasing or building their own hut. The unmarried female migrants, less committed to residence in any particular area, are not inclined towards investing in their own huts. Female migrants who rent huts from squatter landlords paid from M$35.00 - M$60.00 monthly in 1980-81 for a one room hut, without indoor toilet facilities, electricity or piped water.

The entrepreneurs renting huts to migrant factory workers are, in some cases, absentee landlords who began as squatters, invested in materials to build several huts in the area, and moved out after accumulating sufficient capital from renting out the huts. Other squatter landlords have remained in the

settlement. Newly arrived migrant factory workers provide the previous wave of squatters with an opportunity for profit. In two of the case studies presented above, the respondents rent huts from squatter landlords and share the rent with friends or siblings, while the respondent in one of the case studies was subsidized by her in-laws who own a squatter hut. In meeting their housing needs by resorting to squatting, migrant female workers are usually subsidized by their relatives or exploited by squatter entrepreneurs.

**Social Costs Of Squatting**

Although squatting has been described as "sensationally successful" in economic terms (Pirie, 1976), the high cost in physical and social well-being must not be overlooked. The type of lands occupied by squatters expose them to the dangers of floods, fires, landslides, drowning in abandoned mining pools and accidents involving trains. Former mining land, the flood plains of rivers and narrow strips bordering railway tracks are the major locations of squatter settlements in the Kelang Valley (Wehbring, 1976). The absence of effective enforcement of trespassing laws encourages occupation of such unsafe sites. Every year disasters befall squatter areas. In 1981, two particularly serious disasters affecting squatters occurred - a conflagration destroying most of Kpg. Paya, and the Puchong landslide burying 18 people and their homes.

It has been noted that generally in past years "squatters have been the first - and often only - victims" whenever torrential rains cause flooding in low lying areas (Star, 1981). Ironically, squatter settlements are often blamed for impeding drainage and flood alleviation projects. The location and irregular layout of these areas, along with the invariably malfunctioning fire hydrant also obstruct the provision of effective fire services during the inevitable blazes that frequently sweep through the clusters of wooden squatter huts. The threat of fire is amplified by careless wiring, often carried out by unqualified workmen, overloaded sockets, and haphazard use of kerosene lamps and stoves, and leaking canisters of cooking gas. Danger from railway tracks affects those who are tempted to take short-cuts by crossing over the lines, and small children playing on the tracks. Some railway officials, until very recently, tacitly encouraged squatting by collecting rent from the people occupying land alongside the tracks. None of these dangers have deterred squatters from settling on unsuitable sites.

The physical dangers to which squatters are exposed most directly affect married female factory workers. In-depth interviews revealed that these women experience great anxiety concerning the safety of their children. They are unable to supervise their children closely enough to ensure that the children do not play on the railway tracks or near to mining pools, favourite play areas of many squatter children. These children often risk their lives when at play as a result of the lack of safe recreational space in the squatter settlements. The effect of these conditions on family life is shown in the following case.

Case 4: M. and her husband are both migrant factory workers from Melaka living in a hut in Kpg. Railway, a squatter settlement along the railroad tracks behind Jalan Kelang Lama. M., 29 years of age, has been married for nine years and has three children. She and her husband have lived in Kpg. Railway continuously since migrating to Kuala Lumpur seven years ago. After renting a hut for three years, they purchased the one room squatter hut in which they presently live, from a friend for M$700.00. There is no supply of electricity or piped water. The bucket toilet outside of the hut is shared with two other households. M. and her husband occupy the hut alone, as their three children are living with M.'s mother, a rubber small holder in Melaka. M. sent her children to live with their grandmother in her Kampung in Melaka out of concern for their safety after becoming employed as a factory worker two years ago. M. worried about accidents on the railroad tracks. She and her husband regret only being able to see their children five or six times a year on visits lasting two to three days. For M. and her husband disruption of family life has been a high price to pay for living in Kpg. Railway, which is located near to the factories where both are employed.

The issue of obtaining an adequate living situation in which to bring up children is of importance to a significant minority of women factory workers. Among the HAWA Survey I respondents about 22% (N=239) are married, among whom 77% (N=183) have children (Tables I and II).

Migrant workers and their families residing in squatter areas are surrounded by unsanitary conditions that can give rise to disease. Although all of the

TABLE I: MARITAL STATUS OF HAWA SURVEY I RESPONDENTS

| | N | % |
|---|---|---|
| Single | 818 | 76.7 |
| Married | 239 | 22.4 |
| Divorced | 4 | .4 |
| Widowed | 5 | .5 |
| Total | 1066 | 100 |

TABLE II: NUMBER OF CHILDREN OF MARRIED HAWA SURVEY I RESPONDENTS

| | N | % |
|---|---|---|
| None | 54 | 22.6 |
| 1 | 69 | 28.9 |
| 2 - 3 | 90 | 37.7 |
| 4 - 5 | 19 | 7.9 |
| 6 or more | 5 | 2.1 |
| No response | 2 | .8 |
| Total | 239 | 100 |

respondents in the squatter areas have the use of either bucket or pit latrines, they do not always encourage young children in the household to use these facilities. Much human excrement can be observed in open view in the public areas of the settlements; this is particularly true of Kpg. Kerinci. Unsatisfactory hygiene, however, is more a reflection of values and attitudes rather than poverty in itself as shown in the following case study.

Case 5: S., a young wife and mother is 23 years of age, was born and raised in Kuala Lumpur. S. is a second generation squatter and a child of migrants. Her father is originally from Kedah and her mother from Melaka. S.'s father is employed as a bus driver with Sri Jaya. S., the eldest of nine children, completed Form Three, English medium. She has been employed as a production operator for the past three years at Masyur, a watch factory in the Sungai Way Free Trade Zone. S., her husband and two year old son occupy a one room, zinc roofed, wooden squatter house, which they built three years ago. They have no housing expenses such as rent or rates to pay. The house is attractively furnished and decorated with curtains; colourful vinyl floor mats, matching cane furniture and a cabinet displaying casserole sets and dishes. S. and her husband also own a T.V. set, radio cum cassette tape recorder and speakers. The environment of the house is noisy and untidy. S.'s younger nieces and nephews wandered in and out of the house as the radio blasted at full volume and chickens cackled in the compound. Toilet facilities were observed outside the house in the compound, but S. nevertheless instructed her son to defaecate on the front doorstep. S., who demonstrates no concern with hygiene, expressed satisfaction with her living conditions. What is of importance to her is that her parents live next door and her other relatives also live in Kpg. Kerinci. S. has no difficulties concerning childcare as her mother looks after her son during work hours. The mutual aid made possible by the presence of her kinship network within the settlement compensates for the physical conditions of squatter life.

Casual attitudes and practices concerning human waste disposal as described in Case 5, partially account for the unhealthy environment characteristic of squatter settlements. The habitual flooding and drainage problems of the settlements in interaction with unhygienic practices multiply the health hazards faced by squatters. Frequent flooding increases the possibility of pollution from exposed human excrement. During dry weather, flies are numerous and food is easily contaminated.

In addition to health and safety hazards, migrant females living in squatter housing are subjected to an undesirable social environment. The women factory workers and local leaders in the squatter settlements studied, reported that widespread drug addiction, theft and sexual misconduct are of concern to many of the residents. Some of the UMNO branch leaders in Kpg. Medan and Kpg. Jaya, squatter areas located along Jalan Kelang Lama, related that they have taken active steps to involve UMNO members in anti-crime and vice surveillance, as well as liaising closely with the police. In squatter settlements such as Kpg. Railway, also near to Jalan Kelang Lama, where branches of political parties and other community organizations are weak or non-existent, concerted action against criminal activities usually does not occur. Unorganised squatter settlements provide fertile ground for crime. Although several of the community leaders who were interviewed expressed concern about drug taking and sexual misconduct on the part of female factory workers, no definite data is available regarding the actual extent to which the girls themselves are involved in deviance.

**Quality Of Life In Squatter Settlements**

Unmarried female factory workers generally live in bare or sparsely furnished quarters decorated with colourful posters of Malay pop singers, and sometimes Quranic verses. Female factory workers living independently with their friends tend to limit their household furnishings to a few makeshift shelves, woven mats and a kerosene cooker. Unmarried girls shift from place to place frequently, and are reluctant to accumulate much household equipment. Married factory workers or single workers staying with relatives usually live in furnished quarters with at least a few household amenities. Female workers who live with parents, siblings or spouses often pool their money with other family members to jointly purchase such amenities as household decorations, electric fans, refrigerators, television sets, stereo equipment and furniture. The high cost of these consumer goods relative to the wages of female factory workers

makes it difficult for the girls to purchase luxury items as individuals rather than as members of a household.

Migrant female workers perceive improvement in the quality of life in terms of their ability to purchase consumer goods. Squatting is a means of minimizing urban living costs to accumulate sufficient cash for the purchase of consumer goods. Most married workers own a large cabinet displaying expensive but seldom used kitchenware - sets of pyrex casseroles, chinaware, blenders and electric mixers. Ownership of these prestige items represents attainment of a more affluent life style. The goods are usually purchased with annual bonuses, through rotating credit arrangements (kutu), or on hire purchase. It was observed that married workers tend to invest heavily in outfitting their households with consumer amenities. Almost all of the married factory workers in squatter areas who were interviewed had a matched set of cane living room furniture, while the households comprising two or more single workers had no furniture and spread mats for guests.

Savings are allocated mainly for the purchase of consumer goods for display. Rarely do the factory workers' households buy books, or build improved bathing or toilet facilities. Despite no improvement, or in some cases deterioration of their housing conditions after migration, the respondents nevertheless perceive themselves as 'better-off' in that they are able to accumulate cash for remittances to their parents and to eventually acquire consumer goods.

To what extent do migrant female factory workers succeed in realizing their aspirations to acquire household amenities and enjoy a sense of improved quality of life? The findings of HAWA Survey I indicate that these aspirations are not easily attained.

In Table III it can be seen that wrist watches, radios, pyrex casserole sets and furniture are the most commonly owned consumer goods. Aside from wrist watches, fewer than one-half of the HAWA Survey I respondents own any of the other most commonly owned items. Only a minority of the respondents have acquired cassette tape recorders, or electrical goods such as T.V. sets, fans or refrigertors. From these findings, it can be seen that women factory workers find great difficulty in accumulating sufficient savings to purchase most of the household amenities listed in Table III, even the less expensive items such as radios and pyrex sets.

TABLE III: PER CENT OWNERSHIP OF HOUSEHOLD ITEMS, HAWA SURVEY I, 1980

| Household Items | N | % |
|---|---|---|
| Wrist watch | 761 | 71.4 |
| Radio | 438 | 41.1 |
| Pyrex Casserole Set | 332 | 31.1 |
| Furniture | 377 | 35.4 |
| Cassette Tape Recorder | 276 | 25.9 |
| T.V. Set | 278 | 26.1 |
| Electric Fan | 168 | 15.8 |
| Refrigerator | 150 | 14.1 |
| Motorcycle | 51 | 4.8 |
| Total Respondents (thousands) | 1,066 | |

## SQUATTER PHENOMENON

The limited success of women factory workers' attempts to improve their standard of living is shown even more clearly in comparing HAWA Survey I's findings concerning ownership of consumer goods with those of the Population and Housing Census of Malaysia, 1980 (Table IV).

Female factory workers in the Kelang Valley lag far behind the general population of Peninsular Malaysia in ownership of household amenities. Their quality of life reflects minimal benefits from industrial development in the Kelang Valley. As squatters with limited access to consumer goods, migrant female workers experience little or no tangible evidence of the higher living standards which industrialisation promises.

## Conclusion

The findings of this study suggest that the failure of factory managements and public agencies to take responsibility for migrant workers' housing needs, has thrown the burden to the surrounding squatter communities. The earlier waves of migrants both subsidize and exploit the more recently arrived migrant workers. Relatives and friends among the earlier waves of migrants often subsidize the accommodation needs of female factory workers by absorbing the girls into their usually overcrowded households. Female factory workers without relatives to rely upon in the Kelang Valley or who choose not to live with their relatives are often exploited by landlords eager to profit from the housing shortage. Entrepreneurs among the earlier arrived migrants view the female factory workers as a lucrative source of income, demanding excessive rents for illegally constructed huts lacking water, electricity and sanitation.

In migrating to the Kelang Valley for factory employment, female workers do not necessarily improve their living conditions. In some cases, migrant female workers find that the housing in the Kelang Valley available to them entails a lower standard of living than in the rural kampungs from where they have migrated. Although the girls are willing to subject themselves to squatter housing conditions in order to accumulate enough savings to remit money to their parents and to purchase consumer goods, their ability to acquire these goods is in actuality extremely limited. As consumers, the girls lag far behind the general population of Peninsular Malaysia. Their aspirations for higher living standards cannot be accomplished as individual wage earners, but rather as supplemental wage earners within a family household.

TABLE IV: PER CENT OF HOUSEHOLDS POSSESSING SELECTED HOUSEHOLD ITEMS, PENINSULAR MALAYSIA, 1980

| Household Items | % |
|---|---|
| Radio | 73 |
| T.V. Set | 53 |
| Electric Fan | 39 |
| Refrigerator | 28 |
| Motorcycle | 35 |
| Total Households (thousands) | 2,104.6 |

Source:

Population and housing census of Malaysia, 1980. Department of Statistics Malaysia, Kuala Lumpur.

The provision of hostels for factory girls would alleviate the strain on the local housing supply in the vicinity of the Free Trade Zones and would also relieve the extreme overcrowding in the homes of the girls' relatives. It appears that the poorest section of the urban community is absorbing the cost of providing female fctory workers with shelter. Protection from exploitative landlords, undesirable social influences and, health and safety hazards is another important need that hostels for factory workers could meet.

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# THE LANGUAGE OF THE FEMALE FACTORY WORKERS WITH REFERENCE TO DIALECTAL CHANGE AND CODE CREATION: A CASE STUDY

by

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## Introduction

This paper is an attempt to describe the language pattern and form commonly used by female factory workers in their daily communication and interaction among themselves. It represents a preliminary report of an on-going research.

The scope of this research is related to two basic linguistic premises:

(i) All speakers of Malay, including the subjects under study, speak a variety of dialect of Malay. However, through the school system, they have been exposed to a "standard" version of the language, Bahasa Sekolah (the language of the school), used in most formal situations. Dialectal forms of the language varies fairly significantly from the standard variety, some, for example like the northern states of Kedah and Perlis and the north-eastern states of Kelantan and Trengganu, more significantly than others.

(ii) Since factory workers come from various parts of the country, speaking various dialects, there must be a common variety used by them at their new environment, within the factory situation and with the society outside.

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**Female Factory Workers In Malaysia:** This paper focuses on Malay female factory workers (henceforth referred to as Mffw) in the major industrial zones of Peninsular Malaysia, in particular the Kuala Lumpur - Petaling Jaya area. They emerged with the industrialization policy of the Malaysian Government and represent a new element in an everchanging society. As a social group their presence has been received with mixed feelings by the Malaysian society, especially by the Malay sector of the population. But their number has been on the increase and their presence felt (Ungku A. Aziz, 1977 and Appendix III). Together with their male counterparts, Mffw have created changes in the industrial labour scene, participating very actively in nation-building.

Industrialization was introduced in developing countries in the early Sixties, in Asia in countries such as South Korea, Taiwan, Singapore and Hong Kong. Malaysia and the Philippines joined the crowd in the Seventies. In Malaysia, the number of multinational companies involved in light industries that are labour-intensive increased tremendously, as the direct result of governmental planning and the existence of cheap labour. Incentives by the government include the introduction of pioneer status, the provision of amenities such as good communication networks and special areas known as free trade zones, and related labour laws. In 1970, for example, there were 41 electronics firms employing 3,200 workers (of which 99% were female). In 1976, the number increased by leaps and bounds, with 130 firms employing some 47,000 workers. It was reported that in the same year 89.5% of the workers in the clothing industries and 56.8% of the textile industry were female workers (Jamilah Ariffin, 1981).

It can, therefore, be concluded that the new economic policy, through the establishment of factories that are foreign-owned, has offered new avenues for employment for female workers, i.e. as employees in the newly established industrial sector. Today, we find many such industrial zones throughout the country, such as Sungei Way and Ulu Kelang in Selangor, Bayan Lepas in Province Wellesley, Batu Berendam in Melaka and Pengkalan Chepa in Kelantan.

The factory workers under study are those in the industrial zone of Kuala Lumpur-Petaling Jaya. They originate from all parts of the country, in search of employment. The majority possess basic education. In fact, the minimum condition of entry was education up to standard six, i.e. completed primary education (Appendix II).

Linguistically they are a heterogenous group, each worker speaking her own regional dialect. They have migrated in big numbers from the rural areas into the nearest trade zone, but the main area of concentration has been Kuala Lumpur-Petaling Jaya. Eighty two percent of the informants of this study indicated that they are migrants from the surrounding rural areas (Appendix II). In fact, many originated as far as from the East Coast States of Peninsular Malaysia. Appendix IV shows the general rural migration pattern of the factory girls in 1970. It is assumed that some common form of communication will emerge among such a diversified group. This study is aimed at discovering the nature of language used by them in their daily communication, within and outside their working environment. The following aspects will be dealt with :

(i) The phonetic changes that take place within a speaker.

(ii) The process of code creation when they try to accommodate to a new linguistic situation.

(iii) The nature of code-switching among the Mffw when they function as a new social group.

**Methodology:** This research was carried out in two stages. The first stage was to identify the form of the language in use by Mffw. This was done for a period of five months, covering several factories around the Kuala Lumpur-Petaling Jaya area,with special emphasis on electronics firms. The method employed was the anonymous interview technique along the line used by William Labov (1966) when he was doing a study on the form of language used by salesgirls in departmental stores in New York. Observations and sometimes recordings were done without the knowledge of the Mffw. Most of these took place at bus stops, near the guard posts, near the gates, at the canteens, at the telephone boothes and in waiting rooms.

The advantages of the anonymous interview technique are that it provided the evidence of the real language in use by the Mffw, for according to Labov (1966) "...the basic data for any form of general linguistics would be language as it is used by native speakers communicating with each other in everyday life."

## LANGUAGE OF WORKERS

Formal interviews were also carried out, forming the second half of the fieldwork. Questionnaires were given individually during the interviews and conversations were tape-recorded. Linguistic factors given consideration were in relation to :-

(i) Pronunciation.
(ii) Mastery of language.
(iii) Evidence of multi-lingual ability.
(iv) Existence of new codes and styles.
(v) Reading ability, not only in terms of fluency and comprehension but also their knowledge of the jawi script as well as the romanised script, and their reading habits.

Fieldwork was done in four areas with Kuala Lumpur and Petaling Jaya as the base. The other three areas were Ipoh, Senawang and Kota Bharu, chosen particularly for their linguistic variety. The structural set-up for each area is almost similar.

### Common Language Patterns Among The Mffw

Daily communication among Mffw is through the medium of Malay, their mother tongue. In daily communication "...we rarely use the paraphernalia of the written speech form" (Grayshow, 1977). So in order to see the "real" language use of the Mffw, its pattern and form, one has to analyse the data collected through the anonymous interview technique.

This paper approaches the problem from two aspects:

(i) A linguistic aspect.
(ii) A sociolinguistic aspect.

The linguistic aspect covers discussion on phonetics especially the occurrence of phonetic changes. Some aspects of morphology and syntax will also be briefly touched.

In the sociolinguistic analysis, the emphasis will be on the creative nature of the social group, and in the linguistic manipulations that take place when there arose a need in communication.

**Dialectal Change:** As stated earlier, most of the Mffw originate from all parts of the country and have mastered a certain form of regional Malay dialect. They also possess at least basic primary education. This means that they have been exposed to a variety of "standard" Bahasa Malaysia, although the village environment does not always provide them with much chance of using the "school" variety of the language. In the factories, however, especially those around Kuala Lumpur-Petaling Jaya area, speakers felt a need to delete some of the regional phonetic forms, replacing them with new ones that would be more comprehensible and acceptable in the new environment. These changes usually follow the pattern of changing towards the norm, i.e. the standard variety. For example, replacing the final syllable dialectal vowel /a/, /ɔ/ or /ɛ/ with the more acceptable /ə/. Another is the preference for /e/ over /ɛ/ and /o/ over /ɔ/.

Specifically, the important phonetic changes are:

(i) **The use of /e/ instead of /ɛ/**

Below are examples of words containing the phonetic sound [e] as used by the informants under study.

| | | | |
|---|---|---|---|
| ekor | .... [ | ʔeko: ] | tail |
| enak | .... [ | ʔenãʔ ] | delicious |
| elak | .... [ | ʔelaʔ ] | to avoid |
| tengok | .... [ | teŋõʔ ] | to see |
| kuning | .... [ | kunẽŋ ] | yellow |
| ambil | .... [ | ʔambel ] | to take |
| terap | .... [ | terap= ] | to turn over |
| boleh | .... [ | boleh ] | can |
| minit | .... [ | m̃ĩnẽt= ] | minute |
| sen | .... [ | sen ] | cent |
| rileks | .... [ | rilɛk= ] | relax |
| beg | .... [ | bɛg= ] | bag |

/ɛ/ is the normal dialectal variety while /e/ is the Standard Form (Appendix I). From the above list, it is found that /e/ has completely replaced /ɛ/, except for the vowel /ɛ/ which is found in such words such as rileks (relax) and beg (bag).

(ii) **The use of final /ə/**

With regards to the use of the final /ə/ which is normally considered the standard variety, versus /a/ the dialectal form, data gathered in this research reveal that the preference is for /ə/ in the position of the final open syllable, as can be seen in the following examples:

| | | | |
|---|---|---|---|
| bila | ..... [ bilə ] | when |
| lusa | ..... [ lusə ] | day after tomorrow |
| ada | ..... [ ʔadə ] | have |
| dua | ..... [ duə ] | two |
| cuba | ..... [ cubə ] | try |
| tanya | ..... [ taɲə̃ ] | ask |
| sengaja | ..... [ səŋãjə ] | purposely |
| wanita | ..... [ wanĩta ] | woman |

Exceptions are found in words such as bola (ball), wanita (woman) and drama (drama), which are also exceptions for the majority of the Malay speakers.

(iii) **The use of /o/ and /ɔ/**

The same applies to the /o/ and /ɔ/ alternation (Appendix I). With some exceptions, i.e. [ cɔpˀ ] (brand) and [ lɔɣatˀ ] (dialect), the preference is /o/, the standard variety, as can be seen in the examples below:

| | | | |
|---|---|---|---|
| Sombong | ..... [ sombo̯ŋ ] | proud |
| otak | ..... [ ʔota? ] | brain |
| boleh | ..... [ boleh ] | can |
| telor | ..... [ təlo: ] | egg |
| sayur | ..... [ sayo: ] | vegetable |
| bodoh | ..... [ bodoh ] | stupid |
| elok | ..... [ ʔelo? ] | beautiful |
| seronok | ..... [ səronõ? ] | happy |
| cop | ..... [ cɔpˀ ] | chop |

(iv) **The onsonant /r/**

One of the interesting phonological characteristic of the language used by the Mffw is the occurrence of the alveolar trill consonant, /r/ (Appendix I). This is a feature of only the standard variety. All dialects alternate it with [ ɣ ] or [R]. Below is a list of words which contain the consonant /r/:

| | | | | | |
|---|---|---|---|---|---|
| ramai | ..... | [ | ramãi | ] | many |
| ragam | ..... | [ | ragam | ] | whim |
| berapa | ..... | [ | bərapə | ] | how many |
| kurang | ..... | [ | kuraŋ | ] | less |
| seronok | ..... | [ | sərono? | ] | happy |
| mari | ..... | [ | mãri | ] | come |
| burung | ..... | [ | buroŋ | ] | bird |
| ular | ..... | [ | ?ula: | ] | snake |
| benar | ..... | [ | bənã: | ] | true |
| telur | ..... | [ | təlo: | ] | egg |

Throughout this research, the use of the alveolar trill is higher than other alternative forms. The fricative uvular [ R ] and the fricative velar [ ɣ ] sometimes appear, but the number is small and is common only among older female workers.

(v) **The consonant /l/**

Another interesting element found in the language spoken by the Mffw is the occurrence of non-fricative alveolar lateral /l/, in the final syllable (Appendix I). A number of words with such elements are listed below:

| | | | | | |
|---|---|---|---|---|---|
| bawal | ..... | [ | bawal | ] | promfret |
| sambal | ..... | [ | sambal | ] | pounded chillies with salt and dried shrimp paste |
| hafal | ..... | [ | hapal | ] | memorize |
| betul | ..... | [ | bətol | ] | correct |
| awal | ..... | [ | ?awal | ] | early |
| kecil | ..... | [ | kəčel | ] | small |

It was found that speakers from dialectal groups that do not have /l/ in word final positions produce such sounds. Speakers from Kelantan, for example, produce

[ bawal ] instead of [ bawa: ]

and speakers from Perak produce

[ bətol ] instead of [ bətoi ]

It can, therefore, be concluded that Mffw make many phonetic changes in their speech. Although they come from a background of some specific dialects, they quickly adapt their speech to suit the new environment. In the realm of phonetics, a few sound changes take place. It was found that speakers from Kelantan and Kedah, for example, coming out of their rural background for the first time, take only 2 months to make the necessary linguistic changes.

Similar changes also take place at the morphological and syntactical levels. Here, the tendency seems to produce constructions that are easily comprehensible, i.e. complete and meaningful, and very close to the standard variety. Phrases and sentences are fairly well-formed, and the use of affixations nearer the standard than the dialectal variety.

It can be said that these speakers are making an attempt, consciously or otherwise, to produce grammatical constructions that do not show dialectal influence. In fact, we can conclude that an attempt is being made to speak in a way that is leading towards the standard variety, even if the experience is the first time for many of them.

**Code-switching**

Code-switching is a common occurrence among Mffw. By code-switching is meant the alternate use of more than one language; the choice of words or phrase is intelligently done and with specific purposes (Leach, 1954; Salisbury, 1962; Ferguson, 1964; Rice, 1962). Code-switching will appear in a bilingual community where speakers have equal facility in language use. The choice is of course determined by the requirements of intelligibility.

It is believed that code-switching helps to achieve effective communication and that it alternates among languages for much the same reasons that monolinguals select among styles of a single language (Rubbin 1961; Fishman 1965).

Below is a list of sentences with elements of code-switching:

(i) Mula-mula jumpa Motorola then belah kanan dia.
("First you come to Motorola, then turn right").

(ii) Di sini balik kerja, mandi-mandi, relax.
("Upon returning from work, I bathe then relax").

(iii) ..we people...
(".. we....".)

(iv) Macam dia juga operatorlah. Buat recording.
("Like her, I'm an operator, and I do recording").

(v) After form five I kerja.
("I started working after form five").

Code-switching among the Mffw is an everyday occurrence, as it is among other speakers in the Malaysian society at large. English words (rather than phrases) are slipped into their Malay constructions with ease, in particular:

(i) Words relating to the job environment,
e.g. production, inspect, quality, schedule, bonding, etc.

(ii) Pronouns and a few structural words such as then and so, the former because the English pronouns are more neutral in character than Malay pronouns, with its traditional and socio-cultural implications.

However, because the level of proficiency in English is generally low among them, code-switching rarely takes place at the level of long phrases or sentences.

## Code Creation

Language can be referred to as a set of speech forms among which mutual intelligibility exist. As a verbal means of communication language refers to those linguistic symbols which have meanings agreed upon by all parties involved in the communication. Since language functions as an indicator of group identification as well, members of a particular speech community have a tendency to create various aspects of the code for its exclusive use.

Code is sometimes referred to as an ordered set of linguistic signs of the verbal repertoire which co-occur in social situations according to the role attached to it (Hartman, 1969). In order to create a code, a few factors have to exist. Code creation, in order to be accepted by the speech community needs to possess characteristics which may or may not be explicable. It also has to be unique and creative in nature.

Among the Mffw, an interesting phenomenon is code creation. By this is meant the emergence of certain constructions which are specifically found only among their variety of language use. These can be divided into 3 groups:

(i) Codes which are solely Malay words in origin.
(ii) Codes that are entirely of English origin.
(iii) Codes that are made up of words from languages other than English or Malay.

Examples for (i) are :

| | | | | |
|---|---|---|---|---|
| (a) | Ayam tak bertulang | (boneless chicken) | .... | spinach. |
| (b) | Encer-encer | (gaseous) | .... | for a while. |
| (c) | Mat bangau | (Ahmad the stork) | .... | navy. |

The phrases above appear in the everyday conversation of the Mffw. Simple everyday words are arranged in such a way as to bring out special connotations. In (c) for example, Mat (derived from Ahmad, a common Malay male name) is attached to the word bangau (stork); the whiteness of the stork is related to the man who is always in white uniform, that is the navy.

In the second case, the words employed are typically English in origin, which have undergone local colouring. Some examples:

(a) hot ..... angry with/at someone.
(b) sweat ..... worry.
(c) Appollo ..... nurse.

There are codes which are phrases that consist of words which are not only from the Malay language but other languages as well. For example:

| | | | |
|---|---|---|---|
| (a) | Mat Spanner | Ahmad the spanner | male factory worker. |
| (b) | Minah karan | Aminah the current | female factory worker. |
| (c) | Kuih flat | flat cake | a type of cake. |
| (d) | Solid molid | reduplication of the word 'solid' (firm) | sexy (very) |

The above code creations resemble a concrete cohesion of words and are aimed at attaining an appropriate description of a concept. Example (d) is very interesting for the evidence of a morphological process in Malay, i.e. partial reduplication.

From the examples given above on code creation a few conclusions can be made:

(a) Even though codes seem to have been created without reference to any specific language rules, there is an element of grammaticality in them. The "DM" rule seems to be a governing factor. The "DM" rule in Bahasa Malaysia states that the arrangement of a Malay phrase is one of "Described-Describer".

(b) There is an effort to recreate the popularity of some words. Encer-Encer, for example, is an Indonesian word (Jakarta dialect) meaning "gaseous" or one who can easily absorb knowledge. The Mffw, however, have given it a

different connotaion. Through activities of this nature not only are new words created, but words from the languages in the same family are also being utilized.

(c) All 3 types of codes created have been intelligently used in conversations. They are used in appropriate situations and are employed with maximum effectiveness.

Code creation in the language of the Mffw serves not only as a means of effective communication, but indirectly they provided evidence that the Mffw language users have the capability to manipulate words to enhance their verbal communication networks. To them codes indirectly act as

> "...social-cement, keeping people together by engaging in the sociable action of speaking and listening, playing with the common code like any other game, and talking enough information to avoid the pain of the blank mind."
>
> (Grayshow M. C., 1977: 56)

**Conclusion**

The Mffw is an interesting social phenomenon in the Malaysian society. Relatively new, their place in society is still uncertain. In terms of numbers and economic contribution, they represent an important element. Their unstable nature, their newness, their social identity make them an interesting group to study. In terms of linguistics one can discern many interesting charateristics.

In one sense they are interesting for their very nature - a conglomoration of diverse speakers grouped together and required to communicate with one another. What emerges, linguistically speaking, provides interesting findings for students of languages, in particular those promoting the use of another standard variety. In another sense they are a group to watch, in terms of linguistic development. The linguistic adaptations taking place, the creation of new codes, and code-switching are some of the elements that are taking place before our very eyes. There is a wealth of information to be obtained from our female factory workers.

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## APPENDIX I: PHONETIC CHANGE

| Spelling | Pronunciation | No. Of Occurrence | Percentage |
|---|---|---|---|
| final a | /a/ | 34 | 7.6 |
| | /ə/ | 405 | 90.8 |
| | /aʔ/ | 7 | 1.6 |
| r | /r/ | 94 | 88.7 |
| | /ɤ/ | 12 | 11.3 |
| | /R/ | 0 | 0 |
| final r | /ø/ | 44 | 88.0 |
| | /ʕ/ | 4 | 8.0 |
| | /o/ | 2 | 4.0 |
| e | /e/ | 35 | 79.5 |
| | /ɛ/ | 9 | 20.5 |
| o | /o/ | 74 | 89.2 |
| | /ɔ/ | 9 | 10.8 |
| final s | /s/ | 35 | 100.0 |
| final l | /l/ | 11 | 78.6 |
| | /ai/ | 1 | 7.1 |
| | /oi/ | 2 | 14.3 |

## APPENDIX II: INTERESTING VARIABLES ENCOUNTERED IN THE FIELDWORK

| | Variables | % |
|---|---|---|
| 1. | Education attainment : | |
| | (i) Primary Education | 8.0 |
| | (ii) Lower Sec. School | 2.8 |
| | (iii) SRP/LCE | 41.7 |
| | (iv) MCE/SPM | 44.0 |
| 2. | Percentage of migrant workers | 82.8 |
| 3. | Reading habit : | |
| | (i) Daily newspaper | 97.7 |
| | (ii) 1 magazine | 36.6 |
| | (iii) 2 magazines | 32.0 |
| | (iv) 3 magazines | 12.6 |
| | (v) 4 magazines | 2.8 |
| 4. | Can read jawi script | 73.7 |
| 5. | Can read romanized script | 100 |

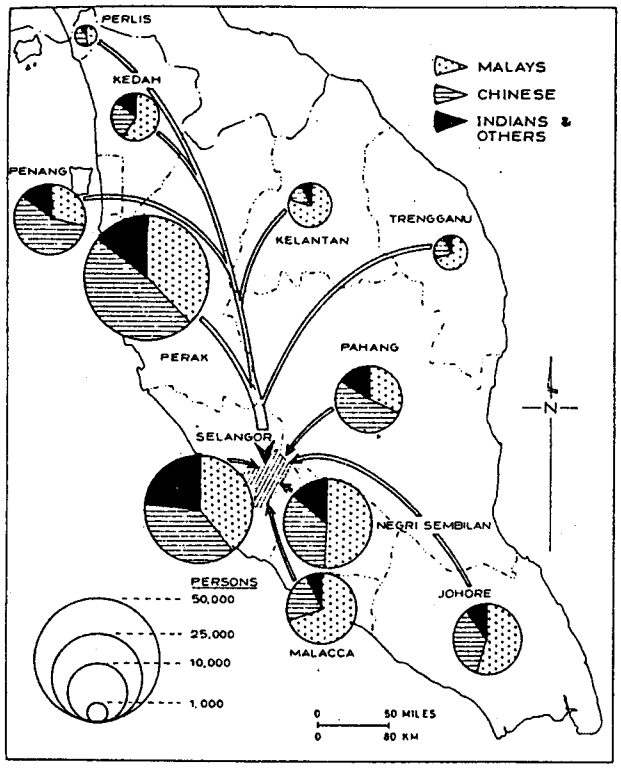
## APPENDIX III: THE NUMBER OF MFFW FROM 10 MAJOR ELECTRONICS INDUSTRIES IN RELATION TO THE TOTAL NUMBER OF WOMEN WORKERS

| Name of Industry | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|---|
| Roxy | 5 (15) | | | | 52 (115) | | | 67 (177) | | 68 (194) |
| Toko | - | 85 (170) | - | 164 (315) | 271 (470) | 346 (512) | 399 (511) | - | - | 634 (901) |
| S.E.H. | - | - | - | - | 63 (116) | - | - | 117 (182) | - | 290 (382) |
| T.I. | - | - | - | - | - | 1009 (1641) | 1139 (1849) | - | 1521 (2461) | - |
| Masyhur | - | - | - | - | - | - | 230 (324) | - | - | 242 (329) |
| Precima | - | - | - | 15 (32) | - | - | 84 (148) | - | - | - |
| R.C.A. | - | - | - | - | - | 1045 (1484) | - | 2344 (3085) | - | 2795 (3427) |
| Monsanto | - | - | - | - | - | - | - | - | 175 (348) | - |
| Matsushita | - | 53 (110) | - | - | - | 264 (494) | - | - | - | - |
| W. Digital | - | - | - | 79 (151) | - | - | - | - | - | - |

Note:

Total number of women workers in brackets.

APPENDIX IV: PATTERN OF MIGRATION MOVEMENTS IN PENINSULAR MALAYSIA, 1970.




Source:

Manjit, Singh Sidhu. Kuala Lumpur and its population. Kuala Lumpur, Surinder Pub., 1978.

# INTERNATIONAL ENVIRONMENT FOR TECHNOLOGICAL AND CULTURAL EXCHANGES IN ASIA

by

Mineo Nakajima*

## Technological And Cultural Exchanges As The Point At Issue

At a meeting on the Japanese diplomatic policy towards Southeast Asian countries which was held in Tokyo some time ago, there was a fundamental and interesting argument between two Japanese participants in connection with technological and cultural exchanges with Southeast Asian countries. One participant was a Japanese political scientist who has achieved excellent results in the field of political and social analyses of Southeast Asian countries.

On the premise that Southeast Asian countries had already passed beyond the period of political instability and are growing towards internal social development, he proposed that Japan should work out a cultural diplomacy policy towards Southeast Asian countries which was based on technological and cultural transfer. He maintained that by doing so, Japan could respond to the Malaysian "Look-East Policy" and Singapore's "Learn from Japanese Experiences" Campaign.

Speaking against him was a social anthropologist who enjoys a reputation as one of the representative Japanese intellectuals. He strongly attacked the proposal made by the political scientist. He said that it was very difficult to export Japanese technology and culture to Southeast Asian countries, and that a diplomatic policy towards Southeast Asian countries which was based on Japanese culture should not be adopted. Thus, he reacted negatively to the suggestion made by the political scientist and said that the economic and technological level in Japan derives not only from the cultural tradition which grew during and after the Edo period but also from the historical heritage accumulated after the Jomon period in the prehistory era. He said, therefore, that it should not be considered an easy option to transfer Japanese technology and culture to countries devoid of such a cultural tradition. This was the reason why the social anthropologist reacted negatively to the cultural and diplomatic proposal

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made by the political scientist. While listening to the argument, I could not help thinking that it was similar to the difference in opinion expressed between two American scholars with respect to the success of the Japanese economy. One was Ezra F. Vogel of Harvard University who leaped suddenly to fame after he published a book entitled "Japan as No. One", and the other was Chalmers Johnson, a political scientist teaching at the University of Berkeley, California, who attracted a good deal of attention by publishing a book entitled "MITI and the Japanese Miracle". Both are scholars of medium standing who majored in East Asian Studies, specializing on China. They are also friends of mine.

Ezra F. Vogel attributed the success of Japan to "things Japanese" and "Japan's individuality", while Chalmers Johnson attributed the success to the modern industrial system and excellent bureaucracy. In short, according to Johnson's hypothesis, Japan's success is based on universal factors, and other countries will find it easy to imitate it. In contrast, Vogel stresses an individuality unique to Japan and argues that it would be difficult to transfer the Japanese recipe for success unaltered to other countries, although from what he says in "Japan as No. One", the Japanese experience may prove to be a good lesson to Americans, who are liable to think that America is No. One in everything.

Thus, the problem relating to the transfer of technology and culture is an extremely important subject involving the history of civilization, and entails a great deal of controversy. Therefore, an easy-going and hasty approach to handling this problem would cause conflict in exchanges with different cultures. The problems of cultural exchanges and conflicts have just been taken up in the fields of international relations and diplomatic policies, and these are important problems which require study in the future.

Under such circumstances, I will try to concentrate my discussion on the Asian international environment, which is expected to serve as a magnetic core attracting technological and cultural exchanges.

## International Environment Of Interdependence

The 1970's was a decade during which men were forced to become aware of the crisis of existence due to the so-called oil crisis. In the 1980's, as the

decade of the New Cold War[1], countries throughout the world are increasingly tending to expand their armaments as if such military expansion is inevitable in the struggle for control over energy sources, other resources and the limited living space on the earth.

Not only the advanced countries of the West but also socialist countries such as the USSR and China, which claim to stand for peaceful principles, are trying to strengthen and expand armaments on one pretext or another. The USSR and China are militaristic countries which allocate more than 10% of their GNPs to military expenditure (as against 5% to 6% for the USA). This kind of military expansion accelerates the massive consumption of resources and energy sources, and the military expansion option is, therefore, nothing but a fool's choice. Under this state of tension, however, people in general are not fully aware of this contradiction. In a couple of centuries' time, will people look back at the 20th Century and laugh at the stupidity of the actions taken?

It is under these circumstances that a hot power game is being played by the USSR, USA and China. As long as it remains only a game, the final crisis can be deterred. As long as it remains basically a balance of terror, the aspect that generates most fear in us is nothing less than the destruction of man caused by an erroneous pull of the trigger by these nuclear powers. For this reason, it is important for us to look at the truth behind the sensational phenomena associated with the existing international tension, to avoid the final crisis, and to search for a new hope for the modern world.

What are the important problems relating to the Asian international environment? Firstly, it is expected that the power game among the super powers will continue to intensify for the time being. A fundamental change in the Chinese domestic administration is taking place in the form of "de-Maoization", and there is an increasing probability of a thaw in relations between China and the USSR. In order to prevent China and the USSR from becoming friends again, the USA is expected to do its utmost to keep these countries apart. The impulse towards military cooperation between China and USA must be perceived in this context. It goes without saying that the stronger the impulse, the more active the USSR's world strategy, particularly its Asian strategy.

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1 With respect to the reason why the 1980's are the age of a "New Cold War" see Nakajima, 1980a.

Secondly, China has a population of one billion, or more than a quarter of the whole population of the world. The national per capita income seems to be between about $260 and $280, or less than one-thirty-fifth of the Japanese national per capita income. Therefore, we cannot help having some apprehensions about whether China will be able to achieve the so-called Four Modernizations. As can be seen from the resource nationalism claimed by the member countries of OPEC, the North-South problems are expected to be the problems of man as a whole. Many regard the rise of the Third World as a tidal current of hope, but I do not think that we can expect much from the "treason" of the Third World. The Third World can no longer simply accuse the advanced countries of exploitation as it did in the 1970's. A rise in oil prices will rebound against the Third World in the form of expensive imports.

Besides, the development of alternative energies will make progress. It is expected, therefore that resource nationalism will not produce a linear effect as before.

Thirdly, the most important thing to note is that international interdependence is expected to increase. It may be said that an increase in interdependence is a characteristic to which importance must be attached as it represents a new tidal current in the modern world.

At the same time, however, with the expansion of such relationships, friction and tension will be amplified and diversified. The increase in international interdependence always involves contact between different cultures and civilizations. Therefore, the problem will get complicated unless there are incessant endeavors for mutual understanding. The unhappy end of good relations between USA and Iran may be said in a way to be a failure of contact between different cultures and civilizations. This kind of risk is also latent in the relationship between the West and the "Open China".

On the other hand, an increase in international interdependence is prone to expand differences among various countries or the disadvantages of one side. One example is the trade friction among the advanced countries (such as the automobile war between Japan and USA). The rise in oil prices has produced an adverse effect upon newly industrializing countries (NICS), which had enjoyed smooth economic growth and which had followed closely behind the advanced countries, and such an adverse effect might lead to the aggravation of

inflation, increased social unrest, and balance of payments deficits. These then are the major pitfalls of the age of interdependence. Therefore, it can be argued that the term "interdependence" translates as "risk" to the Third World.

Nevertheless, when increased interdependence, as the new tidal current of the modern world, is incorporated in international politics and the world economy, it will prove to be an effective prescription which can help man to weather crises and survive.

There is already a worldwide network of interdependence, and countries and regions of the world can sensitively respond to one another. Therefore, free, open and pluralistic international relationships must be established through exchanges in the fields of politics, the economy, culture and so forth.

In particular, open interdependence in the economic field assumes free trade and the liberalization of capital transfers. In view of this, there should be an approach which is capable of avoiding exclusive nationalism and sectionalism. At the same time, a system for international cooperation must be ensured. From these points of view, bilateral and multilateral cooperation must be accelerated.

It goes without saying that international interdependence is most conspicuous in the field of economics. It must be noted, however, that interdependence is widely maintained in the international relationships of today's "New Cold War Era". This kind of interdependence is not the exclusive property of the West or the USSR and East Europe. It is maintained outside political systems in international trade, international finance, multinational enterprises, etc. Interdependence can be observed even in various fields of international culture, and in the export and supply of weapons. There is even interdependence between the USA and USSR which are the principal players in today's "New Cold War". It must be noted that trade and transportation between China and USSR have not been terminated, even though the relationship between these countries was extremely serious. Faced with the "New Cold War Era", we must cooly grasp a modern world characterized by interdependence, and search for the ways and means to overcome any immediate crisis which may arise in the midst of today's international tension.

## New Possibilities In The Asian And Pacific Regions

In the midst of the severe international environment in the "New Cold War Era", there has appeared a wishful new concept of international solidarity in the Asian and Pacific regions. It is referred to either as the Pacific Community or Pacific Cooperation. The Pacific Basin Cooperation Concept[1] is in a way something like a "follow-on" to the age of interdependence. The Pacific Basin Cooperation Concept itself is not necessarily a new concept. The idea was often proposed, albeit with a slightly different nuance. It is ironic that the person who said that, while Europe was falling down, the Asian and Pacific region was full of possibilities in the coming century, was Mary MacLane, deputy editor of the London Economist. Europe is suffering from the British disease (Macrae, 1975).

It is natural that a concept such as the one mentioned above should have various implications. But many people unanimously agree that the 1980's, 1990's and 20th Century will be the age of the Asian and Pacific region. The circum-pan Pacific region is full of possibilities. Industrial countries such as the USA, Canada and Japan and newly industrializing countries such as South Korea, Taiwan, Hongkong, Singapore, Brazil and Mexico are located in this region. The fact that Australia and New Zealand are claiming new identities as "Asian and Pacific" nations has an important historical meaning. ASEAN countries are aiming at unification in terms of industrialization and nation-building. In addition, the islands of the South Pacific are becoming independent countries one after another.

Such being the case, the Pacific Basin Cooperation Concept is fascinating as well as exciting. At the same time, however, there are a number of barriers and problems in this region. The Greater East Asia Co-Prosperity Sphere which Japan advocated during the war was nothing but a nightmare to many Asian and Pacific nations. An anti-hegemonic alliance of the USA, Japan and China may go as far as to become an Eastern version of NATO. Thus, the Asian and Pacific region no longer permits the pursuit of political romanticism and is a region of complex diversity.

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1 The author himself was one of the members of the policy research group. For his views on the Pacific Basin Cooperation Concept advocated by the Ohira Cabinet, see Nakajima, M. (1980b).

Under such circumstances, it is not possible for Japan to advocate Pacific Basin Cooperation for its own sake. Today, when people are required to coexist and co-prosper, the fact that the Pacific Basin Cooperation Concept has received renewed attention must be rated highly.

This is because the concept implies that the system of interdependence provides a very important network for international peace despite the competition between the super powers. For this reason, it must be reconfirmed that the Pacific Basin Cooperation Concept is a long-term vision intended for the prosperity and stability of the Asian and Pacific region. Accordingly, if the Pacific Basin Cooperation Concept is considered to be a universal remedy with an immediate effect, a gap will soon be evident between the ideal and reality. The countries concerned should recognize this concept as reflecting a movement in the direction of prosperity and stability in the Asian and Pacific region, and as the ideal to look to while struggling with realities.

Before considering the ideal of future modernization, it must be remembered that there are a great number of problems that remain unsolved in the Asian and Pacific region. In order to challenge such difficulties, there is no choice but to solve problems on a step by step basis while keeping a long-term vision of the future.

It is impossible to systematically wrap up the Asian and Pacific region into a neat package. In the Asian and Pacific region today, there are countries whose top priority is political independence rather than economic cooperation and interdependence, while there are still other countries whose pressing need is the achievement of economic development and economic independence. If advanced countries come up with economy-oriented solidarity without considering political problems, they would be evading the real problems which await solutions and there would be the possibility of the promotion of regional cooperation lapsing into an "economic club" consisting only of advanced countries.

In order to mutually control closed nationalism, national or group egoism and the underlying strategic and tactical motives called national interests, the long-term and concrete vision discussed above is a vital ingredient. The vision must be the supreme principle for man's coexistence and co-prosperity, and which denies political romanticism.

## Asian International Environment And The "Shadow Of China"

There still are various social and political problems to be resolved in Asia today. In some cases, such problems may lead to war because of hatred and grudges, to international instability, and to increased tension. Against this international environment, a number of Asian countries have suffered and wavered. For this reason, the "Shadow of China" is very long in Southeast Asia. With this knowledge, the People's Republic of China has executed its own strategy.

In view of the above, it may be said that Asian countries are keeping a sharp eye on China. When Japan, which is an economic superpower, began to form close relations with the PRC after the USA approach to China, not only the countries of the Indo-China Peninsular but also ASEAN countries reacted strongly against the formation of a Tokyo-Beijing axis.

Under such circumstances, it will be useful to discuss the "Shadow of China" in Asia today. I have visited Southeast Asia often, and one of the impressions I obtained is that the predominant image of China is quite different from the image of China which we have in Japan. To the Japanese people, China is, so to speak, their cultural home, and the Japanese people tend to have a naive feeling of intimacy with China and feel a kind of "purity" and "sacredness" in connection with China.

On the other hand, other Asians view China from a different perspective. Although a new China was built on the basis of revolutionary purity, China today is a powerful authoritarian state. Therefore, other Asian countries seem to see the ugliness of China which has both strength and authority. It may be said, therefore, that the more the prestige of China rises and the more conspicuous the Chinese role in the international stage, the more clearly they seem to see an aspect of China, or even the threat of a powerful China which endlessly pursues national prestige and interests. This image of China is the "Shadow of China" brought about by the increase in Chinese international prestige and influence.

Secondly, the "Shadow of China" which covers Asia and which causes pressing problems is brought about by the wide dispersion of ethnic Chinese throughout the region. As everyone who visits Southeast Asia discovers, a great number of

Chinese live in the area. These overseas Chinese have a firm grip on economic activities, and cherish Chinese culture and customs. The China with which these peoples are familiar differs greatly from the image of China represented by external phenomena such as the Chinese admission to the United Nations and the American diplomatic approach to China. The third "Shadow of China" was attributable to the Maoist revolutionary "threat", as symbolized by the "export of revolution" and "revolutionary diplomacy". This problem was more keenly perceived by the fact that most of the Asian revolutionary groups are led by Chinese and closely connected with the Chinese Communist Party.

In view of the above, Asian countries are considering measures to respond to the "Shadow of China" with these matters taken into consideration.

For example, it is well known that Malaysia has adopted the Malaysian-oriented "Bumiputra" policy (which was completed by a new economic policy formulated in 1971). This particular policy represents the characteristics of Malaysia, which is a pluralistic state suffering under the "Shadow of China". It must be noted that the "Look East Policy", which Prime Minister Mahathir advocates, aims at Japan and South Korea and not China or Taiwan. Asian countries are struggling with the "Shadow of China" and are promoting their national identities and economic development as common themes. It is, therefore, necessary for us to fully understand the realities of Asia.

**Exchanges Of Technology And Culture And The Role Of Japan**

When the complex and fluid international environment in Asia is carefully examined, it is clear that Japan must endeavor to solve basic problems relating to Japan's cultural and technological exchanges with Asian countries. Measures and institutional and organizational reforms to facilitate smooth international exchanges and mutual understanding, problems relating to the acceptance of students from Asian countries, the employment of foreign teachers, mutual access to library information and academic information, and the breaking of the closed nature of research institutes are important diplomatic themes to be studied. It follows naturally that "area studies" must be accelerated to promote mutual understanding in the Asian and Pacific region.

The importance of "area studies" has been recognized to a considerable extent in Japan. Some universities and research institutes have begun to accept

students from Asian countries. It can be argued then that "area studies" are important not only to facilitate exchanges of different cultures but also to clear the barrier of culture differences. Edward T. Hall (1976), a cultural anthropologist, said that unless one studies and understands foreign cultures, they will always appear tyrannical and tend to dazzle the viewer. Therefore it is necessary for us to acquire the ability to filter the impact and fascination of foreign cultures, and to cooly look at the thus refined foreign cultures through "area studies".

On this basis, cooperation relating to training; technical cooperation; trade cooperation and expansion; industrial adjustment; cooperation in the development of resources (energy development, oceanic development and cooperation in agriculture, forestry and fisheries); the smooth flow of funds (liberalization of financial and capital market); the expansion and improvement of transportation and communication systems (improvement of transportation systems, expansion of communication networks and improvement of emigration and immigration procedures); occupational training and job creation for the development of Asian countries, will take-off. The next step will be the liberalization of the trade in agricultural products and joint development of energy intended for the benefit of developing countries.

Only by pursuing these problems on a long-term basis can technological transfer and cultural exchanges in the Asian and Pacific region make steady progress. While technological transfer and cultural imports are given full play to maximize their input effect, harmony between such technology and culture and local history and tradition will be made possible with the result that the sum of these will contribute to the wealth and development of the Asian and Pacific region.

In the new international environment of the 1980's in Asia, the appraisal and image of Japan has been improved, and Asian countries' trust in Japan has been greatly heightened.[1] As is well known, Japan, which became an economic superpower, thanks to the high economic growth in the 1960's, made inroads into Southeast Asia at the beginning of the 1970's and was frowned upon and severely

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[1] Japanese Government Public Opinion Poll on Japan in ASEAN. Public Information and Cultural Affairs Bureau, Ministry of Foreign Affairs, Japanese Government, 2 November 1983.

criticized by the Asian people because of its aggressive approach to international contact.

The anti-Japanese criticism has gradually faded away now, and the situation has changed a great deal. Today, Asian nations expect Japan to play its international role to the full. Japan should never again fail to meet the expectations of the Asian people.

Japan should not adopt the way of thinking that it is sufficient to reconsider its own share in a give-and-take approach, and neither is it allowed to satisfy itself by being devoted to an ideal vision without regard to the complicated reality and deep rooted stagnation in Asia. It will not be possible for Japan to obtain anything productive from the self-punishment caused by its own assailant-awareness, or from the old fashioned Asian challenge to advanced urban civilization.

It will be important to emerge from a stereotyped view of Asia, to accept the mixture of muddy reality and carefree frankness unique to societies in the South Sea and to acquire a sense of realism in our recognition of Asia.

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# ADAPTIVE WAGE INCENTIVE SYSTEMS

by

Gregory T.S. Thong*

## Introduction

In the performance of their functions, all managers, irrespective of whether they are managing small units or large ones, are confronted with the need to increase productivity. Various approaches have been embarked upon to achieve this end. They may take the form of new technological break-throughs, increased mechanization and capital utilization, improvements in the use of raw materials, reduction of wastage, increasing the effectiveness of managers, getting workers to work harder, etc. One of the means of encouraging the workers to expend more effort at work is through the application of wage incentive systems. Compared to the other methods used to increase productivity, the wage incentive systems have been implemented without incurring high investment costs. Another factor in support of the application of wage incentive systems is that the workers can benefit directly through the avenue of increased wages in exchange for increased effort expended. During this period of continuing increases in inflation, the workers are clamouring for increased wages so that they can maintain their standards of living at the levels that they are accustomed to. But any action taken to increase wages without any corresponding increase in productivity will only contribute towards fuelling the increases in inflation.

The history of the application of wage incentive systems goes back to ancient times when Man first learned how to put his thoughts in written form. Therefore, the literature on this subject is extensive, involving various fields of study like industrial economics, industrial engineering, industrial relations, organizational behaviour, personnel management, production and operations management, psychology and sociology. But, from the Malaysian point of view, the available literature pertains to studies undertaken in a foreign environment. Recorded studies of wage incentive systems in Malaysia are limited and are difficult to access because of their limited circulation.

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In an attempt to contribute towards the mitigation of this defect, a research project was undertaken to study wage incentive systems during the period between mid 1975 and mid 1979. At the outset itself, there was the problem of identifying the research sample. Since Malaysia is in the process of trying to achieve the status of an industrialized nation by 1990, it was felt that it would be very appropriate to confine this study to the manufacturing sector which has been earmarked to make the largest contribution to the Gross National Product by this point in time. The types of manufacturing industries that are more conducive to the application of wage incentive systems were identified first. These industries were pinpointed by referring to the data published in the Cycle of Occupational Wage Surveys - West Malaysia by the Statistics Section, Department of Labour, Ministry of Labour and Manpower.

This was followed by locating the various companies that satisfied the specification requirements in each of the relevant industries. The most common approach was by referring to the collective bargaining agreements, undertaken between the employers and the trade unions, that were deposited with the Industrial Court. The trade unions that were associated with the relevant industries were also approached, as well as personal contacts. Although a particular company might be identified, it cannot be included into the research sample unless the managers of the company are willing to cooperate to divulge the information required for the study. Eventually, information was obtained from 43 companies, in 11 industries, located from Penang in the north to Johore Bahru in the south. The details concerning the industries and the locations of the companies are shown in Tables I and II, respectively.

**Case Studies**

The companies that introduced the adaptive systems were found in the food products industry, the timber products industry, the electronic products industry and the non-metallic mineral products industry. It is proposed that the adaptive systems be elaborated further in the form of case studies.

**The Food Products Industry:** In this industry, the adaptive systems were found in companies that were engaged in fruit canning, and the production of bottled soft-drinks.

TABLE I: INDUSTRIAL CATEGORIES SAMPLED

| | Industry | Malaysian Industrial Classification Code | Number of Companies |
|---|---|---|---|
| I. | Food products | 303, 304, 306, 314 | 5 |
| II. | Textile and wearing apparel | 331, 332, 343 | 7 |
| III. | Timber products | 351 | 4 |
| IV. | Rubber products | 401, 402 | 6 |
| V. | Chemical products | 411, 419 | 3 |
| VI. | Non-metallic mineral products | 431, 433, 439 | 3 |
| VII. | Basic metal products | 441, 446 | 3 |
| VIII. | Fabricated metal products | 451, 454, 455 | 3 |
| IX. | Electrical products | 471, 479 | 3 |
| X. | Electronic products | 471, 479 | 4 |
| XI. | Transport equipment | 483, 485 | 2 |
| | | Total | 43 |

TABLE II: LOCATION OF COMPANIES IN THE SAMPLE

| Location | Number of Companies |
|---|---|
| Industrial Estates | |
| Bayan Lepas Free Trade Zone | 2 |
| Prai | 2 |
| Tasek | 2 |
| Ulu Klang Free Trade Zone | 1 |
| Petaling Jaya | 11 |
| Shah Alam | 5 |
| Senawang | 4 |
| Larkin | 1 |
| Tampoi | 4 |
| Towns and Cities | |
| Penang | 1 |
| Ipoh | 1 |
| Kuala Lumpur | 3 |
| Klang | 2 |
| Malacca | 1 |
| Keluang | 1 |
| States | |
| Pahang | 1 |
| Kelantan | 1 |
| Total | 43 |

**WAGE INCENTIVE SYSTEMS**

**Fruit Canning:** The company employed more than 700 workers, of which more than 60% were women. Approximately two-thirds of the work force were members of a national trade union.

The raw material for the product was supplied by the estate owned by the company as well as by small growers. The supply of the raw material was subjected to seasonal fluctuations. The two peak-seasons occur between April and June, and November and January, respectively. During the peak-seasons, the average monthly supply might exceed that of the off-seasons by 2 to 3 times. Daily fluctuations of supply were evident within the peak-seasons as well as the off-seasons. The management reported that during the peak-seasons, the supply each day ranged between 77 and 173 lorry loads, whereas during the off-seasons, the daily supply might range between 8 to 111 lorry loads.

The raw material was highly perishable. It was necessary to process the raw material as soon as possible after harvesting. Lorries, filled with the raw material, arrived at the factory at 7 o'clock in the morning. The day's supply was processed on the same day, without any being left over for processing the following day. Although the volume of raw material supply fluctuated widely over the year, the company maintained a stable employment policy for the production workers.

The uncertain volume of raw material supply meant that the amount of work available could not be limited to 8 working hours a day. During the off-seasons, the direct production workers were permitted to go home when they completed work for the day, which might take 4 to 5 hours only. On the other hand, during the peak-seasons these workers might work 12 to 15 hours a day.

The wage incentive schemes were introduced in 1947. The production standards were set through the application of past production records. When the workers were unionized in 1976, the piece-rates were established through negotiation between the national trade union and the company. The direct production workers like the quality controllers, fork-lift drivers, boilermen, mechanics, and miscellaneous workers were not paid on piece-rates but on monthly rates.

For the direct production workers, both individual and group piece-rates were applied, but the workers covered by the individual piece-rates were in the

minority. The individual piece-rate schemes were applied where individual output could be measured readily, in terms of raw material cut, and the number of cans filled.

In the group piece-rate schemes, the points system was used to determine each employee's share of the total incentive wages earned by the group. A newly engaged worker might be given 8 points whereas another with 5 years of work experience might receive 11 points. The output of the month, measured in terms of standard cases of the product produced, was multiplied by the relevant piece-rates to derive the total earnings of the group. Each employee's share of the group earnings would be calculated by multiplying the points given to him/her by the total group earnings and dividing by the total points acquired by the whole group.

The company applied 74 piece-rates covering individual and group plans, divided into 12 categories. Three of these categories, all pertaining to groups, were multiple piece-rate plans. These plans involved 14 piece-rates each, which decreased in value as output increased, indicating that they were regressive. There was no ceiling to the output produced. Except for these 3 plans, the others were plans with single piece-rates. For all the individual and group plans, the practice of giving guaranteed basic wages was not incorporated.

The payment of wages was made once a month, but workers could apply for an advance in the middle of the month. The wage computations were undertaken on an electronic computer at the company headquarters located away from the factory. When workers on wage incentives took vacation leave, medical leave, and day-off on public holiday, they were paid at wage rates based on the total wages received the previous year divided by the total number of working days. Thus, when a worker received high incentive earnings the previous year, this benefit would again be reflected in the amount of wages he/she received for the officially accepted days-off for the current year.

In 1979, the management reported that a worker on piece-rates would be able to receive an income of $14 to $15 a day on the average, throughout the year. Earnings would be high during the peak-season raw material supply months and low during the off-season months. This situation of fluctuating wage earnings was accepted by the workers. The majority of the workers had been working in the

company for a number of years. They were fully aware of the reason for the fluctuation of their monthly earnings.

**Bottled Soft-drinks:** The company produced one type of product on a mass and batch production basis, with minor changes caused by different requirements of flavouring. Approximately 700 workers were employed in the company's establishment in Malaysia. About 80% of the workers were women. The male workers were mostly engaged in indirect production activities as lorry drivers and attendants, fork-lift drivers, maintenance personnel, boiler attendants, etc. About half the total number of workers were members of the national trade union for the industry.

The existing plant capacity could not fulfil the demand of the Malaysian market, even though the factory operated on 3 shifts. During the festive seasons, the demand could be 2 to 3 times more than normal. The factory was sited in a busy urban area which was close to the distribution points and the labour supply. The major disadvantage of this location was that there was no more space for further expansion of the production capacity to meet the demand.

Two types of wage incentive schemes were applied. The first, called the factory incentive scheme covering the direct production workers, was introduced in early 1974. The other scheme, referred to as the store delivery incentive scheme for lorry drivers and attendants, was introduced during the last quarter of 1975. Only the store delivery incentive scheme is an adaptive wage incentive system and the operation of this scheme is described in further detail. The company employed 3 industrial engineers who were trained both locally and overseas in the application of Methods Time Measurement (MTM) and time study.

Since factory space was limited, storage space was of high premium value. The product was manufactured in bulk, and because of the high demand, it was advantageous for the company to speed up delivery to the customers. The store delivery incentive scheme was designed to meet these requirements.

Not all the lorry crews participated in the store delivery incentive scheme. About 20% of the crews were long-service employees who were not able to adapt to the demands and pressures exerted by this wage incentive scheme. These workers were paid on hourly rates. They were responsible for special bulk order

deliveries which could be undertaken at a more leisurely pace. The others, all younger men, were covered by the store delivery incentive scheme.

This scheme incorporated a number of specific features, centered around the basis of time saved. These features included travel time, call time, loading and unloading time, and an allowance to cater for travel in rainy weather.

Travel time was divided into 3 parts, such as travelling in the city, the suburbs and outstation. Taking the travelling speed in the city as the base, those for the suburbs and outstation travel were increased by 33% and 47%, respectively.

The call time had 2 parts, for major and minor distribution outlets. The major distribution outlets were given 3 times more time than the minor ones. For loading and unloading, the walking distance was considered. The average walking distance was 40 feet. Two time values were given, one for full load, and the other when no load was carried.

The time saved was evaluated in the following manner. When the time saved fell between 0 and 15 minutes the lorry crew did not qualify for any incentive earnings. For time saved between 16 minutes and 45 minutes, this was considered equivalent to half an hour, and for 46 minutes to 60 minutes, this was reckoned as one hour. The lorry drivers were conversant with this practice. They speeded up when they found that they were short by a few minutes to achieve the next time bracket.

When only one trip was made in a day, the incentive wage rate was one and a half times the basic wage rate. But if more than one trip was made, the last trip of the day was paid for at time and a half, whereas the previous trips undertaken earlier in the day were paid for at double rate. The lorry crews under this scheme were not paid any overtime, even when they worked in excess of the normal working hours. Work on overtime was covered at the rate of time and a half which was paid for the last trip. This scheme was designed to encourage the lorry crews to undertake more delivery trips in a day.

The company introduced the rain allowance to compensate for delays due to rain. Previous rainfall records from the Meteorological Department were examined to determine the maximum number of days of rain per month, Rm, and the

average duration of heavy rainfall in minutes, Td. The rain allowance was calculated by applying the following formula:

$$\text{Rain allowance} = \underset{\text{(in a month)}}{\text{No. of rainy days}} \times ((\text{Td} \times \text{Rm})/30) \times \$y,$$

where $y denotes the monetary value assigned, and 30 is the average number of days a month. The average rainfall allowance for each person per month amounted to about $10.00, and was paid in the following month's pay packet.

The store delivery incentive scheme was reported to be operating successfully. Some of the crew members received incentive earnings approximating 75% to 100% of the basic wages.

The management reported that under the scheme, the lorry drivers took more care in the maintenance of the vehicles. Lorries were sent regularly to the company workshop for checks to ensure that break-downs were minimized. Pressure was exerted on the maintenance staff to give good service, and also to get the vehicles on the road as soon as possible. Each lorry crew, consisting of one driver and 2 to 3 attendants, was found to work more co-operatively among themselves because they found that all of them gained from the scheme.

**Timber Products Industry:** In this industry, the adaptive wage incentive system applied has been referred to as the Pok Chow system. Among the 4 companies in this industry that were studied, 3 applied this system.

Pok Chow is a Chinese term, the meaning of which is difficult to explain. A reference to this term indicated that the most appropriate synonym for describing this system is "gang contracting". The workers who are covered by this system are referred to as "gang contractors". Some people refer to this system as profit sharing.

The characteristics of the operation of the Pok Chow system are:

(i) The gang contractors associate together by mutual consent.

(ii) The size of the group is decided upon by the members themselves.

(iii) Earnings received by the group are tied to the units of output.

(iv) The rate of payment per unit is determined through negotiation between the representative of the gang contractors and the company.

(v) The gang contractors establish among themselves their individual work content and hours of work.

(vi) The sharing of the earnings among the group members is determined by themselves.

(vii) The behaviour of the members of the group are governed by rules and regulations which they have established themselves.

The Pok Chow system was introduced since the earliest organized timber operations in Malaysia. This system was operated by the majority of sawmills in this country, and to a limited extent in plywood factories. In the sawmills, the Pok Chow system was commonly applied to the sawyers.

The common practice is that each gang of sawyers consisted of 5 persons. The chief sawyer or head operator was the representative of the group. His share of the group earnings was 26% to 28%, the "saw doctor" and the second sawyer 20% each, and the third and fourth sawyers 16% or 17% each. The "saw doctor" was a skilled worker, responsible for sharpening the saw blades and maintaining the sawing machines. The second sawyer guided the timber log from side to side during sawing, and the third and fourth sawyers held each end of the log.

One company that was studied operated 1 to 3 shifts of 8 hours each over a 6 day work week, depending upon the demand for sawn timber. The output of each gang of sawyers was paid for in dollars per ton. A premium of about 27% was added to the incentive rate after a certain target output for each month was exceeded. Workers on night shift were paid 40% higher than that for work done during the day shift. In this company, the gang of sawyers consisted of 4 persons excluding the "saw doctor" who was separate from the group and paid on a monthly rate. Information concerning the earnings of 6 gangs of sawyers for the

month of July 1977, indicated that these ranged from a minimum of $1,251.58 to a maximum of $2,392.47. Three groups received earnings in excess of $2,000.00.

According to tradition, workers on the Pok Chow system were not covered by the Employee Provident Fund and Social Security contributions by the company, and the Workmen Compensation Scheme. They were also not entitled to medical leave, vacation leave and public holidays with pay, and pension benefits. However, they were entitled to receive the year-end bonus payment.

**Electronic Products Industry:** The adaptive wage incentive system was applied in a company that was considered to be among some of the largest electronic products companies in Malaysia. During the last quarter of 1977, the company employed about 2,700 workers. The majority of the employees, about 90%, were women. These were all between 17 to 22 years of age. About 48% of the workers were employed in the integrated circuits department, 38% in the power rectifiers department, and the remainder consisted of indirect production workers and office personnel. Like other electronic products companies in Malaysia, this company was not unionized.

In the integrated circuits department, the heart of the production process was wire-bonding, which required approximately 50% of the workers in this department to perform the work. In wire-bonding the workers had to look through microscopes. There was fear among the workers that their eyesight would be impaired when they performed this task. The job also required much mental concentration, skill and dexterity. Additional training of 14 weeks was needed.

Initially, all workers in the department with the same seniority were paid on one prescribed hourly rate. Under such conditions, it was found that the majority of the workers would rather work in sections other than wire-bonding. Some of the workers in wire-bonding, who were not permitted to transfer to other sections, resigned their jobs and joined a textiles factory nearby. The textiles factory paid the workers less wages, and the general working conditions were not so good.

The management felt that there was serious undermanning in the wire-bonding section. The introduction of sophisticated high-speed machines to undertake the work was contemplated, but this was rejected because of increased costs and the need to reduce the labour force by 20%. Some of the production supervisors, who

were previously employed in another electronics company in Malaysia where a wage incentive scheme was applied, suggested that such a scheme be introduced.

This suggestion was accepted. The incentive bonus scheme was implemented in November 1976. The standard of performance for the scheme was established locally by 4 industrial engineers who applied the work-factor method as well as time studies. All the industrial engineers were trained overseas. Under this scheme, the incentive point was 100% efficiency. Increments in efficiency above the incentive point in ranges of 5% up to 30%, received incentive bonus payments corresponding to y, 3y, 6y, 10y, 14y, and 18y cents an hour. For efficiencies above 130%, a flat rate of 22y cents an hour was paid. The scheme tended to be slightly regressive. To qualify for incentive earnings, each worker had to achieve a yield of at least 97%. Workers on probation were not permitted to participate. The scheme covered only the workers in the wire-bonding section.

The management reported that the incentive bonus scheme was successful. One month after the scheme came into force, about 10% of the workers qualified to receive the incentive earnings. There was no longer any difficulty in keeping the wire-bonding section fully manned. Workers in the other sections asked to be covered by the scheme as well. The company did not accede to this request because the scheme was specifically designed to keep the wire-bonding section fully manned. The other workers were advised that if vacancies occurred in this section, they could apply to fill them.

Another method was introduced to induce the workers in the wire-bonding section to work harder. Small flags of different colours were used. A flag was placed at the work station of each worker, indicating whether she was a high, average, or low producer. It was reported that this practice produced some positive results. Some of the workers tried to show that they could maintain high performance. Other means of rewarding high work performance included the presentation of cinema tickets and lunch coupons.

The electronic products produced are mainly exported. Thus, the companies that produced these products are subjected to fluctuations in demand of the countries that import such products. During economic recessions when demand is weak, many companies resorted to the practice of laying-off their workers. This practice is a traumatic experience for the company, the workers and their families.

One electronic products company reported that during the economic recession, no workers were laid-off. With the concurrence of the workers, the company could cut back production, thus reducing the workers' earnings since they were operating under a wage incentive scheme. The workers were advised about the adverse economic situation faced by the company. The majority of the workers were willing to share the burden of reduced pay, instead of some workers receiving their full wages while others had to lose their jobs.

During a 3 month period in 1975, each worker in the company worked only 3 days a week. When the economy improved, the company took advantage of the upswing right away. It did not have to wait until such time that additional workers were employed. The company gained the reputation of being a steady employer. With the application of a wage incentive scheme, the company had 25% to 30% leeway or more in production capacity to play with to meet changing economic situations.

**Fabricated Metal Products Industry:** The company introduced the piece-rate plan in 1974 when it was awarded a $20 million contract to supply a large quantity of steel pipes within an 18 month period. A penalty clause was inserted in the contract documents that the time period of supply should not be exceeded.

To meet the output requirements, the company found that it had almost to double its existing production capacity. The company was aware that further contracts of such magnitude would not be readily forthcoming once this contract was completed. Skilled workers were needed in the production of the steel pipes. If the company hired more workers, some of these workers would need to be trained because they were in short supply. At the end of the 18 month period, the newly employed workers would have to be laid-off.

Instead of operating a second shift, the company decided to introduce the piece-rate plan with a guaranteed base-rate, just for the project period. Initially, when the scheme was implemented, output was erratic. When the workers found that they could not make the production target for the day, they lost interest in working hard that day. They knew that they could still receive basic wages even though production was below target. To overcome this problem, the company changed the calculation of incentive earnings from one which covered output for each day to another which covered a one week period. This change proved to be successful because swings in production were dampened. During the

off-production days, the workers still maintained reasonable output tc ensure that the overall weekly production would not be pulled down.

The decision to apply the piece rate plan was justified. The dateline was met because of increased output by the same number of workers as a result of the incentive plan, along with the introduction of overtime work. Providing overtime work alone would be more expensive, and the output without the piece-rate plan would be inadequate. When the steel pipe contract was completed, the company reverted to its previous practice of paying the workers on day-rates.

**Indirect Wage Incentive System**

In an attempt to overcome the problem of absenteeism as well as to ensure that the workers come to work on time, some companies introduced the perfect attendance bonus scheme or the perfect attendance incentive scheme. In 3 companies where this indirect wage incentive scheme was studied, the terms and conditions of the schemes were included in the collective bargaining agreements between the trade union and the companies. All the 3 companies came from the textiles and wearing apparel industry. Evidence had shown that a number of companies in other industries applied this scheme, but the mode of implementation was not entered in the collective bargaining agreements even though some of these companies were unionized.

There is no standardization in the application of the perfect attendance bonus scheme. The terms and conditions of the scheme stipulated by one company, and accepted by the trade union, which appeared to be extensive included the following:

(i) The employee must be confirmed in his/her appointment.

(ii) Any employee who absents himself/herself without leave on more than one day in any month will not be entitled to the bonus for that month.

(iii) All approved annual leave, study leave, casual leave and sick leave entitlement will not be subject to any deduction from the bonus entitlement for that month.

(iv) Any employee who is on approved leave for more than one day other than annual leave, study leave and medical leave, casual leave, will not be entitled for the bonus for that month.

(v) Any employee who is late for more than three occasions will not be entitled to the above said bonus for that month.

(vi) Any employee on maternity leave shall not be entitled to this benefit.

(vii) Any employee who leaves the company's services with the prior approval of the management shall be entitled to the said bonus proportionately.

(viii) The bonus shall be calculated from the date of confirmation of his/her appointment.

(ix) The payment will be made out not later than the end of February each year.

In this company, the perfect attendance bonus amounted to 5% of the total earnings for the month excluding the special relief allowance and the transport allowance. Each eligible employee in the second company was paid the perfect attendance incentive of $5.00 per month. In the third company, the mode of payment of this incentive was more sophisticated. An employee was paid $4.00 for working continuously for any 7 working days, $9.00 for working continuously for any 14 working days, $15.00 for working continuously for any 21 working days, and $23.00 for working continuously for any 28 working days. The period in which incentive payment was assessed would be the one that was the longest.

Among the 3 companies, the scheme implemented by the third company was the most successful. This was because the workers were given more chances to qualify for the incentive payment each month, and also because the incentive was attractive. The schemes operated by the first and second companies were not successful because the amounts of incentive payments were not attractive enough to interest the workers, since the amounts came to 5% and 3% of the wages received by the lowest paid workers in the two companies respectively.

## The Plantation Industry

The largest trade union in Malaysia, the National Union of Plantation Workers (NUPW) has approximately 140,000 members. The employers association for this industry is the Malayan Agricultural Producers Association (MAPA). MAPA consists of about 200 members who are owners of rubber and oil palm estates, palm oil mills, and cocoa, sugar-cane and tea plantations.

NUPW and MAPA have introduced the price bonus scheme in some of the collective bargaining agreements they are signatories to. In the 114 rubber estates which are members of MAPA, the rubber tappers, field and general employees are paid a basic wage of $4.30 a day. The rubber tappers also received a price bonus which is tied to the price of rubber in the market, including an incentive which is tied to the output of each worker as well as to the price range. The rates of payment of the price bonus and the incentive are shown in Table III.

The price bonus rates for the field and general employees in the rubber estates are different from those paid to the rubber tappers. Daily-rated, piece-rated and monthly-rated employees employed in specific estates that are members of MAPA are eligible for the bonus. The rates for this bonus are indicated in Table IV.

The workers employed in the 110 estates growing oil palm and in the 53 palm oil mills who are members of MAPA are also paid the price bonus based on the price of one ton of palm oil in the market. The rates of payment against the price zones are shown in Table V for palm oil mill employees, while that for the harvesters are not shown here because of the complicated nature of the calculations.

In the plantation industry, the prices of rubber and palm oil are determined by the demand for these commodities. Thus, the introduction of the price bonus element will ensure that the rubber tappers, field and general employees in the rubber estates, the harvesters in the oil palm estates, and the oil palm mill workers will benefit when prices of rubber and palm oil are high.

TABLE III: PRICE BONUS AND INCENTIVE RATES IN THE MAPA/NUPW RUBBER TAPPERS' WAGE AGREEMENT, 1979

| Price Zone (in cents per lb.) | 65/70 | 70/75 | 75/80 | 80/85 | 85/90 | 90/100 | 100/110 | 110/120 |
|---|---|---|---|---|---|---|---|---|
| Basic Wage (in $ per day) | 4.30 | 4.30 | 4.30 | 4.30 | 4.30 | 4.30 | 4.30 | 4.30 |
| Price Bonus (in cents) | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Basic Poundage | | | | | | | | |
| High Yield: | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 |
| Low Yield: | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Incentive | | | | | | | | |
| High Yield: | 10 | 11 | 12 | 13 | 14 | 14 | 14 | 15 |
| Low Yield: | 12 | 13 | 14 | 15 | 16 | 16 | 16 | 17 |

TABLE IV: PRICE BONUS RATES IN THE MAPA/NUPW FIELD AND GENERAL EMPLOYEES AGREEMENT, 1979

| Price Zone (in cents per lb.) | 65/70 | 70/75 | 75/80 | 80/85 | 85/90 | 90/100 | 100/110 | 110/120 |
|---|---|---|---|---|---|---|---|---|
| Basic Wage (in $ per day) | 4.30 | 4.30 | 4.30 | 4.30 | 4.30 | 4.30 | 4.30 | 4.30 |
| Price Bonus (in cents) | 20 | 20 | 40 | 40 | 60 | 80 | 100 | 120 |
| Additional Payment (in cents) | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |

TABLE V: PRICE BONUS RATES IN THE MAPA/NUPW PALM OIL MILL EMPLOYEES AGREEMENT, 1979

| Price Zone (in $ per ton) | 500/599 | 600/699 | 700/799 | 800/899 | 900/999 | 1000/1099 | 1100 and above |
|---|---|---|---|---|---|---|---|
| Price Bonus (in cents) | 20 | 40 | 50 | 70 | 80 | 100 | 140 |

## Conclusion

All the cases of the adaptive wage incentive systems, cited in this paper have a number of characteristics. They are all wage incentive schemes that had been introduced to satisfy specific requirements of the companies that introduced them. They are flexible schemes, and may not necessarily cover all the workers in the companies that applied them. They could be applied over specific groups of workers. Sometimes they are applied for a specific purpose over a specific period of time, at the end of which they are discontinued.

The schemes may be applied when the rate of supply of raw material varies, when the company has inadequate storage space, when it is necessary to mitigate against the instability of worker employment caused by the swings of the economic cycle, and to reduce the incidence of absenteeism among the employees. The Pok Chow system has been applied over a number of years in the timber products industry. It can be said that this practice can be considered as a tradition in this industry. Where the adaptive wage incentive systems are associated with direct production, they have a greater tendency to be implemented successfully.

## APPENDIX I
## GENERAL RESEARCH FINDINGS

Among the 43 companies that were studied, 38 had more than 50% of ownership by investors from different national origins. The number of companies with Malaysian majority ownership was 21; British and Singaporean with 5 each; American with 3; Japanese with 2; and followed by Australian, Canadian, Dutch and German with 1 each. The remaining 3 companies had no racial group which held more than 50% of the investment capital. In these companies, all the chief executives were Japanese. The companies with more than 50% non-Malaysian investment capital were either wholly owned subsidiaries of foreign companies or joint-ventures between foreign companies and Malaysians. In the majority of these companies, the chief executives were expatriates.

The companies applied either direct wage incentive systems like the individual, group and plant-wide schemes or indirect wage incentive systems like profit sharing based on merit, merit rating and attendance bonus. It should be qualified at this point that the companies might employ more than one type of wage incentive system at the same time, usually one from the direct incentive group and another from the indirect incentive group. But the system that was selected as being of representative application was the one with the widest coverage. Table 1 gives the breakdown figures of the various types of schemes applied. The more popular systems are the direct wage incentive systems. Among these, the group schemes tended to be the most popular with 24 companies applying them followed by 7 companies that applied the individual schemes and 5 companies that applied the plant-wide schemes.

The group wage incentive scheme had 100% application in the companies in the food products and timber products industries; 83% in the rubber products industry; 67% in the chemical products, non-metallic mineral products and basic metal industries; 37% in the fabricated metal products industry; 25% in the electronic products industry; and 0% in the electrical products and transport equipment industries. The individual wage incentive scheme was applied predominantly in the textiles and wearing apparel industry (57%); the plant-wide scheme in the electrical products industry (67%); and the merit rating scheme in the electronic products industry (67%).

TABLE 1: INDUSTRY AGAINST TYPE OF WAGE INCENTIVE SCHEMES APPLIED

| Industry | Type of Wage Incentive Schemes Applied | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | Individual | Group | Plant-wide | Profit sharing based on merit | Merit rating | Attendance bonus | |
| Food products | | 5 | | | | | 5 |
| Textiles and wearing apparel | 4 | 2 | | | | 1 | 7 |
| Timber products | | 4 | | | | | 4 |
| Rubber products | | 5 | | | 1 | | 6 |
| Chemical products | | 2 | 1 | | | | 3 |
| Non-metallic mineral products | 1 | 2 | | | | | 3 |
| Basic metal products | | 2 | 1 | | | | 3 |
| Fabricated metal products | 1 | 1 | | 1 | | | 3 |
| Electrical products | | | 2 | | | 1 | 3 |
| Electronic products | | 1 | | 1 | 2 | | 4 |
| Transport equipment | 1 | | 1 | | | | 2 |
| Total | 7 | 24 | 5 | 2 | 3 | 2 | 43 |

Experience has shown that the individual wage incentive scheme is more effective in raising productivity compared with the group scheme. The reason why the individual scheme was popular in the textiles and wearing apparel industry was attributed to the fact that many aspects of production were directly under the control of the individual workers. He/she could see the direct benefits that he/she would receive in the form of increased incentive wages if he/she put in more effort on the job. On the other hand, the incentive wages received from the group scheme were tied to the average work effort contributed by all the members of the group. As such, the high producer would contribute a larger share of the group productivity while the low producer would contribute a smaller share. But both would receive the same amount of wages. This practice is not conducive to encourage the high producer to continue to work harder since the benefit he would receive would be less.

Table 2 shows the information concerning the industries and the degree of success in which the schemes were applied. The wage incentive schemes were applied very successfully in 28% of the companies; successfully in 30%; partially successfully in 26%; partially not successfully in 5%; and not successfully at all in 12% of the companies. It can be said that 58% of the companies had achieved favourable results from the wage incentive schemes that they applied. (Schemes implemented very successfully and successfully were considered to produce favourable results, or designated as being favourably successful).

According to distribution by industry, the schemes were 100% very successful in the timber products industry; 67% very successful in the non-metallic mineral products industry; 80% favourably successful in the food products industry; 71% favourably successful in the textiles and wearing apparel industry; 67% favourably successful in the rubber products industry; and 67% successful in the electrical products industry. The companies in the basic metal products, fabricated metal products and chemical products industries tended to achieve less than satisfactory results from the schemes that they applied.

From the information relating to the type of scheme against the degree of success of application as shown in Table 3, it can be observed that among the direct wage incentive schemes, 33% were very successful; 28% successful; 22% partially successful; 6% partially not successful; and 11% were not

TABLE 2: INDUSTRY AGAINST DEGREE OF SUCCESS IN APPLICATION

| Industry | Degree of Success in Application | | | | | Total |
|---|---|---|---|---|---|---|
| | Not successful | Partially not successful | Partially successful | Successful | Very successful | |
| Food products | | 1 | | 3 | 1 | 5 |
| Textiles and wearing apparel | | | 2 | 3 | 2 | 7 |
| Timber products | | | | | 4 | 4 |
| Rubber products | | | 2 | 2 | 2 | 6 |
| Chemical products | 1 | | 1 | | 1 | 3 |
| Non-metallic mineral products | | | 1 | | 2 | 3 |
| Basic metal products | 1 | | 2 | | | 3 |
| Fabricated metal products | 1 | 1 | 1 | | | 3 |
| Electrical products | | | 1 | 2 | | 3 |
| Electronic products | 1 | | 1 | 2 | | 4 |
| Transport equipment | 1 | | | 1 | | 2 |
| Total | 5 | 2 | 11 | 13 | 12 | 43 |

TABLE 3: TYPE OF WAGE INCENTIVE SCHEMES AGAINST DEGREE OF SUCCESS IN APPLICATION

| Type of Wage Incentive Schemes | Degree of Success in Application | | | | | Total |
|---|---|---|---|---|---|---|
| | Not successful | Partially not successful | Partially successful | Successful | Very Successful | |
| Individual | 2 | | 2 | 1 | 2 | 7 |
| Group | 2 | 2 | 4 | 7 | 9 | 24 |
| Plant-wide | | | 2 | 2 | 1 | 5 |
| Profit sharing based on merit | | | 2 | | | 2 |
| Merit rating | 1 | | | 2 | | 3 |
| Attendance bonus | | | 1 | 1 | | 2 |
| Total | 5 | 2 | 11 | 13 | 12 | 43 |

successful. In the indirect wage incentive schemes category, none were very successful; 47% were successful; 47% were partially successful; none were partially not successful; and 14% were not successful.

Tables 4, 5 and 6 show the data relating the methods of measuring work performance against industry, type of wage incentive schemes applied and the degree of success in application, respectively. The methods of measurement can be divided into two categories, the subjective, non-scientific and crude types and the more objective, scientific-based and refined types. The former include the application of personal assessment, negotiated standards and the use of historical data. The latter comprised activity sampling, standards supplied by the parent company, predetermined motion time systems and stopwatch time study. The results show that 56% of the companies applied crude methods of measuring work performance, with 40% making use of historical data. None of the companies in the sample applied activity sampling.

The crude methods were applied 100% in the timber products industry; 80% in the food products industry; 67% in the non-metallic mineral products industry and the fabricated metal products industry respectively; and 57% in the textiles and wearing apparel industry. Approximately two-thirds of the companies in the rubber products, chemical products, basic metal products and electrical products industries applied the refined methods of measuring work performance.

The information relating the methods of work performance to the type of wage incentive schemes showed that the crude methods of measurement were applied in 53% of the direct wage incentive schemes, and 71% in the indirect schemes. The refined methods of measurement were associated with 47% of the direct wage incentive schemes, and 29% of the indirect schemes.

Among the 24 companies that applied the crude methods of measuring work performance, 38% were very successful in implementing wage incentive schemes; 25% were successful; 13% were partially successful; 4% were partially not successful; and 21% were not successful. The companies that applied refined methods were 16% very successful; 37% successful; 42% partially successful; and 5% partially not successful; and none were not successful. The data indicated that 63% of the companies that applied crude methods for measuring work performance achieved favourable success in the implementation of the wage

TABLE 4: INDUSTRY AGAINST METHODS OF MEASURING WORK PERFORMANCE

| Industry | Methods of Measuring Work Performance | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | Not required/personal assessment | Negotiated standards | Historical data | Activity sampling | Standards from parent company | Predetermined motion time systems | Stopwatch time study | |
| Food products | | | 4 | | | | 1 | 5 |
| Textiles and wearing apparel | 1 | 1 | 2 | | 1 | | 2 | 7 |
| Timber products | | 1 | 3 | | | | | 4 |
| Rubber products | 1 | | 1 | | | 1 | 3 | 6 |
| Chemical products | | | 1 | | | 1 | 1 | 3 |
| Non-metallic mineral products | | | 2 | | 1 | | | 3 |
| Basic metal products | | | 1 | | | | 2 | 3 |
| Fabricated metal products | | | 2 | | | | 1 | 3 |
| Electrical products | 1 | | | | | 1 | 1 | 3 |
| Electronic products | 2 | | | | 1 | | 1 | 4 |
| Transport equipment | | | 1 | | | | 1 | 2 |
| Total | 5 | 2 | 17 | 0 | 3 | 3 | 13 | 43 |

TABLE 5: METHODS OF MEASURING WORK PERFORMANCE AGAINST TYPE OF WAGE INCENTIVE SCHEMES

| Methods of Measuring Work Performance | Type of Wage Incentive Schemes | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | Individual | Group | Plant-Wide | Profit sharing based on merit | Merit rating | Attendance bonus | |
| Not required/personal assessment | | | | 1 | 2 | 2 | 5 |
| Negotiated standards | 1 | 1 | | | | | 2 |
| Historical data | 5 | 12 | | | | | 17 |
| Activity sampling | | | | | | | 0 |
| Standards from parent company | | 3 | | | | | 3 |
| Predetermined motion time systems | | 2 | 1 | | | | 3 |
| Stopwatch time study | 1 | 6 | 4 | 1 | 1 | | 13 |
| Total | 7 | 24 | 5 | 2 | 3 | 2 | 43 |

TABLE 6: METHODS OF MEASURING WORK PERFORMANCE AGAINST DEGREE OF SUCCESS IN APPLICATION

| Methods of Measuring Work Performance | Degree of Success in Application | | | | | Total |
|---|---|---|---|---|---|---|
| | Not Successful | Partially not successful | Partially successful | Successful | Very Successful | |
| Not required/personal assessment | 1 | | 2 | 2 | | 5 |
| Negotiated standards | | | | | 2 | 2 |
| Historical data | 4 | 1 | 1 | 4 | 7 | 17 |
| Activity sampling | | | | | | 0 |
| Standards from parent company | | | | 2 | 1 | 3 |
| Predetermined motion time systems | | | 2 | 1 | | 3 |
| Stopwatch time study | | 1 | 6 | 4 | 2 | 13 |
| Total | 5 | 2 | 11 | 13 | 12 | 43 |

incentive schemes, while 53% of the companies that applied the refined methods achieved a similar degree of success in implementation. This finding could be taken to mean that a larger number of companies that applied the crude methods of measuring work performance achieved favourable success in the implementation of wage incentive schemes compared to those companies that used the more refined methods. This result might only be relevant in the local scene because relatively few companies have the trained staff to apply the refined methods. The majority of the companies had to depend on the use of the crude methods in order to make use of wage incentive schemes.

# RESISTANCE TO TECHNOLOGY TRANSFER: REMARKS ON CULTURAL DYNAMICS

by

Giancarlo Quaranta*

During the preparatory stage of this Symposium, one of the positions of Centre February '74 was that there existed no real possibility of a specialistic approach to deal with the Symposium topics. I confirm this position.

Present among us are in fact experts in the field of technology; in the field of the relationship between technology and society; and the specific phenomenon studied in the human sciences called cultural change, as well as experts in development, with a professional variety ranging from pure research to true and proper social technology.

However, we lack specialists in the relationships between culture, development and technology.

I should like now to say a few words about the fact that, above and beyond all the things that have been said, after three days of work and years of reflection, the very concepts of technology, cultural change and development still tend to escape us.

Let us be content with the sole example of the concept of development, to say nothing of culture and cultural change.

The American sociologist Fred W. Riggs, of the University of Hawaii in a text still to be published by UNESCO in collaboration with the Columbia University of New York, but already made available in a major portion to the Centre's journal, Laboratorio di Scienze dell'Uomo, has discovered more than ninety definitions of the concept of development within the sole area represented by texts of political science.

Needless to say, we are now facing a paradox, since on the basis of the concepts of development, plans for intervention are organized, as well as

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investments of human and financial resources, and even multi-annual social programs.

As shown by Dr. Cicerchia, who is present in this Symposium, in the introductory essay in Riggs' work, the difficulty in defining the concept of development strongly affects in a negative way the very possibility of operating in the direction of development.

Evidently, a radical turn is required in the way one knows, deals with and solves such very important problems for the whole of mankind.

Otherwise one risks an anthropological failure of global dimensions.

To avoid such a deep crisis, we must re-think in a new way the concepts of technology, culture and development.

Obviously, this Symposium cannot of itself solve the problem, but it can make a contribution not so much in arriving immediately at new definitions, but rather to give rise to a new way of thinking, which is able to bring about new, and operationally fruitful definitions.

At this stage two observations seem necessary. The first is, why a new way of thinking rather than a new way of acting, is so important.

The second concerns the characteristics that a new way of conceiving technology, development and culture ought to have.

I now formulate the first explicit observation, asserting that the experience of cooperation in development, studied by me in sufficiently vast areas such as the eight Sahelian countries (Senegal, Mali, Mauritania, Niger, Gambia, Chad, Cape Vert and Upper Volta), has largely shown that a merely technical and economicistic trend of programs of cooperation often produced effects which are the antithesis of those hoped for.

We can in fact state that, for example, major parts of agro-alimentary projects which have been carried out in the Sahelian area, have failed even in their economic objectives, precisely, because they have been thought of as mere technical-economic programs.

With regard to this, three examples are of value.

The first example is represented by the relationship between commercial and non-commercial resources.

In almost all Sahelian countries, in fact, the incentive of commercial resources such as cotton and livestock has reduced the non-commercial resources, which are so indispensable for the survival of the population (cereals, etc.), since the major part of the fertile land has been allocated for the expansion of commercial resources, together with the trade network and the infrastructures. This has led to an increase of phenomena such as famine, drought and desertification.

The second example is represented by the ecological paradoxes caused by technological interventions.

It is sufficient to present the case of the uncontrolled import of cattle and the expansion of the network of water wells, which caused, on the one hand, the destruction of the grass and the increase in desertification and, on the other hand, the lowering of the level of the Niger river and an overall reduction of the water supply.

The third example refers to the impoverishment of countries that should receive aid, caused by pathological relationships with the international market, which is concretized in the fact that the whole economy is organized in view of the international market, thereby giving pride of place to only two or three products. The case of Upper Volta is a classic example with regard to this. In fact, consider that in the year 1978, the Upper Volta's Gross Domestic Product was 862 million dollars, 38% of which, equalling 314 million dollars, was represented by the Country's agricultural production. In the same year, Upper Volta's exports were 107.8 million dollars, 95% of which was represented by the sale of agricultural products, and 79% of which was equal to 86 million dollars, by the sale of three products only, namely: livestock, cotton and oil seeds. For the same period, public aid to development was 223 million dollars, 47 million dollars alone of which was allocated for agricultural and rural development, while the alimentary aid amounted to 23 million dollars.

The comparison of these data show that about a third of the agricultural production was set aside for export. Over three quarters of the exported products, besides, came from cultivation or production of the three sole products set aside for foreign trade. This has brought about a kind of production based on the exploitation of the best soil, with sophisticated and intensive techniques and the huge investments of capital. Furthermore, the priority given to such products in the use of the already insufficient infrastructures, for the purpose of favouring exports, has damaged the economic balance of the Country as a whole. This kind of economic policy usually causes, especially when the demand for the privileged products decreases on the international market, not only imbalances in the balance of trade, but also phenomena of true and proper economic and political dependence.

We can say that a way of proceeding in favor of development based on a cold consideration of facts, such as we find in some classics of the sociology of modernization, by virtue of which development coincides with the diffusion of railway networks, the level of electric energy or steel production, or where development coincides with the Gross Domestic Product, cannot but be defined as childish and politically dangerous.

Such a way of proceeding, in fact never takes into account the fact that electric energy, railways or GDP, are just names we attribute not to mere technological or economic processes or mere material objects, but complex human and cultural phenomena.

I cannot avoid but express my gratitude for the effort of the Honda Foundation which, by means of a set of symposia begun in 1976, and above all in the recent symposium in London, April 1983, has tried to stress the intrinsic humanistic nature of technological processes. I will try to go a step further, if I may be permitted, and attempt to stress the scientific coordinates of a new discipline, so to speak. Hopefully, this will enable us to grasp not only the humanistic nature of technological processes, or the non-merely economicistic perspective of development, or the fact that in every trait of cultural change human psychology is even painfully involved. But above all, the theoretical and, therefore, scientific and hence measurable relationships between technology, cultural change and development, should be considered.

**RESISTANCE**

Since it is a matter of an initial form of contribution, my task shall be realized only by starting out from the observation of a system of phenomena whose reality is not in question.

I intend to speak about resistance to the introduction of new technologies, or to the change of technologies even in already industrialized societies.

It will be thus possible to discover, for example, how a dam with its effects in the fields of energy and food production, is never just "a thing", but always a cultural system, and that it requires to be designed as such.

The second explicit observation derives directly from the former, and can be summarized in the aphorism according to which technology, culture and development are often just different facets of the same human existence.

A new way to get close to such an existence is therefore required, which will keep the positive analytic attitude of the scientific treatment so far matured, while trying, both from the methodological and operational points of view, new forms of synthesis.

New forms, to be explicit, which will not bind culture to a system of mere variables, that is a system of accidental elements, but will allow technology to be seen in terms of culture and culture in terms of technology.

This having been said, I would consider it advisable to come to examine some cases, which have been observed for almost a decade of research and surveys carried out by the Centre February '74, directed for the most part by myself in America, Africa and the Middle East, as well as to describe summarily and rapidly some empirical data from a research on planning in Sahel, committed to us by our Ministry for Foreign Affairs.

**With reference to the surveys carried out in Africa, America and the Middle East,** I can point out the following data, which are exemplary with regard to the different types of resistance to technological change and technology transfer, namely:

(i) Resistance of a religious origin:

(a) Navajo revolt in 1978, Shiprock, against the uranium mining which, upsetting the soil, violated the myth of the sacredness of Mother Earth; and

(b) the sense of compulsion among South-Western American Indians causing them to take part in both family and community religious ceremonies (in contrast to work timetables), the violation of which, as ascertained during 1979-1981 surveys, could involve the loss of heredity rights or family status.

(ii) Obstacles deriving from space alteration:

(a) the case of deviance and illness of a social origin (such as anorexia and heart attack), brought about among Egyptian Nubians by the reduction of housing space after the construction of the Aswan High Dam and their removal to a desert zone in 1964; and

(b) the abandonment, by polygamic social groups, of villages that were built according to the pattern of the nuclear family in Algeria, which was observed during a survey in 1981.

(iii) Inadequacies in the management of systems of service: like in the case of the city of Kinshasa, Zaire, where from a total of 1349 buses only 134 were circulating in 1977, for a total population of nearly 3 million inhabitants, while 1215 buses were out of order due to lack of spare parts.

(iv) Marginalization and destruction of ethnic groups:

(a) of Bushari nomads, on the boundary between Egypt and Sudan, who have lost, since the building of the Aswan High Dam, pastures, wells and markets, without any indemnity;

(b) of Tuareg nomads in Algeria, who have been egged on, without any success, to become settled peasants, and have instead become smugglers, unemployed or dependent on social welfare; and

(c) of Maasai nomads in Tanzania, toward whom restrictive regulations are applied, concerning hunting, herd mobility, weapon use and above all nomadism, which is leading to the extinction of the population arising from their pathological refusal of any form of technological renewal.

**With reference to Sahel,** I can offer some empirical data from a research committed to us, as mentioned by our Ministry for Foreign Affairs.

A recurring problem is represented by the difficulties deriving from the lack of supplying materials and of technical assistance, both during the interventions, and after their conclusion. In Senegal, during an USAID (United States Agency for International Aid) intervention, 100% of the pumps for irrigation have definitively broken down, due to lack of maintenance and lack of personnel capable of providing such maintenance and, in general, of guaranteeing control and ensuring the fixing of the plants.

Negative population reaction to technological innovations is often tied to the very scarce involvement of the population even as unskilled manpower. Furthermore, we have to say that of the 800 interventions considered in Sahel, not one is exclusively directed by local personnel.

Training courses fail due to the choice of students and/or teachers, as often the population, in the case of the first, does not accept; for example, that women should have an active role in production and, in the latter case, refusal of low-status teachers.

This happened in Mali, in an USAID project, because the teachers were mere civil employees, or in the case of Kaarta, again in Mali, where they were too young. This is to say nothing of the case where the personnel is inadequately trained or the courses badly carried out. In another USAID project in Mali, courses for functional literacy and the training of 160 rural divulgers and farmers for the production of millet, lasted only three days.

Often the tradition of every family to cultivate its own field has been an obstacle to the success of interventions, such as in Niger, within the framework of a French programme in Dosso, which provided for the introduction of cooperatives and forms of collective ownership.

In Niger a PNUD-UNICEF intervention even tried to create fishermen cooperatives in a cultural area where the population traditionally reckon fish to be the cause of leprosy.

Particularly recurrent is the phenomenon of the refusal of new forms of time organization, involved in all technology transfer. In 1978, in Senegal, for instance, within the framework of the Anambé project, the population refused a new agricultural calendar, indispensable for the new irriguous agriculture, which was replacing the previous alluvional one, thereby practically causing the whole project to fail.

I spoke above of the need for a scientific approach which would permit technology to be thought out in terms of culture and culture in terms of technology, so as to attain correct information about the problem of development.

The cases which I have briefly looked at are all cases of resistance - mostly unexplainable in accordance with common sense - toward operations of technological change or technology transfer, which seemed to the organizing bodies or the governments concerned during the project stage, to be positive.

Particularly in Sahel, the relationship between approved projects and failed interventions is impressive.

I shall try to order the empirical data previously outlined, in order to overcome the common sense which is peculiar not only to politicians, but is often also characteristic of the men of technology themselves.

I will proceed according to two theoretical-methodological scenarios, that are the theory of living systems and the theory of evolutionistic structuralism.

## RESISTANCE

Each of these two theoretical frameworks will provide a priori information capable of explaining the causes of the unexpected resistance to technological renewal.

In other words, we could say that each of the two theoretical frameworks represents an explanatory and interpretative model, with predictive attitudes.

### Theory Of Living Systems

It is possible to apply this theory to culture. I cannot on this occasion present the complex use of the diverse concepts which derive from it.

Instead, the model can easily be made operational by applying the concepts of negative and positive feedback to the couple input-output, as well as the concept of receptor.

It is obviously necessary to homogenize all the cultural material, be it ritual or new technology or any consumption good, as was already tested in our own researches and those of others, by means of the concept of information. In this way it is possible to affirm that when a cultural system, i.e. a culture, articulated in subsystems, receives an input containing a new information pool that is exogenous cultural material, there are two kinds of reactions.

The first one can be a reaction of positive feedback, consisting in the fact that the culture is not able to receive or to stop the new input, thus accentuating its strength and even its destructive effects, which in the case of technology transfer will consist of the a-critical acceptance of the new technology as a "thing", the destruction of large traits of the original culture, and finally even in the abandonment of the new technology. The new technology may not be kept for solely apparent technical reasons, such as when due to the incapability of learning, the lack of spare parts or the impossibility of coordinating the new technology with the other systems of subsistence.

The second reaction could be that of negative feedback, which takes place when the new input is absorbed and then kept by the culture's receptors, that is its extra-somatic and collective memories, which are represented by language, ritual, institutional processes, mythical contexts and space-time field.

I will limit myself to stressing the opportunities which an explanatory model grounded on such theory can offer concerning resistance to technological change.

Such a model, in fact, tells us that culture is a system of systems interacting according to quantitative and qualitative relationships, which are determined and not casual.

It is thus possible to ascertain that, once the modification of a unit of a system or a subsystem has taken place, there will be a corresponding and complementary alteration in the other units of the system considered and in the other subsystems.

Within this framework, it is possible to state that technology is not a "thing", but a subsystem of the cultural system within whose interior it has been produced.

Technology, furthermore, is something which concerns not only the "subsistence" subsystem of a culture, but involves all the other subsystems of the culture concerned.

A specific technology of a specific culture contains somehow the conception of time, rituality, symbols, mythical contexts, institutionalization processes, values of such a culture.

Conversely, when technology encounters a new culture, it not only alters the subsystems of the system of this culture, but affects also all the other subsystems, ranging from mythical contexts to status formation processes, to symbols, to rites, and so on.

In such a case, the new technology is accepted not as a thing, but as a cultural system which fits in, more or less harmoniously, with the recipient culture.

In this way, resistance is either reduced or does not arise at all, because the new technology is somehow masticated and digested by the culture of arrival. The new technology is disaggregated in its hidden elements and, so to speak, reconstructed on the basis of a re-elaboration of these elements, which are

rituality, mythical contexts, the space-time field and so on, in syntony with the pre-existing ones.

It is necessary to state that any technology is at once a system of techniques and a social system. In other words, it requires and produces new traits of social organization.

This means that any technology, even the simplest, is structurally tied to given institutional processes, values, status, and typical roles. It has its own juridical norms and physical infrastructures which are moulded on the basis of the above mentioned social factors, as well as on the basis of material needs.

To introduce a new technology without also taking into account the sociological nature of the problem, often causes resistance effects such as those we have hitherto stressed; the most important of which is certainly represented not so much by the direct refusal of the technology in question (this case rarely occurs), but rather by the progressive expulsion of the new technology from the recipient society. This happens:

(i) **either because the social organizational traits necessary for the new technology are not quantitatively adequate** (suffice it to recall, in the case of certain technologies, the problems of a trade network for the distribution of spare parts with scarce peripheral ramifications);

(ii) **either because these traits are qualitatively inadequate,** in the sense that they contrast, for instance, with core aspects of the recipient system. Some examples are processes of status formation (it could be the case with the schools for technicians in Sahel); the family structure (when nuclear houses are built in societies with multinuclear or joint families); and religion. In the example for religion, it could be the case of the timetable of work contrasting with the religious calendar, or the relationship between the working week and religious feasts, which creates problems also in Italy, where the recent abolition of some religious feasts, for productivity

requirements, has caused widespread discontent among the population.

**The second explanatory model**, drawn from the new theories of evolutionistic structuralism recently elaborated by D'Aquili, Laughlin and McManus, tells us what is the real relationship between man and environment; and gives us precious information about this relationship.

According to the above mentioned authors, all living organism have two environments. The first is called "operational environment" (abbreviation Eo) and is represented by the system of relations and events which are experienced by the organism having contact with the environment for his own survival.

We could say that this environment is the one which is considered by the external observer or which is definable from factual elements observable by anybody.

The second environment, of no lesser importance than the former, is called "cognized environment" (abbreviation Ec), and has a statute which is mainly collective and mental though not psychological.

It arises from what the authors call "cognitive imperative", which characterizes all living beings, and particularly man.

We could define this imperative as an inexorable requirement, **vis-a-vis** every phenomenon occurring in the operational environment (Eo) to reply - prior to producing any kind of even motor operation - to the question "What is this?".

The true environment of an organism, according to the theory we are examining, is therefore the one about which one believes to know the explanations of the relationships between phenomena, as casual relationships or relationships in accordance with the scheme of oppositions or diads.

Such an environment has been built by the "homo" kind, especially by means of language and has been concretized in an assiduous myth-making and symbolic activity.

## RESISTANCE

The theory we are dealing with offers a particularly useful model to help understand the resistance to technological change without attaching to peoples involved in the technology transfer, the attribute of stupidity.

The model, in fact, (and this could be our conclusion) tells us that man has two environments, Eo and Ec, and that acting on Eo only, one does not act globally on the eco-anthropological relationships of a population, but only one aspect of it.

In fact, there is also the other side of the coin, that is Ec, which is maybe the most human - not humanistic - but nonetheless real part of the man-environment relationship.

In it we find myths, we experience the power of symbols and institutions, where causal explanations are innerved, maybe not very scientific from a Western point of view, but with a social and cultural strength which cannot be overcome or ignored, or dispensed with by salesmen speeches.

If one does not also work on Ec, one will not understand the resistance of many populations in the process of accepting technological innovations. In fact from the point of view of Ec, many of these innovations involve the shifting of the greater part of individuals from the cultural core to its periphery, and at the same time also involving that overall anomy which characterizes the societies which are the object of modernization and acculturation processes.

Acting on Eo only one produces a dangerous destruction of Ec; dangerous because man cannot live without meanings or explanations. Otherwise, there will be an increase of anxiety, anomy and above all a loss of meanings, which does not bind itself to the religious sphere, but involves the whole of existence.

Probably in the light of the theory of the two environments or double environment of man, it is possible for social scientists, economic agents, technologists and politicians, to learn firstly how cultural change occurs and how man or a society can be changed; and, secondly, that only a harmonic relationship between Eo and Ec could produce that process of development, somehow enigmatic because it is not mere economic growth. As I have said earlier, notwithstanding the ambiguity of the term, but probably with great

confidence in the possibility of man's emancipation and redemption, we continue to call this desired process **development**.

# THE IMPACT OF JAPANESE INVESTMENT IN MALAYSIA: A SUMMARY OF EMPIRICAL WORK DONE

by

Chee Peng Lim*

Lee Poh Ping*

## Introduction

Our study of the impact of Japanese direct investment in Malaysia was first undertaken in the year 1978 in a joint research project with the Institute of Developing Economies in Tokyo; the study was subsequently updated to 1980. Our main objective was to collect basic data on Japanese investment, and then to use them to analyse their impact. What motivated us then was a belief in the importance of this subject-matter (investment, together with trade, constituted two of the most important aspects of Japanese economic relations with Malaysia and Southeast Asia), and the almost complete lack of systematic empirical studies of this investment as it related to Malaysia. We also held to the belief that such a topic could not be completely understood without some knowledge of the political background, in this case that of the international political environment of Japanese relations with Malaysia and Southeast Asia.

The following sources were used. In 1978, there were five. The first source came from a general survey of Japanese enterprises carried out by the Japanese Embassy and the Japan External Trade Organization (JETRO). The Survey was carried out in 1974 and covered a number of areas such as period of establishment, number of employees, value of turnover, and the contributions of Japanese firms to the local community. The second source came from a current listing of Japanese enterprises in Malaysia maintained by JETRO. This list was compiled in February 1978. The JETRO list included such information as location, date of establishment, number of employees, and type of activity. The third source came from a sample survey of eighteen Japanese firms which we carried out. The sample firms were located all over Malaysia and the relevant personnel interviewed with the help of a structured questionnaire (Appendix I). Almost all the firms were selected from the manufacturing sector because this

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was the fastest growing sector in the Malaysian economy and also one which had the highest proportion of Japanese investment. Furthermore, the manufacturing sector had strong linkage effects and is important in terms of employment generation and transfer of technology, the two issues which form the focus of this study. The fourth source of data came from primary (such as newspapers and documents) and secondary sources (such as relevant books). The fifth source consisted of discussions and interviews with Malaysians who have been involved with Japanese enterprises, with Japanese scholars and others who gave much insight into the topic.

In 1980, we supplemented the data collected with a survey of Japanese joint ventures in Malaysia, and updated them with the 1980 JETRO compilation of Japanese companies in Malaysia.[1]

Basically, we investigated the following areas:

(i) the historical-political background of Japanese relations with Malaysia and its relationship with investment;

(ii) the general characteristics of Japanese direct investment in Malaysia such as incentives for Japanese firms, their size, the equity structure, their partners, their market, and their profits;

(iii) the impact of this investment on employment, training, subcontracting; and

(iv) on the transfer of technology. (Because of its relative importance, this presentation also involves some discussion of the findings).

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1 JETRO. Japanese related companies in Malaysia. Kuala Lumpur, April 1980. Mimeo.

These were our findings:

(i) Foreign policy changes in Japan and the nature of Japanese political relations with Malaysia and Southeast Asia influenced Japanese investment in Malaysia and Southeast Asia. This can be best seen by outlining the stages of Japanese political involvement in Southeast Asia.

(a) 1951, 1957-1958 - problem of reparation war memories made investment difficult;

(b) 1957-1958, late 1960's - settlement of reparations with Indonesia and Philippines allowed for cautious beginning of Japanese investment in Malaysia and Southeast Asia. At the same time the assumption of premiership by Nobusuhe Kishi brought a greater political interest in Southeast Asia.

(c) Late 1960's to 1980 - pressures on Japan to play a role from the United States, some Southeast Asian countries and within Japan commensurate with her economic strength greatly increased Japanese investment, this time even including projects of vast capitalization.

(ii) We found that the basic reasons for Japanese investment in Malaysia were market considerations, Malaysian government incentives and resource exploitation. Japanese firms in Malaysia were generally small in size. The figures for 1980 show that slightly less than half the firms employed less than 50 workers while about 13% of the firms employed 500 or more workers. These were not only small in terms of employment; but they were also small in terms of paid-up capital. Nearly a third of these firms had less than $ million paid-up capital each; less than 16% of the firms have paid-up capital of less than $250,000. The majority of firms with a low paid-up capital were engaged in trade and services. Regarding the equity structure, the data for 1974 shows that of the 163 Japanese firms then in Malaysia, 20 were wholly-owned by Japanese investors. The rest were joint ventures with Malaysians. The

local partners of Japanese firms, consisted of government or quasi-government dominated organizations and invividuals. In a number of cases, they included a Japanese trading company which invariably consisted of one of the big trading companies such as Mitsubishi Corporation, Mitsui Co. Ltd., and so on. The local partners were mostly distributors or principal customers. In part, the selection of these partners was an act of expediency, since 'ease of entry' was an important consideration in establishing a joint venture. It was also a matter of habit. Japanese companies regarded a business relationship as being fundamentally an organic link, which should grow and flourish. They prefer to do business with people they know, if for no other reason than that this tended to be a very practical way of reducing uncertainty. The Japanese firms generally produced for the domestic market, and most of them fell into the import substitution category. There was, however, some tendency to an increase in export oriented type of investment. With respect to profit, data collected from our survey from firms show that Japanese firms in Malaysia were making reasonable profits. Only one sample firm suffered a loss in 1977, and that was probably due to the fact that the firm had just been established.

(iii) The major impact of Japanese direct investment or JDI on the Malaysian economy is seen mainly in the area of employment, training, subcontracting and the transfer of technology. We were unable to study the impact of JDI on other areas of the Malaysian economy such as its effect on the Balance of Payments, because of the lack of data. We begin with employment.

**Employment**

Malaysia has an unemployment rate in excess of 5% of the labour force, and every year nearly 150,000 workers enter the labour market. At the same time, Malaysia also suffers from a shortage of skilled and experienced industrial workers. This shortage may be attributed to the inadequacy and shortcomings of government-sponsored training schemes to meet the demand for skilled workers. In view of these two problems, unemployment and shortage of skilled workers, obviously the objective of government policy is to generate more employment

opportunities and increase the reservoir of skilled manpower. It follows that Japanese enterprises would have a favourable impact on the economy if they can contribute towards the achievement of this objective.

With respect to employment, Japanese firms in Malaysia employ a total of 50,371 workers, 89% of whom are in manufacturing. This, of course, is only a fraction of the total labour force in Malaysia which numbers more than 5.4 million. The bulk of the workers in Japanese firms is employed by large companies employing 250 and more workers. On the whole, it would appear that Japanese firms are rather capital-intensive since it takes an investment of about $18,000 to provide a job for one worker. The reason may be that most of the Japanese firms are concentrated in the manufacturing sector which is relatively capital-intensive compared, to say, the service sector where there are very few Japanese firms.

In line with the government policy of providing more industrial employment to bumiputeras, about 45% of the workers in Japanese firms are bumiputeras. Japanese employees form only about 2.4% of the total labour force. Again in line with government policy, Japanese personnel in Japanese firms are mainly restricted to top line managers or professionals. The line-up, of course, reflects the composition of Japanese equity and control in the firms. Where the Japanese investors have a controlling interest in the firm, the chief executive is generally a Japanese. Other top posts generally held by Japanese expatriates are the posts of Production Manager and Chief Engineer. This is not surprising since the Japanese partners are generally responsible for the technical side of the joint ventures (see below).

In the 1978 study, we found that the largest number of Japanese expatriates in any one firm is 12. The firm referred to is a wholly-owned Japanese subsidiary producing electronic components, all of which are exported. The firm has a total labour force of 450 workers and was established in 1974. The posts held by the Japanese are as follows: Managing Director, Technical Director, Finance Manager, Planning and Purchase Manager, Quality Control Manager, Production-cum-Chief Engineer and Process (Engineers). Generally, a large number of Japanese expatriates are sent before production commences. The Japanese help to get the firm ready for production and supervise initial production runs. The number of such staff may be quite large. In one electronic component manufacturing firm, for example, the parent company sent

about thirty to forty technical experts over a period of time to set up the factory and install the machinery. However, once the factory is running smoothly, the number of Japanese expatriates is reduced.

In almost all cases, the Japanese expatriates came from the parent company and had been working there for a considerable length of time. They were also well qualified and had considerable experience. For example, the Managing Director of an electronic component firm has a doctorate in engineering and did his postgraduate training in the U.S. He had worked with the parent company for twelve to thirteen years. Previously, he worked with a government organization dealing with telecommunications. His last post in the parent company was that of General Manager. The Japanese Managing Director of another electronic component company also has an electrical engineering degree and was the President of one of the parent company's subsidiaries in Japan before being posted here.

**Training**

Apart from generating employment opportunities, Japanese firms also have a favourable impact on the economy if they help to train the local workers, and thus build up a pool of skilled manpower. At every level of activity, from production worker to manager, if Japanese firms develop trained and disciplined workers, the host country gains. This is, in fact, a true externality since the development of skills is considered to be one of the most important aspects of development, and the transplanting of skills is considered to be one of the important external effects of foreign investment. In our previous study, we found that all Japanese firms in the sample had training schemes for local workers. Training activity is generally intensified in the initial stages of a new project, or with the introduction of a major change in technology. Most firms provide on-the-job training, although quite a number also send their employees to the parent company for training. In some cases, trainees are also sent for training with machinery suppliers. The trainees usually include those designated to become supervisors and engineers. However, a nucleus of production workers is sometimes included. These worker-trainees are expected to act as pace-setters in their own plants.

The training courses generally vary from 3 to 6 months. During that time, the trainees are assigned to the same operations and equipment that they will be working on when they return to their own plants. As a rule, Japanese firms do not mind investing time and money in exposing their foreign workers to the in-plant operations and production culture of the Japanese parent firms. Unfortunately, sometimes the investment has to be written off because a number of trainees leave to join other firms, once they have completed their training programme. As a result, some of the Japanese firms have reduced the number of trainees sent overseas and instead concentrate on local on-the-job training programmes.

The number of trainees sent on courses to Japan is quite large in some Japanese firms. One electronic component manufacturer, for example, has sent 160 workers to Japan. The workers come from all levels although they comprise mainly of staff having supervisory rank or above. All its managers and trainees are trained in Japan. The firm has 640 workers.

Apart from training their own workers, some Japanese firms also provide training for outsiders. This refers mainly to local suppliers and distributors. The training of suppliers and their local employees was undertaken to ensure appropriate levels of equality, reliable delivery, after-sales service, and so on. Such training, however, was rather rare and mainly confined to firms which depend heavily on subcontracting. The normal procedure followed in training local suppliers was to send an engineer and a quality-control man to the supplier, sometimes for a period of months, to attempt to iron out difficulties directly in the plant. A diesel engine assembler not only provides training for supplier firms but also trains officials and students from various government bodies such as the Fisheries Development Authority (MAJUIKAN), Tunku Abdul Rahman (TAR) College, Fishery Institute and MARA.

Training provided to distributors was more often concentrated on promoting and developing more effective channels for marketing, distributing, and servicing the products. This may be due to the scarcity of effective distributors and dealers. The training of distributors and dealers generally took three forms: training in how to sell the product, training in how to service the product, and training in how to manage a growing independent business (including inventory and cost control).

**Subcontracting**

The Japanese economy is well-known for its reliance on subcontracting. Indeed, this practice makes a significant contribution to the efficiency of the Japanese economy. In view of this, one would have thought that Japanese firms would introduce such a practice to Malaysia and, in doing so, would have helped the development of local ancillary firms and, perhaps in the long run, also improve the industrial efficiency of the Malaysian economy. Unfortunately, however, there is not much evidence that Japanese firms in Malaysia are making a useful contribution in this respect. When asked if they obtain any of the components used in the assembly of their final products from local firms, many Japanese firms answered in the negative. When pressed for an explanation, they offered the usual excuse - nobody is making the component locally. If the component were manufactured locally, then the excuse would be that the local component is relatively expensive or of poor quality.

It is, of course, possible that the excuses may be valid, but given their experience in developing ancillary firms, the Japanese firms in Malaysia, one could have hoped, would take the lead in stimulating such firms locally by encouraging the production of components which are still being imported, or help in improving the quality and price of existing components. We tried to look for such evidence in our 1978 study but could hardly find any. In short, Japanese firms in Malaysia do not appear to have very strong linkages with local firms.

Let us consider the demand for local raw materials. Apart from Malayawata Steel Berhad which makes maximum use of local raw materials (iron ore and charcoal), a number of Japanese firms use imported raw materials. In some cases, this is because the material is not available locally or the local material is not suitable. As a result, some firms use a high proportion of imported materials. For example, in the Japanese textile mill, all the cotton and chemicals are imported. Only the caustic soda is purchased locally. In the case of a firm manufacturing nuts and bolts, the steel is imported from Japan because local steel is not suitable for the required quality specifications of the final product. A Japanese electronic component manufacturer only purchases its soldering flax and resin locally. All other materials - wafer, cradel, gold tape, and gold wire are imported. According to the firm, these materials are not available locally.

We now come to the components. As in the case of raw materials, many of the components used by Japanese firms in the assembly of their final products are imported, mainly from Japan. For example, an electric cable manufacturer imports its aluminium rod, copper wire and polythene tape from Japan; its PVC from Singapore; and buys the steel wire from a local supplier. Imports from Japan form 59.3% of the total value of the product; imports from Singapore 21.5% while the rest comes from local sources. A diesel engine assembler only makes use of the locally-made wooden base and wooden box. These comprise less than 5% of the value of the engine. All other components are imported from the parent company. However, the firm said that it would be manufacturing some of the components locally in future. These would include the flywheel, engine side cover, piston, filter, copper pipe, wire, cable, starting chain and exhaust system. The firm is enjoying pioneer status and, according to it, one of the conditions required the firm to manufacture at least 20% of the value of the parts used in the assembly of the engine.

The progressive manufacture of components produced or the use of components produced by local suppliers may be a hopeful sign for the future. The case of a spark plug manufacturer is one illustration. The manufacturer was established in 1974. Initially, all the components used in the assembly of its spark plug were imported from Japan. In 1976, it started the first stage of its manufacturing programme by producing talc powdering, sheet packing, wire packing and terminal nuts. At the second stage, which will begin in 1979 it will manufacture metal shells with side electrodes and gaskets. The firm has no plan to proceed beyond the third stage and will thus continue to import the following components from its parent company: ceramic insulation with centre electrodes and raw materials for sheet packing, wire packing, terminal nuts, gaskets and metal shells which are imported prepressed.

For another illustration, we consider the case of an electrical appliance manufacturer whose products probably incorporate a relatively high percentage of local content. Its electric fan has 70% local content. All the components used in the assembly of the fan are purchased from local suppliers except for the switch, gear and bearing metal, all of which are imported. Its television receiver has 65% local content. The local components include the capacitator, resistor, turner, plastic parts and wooden cabinet. This particular firm has established a wholly-owned subsidiary to produce electronic components, such as the variable resistor and electrolytic capacitator.

Another electrical appliance manufacturer reported the local content as a proportion of total value in its final products as follows: T.V. receiver 20%, electric fan 60%, refrigerator 30%, and air conditioner 10%.

Unfortunately, the above illustrations appear to be the exceptions rather than the rule. Most products of the Japanese firms here still have a low percentage of local content. However, the government is keeping up its pressure on Japanese firms to induce them to use more locally produced components. Under such pressure, a Japanese telecommunications equipment manufacturer has started producing its own coil and transformer. At the moment, it is evaluating the production of printed circuit boards. In the case of an agricultural machinery assembly firm, one of the conditions attached to the approval of its licence was a requirement to use the following locally produced components: tyre, cables and wires, nuts and bolts, metal sheet covers and paint. In addition to these components, the firm is required to progressively delete from its completely knocked down (c.k.d.) pack a list of rubber and plastic parts specified by the government. These deleted items are checked once a year when the firm's licence comes up for renewal, Japanese firms using local components tend to buy from only one or two suppliers. Unlike the situation in Japan, the relationship between the purchasing and supplying firms is not very close. According to the Japanese firms, the local suppliers prefer to be independent instead of being tied closely to one purchaser. In any case, the volume supplied to any one firm is relatively small, so the suppliers need more than one purchaser. In view of the loose ties between the Japanese firms and their suppliers, we did not expect the former to provide any technical assistance to the latter. In fact, among the sample firms, only one respondent stated that it advised its suppliers on measures to rationalize their production systems. This firm also trained personnel from the supplier firm.

Finally, another type of local purchase which Japanese firms can do more of, is the purchase of local machinery. Some Japanese firms do purchase local machinery but these are mainly confined to simple machinery as jigs, tools and dies. In addition equipment are also fabricated locally. Thus, a spark plug manufacturer said that its conveyor system was designed in Japan but fabricated locally.

To sum up, the extensive use of domestic materials promotes significant linkage effects to stimulate the growth of domestic input industries. The above evidence suggests that Malaysia has not benefited greatly from the possible linkage effects of JDI.

**Transfer Of Technology**

Foreign investment normally results in a transfer of considerable technology to the host country. Such a transfer of technology is sometimes considered to be the major benefit of foreign investment. This is particularly so for a developing country like Malaysia which has a wide technology gap. Thus, in order to evaluate JDI in Malaysia adequately, it is necessary to consider not just its proximate effects on employment, training and the like, but also to look at the transfer of technology.

However, while the mere transfer of technology may be important, it is also necessary to consider the extent to which the technology transferred has been adapted to suit the local environment. Technology developed in the developed countries is generally based upon the requirement of such countries, and not upon the requirements relevant to the developing countries. As a result, the technology developed is often of a capital-intensive nature, whereas the relevant one would require a labour-intensive or, at least an intermediate technology. In view of this, not just the extent but also the type of technology transferred to Malaysia by Japanese firms will be examined.

The transfer of technology can take the following forms:

(i) Transfer of designs, use of patents, blueprints, technical literature and technical advice;

(ii) Transfer of machinery and equipment including a complete "turn-key" point; and

(iii) Transfer of skill.

The transfer of designs, patents, etc., generally comprises a small proportion, compared with other forms of transfer, such as the transfer of machinery and skill. For this reason, we will concentrate mainly on the transfer of machinery. The transfer of skill has already been described earlier.

**Transfer Of Machinery And Equipment**

Japanese firms in Malaysia rely heavily on their parent firms for much of their durable and non-durable capital goods. In a number of cases, all the imported machinery used in the firms originated from Japan. Some of the joint venture agreements between Malaysian and Japanese investors have a clause mentioning the obligation of the affiliated companies to purchase certain key non-durable capital goods from their parent or related firm in Japan unless this was disadvantageous to them in terms of cost, quality or time of delivery. Aside from such clauses, it is also possible that heavy reliance on Japanese products may be due to their competitiveness as well as the bias of most Japanese managers. Some of the Japanese managers interviewed, however, claim that they do not show any undue favouritism on their part towards Japanese products. There may be some truth in this since a number of non-Japanese firms are also using Japanese machinery. However, there have been complaints by some of their local partners that Japanese machinery has been imported even though the cost is higher than machinery of similar quality available in other countries. In fact, if Japanese products were truly competitive in price, quality, and delivery time with goods from other countries, Japanese investors should strike out clauses on the obligatory purchase of Japanese machinery from their joint venture agreements.

By and large, the machinery used in Japanese firms is not the most up-to-date by Japanese standards. In some cases, the reason is that the most up-to-date machinery is too sophisticated and too capital intensive to suit the volume of local operation. In fact, the size of the local market, rather than factor endowments, appears to dictate the choice of capital goods. In a few cases, the Japanese firms did say that they did not use the most advanced machinery because they wanted to provide more employment (which might be another way of saying that they wanted to take advantage of the relatively low wage situation in Malaysia).

The purchase of used machinery is not very common among Japanese firms. When such a purchase is made, there is generally a good reason for it. For example, a Japanese textile mill bought reconditioned machinery from Japan because there was a boom in textile machinery. The waiting time for new textile machinery was three years. In view of this, the firm decided to buy reconditioned machinery which was readily available.

An interesting example of technology transfer which concerns a Japanese firm with very little Japanese equity suitably concludes this chapter. The managing director who is Malaysian, wanted his factory manager to gather more information about the manufacture of nuts and bolts. So he sent his manager to Osaka Rashi, a Japanese manufacturer of high quality nuts and bolts for export to the U.S.A. Osaka Rashi provided the manager full access to its technical know-how even though the company had no equity in the local firm. When asked to give what he thought was the reason for this cooperation, the managing director said that Osaka Rashi, producing at full capacity, was not worried about competition from any other firm. In fact, Osaka Rashi hoped that the local firm would be able to achieve international standards so that it would be able to supply those customers which Osaka Rashi had to turn away. This same firm also obtained some training facility from a machinery supplier in Japan, who sent two engineers to train its local staff.

From the above discussion, it is clear that Japan is an important supplier of technology to Malaysia. Although figures are not available an indication of the importance of Japanese technology exports to Malaysia may be seen in Table I, which shows the export receipts for Japanese technology from various sources in 1979. Table I shows that export receipts from the Japanese is highest for Southeast Asia.

**Transfer Of Appropriate Technology**

Whether the most appropriate technology is transferred via direct investment depends upon the degree of substitutability between capital and labour in the product process and on the composition of production. Considerable evidence suggests that, in many large-scale manufacturing operations, the opportunities are limited for choosing from among the available tehnologies more economically efficient and at the same time labour-intensive techniques. Still, examples are

TABLE I: JAPAN'S TECHNOLOGY EXPORT RECEIPTS FROM VARIOUS SOURCES, 1979

| Region | % |
|---|---|
| Southeast Asia | 31.5 |
| Europe | 15.3 |
| North America | 13.8 |
| East Asia | 10.3 |
| Latin America | 7.8 |
| Rest of the world | 21.3 |
| Total | 100.0 |

Source:

Professor T. Roehl, School of Business Administration University of Washington.

available of adaptations in technology to take advantage of the difference in factor costs between developed and developing contries. The choice of product-mix probably has a greater effect on the capital intensity of production for the economy as a whole.

Japanese direct investment in Malaysia tends to concentrate in those sectors where opportunities are limited for choosing the most appropriate type of technology. Thus, in most cases, most Japanese firms introduced their production technology to Malaysia intact. Adaptation was made only in a few cases. In such cases, adaptation was mainly in respect of production equipment and production techniques rather than in terms of product design. Adaptations were more frequent, the higher the degree of local ownership and control and the greater the independence of the subsidiary from the parent company.

The most important reason given for technological adaptation was to scale down plant and equipment to the lower volume found in the Malaysian market. This was particularly true in the case of Japanese firms producing exclusively or mainly for the local market. There were relatively few instances of adaptation to take advantage of low labour cost, or to make up for the absence of skilled labour in Malaysia. Most of the other reasons given for adaptation were related to requirements of the local market dictated by special characteristics of demand, government regulations and standards, or the quality of raw materials and components purchased locally under mandatory requirements.

Finally, it should also be noted that an important requirement for technological adaptation is the establishment of local Research and Development (R & D) facilities. In our 1978 study, we found that none of the Japanese firms has established such facilities and we believe the same applies to most of the other firms outside the sample.

## APPENDIX I: SURVEY QUESTIONNAIRE OF JAPANESE DIRECT INVESTMENT IN MALAYSIA

Nameof Enumerator:_____ Date _____

Sample No.:_____ Name of Firm: _____

Address:_____

### A. Employment & Training

1. What is the average turnover rate per annum of your workers by type of employment?

   (i) foreman and supervisor _____%
   (ii) production workers _____%
   (iii) all other category _____%

2. Please give particulars of the foreign workers employed in your firm by type of workers as follows:

| | | No. of foreign workers | |
|---|---|---|---|
| | | Japanese | Non-Japanese |
| (a) | (i) Management | _____ | _____ |
| | (ii) Technical/Professional | _____ | _____ |
| | (iii) Foreman & Supervisors | _____ | _____ |
| | (iv) Other (specify) | _____ | _____ |

   (b) How many Japanese workers came from the parent company?_____

   (c) How many Japanese workers did you have initially?_____

3. Did the parent firm send any technical experts to start production in the firm? If yes, how many experts, how long were they here and what type of experts?

4. How many workers in your firm have been provided with training opportunities by type of training?

| | | On-the-job | Off-the-job In-plant | Off-the-job Out-of-plant* |
|---|---|---|---|---|
| (i) | management | _____ | _____ | _____ |
| (ii) | foreman/supervisor | _____ | _____ | _____ |
| (iii) | production worker | _____ | _____ | _____ |

* If Off-the-job Out-of-plant training is provided, state the name of the training institute and place:

5. What is the average duration of each type of training provided?

| | | |
|---|---|---|
| (i) | on-the-job | _____ year |
| (ii) | off-the-job in-plant | _____ year |
| (iii) | off-the-job out-of-plant | _____ year |

6. Do you provide any training for your supplier firms and distributors? If yes, please describe the training provided.

7. Do you have any problem getting work permits for your expatriate staff? If yes, please explain.

## B. Production and Technology

1. Of the five major pieces of machinery used in your firm, how would you rank them

| | | | |
|---|---|---|---|
| (a) in terms of model | - (i) | oldest | [ ] |
| | (ii) | latest | [ ] |
| | (iii) | intermediate | [ ] |
| (b) in terms of automation | - (i) | completely automatic | [ ] |
| | (ii) | semi-automatic | [ ] |
| | (iii) | manually operated | [ ] |

2. From which country or countries did the above 5 major pieces of machinery originate?

   Were they purchased new or secondhand?

3. What is the most difficult production process in the manufacture of your main product? What is the length of training required for this process? Do you have any problem training the workers to use this process? If yes, please explain.

   (i) most difficult process
   (ii) length of training required
   (iii) problem in training

4. Where do you carry out maintenance and repair of your machinery?

   (i) in your own firm
   (ii) outside your firm - 1. by an outside local firm
   2. by an outside foreign firm

**JAPANESE INVESTMENT**

5. Did your firm make any technological adaptation for the Malaysian environment in terms of

   (i) product design
   (ii) production design
   (iii) production equipment/machinery
   (iv) organization

   If yes, please describe

   (i) the nature of the adaptation

   (ii) the cost of the adaptation

   (iii) the reasons for adaptation

## C. Linkages

1. Was any part or component used in the manufacture of any of your products purchased from an outside local manufacturer in 1977? If yes, please indicate as follows:

| | Part/Component Purchased | % of Total Value of Finished Product |
|---|---|---|
| (i) | _____ | _____ |
| (ii) | _____ | _____ |
| (iii) | _____ | _____ |
| (iv) | _____ | _____ |
| (v) | _____ | _____ |
| (vi) | other | _____ |

2. How many local suppliers do you have and what do they supply?

| Supplier | Items Supplied |
|---|---|
| Supplier 1 | _____ |
| Supplier 2 | _____ |
| Supplier 3 | _____ |
| Supplier 4 | _____ |
| Supplier 5 | _____ |
| Supplier 6 | _____ |
| Supplier 7 | _____ |
| Supplier 8 | _____ |
| Supplier 9 | _____ |

**JAPANESE INVESTMENT**

3. What value percentage of total requirements of materials and services was supplied by:

   (i) local firms _____%
   (ii) parent company _____%
   (iii) other (specify ) _____%

4. If import requirements are substantial, is this because local suppliers are

   (i) not available
   (ii) not competitive, that is, prices too high
   (iii) not up to quality specifications
   (iv) other reason (specify )

5. Has any local supplier come into being as a result, direct or indirect, of your activities? If yes, how many?

   Number of local suppliers _____

6. Has any local distributor or sales organization come into being as a result, direct or indirect, of your activities? If yes, how many?

   _____

7. Are you taking or planning to take any positive step to encourage local entrepreneurship? If yes, please describe.

8. Do you have any plan to use more locally produced components in the manufacture of your main products in the near future? If yes, please explain.

## D. General Information

1. Please indicate the distribution of ownership of your firm based on capital invested as at 31.12.77 as follows:

| | | |
|---|---|---|
| (i) | Local | _____% |
| (ii) | Foreign - Japanese | _____% |
| | non-Japanese | _____% |
| | Total | 100% |

2. Has there been any equity restructuring in the firm since its establishment? If yes, please explain what happened.

3. Does the firm plan to restructure its equity in the near future? If yes, please describe the plan.

4. Do you have to seek approval from your parent firm if you wish to make a decision in any one of the following areas:

   (i) capital investment
   (ii) financial loan
   (iii) product change and diversification
   (iv) appointment to Board of Directors
   (v) pricing policy
   (vi) disposition of earned profits
   (vii) export market development
   (viii) domestic market development
   (ix) production volume.

5. Why did your firm choose Malaysia for its investment location?

6. Do you have any licensing agreement with any foreign firm? If yes, what restriction if any, is contained in the agreement? (Alternative question: Are any of the following restrictions contained in the agreement?)

   (i) export restriction - please explain
   (ii) tied purchase (equipment/material) - please explain
   (iii) restriction on production pattern - please explain

**JAPANESE INVESTMENT**

7. Do you export any of your products? If yes

   (i) what percent of your total sales is exported? _____%
   (ii) what percent of your export goes to Japan? _____%
   (iii) what other countries do you export to (in order of importance?)

8. How much did your firm spend on advertising in 1977?

   $ _____

9. Please estimate the market share for your main product in Malaysia as a percent of the total market?

   _____%

10. How many other firms are producing the same product as your main product in Malaysia?

    No. of other local firms _____
    No. of other foreign firms _____
    No. of other Japanese firms _____

11. What was your firm's net profit after tax in 1977?

12. Can we have a copy of the following:

    (i) annual report
    (ii) company and product brochure

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Name of Person interviewed: _____
Status of person interviewed: _____
Was the respondent

   (i) very co-operative _____
   (ii) quite co-operative _____
   (iii) nonco-operative _____

## APPENDIX II: SUPPLEMENTARY QUESTIONNAIRE

1. Where is the firm located?

   (i) an industrial estate
   (ii) free trade zone
   (iii) an urban area
   (iv) a rural area

2. In what year was the firm registered/incorporated? _____

3. What is the legal organization of the firm?

   (i) individual proprietorship
   (ii) partnership
   (iii) private limited company
   (iv) public limited company
   (v) other (specify _____)

4. What was the total book value of the fixed assets in the firm in December 1977?

   $ _____

5. Please list the products traded/manufactured by the firm in 1977. (Please enclose a product brochure if available.)

| | Product | % of Total Sales |
|---|---|---|
| (i) | _____ | _____ |
| (ii) | _____ | _____ |
| (iii) | _____ | _____ |
| (iv) | _____ | _____ |
| (v) | _____ | _____ |
| (vi) | other | |
| | Total | 100 |

6. When the firm first started production what was

   (i) its initial investment $ _____
   (ii) its value of initial turnover $ _____
   (iii) its initial labour force _____ workers

7. How do you sell your finished product and what percent goes through each channel?

   (i) directly to final consumers
   (ii) through retailers
   (iii) through wholesalers.
   (iv) other (specify _____)

8. What was the total payroll for the firm in 1977? $ _____

9. Please indicate your labour force as follows:

| | Category | Parttime | Fulltime |
|---|---|---|---|
| (i) | managerial, professional, technical and supervisory | _____ | _____ |
| (ii) | clerical & related occupation and general workers | _____ | _____ |
| (iii) | directly employed factory worker | | |
| | 1. skilled | _____ | _____ |
| | 2. unskilled | _____ | _____ |
| (iv) | factory workers employed through contractor | _____ | _____ |
| (v) | other (specify_____) | | |

10. What incentive or assistance has the firm received from any organization or government?

    (i) pioneer status (number of years _____)
    (ii) investment tax credit
    (iii) labour utilization relief
    (iv) export incentive

(v) location incentive

(vi) other fiscal incentive (specify _____)

(vii) non-fiscal incentive or assistance (specify type and source):

11. Please give a brief history of the firm as well as any brochure or pamphlet relating to it.

## Chief Executive

1. **Age (years)**

| Less than 30 | 30 - 39 | 40 - 49 | 50 - 59 | More than 60 |
|---|---|---|---|---|
| | | | | |

2. **Sex**

| Male | Female |
|---|---|
| | |

3. **Race**

| Malay | Chinese | Indian | Other |
|---|---|---|---|
| | | | |

4. **Formal Education**

| Level of Formal Education | Primary | Secondary | | Other Post Secondary | University |
|---|---|---|---|---|---|
| | | Lower | Upper | | |
| (i) Main medium of instruction | | | | | |
| (ii) Qualification obtained | | | | | |

5. **Professional Qualification and/or Training**

6. **Previous Occupation and/or Experience**[1]

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[1] If your previous occupation and/or experience was unrelated to your present occupation, please explain how you were able to initiate your present establishment.

## APPENDIX III: JAPANESE FIRMS IN MALAYSIA BY PERIOD OF ESTABLISHMENT, UP TO 1980

| Type of Activities | Before 1960 | 1960-1964 | 1965-1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Manufacturing | 4 | 11 | 29 | 12 | 6 | 12 | 36 | 19 | 7 | 5 | 2 | 3 | 12 | 6 | 164 |
| Mining | - | - | 3 | - | - | - | 2 | 1 | - | - | - | - | - | - | 6 |
| Trading/Commerce | 9 | 7 | 8 | 4 | 3 | 2 | 8 | 6 | 3 | 6 | 2 | 2 | 2 | - | 62 |
| Finance/Insurance | 1 | 1 | - | 1 | - | 2 | 4 | 4 | 2 | - | - | - | 1 | - | 16 |
| Construction/ Engineering | - | - | - | - | 1 | 5 | 5 | 1 | 6 | 1 | 2 | 5 | - | - | 26 |
| Miscellaneous | 1 | 1 | - | 1 | 1 | 1 | 4 | 2 | - | 3 | 1 | - | 1 | - | 16 |
| Affiliated firms | - | - | - | 1 | - | 1 | 2 | 2 | - | - | 1 | - | 1 | - | 8 |
| Total | 15 (5.0) | 20 (6.7) | 40 (13.3) | 19 (6.4) | 11 (3.7) | 23 (7.7) | 61 (20.4) | 35 (11.7) | 18 (6.0) | 15 (5.0) | 8 (2.7) | 10 (3.3) | 17 (5.7) | 6 (2.0) | 298 (100.0) |

Source:

JETRO.

## APPENDIX IV: TYPE OF INVESTMENT INCENTIVE RECEIVED BY JAPANESE FIRMS IN MALAYSIA, 1980

| Types of Investment Incentive | No. of Firms | % |
|---|---|---|
| Pioneer Status | 52 | 15.8 |
| Investment Tax Credit | 3 | 0.9 |
| Labour Utilization Relief | 1 | 0.3 |
| Incentive Period Ended | 38 | 11.6 |
| Incentive not specified | 2 | 0.6 |
| No response | 198 | 60.2 |
| No incentive | 35 | 10.6 |
| Total | 329 | 100.0 |

Source:

JETRO.

APPENDIX V: DISTRIBUTION OF PAID-UP CAPITAL IN JAPANESE FIRMS IN MALAYSIA BY TYPE OF ACTIVITY, 1980

| Activity | Paid-up capital ($'000) | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | Less than 250 | 250 to 499 | 500 to 999 | 1,000 to 2,999 | 3,000 to 4,999 | 5,000 to 9,999 | 10,000 to above | |
| Manufacturing | 11 (7.4) | 12 (8.1) | 14 (9.4) | 43 (28.9) | 28 (18.8) | 21 (14.1) | 20 (13.4) | 149 |
| Mining | - ( - ) | 1 (33.3) | - ( - ) | 2 (67.7) | - ( - ) | - ( - ) | - ( - ) | 3 |
| Trading/ Commerce | 9 (56.3) | 2 (12.5) | - ( - ) | 4 (25.0) | - ( - ) | 1 (6.3) | - ( - ) | 16 |
| Financing/ Insurance | - ( - ) | - ( - ) | - ( - ) | 4 (33.3) | 2 (16.7) | 4 (33.3) | 2 (16.7) | 12 |
| Construction/ Engineering | 6 (50.0) | 3 (25.0) | - ( - ) | 1 (8.3) | - ( - ) | 1 (8.3) | 1 (8.3) | 12 |
| Miscellaneous | 6 (46.2) | 2 (15.4) | 1 (7.7) | 2 (15.4) | - ( - ) | - ( - ) | 2 (15.4) | 13 |
| Affiliated firms | 1 (33.3) | - ( - ) | - ( - ) | 1 (33.3) | 1 (33.3) | - ( - ) | - ( - ) | 3 |
| Total | 33 (15.7) | 20 (9.6) | 15 (7.2) | 57 (27.4) | 31 (14.9) | 27 (13.0) | 25 (12.0) | 208 (100.0) |

Note:

Figures in brackets refer to percentages.

Source:

JETRO.

## APPENDIX VI: DISTRIBUTION OF EMPLOYMENT IN JAPANESE FIRMS IN MALAYSIA BY TYPE OF ACTIVITY, 1980

| Activity | Employment Size Group | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Less than 25 | 25-49 | 50-74 | 75-99 | 100-249 | 250-499 | 500-999 | 1000 & over | |
| Manufacturing | 12 (8.6) | 11 (7.9) | 8 (5.7) | 19 (13.6) | 40 (28.6) | 22 (15.7) | 17 (12.1) | 11 (7.9) | 140 |
| Mining | - ( - ) | 2 (66.7) | - ( - ) | - ( - ) | 1 (33.3) | - ( - ) | - ( - ) | - ( - ) | 3 |
| Trading/ Commerce | 25 (64.1) | 9 (23.1) | 2 (5.1) | - ( - ) | 3 (7.7) | - ( - ) | - ( - ) | - ( - ) | 39 |
| Financing/ Insurance | 6 (40.0) | 6 (40.0) | 2 (13.3) | - ( - ) | 1 (6.7) | - ( - ) | - ( - ) | - ( - ) | 15 |
| Construction/ Engineering | 12 (70.6) | 1 (5.9) | - ( - ) | - ( - ) | 1 (5.9) | 2 (11.8) | 1 (5.9) | - ( - ) | 17 |
| Miscellaneous | 8 (57.1) | 2 (14.3) | 2 (14.3) | - ( - ) | 1 (7.1) | - ( - ) | 1 (7.1) | - ( - ) | 14 |
| Affiliated Firms | - ( - ) | 2 (50.0) | - ( - ) | - ( - ) | 1 (25.0) | - ( - ) | 1 (25.0) | - ( - ) | 4 |
| Total | 63 (27.2) | 33 (14.2) | 14 (6.0) | 19 (8.2) | 48 (20.7) | 24 (10.3) | 20 (8.6) | 11 (4.7) | 232 (100.0) |

Note:

Figures in brackets refer to percentages.

Source:

JETRO.

## APPENDIX VII: TOTAL NUMBER OF JAPANESE FIRMS IN MALAYSIA BY TYPE OF ACTIVITY, 1980

| Type of Activity | Total No. of Firms | % | Peninsular Malaysia | | East Malaysia | |
|---|---|---|---|---|---|---|
| | | | No. of firms | % | No. of firms | % |
| Manufacturing | 155 | 47.1 | 146 | 53.3 | 9 | 16.4 |
| Mining | 7 | 2.1 | 4 | 1.5 | 3 | 5.5 |
| Trading/Commerce | 81 | 24.6 | 50 | 18.2 | 31 | 56.4 |
| Finance/Insurance | 16 | 4.9 | 16 | 5.8 | - | - |
| Construction/ Engineering | 30 | 9.1 | 22 | 8.0 | 8 | 14.5 |
| Miscellaneous | 16 | 4.9 | 16 | 5.8 | - | - |
| Affiliated Firms | 24 | 7.3 | 20 | 7.3 | 4 | 7.3 |
| Total | 329 | 100.0 | 274 | 100.0 | 55 | 100.0 |

Source:

JETRO.

## APPENDIX VIII: NUMBER OF JAPANESE FIRMS IN MALAYSIA BY TYPE OF MANUFACTURING ACTIVITY (3 DIGIT LEVEL), 1980

| Manufacturing Activity | No. of Firms | % |
|---|---|---|
| Spinning, weaving and finishing of textiles (331) | 17 | 11.0 |
| Sawmill, planning and other wood mills (351) | 16 | 10.4 |
| Radio and communications equipment including electronics products (473) | 16 | 10.4 |
| Iron and steel basic industries (foundries) (442) | 10 | 6.5 |
| Industrial chemicals (411) | 9 | 5.8 |
| Miscellaneous electrical apparatus, not elsewhere classified (479) | 8 | 5.2 |
| Miscellaneous chemical products (419) | 7 | 4.6 |
| Mfr. of rubber products, n.e.c. | 6 | 3.9 |
| Mfr. of furniture and fixtures except primarily of metal | 6 | 3.9 |
| Vegetable and animal oils and fats, not elsewhere classified (412) | 5 | 3.2 |
| Mfr. and assembly of transport vehicles | 4 | 2.6 |
| Cables and wires | 4 | 2.6 |
| Canning, preserving and processing of fish, crustacea and similar food (304) | 4 | 2.6 |
| Mfr. of soap and cleaning preparations, perfume, cosmetics and other toilet preparations (419) | 3 | 1.9 |
| Mfr. of plastic products, n.e.c. (341) | 3 | 1.9 |
| Mfr. of wire and wire products (453) | 3 | 1.9 |
| Mfr. of pottery, china and earthenware (433) | 3 | 1.9 |
| Mfr. of fertilizers and pesticides (419) | 2 | 1.3 |
| Electrical appliance (472) | 2 | 1.3 |
| Clothing factories (343) | 2 | 1.3 |
| Mfr. of synthetic resins, plastic material and man-made fibres except glass | 2 | 1.3 |
| Mfr. of paper & paper products, printing and publishing | 2 | 1.3 |
| Others | 20 | 13.0 |
| Total | 154 | 100.0 |

Note: Figures in brackets refer to the Revised Malaysia Industrial Classification

Source: JETRO.

## APPENDIX IX: JAPANESE PRIVATE DIRECT INVESTMENT IN MALAYSIA (AS OF MAY 1978)

| Code Sectors | No. of Case | | Part of cap. paid in by Jap. Enterprise (1,000 US$) | Share of Japanese Capital (%) | Total paid up capital of local Enterprise (1,000 US$) |
|---|---|---|---|---|---|
| | Number | % | | | |
| Total (All Sectors) | 185 | | 248,787 | (31.2) | 797,228 |
| Manufacturing | 117 | 100.0 | 165,633 | (46.2) | 358,821 |
| Processed Food | 2 | 1.7 | 3,026 | (57.8) | 5,238 |
| Textile and Textile Products | 12 | 10.3 | 66,468 | (62.1) | 107,106 |
| Pulp & Paper | 7 | 6.0 | 3,373 | (66.6) | 5,065 |
| Woods & Wooden Products | 9 | 7.7 | 4,439 | (38.3) | 11,584 |
| Chemicals | 19 | 16.2 | 5,259 | (27.2) | 19,359 |
| Rubber and Rubber Products | 4 | 3.4 | 1,309 | (44.5) | 2,939 |
| Cement and Ceramics | 7 | 6.0 | 6,067 | (25.8) | 23,535 |
| Metals and Metal Products | 15 | 12.8 | 15,382 | (36.7) | 41,914 |
| Machinery | 1 | 0.9 | 466 | (39.2) | 1,189 |
| Electrical Machinery | 21 | 17.9 | 32,726 | (86.1) | 38,027 |
| Transportation Equipment | 7 | 6.0 | 21,452 | (23.0) | 93,107 |
| Precision Instruments | 3 | 2.6 | 2,266 | (98.7) | 2,297 |
| Other Manufacturing Products | 10 | 8.5 | 3,400 | (45.6) | 7,462 |

Source:

Katano, H. Japanese enterprises in ASEAN countries. Kobe, Kobe University, 1981.

## APPENDIX X: EMPLOYMENT IN JAPANESE FIRMS IN MALAYSIA, 1974

| | (A) Total Employees (persons) | (B) Bumiputra Employees | Percentage share Column B / Column A | Japanese Employees |
|---|---|---|---|---|
| (a) Manufacturing | 23,457 | 10,796 | 45.9 | 418 |
| (b) Trading | 291 | 85 | 15.8 | 46 |
| (c) Financing/insurance | 347 | 119 | 34.3 | 21 |
| (d) Construction | 974 | 444 | 45.5 | 101 |
| (e) Others | 145 | 52 | 35.9 | 26 |
| Total | 25,214 | 11,496 | 45.6 | 612 |

Source:

The Japanese Embassy.

# DEVELOPMENT OF INGENUITY IN ENGINEERING EDUCATION

by

Toshiro Terano*

## From Imitation To Creativity

When learning new things, we begin by imitating others. Infants learn how to speak and act by imitating grown-ups' speech and behaviour. In the case of most sports and accomplishments, learners also begin with the training of standard form. These standard forms are the results of the accumulated wisdom and experience of our forerunners, and imitating such standards is a shortcut to attaining proficiency.

The question is how far should learners continue to imitate others when learning new things. The target of a learning process is not fixed; rather, it is usually reset at higher levels as the student makes progress. J. Rasmussen (1981) in Denmark divides the errors commited by workers during plant operation, for instance, into three different levels. Accordingly, it is desirable that safety education for operators be given at these different levels.

Skill level comes first. Operators should be trained to respond automatically to prevent any danger accompanied by machine failure. Training at the skill level is also necessary to prevent traffic accidents, or to ensure appropriate measures are taken in the event of an earthquake or fire. This may be the training of standard form. The second level is called the rule level, and training at this level is required to prepare for more complex problems for which the appropriate response is difficult to determine intuitively. In this case, operators are required to refer to an operational manual to find the response applying to any specific trouble. A manual is a textbook in which potential causes of trouble are listed, and applicable countermeasures are described as rules. Training at this level is no better than imitation, in that standard rules must be followed. It must be noted, however, that at the rule level operators are required to find rules which apply to any particular case by

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himself. This is a level of education where operators require the ability to use knowledge already acquired.

The third level is the knowledge level. Most serious plant accidents may be attributed to a combination of causes. An unlimited number of combinations of causes can be considered, which cannot all be described in the manual. Therefore, operators must make the most of their own knowledge and experience to detect the causes of an accident and consider appropriate measures to cope with the situation. This is a creative approach to problem solving. For this reason, operators acting at this level inevitably do so as individuals and the approach varies. Thus, learning should not end with imitation, even though it should begin at this level. Learning should be elevated to the level of creativity. If the learning process ends with imitation, it cannot contribute to the development of society, and there are cases where it produces adverse effects upon not only the person involved but also others. It should be remembered in this connection that whether it is possible to raise the level of learning depends more upon the quality of instructors than upon the trainees' eagerness and ability to learn.

**Knowledge And Intellectual Faculties**

Rapid technological progress has been made in recent years; therefore, university students majoring in engineering must acquire an enormous amount of knowledge. They are so occupied filling their heads with knowledge that they cannot afford to spare time to fully absorb or apply the knowledge crammed into their heads. This kind of education is liable to cultivate men of encyclopaedic knowledge, and not creative men who can think and act for themselves.

I would now, like to discuss the relationship between knowledge and intellectual faculties. It was thought in the past that intellectuals naturally had depth of knowledge, and that the converse was also true. With the development of computers and the progress of research relating to artificial intelligence, however, it has become clear that the relationship does not always hold true. Today's computers have an enormous memory capacity and do not forget. Their operating speeds are also very fast, so it may be said that computers surpass human beings by a long way as far as volume and accuracy of knowledge are concerned.

However, despite the fact that many scholars specializing in artificial intelligence have endeavored to provide computers with creative power, they have not yet succeeded in doing so. For instance, games which are very easy for human beings to play and objects that are extremely easy for them to recognize, are very difficult for computers to play or recognize. This is attributable to the fact that while computers are good at logical and analytical processes, creative faculties are based on illogical and synthetical thinking. Scholars have given up the idea of providing computers with creative functions, instead, they are conducting research relating to a man-machine system in which computers are assigned to memorizing and processing knowledge and simple reasoning, while human beings are assigned to take charge of creative and synthetical functions by engaging in a dialogue with computers. Perhaps, I am going too far in saying this, but it seems to me that profound knowledge will no longer be a prerequisite to intellectual faculties and only creative acts will remain within the intellectual province of human beings.

Incidentally, what motivates human beings to carry out creative activities? I think it is man's will to live and lead a better life. To have a target at all times and to be eager to attain the target causes an enormous amount of knowledge to be concentrated in a point, and then new ideas come up in the brain. Therefore, if the creative power of students is to be promoted, it is necessary to have the students set goals and train them to concentrate their minds on the attainment of the goal. It goes without saying that this suggests a different approach to knowledge education.

When I visited a Swiss engineering university some years ago, I was surprised to find that the advanced mechanical engineering course was divided into disciplines such as "automatic control" and "hydroelectric power generation". According to a professor, this system was not designed to cultivate specialists in small branches of study. As a matter of fact, graduates were employed in various different fields. The professor said that the object of the system was to select concrete examples from such small branches of learning and teach the scheme of mechanical engineering through actual problems, and that this way made it easier for students to understand that engineering is goal-oriented.

In Japan on the other hand, general theories are taught first, and examples are given later. It is certain that this method is more effective in educating

students at an imitation level. From the viewpoint of creative education however, it is difficult to state positively that the Japanese method is superior to the Swiss method.

## Systems Engineering As Creative Methodology

I have already argued that goal-oriented thinking is vital for creativity, but what methods are available to train students to have goal-oriented minds must receive attention. I think that one answer to this question is the way of thinking adopted in systems engineering.

Primarily, systems engineering is a methodology intended to develop new large-scale systems in a rational way. It has some characteristics missing in conventional engineering, and the way of thinking adopted in systems engineering is best suited to the cultivation of a creative approach to problem solving. This is attributable to the fact that only a major target is set for a project. The engineers involved are required to realize a system which satisfies the goal without having any knowledge of the project details of the method or means of completing the system. This method is also applicable to minor creative problems.

I would like to refer to the characteristics of the approach involved in systems engineering, namely:

(i) Total thinking:

First, the background and prerequisites of a given target or problem are analyzed to grasp the general outline of the target. This means objective study of the target at a higher level, and doing so facilitates the understanding and assessing of the target or problem itself.

(ii) Structure of target:

An overall target is divided into intermediary targets which in turn are divided further into detailed targets. These general, intermediary and detailed targets can be expressed

hierarchically in the form of a tree graph, by using which the details of the multiobjective problems are clarified, and the creation of alternatives for attaining the targets is made easier.

(iii) Creation of alternatives:

Several alternative methods for attaining a target must always be considered. This is because considering alternatives is an effective way of understanding that the solution of an engineering problem is not unique; and that because the resulting synergistic effect stimulates ideas the comparative assessment through such a method of considering alternatives is easier.

(iv) Analysis and synthesis:

In designing systems, a problem is analyzed into its components which in turn are brought together in a new structure. Thus analysis and synthesis are repeated.

(v) Teamwork:

The development of a system cannot be accomplished by a single person. A team must be organized and the team members would cooperate in tackling the problem. During the process, group discussion for developing ideas, division of work among the team members and leadership are required, while self-assertion and understanding other members' opinions are promoted.

(vi) Procedure of development:

A minute procedure is established to facilitate smooth development, under the constraints of resources and time.

## Examples Of Creative Education In Engineering Schools

The Control Engineering Department of the Tokyo Institute of Technology, where I taught until last year, had curricula intended for the development of creativity. For instance, "Creativity Training" is given to sophomores. They are made to acquire an approach to problem solving through creative thinking. Juniors have a course of study entitled "Design of Control Systems", in which each team consisting of eight members is required to design an unit embodying a given time.

As indicated in Table I, all the themes given to students related to problems which had not been tackled before. Team members put their heads together, check available data, perform calculations, consider the means of solving the problem, prepare a design drawing and present it together with a paper. Professors attend students' discussions, but do not in principle interrupt them with remarks, although they do teach the students how to carry out discussions and give hints when the team members get stuck. Each team presents an interim report and a final report, which are then subjected to criticism by all the students belonging to the other teams.

All seniors are assigned to present graduation theses, and they devote a whole year to that end. They prepare these under the guidance of their academic advisors. Of these quite a few are worthy of being read at meetings of the related academic society.

At the graduate school, they have a course called "Automatic Control Practice". In this course, the "Design of Control Systems" is elevated to the level where actual units are manufactured according to the designs. In other words, whereas seniors are required to embody given ideas in the form of designs, graduate students are required to manufacture real objects based on such ideas. The budget available for manufacturing is limited to Yen 50,000 per idea, and the time allowed is six months. Many teams devote their Summer vacation to these projects.

One team consists of five graduate students. Some of the themes so far taken up are listed in Table II. The efforts made and abilities displayed by graduate students often prove to be greater than we had expected. They devote themselves to research, experimentation and manufacture even on holidays, and

TABLE I: SOME OF THE TOPICS USED IN "DESIGN OF CONTROL SYSTEMS"

| TOPICS |
|---|
| . A bed specially designed for a bedridden old person |
| . A facility that can accommodate a great number of bicycles at a time |
| . A painting which changes its composition |
| . An automatic door - "Open Sesame" |
| . A device to prevent cranes from swinging |
| . Marionettes that play out a drama |
| . A robot that cleans power-transmission lines damaged by briny air |
| . A device which can perform cutting test for cutlery |
| . Equipment utilizing a face graph |
| . A skyscraper window cleaner |

TABLE II: SOME OF THE TOPICS USED IN "AUTOMATIC CONTROL PRACTICE"

| TOPICS |
|---|
| . A device that automatically turns off a gas heater in the event of an earthquake |
| . A fan which simulates natural wind |
| . A golf simulator |
| . A mobile show-window |
| . Computer games |
| . A doll which makes different expressions |
| . A robot which can climb a tree |
| . A swimming model of fish |
| . A meter that indicates the distance between two cars running in the same direction |
| . A bill counting machine |
| . Educational, experimental equipment of modern control theory |

many of the products thus manufactured are of a quality that can pass as inventions.

The structure of this course was changed in 1981. Instead of working on different themes, teams are required to compete on a single theme given by academic advisors. The theme given in 1981 was, "Make a vehicle using two small dry cells which is capable of carrying one person for a distance of 100 meters". Victory was to go to the team making the vehicle which travelled the specified distance in the shortest time. It was allowed for vehicles to accumulate energy using the same cells with one person on board for 10 minutes before the start. Four teams took up the challenge making vehicles based on different principles. A race was held and the results were better than the professors had expected. The winning team placed a slanting runway behind the starting point. They pulled the vehicle up the slanting runway with one person on board and the vehicle travelled the distance of 100 meters using only the force of inertia acting upon the vehicle.

The runner-up vehicle was designed so that the seat could move up and down. It ran by the force generated by the weight of the person on the seat which had been raised to the maximum height during the 10 minutes. The vehicle which was placed third was equipped with a large condenser and ran on the energy generated by charging the condenser before start.

The vehicle placed fourth used a launcher and was pushed forward by the force of a weight.

Although these vehicles varied in the time required to travel the same distance, all of them had their own merits, and we learned a lot from the ideas involved.

In addition, the graduate school provides a course called "Advanced Methods of Systems Engineering", in which graduate students attend lectures and carry out exercises. Although all the problems assigned to graduate students are directly related to matters with which we come into contact with in our daily lives, they are designed in such a way as to be solved by the creative approach and logical procedure adopted in systems engineering. Students are required to present papers. As indicated in Table III, they choose one of the themes given

TABLE III: THEMES IN "ADVANCED METHODS OF SYSTEMS ENGINEERING"

| THEMES |
| --- |
| . Design as fully automated a system as possible for an office, factory, home or school |
| . Design a system for rescuing crew members trapped in a capsized ship |
| . Design a system to prevent one of the various dangers encountered in our daily life (traffic accident, sudden illness, crime, fire, or earthquake) |

and prepare a basic plan using a systems engineering approach. In this course, eager students also survey literature and data, and present detailed papers.

Through this teaching experience, we found that the following are both necessary and effective to stimulate students' creativity:

(i) Teachers themselves should be interested in creative thinking.

(ii) Themes should be slightly above the level of the students involved and they should interest the students.

(iii) Students must be made to fully grasp the objectivity and necessity of the theme.

(iv) Teams should be organized and they should be held responsible for accomplishing the work assigned to them.

(v) Teams should be made to compete among themselves and the winning team should be commended.

(vi) At first, teachers should instruct the teams on methodology.

(vii) Teachers should attend students' meetings, but should not meddle in students' discussions.

(viii) The time limit for research should be observed.

(ix) Students should not just put forward an idea but should materialize it.

**Conclusion**

I have referred to some examples of creative education at the Tokyo Institute of Technology. It must be noted, however, that there are many other educational methods available to achieve the same objectives including the simulation game and communication game, which are adopted by Harvard University; minor commissioned projects, imaginarium, etc. of Stanford University; the idea

contest implemented by Honda Motor Co., Ltd.; and in-company proposal systems employed by most Japanese enterprises.

We are often liable to criticize the lack of creativity on the part of students. In my opinion, however, the lack of creativity is attributable to the educational system which tends to spoil the students' natural creativity. With good teachers, students often give full play to their creative power, with respect to matters in which they are interested. In other words, it is teachers rather than students who have to look to themselves in connection with the lack of creativity exhibited by students.

Creativity is required not only in engineering but also in other fields. The world is approaching the Information Age. The use of information will affect the futures of individuals and enterprises. The value of information is subjective and not universal; therefore, information users must evaluate specific information and consider its use. This is a matter relating to creativity affecting all of us.

I hope that the day will come soon when an idea contest on world peace will be held.

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# RESEARCH TOWARDS THE DEVELOPMENT OF A PHARMACEUTICAL INDUSTRY IN THE ASEAN REGION

by

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## Introduction

An important component of the pharmaceutical industries is antibiotic production by microbial fermentation. The useful antibiotics include many effective antibacterial agents, a few antifungal and anticancer drugs. Antibiotics and other drugs developed through microbial means account for about 20% of prescription drugs in the United States. In 1978, the worldwide sales of four important groups of antibiotics, the penicillins, cephalosporins, tetracyclines and erythromycins amounted to US$4.2 billion. In Japan, a leading nation in the world for the microbial industries, the fermentation industries accounted for 2% of the total manufacturing industries for its contribution to the Japanese economy as compared to 7.7% and 10.8% for the chemical and food industries respectively. For the fermentation industries, the antibiotics accounted for 11% (US$600 million) as compared with 75% for the alcoholic industries (spirits, wine, sake, beer), and 9% for traditional fermented food (soy sauce, miso, vinegar) respectively. The antibiotics industries first started with penicillin production in 1946 with American assistance. Since then, Japanese research and development have resulted in the discovery of about 30 antibiotics of practical significance. These include antimicrobials, anticancer antibiotics, food additives and agents (blasticidin S) for control of rice diseases.

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## PHARMACEUTICAL INDUSTRY

The antibiotics industries can be characterized as advanced patent-controlled biotechnology highly dependent on intensive research and operated mainly by a small number (about 30) of very large multinational corporations in the technologically advanced countries in North America, Europe and Japan. Most developing countries including those in the ASEAN region have no antibiotics production plants and are dependent on industrial countries for their needs. In this country, the lack of the antibiotics fermentation industries have hindered the development and utilization of the new biotechnology, recently boosted by exciting discoveries and inventions in molecular genetics. There is thus a lack of opportunities for employment of graduates in biochemistry, genetics, microbiology and other related disciplines in experimental biology and chemistry. This is particularly so in the area of research and development.

In the hope of contributing towards the future development of biotechnology in Malaysia, the microbiology group of the Department of Genetics and Cellular Biology, University of Malaya have for the past six years been carrying out research on the production of industrially and clinically important antibiotics. There are about 5,500 antibiotics described in the literature produced from fermentation by a few filamentous fungi (Penicillium, Cephalosporium), Bacillus, and mainly (65%) by filamentous Streptomyces and related bacteria. Only about 50 are produced commercially. From these, two important groups of antibiotics, the antibacterial β-lactams produced by fungi and the anticancer anthracyclines produced by Streptomyces were chosen for study.

### β-lactam Antibiotics

The β-lactam antibiotics have been and still remain the most important antibacterial antibiotics due to their effectiveness and lack of toxicity with penicillins. They account for an annual production (1980) of 17,000 tons and 1200 tons for cephalosporins on a worldwide basis (Demain, 1981). The market value for penicillins in the USA for 1979 was US$230 million (Aharonowitz and Cohen, 1981). Through the use of the penicillin nucleus, 6-aminopenicillanic acid (6-APA) derived from enzymatic removal of the benzyl side chain of benzylpenicillin produced by Penicillium chrysogenum, many new side chains can be attached by chemical means yielding many kinds of semi-synthetic penicillins with properties superior to benzylpenicillin. Good examples are methicillin, resistant to penicillinase produced by penicillin-resistant Staphylococcus aureus; cloxacillin, an oral derivative and also active against penicillinase

producing Staphylococcus aureus; ampicillin, a broad spectrum derivative effective for the treatment of infections with Gram-negative bacteria and carbenicillin effective against Pseudomonas aeruginosa. At present there is a Beecham owned plant in Singapore for the manufacture of semi-synthetic penicillins for worldwide consumption. However, the benzylpenicillin used is produced elsewhere.

The second important group of β-lactam antibiotics comprises the penicillin-related cephalosporins discovered by Abraham and Newton (Abraham, 1977). The parent compound, cephalosporin C is produced by the fungus, Cephalosporium acremonium originally isolated by Giuseppe Brotzu from a sewage outfall at Cagliari, Sardinia. Following the process described earlier for the development of semi-synthetic penicillins, the cephalosporin nucleus, 7-aminocephalosporanic acid (7-ACA) is obtained by chemical deletion of the side chain of cephalosporin C and many new side chains joined to the nucleus by chemical means leading to the manufacture of many semi-synthetic cephalosporins with superior properties. Early examples are cephalothin from Eli Lilly and cephaloridine from Glaxo which are active against penicillin-resistant staphylococci and also active against Gram-negative bacteria. In addition, they do not provoke allergic reaction in patients hypersensitive to penicillin. At present, there are many kinds of superior semi-synthetic cephalosporins with effectiveness against various recalcitrant bacteria as well as with remarkable safety, flooding the market. Cephalosporins now account for approximately 35% of all antibiotic use with annual worldwide sales of about US$1 billion (Maugh II, 1981).

An exciting recent development in the research on β-lactam antibiotics has been the discovery and isolation of new β-lactam antibiotics with novel nuclear structures from Streptomyces and other bacteria (Kitano, 1983). These include cephamycins (7 methoxycephalosporins) produced by Streptomyces clavuligerus and Streptomyces lipmanni, nocardicins from Nocardia uniformis subsp. tsuyamanensis, thienamycins from Streptomyces cattleya, the monobactams produced by a range of non-filamentous Gram-negative bacteria (Acetobacter, Agrobacterium radiobacter, Chromobacterium violaceum, Gluconobacter, Pseudomonas acidophila) and the β-lactamase inhibitor, clavulanic acid produced by Streptomyces clavuligerus. As the knowledge on the molecular genetics of Streptomyces and other bacteria is much more advanced than that on fungi, the utilization of recombinant DNA technology will also lead to the design of novel strains for the production of

new β-lactam antibiotics with desirable characteristics and higher productivity.

**Anticancer Antibiotics - Anthracyclines**

There is at present still a good scope for the development of effective anticancer antibiotics of lesser toxicity. In 1980, for the United States, the approximate number of cancer patients cured by chemotherapy was about 46,000 (6% of all cancer cases). Chemotherapy involves a group of 37 anticancer drugs, many of synthetic origins, and 6 of them are antibiotics produced by Streptomyces. The antibiotics are actinomycin D, bleomycin, mitomycin C, mithramycin, daunomycin and adriamycin. The most important anticancer antibiotic is adriamycin, an anthracycline antibiotic isolated from the mycelia of a red mutant, Streptomyces peucetius var. caesius. Adriamycin is used for the treatment of a wide spectrum of solid tumors and hematological malignancies (Blum and Carter, 1974). These include acute lymphoblastic leukemia, acute myeloblastic leukemia, Wilms' tumor, neuroblastoma, soft tissues and bone sarcomas, breast carcinoma, ovarian carcinoma, transitional cell bladder carcinoma, thyroid carcinoma, lymphomas of both Hodgkin and non-Hodgkin types and bronchogenic carcinoma (small cell type). It is worth noting that adriamycin is derived during fermentation by a specific 14-hydroxylation of daunomycin which itself is limited to treatment for leukemia. There are still many limitations in adriamycin therapy. The response rate of these cancers to adriamycin therapy varies from 18% (bronchogenic and ovarian carcinoma) to 65% (Wilms' tumor). Adriamycin causes various kinds of toxicities including alopecia, stomatitis, leukopenia, mild nausea and vomiting, mutagenicity and cardiac irregularities. Cardiac toxicities are of two types, namely:

(i) temporary, non-dose related; and

(ii) drug induced dose related, with level above 550 mg per $m^2$ (body surface area) resulting in congestive heart failure.

This serious side effect limits the amount and duration of drug therapy. Much efforts have been spent to develop derivatives of adriamycin with lesser cardiotoxicities. It is significant that a recently isolated yellow anthracycline, aclacinomycin A from Streptomyces galilaeus MA 144-M1 has much lesser cardiotoxicity than adriamycin and is non-mutagenic (Oki et al., 1980).

The results of clinical trials of aclacinomycin A in Japan since 1976 indicate that this antibiotic is active on acute leukemia refractory to daunomycin and adriamycin, malignant lymphoma, breast, ovarian, lung, stomach and urinary bladder cancers and with a low incidence of alopecia, necrosis, stomatitis and cumulative dose-dependent cardiomyopathy.

Progress has also been made for chemically modified adriamycins. Arcamone (1979) reported that 4'-deoxyadriamycin, 4-demethoxyadriamycin and 4'-epiadriamycin appear to have potentially reduced cardiotoxicity. Umezawa et al. (1979) synthesized 4'-O-tetrahydropyranyl adriamycin (THP-ADM) from adriamycin. THP-ADM has a much greater activity against experimental mouse L1210 leukemia than adriamycin. Furthermore, this compound is the least toxic and, particularly, the least cardiotoxic anthracycline ever reported. If the lower cardiotoxicity and better antitumour activity of THP-ADM are confirmed by clinical trials, this will be a significant contribution to cancer chemotherapy.

Two related areas of research were carried out. These are firstly, the genetic control of the biosynthesis of daunomycin and adriamycin; and secondly, the development of production media utilizing agricultural raw materials and byproducts found abundantly in Malaysia and the ASEAN region.

## Genetic Control Of The Biosynthesis Of Daunomycin And Adriamycin In *Streptomyces peucetius* var. *caesius*

There are several reasons for a detailed study of the genetic control of the biosynthesis of antibiotics, namely:

(i) Antibiotics are considered secondary metabolites, non-essential for the growth of the producer organisms, in contrast to primary metabolites such as amino acids. In marked contrast to the biosynthesis of primary metabolites, a detailed knowledge of the specific steps in terms of the intermediates, the responsible enzymes and their structural genes, is lacking in the biosynthesis of many antibiotics. Only recently, have some information been obtained on these topics for the β-lactam antibiotics (Hook, Elander and Morin, 1982), erythromycins (Corcoran, 1981) and tetracyclines (Rhodes et al., 1981).

(ii) There has been the ability to produce some superior derivatives of antibiotics from mutants of producer microorganisms and by other techniques of genetic manipulation (Fleck, 1979). Examples are rifamycin SV first produced by chemical modification from rifamycin B, and later by a mutant of Nocardia mediterranei, and the finding that a mutation of Streptomyces aureofaciens resulted in the production of 6-demethylchlortetracycline and 6-demethyltetracycline with greater stability to acid and alkali than the original methylated tetracyclines, and they are commercial antibiotics.

(iii) The locations of the structural genes in the genome of Streptomyces for the synthesis of various antibiotics and their manipulation by the modern techniques of genetic engineering are of great current interest as fresh approaches to antibiotic production (Hopwood and Chater, 1980). In Streptomyces coelicolor A 3 (2) the structural genes for the biosynthesis of the antibiotic methylenomycin A are located on a sex factor plasmid (SCPI) while those for another antibiotic, actinorhodin are located on the bacterial chromosome. In Streptomyces rimosus, the structural genes for the biosynthesis of oxytetracycline are divided into two groups, with those responsible in the early part of the pathway prior to anhydrotetracycline (ATC) clustered together in the circular chromosome and separated widely from the cluster of genes controlling the late steps following ATC (Rhodes et al., 1981).

(iv) Repeated mutations and selections have been most effective for increasing the yield of antibiotics. For example, the yield of penicillin production by Penicillium chrysogenum had increased by 117 times from 60 mg per litre by the original strain, NRRL-1951 to 7 gm per litre produced by the final strain E-15.1 owned by Eli Lilly Ltd. (Aharonowitz and Cohen, 1981). Presumably, these were mutations affecting the regulatory genes responsible for the regulation of antibiotic synthesis probably including those involved in carbon catabolite, nitrogen metabolite and phosphate regulation (Martin and Demain, 1980).

**Mutants Blocked In The Synthesis Of Adriamycin In Streptomyces peucetius var. caesius**

It has earlier been stated that adriamycin is produced by a red mutant (Streptomyces peucetius var. caesius) of the original daunomycin producer, S.peucetius. (Arcamone et al., 1969). Through a synthesis of various findings established in various laboratories (Grein, 1981; Ho et al., 1980; McGuire et al., 1980; Yoshimoto et al., 1980) using mutants belonging to different species of Streptomyces producing a number of anthracyclines a tentative simplified biosynthetic pathway for adriamycin in Streptomyces peucetius var. caesius can be established as follows:

9 acetate + 1 propionate ---(polyketide synthesis)---> hypothetical dekaketide

---> alkavinone ---(11-hydroxylation)---> $\epsilon$-rhodomycinone ---(glycosidation)--->

daunomycin ---(14-hydroxylation)---> adriamycin.

Two stable mutants of Streptomyces peucetius var. caesius blocked in the biosynthesis of adriamycin were isolated in Malaysia. These are recognized by their colour, and are non-inhibitory to the growth of Bacillus subtilis. The isolation and characterization on the types of adriamycin precursors accumulated by these two mutants were mainly carried out at the Massachusetts Institute of Technology with the collaboration of A.L. Demain, L.S. Sui and G. Büchi.

The first mutant (H6125) with bright purple mycelia accumulates a major compound which co-chromatograph with $\epsilon$-rhodomycinone in high performance liquid chromatography (HPLC) and thin layer chromatography (TLC) systems, and also has identical mass spectrum and UV-visible spectrum with it. Presumably the mutation caused a defect in the biosynthetic step immediately following $\epsilon$-rhodomycinone resulting in its accumulation.

The second mutant (H6101NS) with whitish-yellow mycelia, produced three sets of compounds, namely: (i) yellowish compounds, soluble in acetone (organic phase), and (ii) yellowish-white compounds soluble in water (aqueous phase), which in turn are divided into (a) yellow methanol-soluble compounds, and (b) white, methanol-insoluble compounds. All the yellow compounds fluorescence blue under long UV, and thus may be non-anthracyclines, as anthracyclines and

anthracyclinones fluorescence orange. Aklavinone and 11-deoxyanthracyclines were also shown to be absent. The H6101 NS mutation must have caused a block in the very early stage of anthracycline biosynthesis resulting in the non-production of anthracyclines and anthracyclinones. The step involved seemed to precede aklavinone as it was not detected.

It is of interest to note that the recently discovered anthracycline, aclacinomycin A with lesser cardiotoxicity contains the aglycone, aklavinone. Work at present concentrates on the chemical identification of the compounds accumulated by the two mutants using spectroscopic techniques including the use of proton nuclear magnetic resonance spectroscopy (proton NMR) and infra-red spectroscopy. Another aspect of the work is to determine whether the two mutations are chromosomal or plasmid borne. Ho et al. (1980) first succeeded in developing an experimental conjugation genetic system for streptomyces peucetius var. caesius and in demonstrating recombination between the phenylalanine and serine markers located on the bacterial chromosome. Later 5 four-factor crosses by Ho C.C. and Chye M.L., through adopting the crossing and analysis procedures used in Streptomyces rimosus (Friend and Hopwood, 1971) resulted in the construction of a circular genetic map with the sequence of locations of auxotrophic markers as follows: phe - met - ser - ade - leu - phe. It is interesting that this sequence is very similar to that of Streptomyces coelicolor and streptomyces rimosus. Work is in progress to locate the two mutants blocked in adriamycin biosynthesis with reference to the genetic markers mentioned above.

**Design Of Antibiotic Production Media Containing Malaysian Agricultural Raw Materials And Byproducts**

The antibiotics fermentation industries are dependent on their raw materials from agricultural products, particularly the byproducts. (Zabriskie et al., 1980). Fermentation nutrients can be classified as sources of carbon, nitrogen, vitamins and inorganic components. The cost of the fermentation substrates contributes about half of the production cost for antibiotics. For example, in benzylpenicillin production, the cost of the raw materials (carbohydrates, phenylacetate, various salts) accounted for 44% of the total cost compared to 12% for utilities in terms of steam and electricity. (Flines, 1980). In consideration of the utilization of crude agricultural materials, a few unique features of antibiotic synthesis needed to be considered:

(i) the special characteristics of production of antibiotics as secondary metabolites.
Antibiotics as secondary metabolites are usually produced only at low specific growth rate, with the production phase (idiophase) usually occurring after most of the cellular growth has already occurred. The factor that controls the onset of antibiotic biosynthesis is probably a deficiency of one or more nutritional growth limiting component, for example glucose. Thus, in practical terms, the seed medium used for cell growth is different from the production medium;

(ii) the chemical nature of the materials in terms of the chemical constituents, for example the amount of glucose present, their availability and rate of release to the microorganism;

(iii) constituents which serve as side chains of antibiotics; and

(iv) absence or high level of inorganic constituents such as phosphate, iron which may decrease antibiotic production.

Carbohydrates such as glucose generally derived from corn starch and sucrose from molasses are generally used for antibiotic production. However, different kinds of sugars affect productivity differently. For example, glucose favours cell growth but interferes with the production of many antibiotics (penicillin, cephalosporin C, streptomycin) while lactose favours penicillin production (Martin and Demain, 1980).

Oils from animal and plant sources are versatile substrates although they usually serve not as sole carbon sources but as co-substrates with other carbon sources. Oils have been reported to be used in the production of penicillin, cephalosporin, tetracyclines and streptomycin.

A good example of the utilization of an agricultural byproduct for antibiotic fermentation is the use of corn steep liquor for penicillin production. A five fold increase of penicillin yield was obtained when corn steep liquor, an effluent from the corn starch manufacturing industry, was added to the fermentation medium for Penicillium chrysogenum. It was later found that corn steep liquor contains phenylacetic acid, a precursor of benzylpenicillin.

## PHARMACEUTICAL INDUSTRY

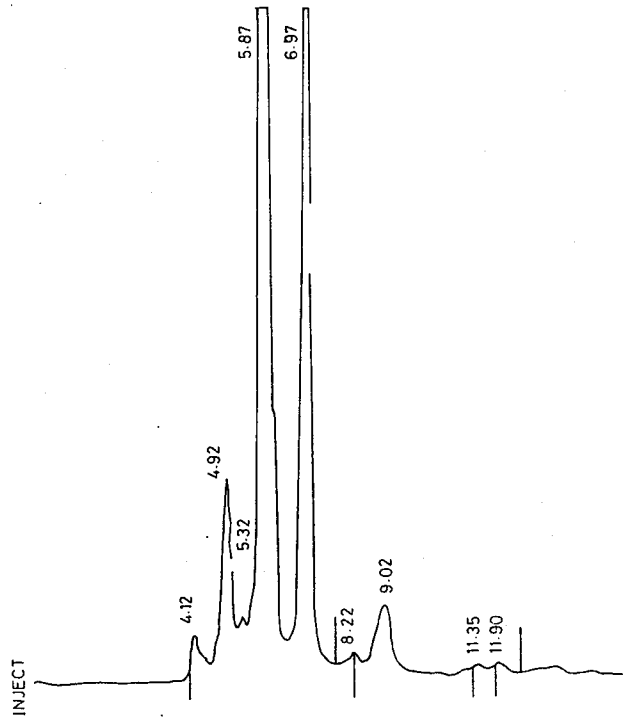
Malaysia is a major producer of many agricultural products such as rubber, palm oil, cocoa, rice and tapioca. Some of these items and their byproducts may be able to be utilized as substrates for industrial production of antibiotics.

The following examples are some of the current research programmes on this subject, namely:

(i) **Production Of Daunomycin And Adriamycin By Streptomyces peucetius var. caesius**

It is particularly difficult to develop a suitable medium for the production of daunomycin and adriamycin by Streptomyces peucetius var. caesius (IMRU 3920 hereby called H3502). The original medium called ADI with the following composition of sucrose 2 gm, Bacto (Difco) yeast extract 0.5 gm, $NaNO_3$ 0.2 gm, $K_2HPO_4$ 0.2 gm, $MgSO_4$ $7H_20$ 0.1 gm, and distilled water 100 ml is not suitable for the production of adriamycin and daunomycin. In experiments carried out with the assistance of A.L. Francis and M.L. Chan it was discovered that phosphate concentration influenced the amount of antimicrobial substances produced by H3502. It was shown that with the increase in $K_2HPO_4$ concentration from 2 gm per litre to 12 gm per litre, there was an increase in anthracyclines production (as determined by assaying the antimicrobial activity of the red pigments isolated against Bacillus subtilis ATCC 6633). However, when the $K_2HPO_4$ concentration in the ADI medium was further increased to 20 gm per litre, the amount of glycoside produced was greatly reduced. Through the use of HPLC, it was shown that the rise of antimicrobial activity with increase of phosphate concentration was directly related to the concentration of daunomycin. At the optimal phosphate concentration of 12 gm per litre of $K_2HPO_4$, it can be seen in the high performance liquid chromatogram (Figures IA and IB) that besides daunomycin, adriamycin was also produced in a small amount. Current work is in progress concerning use of agricultural raw materials and byproducts in combination with various concentrations of phosphate for the maximum product of adriamycin.

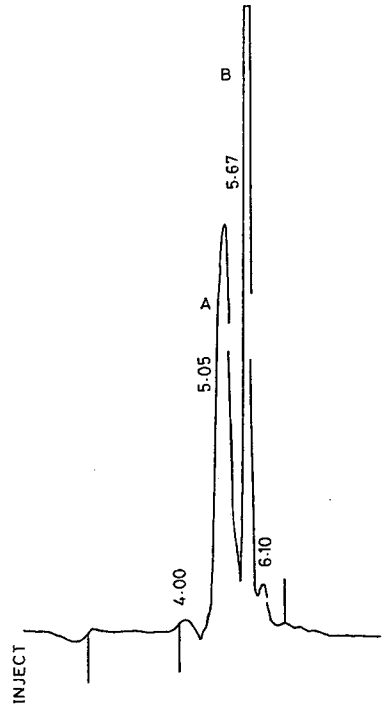
FIGURE IA: DETECTION OF PRODUCTION OF ADRIAMYCIN AND DAUNOMYCIN BY H3502 IN PHOSPHATE SUPPLEMENTED MEDIUM




Note:

**Experimental Conditions:** Detection of production of adriamycin and daunomycin by H3502 in 40ml modified ADI medium containing 1.2% $K_2HPO_4$ contained in a 250ml baffled flask rotated at 220 r.p.m. for 144 hours at 28°C. The pigments have been isolated and purified following the method of Arcamone et al (1969) up to the treatment with methanolic hydrogen chloride. The orange-red solution was filtered through Sep-pak C18 cartridge (Waters). Separation of anthracyclines was by reverse phase chromatography using a semiprep µ Bondapak Tm/C18 column (Waters). The solvents used for isocratic separation was 50% acetonitrile + 0.1% TFA and 50% distilled water + 0.1% TFA. Flow rate used was 2.5mls per minute. Detection with absorbance at 254nm with 0.1 auf sensitivity. The peaks with retention times 4.92 minutes and 5.87 minutes correspond to adriamycin and daunomycin respectively as compared to chromatographs with authentic compounds (Figure IB).

FIGURE IB: CHROMATOGRAMS OF AUTHENTIC ADRIAMYCIN AND DAUNOMYCIN IN HPLC*




Note:

*Using the conditions described in Figure IA

A = adriamycin

B = daunomycin

(ii) **Production Of Penicillin And Cephalosporin C In Production Media Containing Agricultural Byproducts**

Three agricultural byproducts were used. These were sugar cane molasses, solid tapioca residue after starch extraction, and oil palm kernel meal after oil extraction. It was estimated that the annual production of these byproducts in Peninsular Malaysia were as follows: sugar cane molasses, 52,136 tonnes; and palm kernel meal, 241,300 tonnes (Wahab and Tan, 1983). The amount of tapioca solid waste from the tapioca starch industry was about 44,800 tonnes per year. The approximate composition of these three agricultural byproducts are given in Table I.

(a) **Production Of Cephalosporin C By Cephalosporium acremonium:** Initial studies using three strains of Cephalosporium acremonium, namely M224 (CF/A/3, gift of Farmitalia), M70 (C91, gift of E.P. Abraham), and M219 (CW19, gift of A.L. Demain) were tested for cephalosporin C production on medium containing tapioca solid waste, palm kernel meal (after removal of oil by hexane) and molasses. M224 fermentation in 4% tapioca waste gave the best production of cephalosporin C. Cephalosporin C production by M224 in palm kernel meal and molasses was also higher than that by M70 and M219. Not all factors which have been reported in the literature influencing cephalosporin C production affected the production of cephalosporin C by M224 in tapioca waste medium. The addition of lysine and oleic acid did not have a significant effect, while the addition of DL-methionine (0.25%) and L-valine (0.25%) is required for maximum production of cephalosporin C by M224.

Later experiments were carried out to compare the maximum production of cephalosporin C by M224 and a new strain, H1108 (ATCC48272) under optimum conditions (both medium and environmental conditions) using these agricultural byproducts as compared to glucose. The results (Table II) showed that tapioca waste and molasses can be used for cephalosporin C production. For cephalosporin C

TABLE I: APPROXIMATE COMPOSITION OF SUGAR CANE MOLASSES, SOLID TAPIOCA WASTE AND OIL PALM KERNEL MEAL

| | |
|---|---|
| Sugar cane molasses (in %) | |
| Water | 23.9 |
| Sucrose | 42.9 |
| Reducing sugars | 18.5 |
| Ash (minerals) | 9.6 |
| Solid tapioca waste (in %) | |
| Water | 12.7 |
| Carbohydrates (mainly cellulose, small amount of starch) | 65.9 |
| Fibre | 8.1 |
| Protein | 2.5 |
| Lipids | 1.0 |
| Ash (minerals) | 9.1 |
| Screw-pressed palm kernel meal (in %) | |
| Water | 6.4 |
| Carbohydrates | 45.8 |
| Fibre | 13.7 |
| Protein | 15.0 |
| Lipids | 9.0 |
| Ash (minerals) | 3.9 |
| Shell content | 6.2 |

TABLE II: PRODUCTION OF CEPHALOSPORIN C BY TWO STRAINS (M224, H1108) OF *Cephalosporium acremonium*

| MEDIUM WITH | AFTER 96 HRS. OF FERMENTATION | M224 | H1108 |
|---|---|---|---|
| GLUCOSE (10%) | pH | | 6.6 |
| | β-LACTAM ANTIBIOTICS (μG/ML) | - | 313 |
| | CEPHALOSPORIN C (μG/ML) | | 21 |
| TAPIOCA WASTE (4%) | pH | 7.1 | 8.2 |
| | β-LACTAM ANTIBIOTICS (μG/ML) | 570 | 685 |
| | CEPHALOSPORIN C (μG/ML) | 255 | 45.5 |
| MOLASSES (8%) | pH | 7.3 | 7.9 |
| | β-LACTAM ANTIBIOTICS (μG/ML) | 203 | 567.5 |
| | CEPHALOSPORIN C (μG/ML) | 30.5 | 96 |
| SCREW-PRESSED PALM KERNEL MEAL(20%) | pH | - | 7.1 |
| | β-LACTAM ANTIBIOTICS (μG/ML) | - | 0 |
| | CEPHALOSPORIN C (μG/ML) | - | 0 |

\- = NOT DETERMINED

Note:

**Experimental Conditions:** Fermentation at 28°C with 50ml of medium inoculated with 10ml of inoculum contained in a 250ml baffled flask rotated at 220 r.p.m. Components of the fermentation medium (without the carbon source) were as follows:

Salts 11 A 135ml, Salt B 7.5ml, DL-methionine 2.5gm, L-asparagine 7.5gm, L-valine 2.5gm, distilled water to make up 1000ml of solution. pH 7.4. Composition of salts 11 A (per litre) was as follows: $KH_2PO_4$ 115gm, $K_2HPO_4$ 156gm, $Na_2SO_4$ 5.6gm, $MgSO_4\ 7H_2O$ 1.3gm, $ZnSO_4\ 7H_2O$ 220mg, $MnSO_4\ 4H_2O$ 220mg, $CuSO_4\ 5H_2O$ 55mg, $CaCl_2$ 425mg, distilled water to make up 1 litre of solution. Composition of salt B (per litre) was as follows: $Fe(NH_4)_2(SO_4)_2\ 6H_2O$ 20gm, distilled water to make up to 1 litre of solution. Cephalosporin C was assayed after treatment with penicillinase (Difco) by the paper disc agar diffusion technique for inhibition against a β-lactam supersensitive strain, *Escherichia coli* ESS 22-31, with cephalosporin C as standard.

production, M224 seems to utilize tapioca waste better than molasses while the reverse is true for H1108.

(b) **Production Of Benzylpenicillin By Penicillium chrysogenum In Medium Containing Palm Kernel Meal:** A high producer strain of Penicillium chrysogenum, H1107 (ATCC 48271), was shown to be able to produce benzylpenicillin in a synthetic medium (Jarvis and Johnson, 1947) containing palm kernel meal (after oil extraction by the screw press). The results as presented in Figure II shows that 1% palm kernel meal can substitute 5% lactose as a carbon source, but that the peak production of benzylpenicillin was delayed from 96 hours to 144 hours.

## Discussion

This paper has reviewed the scope of the future development of industrial antibiotics fermentation industries in Malaysia.

Malaysia needs to develop a high level of competence in research and development in biotechnology covering the disciplines of biochemistry, chemistry, genetics, microbiology, molecular biology, pharmacology and biochemical engineering in order to be able to run fermentation plants for the production of antibiotics for worldwide sale, and to develop new areas of research and development leading to the discoveries of new antibiotics and other pharmaceuticals which could be patented and produced commercially.

From the preliminary results that have been obtained, it seems very likely that agricultural raw materials and byproducts like palm oil, palm kernel meal will have the quantity, quality and consistency to provide raw materials for some antibiotics fermentation. Hopefully, this will provide a new outlet for the palm oil industry.

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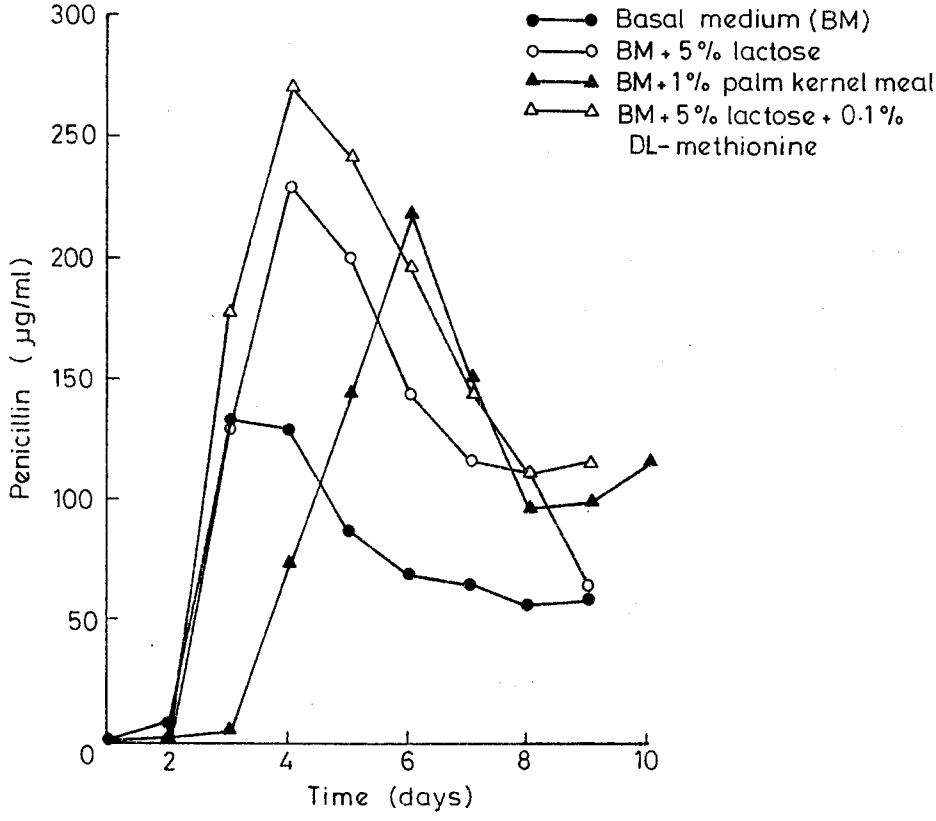
FIGURE II: PRODUCTION OF PENICILLIN BY Penicillium chrysogenum (H1107)




Note:

**Experimental Conditions:** Fermentation at 28°C with 90ml of medium inoculated with a 10ml of inoculum contained in 500ml baffled flask rotated at 220 r.p.m. Components (gm per litre) of Basal medium were as follows: glucose 7.5, ammonium acetate 3.0, ammonium lactate 5.0, $KH_2PO_4$ 3.0, $FeSO_4$ $7H_2O$ 0.1, $MgSO_4$ $7H_2O$ 0.25, $CuSO_4$ $5H_2O$ 0.005, $ZnSO_4$ $7H_2O$ 0.02, $Na_2SO_4$ 0.5, $MnSO_4$ $H_2O$ 0.02, $CaCl_2$ $2H_2O$ 0.05, pH adjusted to pH 6.5 (by ION NaOH). 0.01% (final concentration) of phenylacetic acid was added after 48 hours of incubation. Penicillin was assayed by the paper disc agar diffusion technique for inhibition against a β-lactam supersensitive strain, Escherichia coli ESS 22-31, with benzylpenicillin as standard. The antibiotic assayed was most likely benzylpenicillin as it was destroyed by Penicillinase (Difco).

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# URBAN PLANNING AND TRANSPORTATION: JAPANESE EXPERIENCES TOWARDS A MOTORIZED URBAN SOCIETY

by

Katsutoshi Ota*

## Introduction: Urbanization And Auto-explosion In Southeast Asian Context

Today, we find the most serious traffic congestion in the largest cities in the developing countries which are considered 'poor'. Heavy traffic congestion, unbearable noise and exhaust fumes plaguing big Asian cities like Manila and Bangkok may be considered to represent the rapid urban development and population concentration in the capital cities, and also the concentration of the national wealth. As it has been pointed out that urbanization proceeds with economic development, urban population has been growing more rapidly than national total population at 3% to 4% per year in the Southeast Asian countries (Table I). Furthermore, most of urban population is concentrated in the primate city or the capital, and its population growth rate is much higher than other cities in the country.

On the other hand, we find that motorization in terms of vehicle ownership has been proceeding much faster than the urbanization in the Southeast Asian countries (Table II). Although the term 'population explosion' is sometimes used for the rapid population growth in the developing countries, we find a much stronger 'auto explosion' there.

In addition to cars and trucks included in Table II, we find that motorcycles are increasing more rapidly, and their share in the total motorized mode of transport is also substantial (e.g. Jakarta - 58% in 1976; Kuala Lumpur - 36% in 1973). Another point to notice is that vehicles are concentrated in the capitals. For example, 61% of the cars in the Philippines are concentrated in Manila.

The 'Auto explosion' in large cities is a result of economic growth and rapid urbanization. But at the same time, it is accelerated by the inadequate provision of the public transport system.

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**TABLE I: URBANIZATION IN SOUTHEAST ASIAN COUNTRIES**

| | Population | | GNP per capita | | Urban Population | | |
|---|---|---|---|---|---|---|---|
| | (Millions) 1981 | Average annual growth (%) 1970-81 | (Dollars) 1981 | Average Annual growth (%) 1960-81 | As % of total pop. 1981 | Average annual growth (%) 1970-81 | In largest city (%) 1980 |
| Indonesia | 149.5 | 2.3 | 530 | 4.1 | 21 | 4.0 | 23 |
| Thailand | 48.0 | 2.5 | 770 | 4.6 | 15 | 3.4 | 69 |
| The Philippines | 49.6 | 2.7 | 790 | 2.8 | 37 | 3.7 | 30 |
| Malaysia | 14.2 | 2.5 | 1,840 | 4.3 | 30 | 3.3 | 27 |
| Singapore | 2.4 | 1.5 | 5,240 | 7.4 | 100 | 1.5 | 100 |
| Japan | 117.6 | 1.1 | 10,080 | 6.3 | 79 | 2.0 | 22 |

Source:

The World Bank. World development report 1983. August 1983.

TABLE II: VEHICLE OWNERSHIP IN SOUTHEAST ASIAN COUNTRIES

| | Total Vehicles 1980 (in thousands) | | Average Annual Growth Rate 1970-80 (%/year) | | Ownership Level 1980 (vehicles per 1,000 persons) | |
|---|---|---|---|---|---|---|
| | cars | trucks | cars | trucks | cars | trucks |
| Indonesia | 600 | 475 | 9.5 | 14.2 | 4 | 3 |
| Thailand | 400 | 400 | 7.0 | 9.1 | 8 | 8 |
| The Philippines | 550 | 500 | 7.0 | 10.8 | 11 | 10 |
| Malaysia | 600 | 160 | 7.9 | 6.8 | 45 | 12 |
| Singapore | 165 | 88 | 1.0 | 9.1 | 69 | 37 |
| Japan | 23,660 | 14,197 | 10.4 | 4.9 | 203 | 122 |
| Great Britain | 15,438 | 1,913 | 2.7 | 0.8 | 276 | 34 |
| USA | 123,467 | 35,562 | 3.5 | 6.4 | 542 | 156 |

Note:

Motorcycle is not included. Bus is included in 'Trucks'.

Source:

Nissan Motor Co. Motor industry handbook, 1975 and 1982.

## MOTORIZED URBAN SOCIETY

Japanese experiences towards a motorized urban society may provide some clues for the newly motorizing countries. I want to discuss here our urban transportation problems and approaches, especially with respect to urban planning.

### Trends Of Japanese Urbanization And Motorization

**Urbanization:** Japan is a highly urbanized society. Over three-quarters of the people live in cities. The urban population is concentrated in the built-up areas or DIDs (Densely Inhabited Districts: as defined in the Japanese Census, these have a population density of at least 4,000 persons per square kilometer). Today about 60% of our population live in DIDs which occupy just about 2.2% of the national land area.

In the year 2000, it is estimated that about 1.5 times more people than the 1975 level, or about 73% of the total population will live in DIDs. Along with this population increase, the land area of DIDs will expand more rapidly and will take up about 1.8 times more land area than the 1975 level.

This rapid urban expansion with a lower population density will bring about a large increase in urban transport demand, expecially in automobile traffic.

### Motorization

Japanese motorization has proceeded rapidly since the War. Motor vehicle ownership increased from 20 (5 cars) per 1,000 persons in 1960 to 255 (170 cars) in 1970, and to 324 (203 cars) in 1980. Japan now has more vehicles than any other country in the world except the United States, and the vehicle ownership has approached the levels of Western European countries. In terms of vehicles per land area, Japan is one of the most densely 'populated' countries in the world.

In the year 2000, vehicle ownership is estimated to reach about 390 (263 cars) per 1,000 persons.

Direct impact of motorization is clearly reflected in the pattern of commuting mode. According to the 1980 Census, the most popular transport mode of commutation is now the car, instead of rail which was the most popular 10

years ago (Table III). An interesting change in the last 10 years is the 134% increase in the use of bicycles and motorcycles, which used to be on the decline as a transport mode. This revival of bicycles has been brought about partly by the decreased service level of buses in terms of time, reliability and fare, which in turn was caused by the increased traffic congestion.

The pattern of motorization and its impact is quite different according to places. Car ownership and use are the lowest in large metropolitan areas. In the case of Tokyo, car ownership level is the lowest at 70 cars per 100 households, and 71% of commuters to central Tokyo use rail and subways. On the other hand, car ownership level is the highest in Gunma prefecture at 166 cars per 100 households, and 49% of commuters to its capital city, Maebashi use cars (Table III).

Lower car ownership and use among the residents in larger cities suggest that motorization growth does not proceed automatically with economic growth.

Availability of good public transport services (rail) partly explains the lower reliance on cars there. But this kind of 'selective' motorization is not necessarily the result of deliberate efforts to contain motorization. It is rather a natural reaction of urban residents to heavy traffic congestion.

**Long-term Problems In A Motorizing Urban Society**

The rapid transformation of Japanese cities towards a motorized society has brought about difficult but familiar problems like traffic congestion, accidents, noise and air pollution.

Besides these direct and immediate problems caused by road traffic, there are also difficult long-term impacts. First is the problem of the transportation poor. Motorization tends to widen the mobility gap between car users and those who cannot own or use cars due to economic, physical or other restrictions. Since limited mobility leads to lower participation in economic, social and cultural activities, the gap in welfare levels between the two groups will also widen. So the provision of adequate public transport services for the transportation poor is an important social issue in a motorized society. As I will explain further later, this is an increasingly difficult task for the

**TABLE III: MODE OF COMMUTING (BY PLACE OF WORK OR SCHOOLING) IN JAPAN**

| Mode | Japan | | Tokyo ward area | | Maebashi City | | Great Britain | U.S.A. |
|---|---|---|---|---|---|---|---|---|
| | 1970 | 1980 | 1970 | 1980 | 1970 | 1980 | 1975/6 | 1975 |
| | % | % | % | % | % | % | % | % |
| Foot | 22.1 | 14.0 (79) | 15.1 | 10.7 | 15.8 | 8.8 | 19 | 4.9 |
| Bicycle or motorcycle | 15.2 | 16.4 (134) | 3.1 | 5.9 | 25.0 | 23.0 | 6 | 1.0 |
| Bus | 15.6 | 10.1 (81) | 7.2 | 3.4 | 22.2 | 7.9 | 15 | 4.0 |
| Rail | 29.6 | 26.7 (113) | 66.5 | 70.9 | 11.3 | 8.2 | 4 | 2.0 |
| Car | 14.5 | 28.9 (249) | 7.2 | 7.2 | 24.9 | 49.0 | 51 | 87.5 |
| Others | 3.0 | 3.9 ( - ) | 0.9 | 0.9 | 0.7 | 3.0 | 4 | 0.6 |
| Total Number of Commuters (thousands) | 39,401 | 49,188 (125) | 5,599 | 6,329 | 104 | 131 | - | - |

Note:

Commuters includes journey-to-school as well as journey-to-work made by persons, 15 years of age and over.

Others includes taxi, other modes and 'unknown'.

Numbers in parentheses are indexes based on 1970 commuters.

Source:

Japan - 1980 Census.

Great Britain - Department of Transport. National travel survey : 1975/6 report. 1979.

USA - U.S. Department of Commerce. The journey to work in the United States: 1975. 1979.

conventional public transport modes under the dispersed urban spatial structure emerging from motorization.

Second is the locational impacts on urban activities. According to our study of changes in the urban spatial structure, we found that a rapid dispersal or suburbanization of population and employment has proceeded not only in large metropolitan areas but also in smaller cities. So we observe today, a lot of new development such as in the form of shopping centers; specialized stores dealing with books and furniture; 'family restaurants' along by-passes and major arterials in suburbs; in addition to new residential development.

This reorganization or 'motorization' of the urban spatial structure has significant effects on urban transport demands. The demand pattern has changed from radial intensive movements towards a center, to much more dispersed extensive movements. Since rail and buses are most efficient in providing line-haul services for intensive transport demand, the conventional public transport finds it difficult to provide adequate services for the dispersed extensive transport demand.

This suggests that we need to control the location of new development so as to encourage the formation of an intensive transport corridor, in order to provide efficient and viable public transport services. This is a role of urban planning, and this role is especially important where rapid urbanization and urban expansion is expected.

Another issue is how to accommodate the dispersed traffic demand or how to provide an adequate road network in pace with rapid motorization and urban expansion. We find that it is a very difficult task, and we have not yet succeeded in this respect.

**Provision Of Adequate Road System**

The provision of urban roads is still very poor in Japan. For example in the case of residential roads, according to the 1973 Housing Census, more than a half of urban houses in DIDs were abutting on narrow roads with the width of less than 4 meters, which is the minimum width for new construction required by the national building code. Furthermore, 12% of all houses there were abutting on especially narrow roads with the width of less than 2 meters, where

vehicles find it difficult to access. This poor condition of residential roads cause not only limited car access, but also operational problems for emergency vehicles, and problems of a poor sanitary environment.

Ideally, an urban road network should be hierarchically composed of different functional classes of road, i.e. major arterial, arterial, local distributor and access road. According to our experiences, the desirable length of major arterial and arterial is about 2 to 4 kilometers for each built-up area of 1 square kilometer. This corresponds to a grid of roads with the spacing of 500 meters to 1 kilometer. If we include all classes of roads, the desirable length is at least about 25 kilometers per square kilometer, and the desirable ratio of road area to total land area is at least 20%.

However, the present condition of urban road network is very poor. As shown in Table IV, the length of 'Urban Planning Road' which corresponds to major arterial and arterial is just about 1 kilometer per square kilometer of urban land. Although local governments have invested lots of money and efforts to improve them with the aid of statutory restriction of new land uses on the designated right-of-way, the improvement of urban planning road is very slow. Only 42% of the planned roads have been accomplished so far. If the past pace of improvement continues, it will take several decades to complete the current plan. Even if the current plan is fully executed, arterial road network is less than the above-mentioned desirable level.

This shows the enormous difficulties of providing new roads, or of the widening of the existing roads, expecially in built-up areas. People oppose the land take-over and fear the possible environmental pollution along the proposed road. Many people agree with the general necessity of arterial roads, but oppose them when they are planned in front of their houses.

Because of this enormous difficulty of providing adequate roads after the development, the control of new urban development in suburbs becomes critically important especially when rapid urban expansion is expected to continue. Various controls on new development have been introduced in the last 15 years or so. Except for specially permitted large scale planned development, new development is only allowed within designated area, or Urbanization Promotion Area. Even within these areas, development with an area more than 1,000 square

TABLE IV: DENSITIES OF URBAN PLANNING ROAD IN URBANIZATION PROMOTION AREA, MARCH 1981

| | Built-up Area (DID) | Outer Area (Non-DID) | Total |
|---|---|---|---|
| Land Area ($km^2$) | 8,259 | 7,833 | 16,092 |
| Road Length Density ($km/km^2$) | | | |
| a. Plan | 2.71 | 2.15 | 2.44 |
| b. Existing | 1.30 | 0.71 | 1.01 |
| % (b/a) | 48 | 33 | 42 |

Note:

According to Japanese Urban Planning Law, each city designates the Urbanization Promotion Area and Urbanization Control Area. Urban Planning Road is statutory designated arterial street by the Law.

DID is an area with a population density of at least 4,000 persons per square kilometer.

Source:

Ministry of Construction, Japan.

meters should have a prefectural governer's permission. Many municipalities also have bylaws to control a much smaller scale development.

These controls require each new development to provide basic infrastructure including road, sewage and park, and also give guidelines in their design and construction. These legal control measures assure the provision of adequate residential access roads at least within new development sites. But, it is very difficult to sequire arterial roads which normally require four traffic lanes by these controls. So, new residential areas tend to spread sporadically without appropriate arterial roads to connect them to the existing built-up areas.

In addition, much smaller scale development which evade the development controls take place haphazardly for the remaining agricultural, forest or other vacant areas. The residents in these sprawling areas rely on the existing narrow inter-community roads for their daily transport needs. The contradiction here is that in the suburban area where the potential benefit of car use is greatest, we find a precondition of motorization where adequate road network is least prepared.

Table V illustrates the poor condition of roads in an unplanned sprawl area in comparison with one in a planned development area. A sprawl area has only narrow access roads and no arterial road which allows two vehicles to pass through smoothly.

One of the most effective measures to provide an adequate road network is through a 'Land Readjustment' program. A land readjustment program is an example of a method of urban development which utilizes the vitality of the private sector in suburban areas where urban expansion is in progress. The method is to replot the land, fully respecting the existing ownership relations of the subdivided private properties, and to create an attractive urbanized area by having land owners each offer a small portion of thier plots of land so that it would be used for constructing roads, parks and other public facilities (Figure I). This method has the merit of the land owners being able to expect the price of their land to appreciate, so that the net gain in value of the remaining land exceeds the value of the portion sacrificed in the public interest, once the area is improved for urban use. On the public side, there is the advantage of being able to secure land for building public facilities, including arterial roads.

TABLE V: COMPARISON OF ROADS IN PLANNED AND UNPLANNED SUBURBAN DEVELOPMENT

| | Unplanned Development (Sprawl Area) | Planned Development (Land Readjustment Area) |
|---|---|---|
| Average Road Width | 4.4m | 8.7m |
| Road Area Ratio | 9.3% | 20.6% |
| % of Narrow Roads | 39.4% | 0.0% |
| % of Paved Roads | 71.4% | 100.0% |

Note:

Road Area Ratio is the ratio of road area in the total land area of the development.

% of Narrow Roads is the percentage of narrow roads with the width of less than 4m to the total length of the roads in the development.

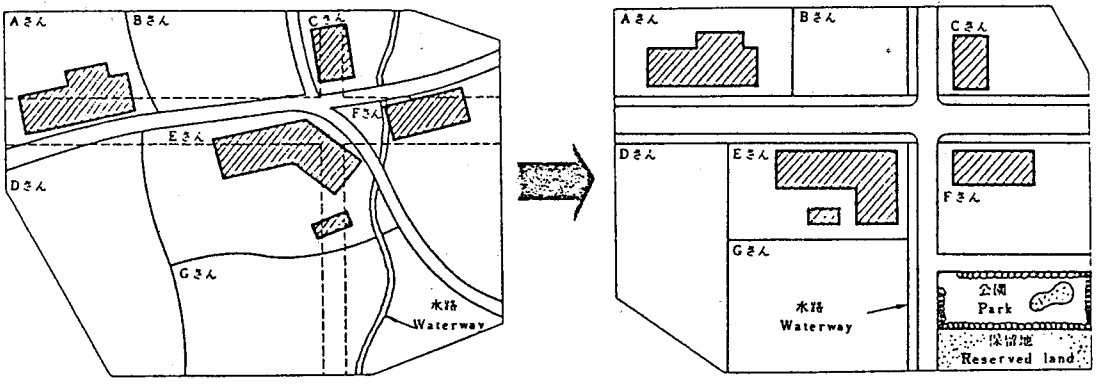
Source:

Ministry of Construction, Japan.

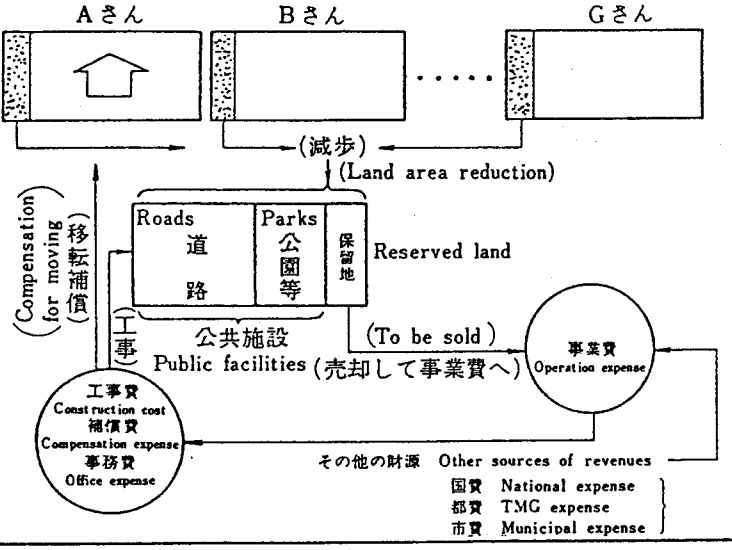
FIGURE I: OUTLINE OF LAND READJUSTMENT PROGRAM

整 理 前
Before the land readjustment scheme was effected

整 理 後
After the land readjustment scheme was effected




事業のしくみ
System of effecting the scheme




Source:

Tokyo Metropolitan Government. Planning for Tokyo.1979.

In Japan, it has been the major method to supply the improved land for urban expansion. Consequently, approximately one-third of the nation's built-up area has been developed under this program. As this program does not entail the forced purchase of land but is rather based on an agreement with the owners, it requires time and patience from the public body administering the plan. However, it is a successful method applicable in the area immediately surrounding the city, where building-up can be expected to occur.

**Summary And Concluding Remarks**

So far, I discussed the problems and experiences of the Japanese process towards a motorized urban society. Our motorization has proceeded by private decisions of owning and using cars with little direct public interventions. Selective motorization as illustrated in lower car use in large metropolitan areas is not the result of a deliberate policy to contain motorization.

Although motorization provides improved mobility for many who can afford cars, it has at the same time brought about difficult problems like enviromental pollution and the transportation poor.

The provision of an adequate road network in pace with motorization is another difficult task for the society. The poor condition of Japanese urban roads is partly the result of the lack of an integrated transport and land use planning. Land use control, development control and other legal measures have been introduced for better urban expansion. But they have limitations in producing an urban area with an adequate road network. We find that a land readjustment program is one of the most effective methods in this respect.

In the context of developing countries, the provision of an adequate road network to meet rapidly increasing demand caused by auto-explosion should be more difficult under the severe resource constraints. Then, the concept of selective motorization or demand management of car traffic through intensive urban development along transit corridor, traffic restraint and other measures should be seriously examined. Promotion of low cost and convenient public transport modes including locally generated paratransit is especially important since car ownership is limited to those in the higher income groups.

# UTILIZATION OF DRIED PALM OIL MILL EFFLUENT: PRESENT STATUS AND FUTURE POTENTIALS

by

A.A. Ravoof*

J.B. Sutanto**

## Introduction

Oil palm is now the largest agro-industrial crop in Malaysian agriculture. From an insignificant producer of less than 120,000 tons of palm oil per year in the early 60's, oil palm catapulted Malaysia into number one position with an estimated area of nearly 1.0 million ha of mature oil palm, with an expected production of over 4.0 million tons and export of 3.5 million tons of palm oil for 1983 (PORIM, 1983).[1] This spectacular success is an unique achievement within a relatively short span of two decades which has no parallel in the annals of agriculture, especially when one considers the fact that oil palm is a perennial plantation crop with a replanting cycle of at least 25 years.

The sweet scent of economic boom from the export of this main product viz. palm oil, unfortunately brought about a sour note of environmental doom from its left-over by-product viz. palm oil mill effluent (POME). For every ton of crude palm oil (CPO) produced, the mills concurrently produce 2.5 to 3.5 times as much POME with about 5.0% solids (2.0% dissolved and 3.0% suspended) having high BOD (20,000 to 40,000 ppm) and COD (40,000 to 70,000). Until the early 70's the mills were happily and indiscriminately discharging raw POME into waterways. Alarmed by the resultant environmental disaster, the Department of Environment stipulated stringent standards for the treatment and disposal of treated POME into waterways (Dept. of Environment, 1977). The palm oil mills have developed several systems of biological treatment (anaerobic and/or aerobic digestion) aimed at reducing the BOD and COD so that the digested effluent can be safely

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1 Palm Oil Research Institute of Malaysia, Personal Communication, 1983.

discharged into waterways. This system of "wasting money to dump money" went on for a few years. However, continued research on POME has shown its potential value as a possible source of fertilizer and an animal feed ingredient. Thus, interestingly enough, the DOE regulation has elevated the status of POME as a waste product to that of an economic and useful by-product.

Devendra, Yeong and Ong (1981) and Yeow and Yeop (1981) have published comprehensive reviews covering the potentials of POME in animal nutrition and agriculture respectively. The former review the potential value of POME in animal nutrition with particular reference to types of effluents, their nutritional value, optimal levels in feed formulations, performance of animals and economics of various formulations used. The latter deal with properties of raw and treated POME, their plant nutrient composition, methods and levels of land application, equipment and machinery required to do so, crop performance and economics of various systems of application and dosages. Their paper also deals with the volume of effluent generated in one year and its value on a fertilizer equivalent basis (Table I). This present paper deals exclusively with the production and utilization of dried POME with particular reference to its present status and future potential.

**Systems Of Drying POME And Their Relative Merits**

**Natural or Sun Drying: Natural** or **sun drying** is generally limited to drying of the treated or digested POME. In the **lagoon** and **flat bed** systems, digested POME is let in to a depth of 15 to 25 cm. and allowed to sun dry to solids. In the case of the sand bed system, anaerobically digested POME is applied on top where liquid percolates through a sand filter leaving the solids on top which gets sun dried. These systems require extensive land areas. Although these are cost effective as they eliminate the need for expensive drier installations, they work well only during dry seasons, and get very inefficient, messy and slow during the rainy seasons. In addition, the dried "cake" scraped off the lagoons and sand beds are generally suitable only as fertilizer; and not as animal feed ingredient due to the high soil or sand content. The product collected from flat beds with concrete flooring may be used as animal feed. However, the end product is not sufficiently dry but is of variable water content and quality, and must be consumed almost immediately to avoid further degradation and quality deterioration.

TABLE I: ESTIMATED FERTILIZER EQUIVALENT OF PALM OIL MILL EFFLUENT PRODUCED AND ITS FERTILIZER VALUE PER ANNUM*

| AS FERTILIZER | FERTILIZER EQUIVALENT (MILLION TONS) | FERTILIZER VALUE (MILLION M$) |
|---|---|---|
| AMMONIUM SULPHATE | 4.53 | 19.2 |
| ROCK PHOSPHATE | 1.14 | 2.6 |
| MURIATE OF POTASH | 4.12 | 19.5 |
| KIESERITE | 3.56 | 10.7 |
| TOTAL | | 52.0 |

Note:

* AT AN ESTIMATED DAILY OUT-PUT OF 25 MILLION LITRES OF FRESH POME.

Source:

Yeow and Yeop, 1981.

**Artificial Drying:** In contrast, the artificial drying systems handle only raw untreated effluents. In the **Antara process,** the raw effluent from the high speed nozzle centrifuge separators is discharged into a series of deep tanks and allowed to settle in order to recover as much of the residual oil as possible. Then the underflow is mixed with small quantities of flocculating agents (polyelectrolytes) to remove the suspended solids. Then the thickened effluent is dewatered by passing through a series of bellow-like special cloth filters; the wet cake is scraped off manually from between folds of filters which is very slow and cumbersome; and the wet cake is dried in a rotary drier. One serious problem is the specific filteration resistance during dewatering which is at least ten times as much as the normal waste water. Presently, this system is operational in only one mill with a capacity of 10 tons FFB/hr. This process has failed to attract the industry probably due to its inherent problems such as slowness and inefficiency which are unacceptable for mills with higher crushing capacities.

The United Plantation - Humbolt Wedag **Decanter/Drier system** appears to be relatively more advantageous than the Antara process. This system has been jointly developed by a local firm (United Plantation) and a German engineering firm (Humbolt-Wedag). This process is presently geared to handle only the effluent produced in the clarification station which constitutes about 75% of the total effluent out-put in the mill. In the conventional system, the crude oil from the screw press is mixed with hot water to help separate the oil and suspended solids efficiently, which adds to the volume of the effluent produced. The U.P.-Humbolt system eliminates the need for addition of water, and the large scroll-type decanter separates the water and oil from the heavy sludge, and the resultant effluent has higher levels of solids (up to 18.0%). This heavy sludge is pumped direct into a rotary drier, and hot flue gases and waste boiler heat are used (co-current) to dry the sludge to a level of high solids (>85.0%) and low water (<15.0%). The drier also acts as a very efficient trap for fly ash in the flue gas which may add to the total ash content of the dried POME. If the ash becomes excessive, the final product may become unsuitable for use as animal feed. Fly ash has been estimated to be in the order of 80 kg of solids/hr for a 60 tons FFB/hr mill (Woo, 1978). However, such a high ash content may actually be an advantage as it may enhance the K level when the dried POME is used as fertilizer.

## DRIED PALM OIL

Judging from the number of palm oil mills with the decanter-drier system (12 in Malaysia and 1 in Indonesia) as shown in Table II, it appears reasonable to assume that several of the new mills under construction may opt to incorporate the decanter-drier system as a standard accessory. According to Ow (1983)[1], 3 more mills in Malaysia and 1 each in Indonesia and Philippines may incorporate the decanter-drier system in their mills under construction.

### Dried POME

**Properties:** Dried POME is a dark-brown granular material with a pleasant fruity smell probably arising from the caramelization of the soluble sugars in the raw POME during drum drying. It is light (sp. gr. of less than 0.5), low in water (less than 15.0%), high in solids (more than 85.0%), and nearly sterile if collected from the delivery end of the drier. General and plant nutrient compositions together with fertilizer equivalent is presented in Tables III A & B respectively. If the dried POME is left exposed to the atmosphere, it tends to absorb moisture (hygroscopic) and turns mouldy and rancid and may become unsuitable as an animal feed.

**Relative Merits:** POME is the by-product of the physical processing of oil palm bunches and is rich in organic matter and plant nutrients. Regardless of whether it is raw or digested or dried POME, it is non-phytotoxic and, therefore, can safely be returned to the soil as a fertilizer. However, the levels of plant nutrients in POME are neither balanced nor readily available, making it necessary to fortify to suit specific soils and/or crops. The relative merits of dried POME are listed in Appendix I.

In addition, dried POME can be applied throughout the year whereas the application of liquid POME during the rainy season is very difficult, inefficient, and even dangerous environmentally due to possible run-off into waterways. However, application of liquid POME is of special advantage during the dry season as an important source of supplementary irrigation due to its high water content. The raw liquid POME forms a very stable emulsion due to its oil content (0.8 to 2.0%), and if applied in excessive amounts, the soil tends to clog-up and becomes puddled making normal field operations difficult.

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1 Ow. Personal communication, 1983.

TABLE II: LIST OF INSTALLATIONS OF DECANTER-DRIER SYSTEM IN PALM OIL MILLS

| YEAR | PLACE OF INSTALLATION | AGENCY | CAPACITY TONS OF FFB/HR. |
|---|---|---|---|
| 1978 | UNITED PLANTATION BHD.<br>ULU BERNAM MILL, TELUK INTAN | U.P. | 40 |
| 1979 | KECK SENG BHD.<br>MASAI MILL, JOHORE | IND. | 30 |
| 1980 | UNITED PLANTATION BHD.<br>JENDARATA, TELUK INTAN | U.P. | 60 |
| 1981 | SOUTHERN MALAY OIL MILL<br>JOHORE | IND. | 30 |
| 1981 | ANSON OIL MILL SDN. BHD.<br>PERAK | IND. | 30 |
| 1982 | TAI TAIK,<br>KOTA TINGGI | IND. | 60 |
| 1982 | FELDA MILL CORPORATION,<br>BUKIT BESAR OIL MILL | FELDA | 30 |
| 1982 | RISDA KETENGAH,<br>DURIAN MAS OIL MILL | SEDC | 30/60 |
| 1982 | KETENGAH,<br>PANJI ALAM OIL MILL | SEDC | 30/60 |
| 1982 | KETENGAH,<br>RAKYAT KETENGAH PERWIRA OIL MILL | SEDC | 30/60 |
| 1983 | MINSAI IND SDN. BHD. | IND. | 30/60 |
| 1983 | GUTHRIE PALM OIL MILL | GUTHRIE | 40 |
| 1983 | PT PERKEBUNAN VI,<br>PKS BERANGIR OIL MILL | INDON. | 30/60 |

Source:

Ow, P. Personal communication, 1983.

TABLE IIIA: COMPOSITION OF DRIED POME

| COMPONENT | % |
|---|---|
| MOISTURE | 5 TO 15 |
| ASH | 15 TO 22 |
| SILICA | 7 TO 10 |
| ETHER EXTRACT | 11 TO 13 |
| CRUDE FIBRE | 11 TO 14 |
| CRUDE PROTEIN | 11 TO 13 |
| CRUDE CELLULOSE | 20 |
| N F E. | 28 |
| TOTAL - N | 1.8 TO 2.3 |
| CARBON | 37 |
| C/N RATIO | 18 TO 20 |

Source:

JORGENSEN AND SINGH, 1982.

TABLE IIIB: PLANT NUTRIENT COMPOSITION OF DRIED POME

| NUTRIENT | RANGE | MEAN | FERTILIZER EQUIVALENT/# (TON AT 10% MOISTURE) | |
|---|---|---|---|---|
| MACRO, % | | | | |
| N | 1.8 TO 2.3 | 2.0 | AS UREA | 45 KG. |
| $P_2O_5$ | 0.5 TO 0.9 | 0.75 | AS ROCK PHOSPHATE | 21 KG. |
| $K_2O$ | 2.1 TO 4.0 | 3.0 | AS MURIATE | 50 KG. |
| Mg O | 0.8 TO 1.5 | 1.1 | KIESERITE | 42 KG. |
| Ca O | 0.8 TO 1.2 | 1.0 | | |
| MICRO, PPM. | | | | |
| BORON | 20 | | | |
| COPPER | 20 TO 50 | | | |
| IRON | 3000 TO 5000 | | | |
| MANGANESE | 50 TO 70 | | | |
| ZINC | 20 TO 100. | | | |

NOTE:

* ESTIMATED VALUE OF POME AT THE PRESENT FERTILIZER PRICES:

M$ = 70.0 PER TON.

SOURCE:

JORGENSEN AND SINGH, 1982.

However, the application of dried POME even in excessive amounts appears unlikely to create much of a puddled effect. Dried POME does not reconstitute into a stable emulsion in water as fresh POME does, probably due to some irreversible physico-chemical changes that have taken place during drying.

**Utilization Of Dried POME: Present Status**

Although the production and availability of raw POME in Malaysia is just as old as the production of palm oil itself, serious efforts in treating and recycling did not come about until the mid 70's. Out of necessity, the areas of research were in isolated pockets scattered around the palm oil mills. The test crops were generally those at their disposal viz. plantation crops. As these are perennials, the duration of research studies was out of necessity long term, even for drawing tentative conclusions, as evident from several of the papers published so far.

Production of dried POME came into the picture only in 1978. Until 1980, there were only 2 of the United Plantation mills producing dried POME which was in the order of around 100 tons a month. From 1981 onwards, the installation of the decanter/drier system went on at an accelerated pace largely due to the aggressive marketing strategy followed by M/S Flumech Sdn. Bhd. of Malaysia. At present, there are a total of 12 mills in Malaysia producing in excess of 12,000 tons of dried POME per year. It is assumed that every 100 tons of fresh fruit bunch (FFB) would produce about 20% crude palm oil and 2.0% POME solids. In the decanter/drier system, recoverable dried POME has been found to be around 1.5 tons for every 100 tons FFB processed, primarily because only 75% of the total volume of effluent generated in the mill comes from the clarification station which is subjected to the decanter/drier system. Thus, a 30 tons/hr FFB mill would theoretically be producing 9.0 tons of dried POME per 20 hr. working day.

Pioneering research on the utilization of dried POME centered around the United Plantation in Teluk Intan; it was a partner in the development of the decanter/drier system. The first report on its effects on the yield of annual crops was published by Jorgensen and Singh in 1981. Five annuals consisting of three vegetables (long beans, okra and eggplant) and two grain crops (maize and sorghum) were grown on peat soil fertilized with dried POME alone or in the combination with 1/3 level of standard NPK fertilizer mixture (Table IV). They concluded that:

TABLE IV: EFFECTS OF DRIED POME ON YIELD OF ANNUAL CROPS, TONS/HA.

| TREATMENT | EGG-PLANT | OKRA | LONG BEANS | MAIZE* | SORGHUM* |
|---|---|---|---|---|---|
| CONTROL | 3.8 | 6.7 | 23.8 | 1.0 | 1.2 |
| INORGANIC (NPK)# | 53.2 | 15.2 | 35.8 | 4.3 | 4.6 |
| POME 10 T/HA. | 8.5 | 11.1 | 28.0 | 1.6 | 2.5 |
| POME 20 T/HA. | 17.2 | 13.9 | 33.3 | 3.1 | 3.5 |
| POME 30 T/HA. | 27.3 | 16.3 | 37.8 | 4.5 | 4.8 |
| POME 10 T/HA. + 1/3 NPK | 29.5 | 16.4 | 37.3 | 3.7 | 4.0 |
| POME 20 T/HA. + 1/3 NPK | 35.3 | 24.8 | 42.0 | 4.6 | 4.5 |
| POME 30 T/HA. + 1/3 NPK | 52.0 | 18.9 | 39.7 | 5.0 | 5.2 |
| LSD. P=0.05 | 9.1 | 6.3 | 7.1 | 0.4 | 0.5 |
| P=0.01 | 12.7 | 8.8 | 9.9 | 0.6 | 0.7 |

NOTES:

# FOR OKRA, LONG BEANS, MAIZE AND SORGHUM: FOR EGGPLANT:

| | |
|---|---|
| N = 200 KG/HA. | 300 KG/HA. |
| $P_2O_5$ = 72 KG/HA. | 150 KG/HA. |
| $K_2O$ = 102 KG/HA. | 212 KG/HA. |

* MAIZE AND SORGHUM AT 15% MOISTURE LEVEL.

SOURCE:

JORGENSEN AND SINGH, 1982.

(i) application of dried POME increased the yield of all crops; the increases being directly proportional to levels applied.

(ii) supplementary NPK improved the yield of all crops at all levels compared to POME only.

(iii) highest yield of long beans and okra was obtained at 20 tons of POME + 1/3 NPK/ha.

(iv) highest yield of eggplant was obtained with inorganic fertilizer closely followed by 30 tons of POME + 1/3 NPK/ha.

(v) with grain crops (maize and sorghum), the highest yield was obtained at 30 tons of POME + 1/3 NPK/ha.

Similar results were obtained on cucumber with dried POME and supplementary NPK. Tomato seedlings at 100 and 200 g. per pot showed vigorous growth over control. Growth was even better with supplementary diammonium phosphate application. It can, thus, be concluded that POME with supplementary NPK is just as good or better than the conventional inorganic fertilizer applications. Preliminary trials with cocoa, coconut and oil palm showed encouraging results on growth of seedlings and immature plants. Mature plants produced better growth and yield. However, it is too early for any definitive conclusions (Jorgensen and Singh, 1983).

At the University of Malaya farm, Napier grass and cassava were grown for forage in pure stands or in 1:1 mixture on a land fill-area (sub-soil) fertilized with dried POME (supplied by kind courtesy of United Plantation). Cuttings of grass and cassava were planted at a density of 25,000 plants/ha. The first harvest was made 3 months after planting, and thereafter at six-weeks intervals. Plants received three levels of dried POME (0.75 ton, 1.5 tons or 2.25 tons after each cutting). Rock phosphate or bowl sludge (by-product rich in available P and Mg from rubber latex concentrate factories) alone or as supplements to dried POME were also included together with two controls: no fertilizer control and inorganic fertilizer control (0.25 tons of standard

12:12:17:2 NPK mixture after each cutting). Results (Ravoof, 1983)[1] have shown that plots receiving the NPK mixture produced the best yield closely followed by all levels of dried POME with supplementary bowl sludge. Yield at all levels of dried POME alone were intermediate while those with bowl sludge alone were low, and those with rock phosphate alone or unfertilized control were the lowest. Although applications of dried POME alone or in combination with bowl sludge showed a tendency to produce higher yields with increasing levels, the yield increases were not necessarily linearly related to rates of application. Furthermore, the yield tended to fluctuate widely depending on the season. It was observed that the dried POME and bowl sludge, being light and surface applied, tended to float away and be lost following heavy rains.

Animal feeding trials on dried POME as concentrate pellets for goats were started in 1981 at the Institute of Advanced Studies, University of Malaya. Preliminary results were reported by Lim et al. (1981). Goats were supplied with 50% of the dry matter intake requirement from pellets and the rest from grass while controls received only grass. The concentrate pellets contained 40%, 50% and 75% dried POME together with various levels of copra cake, tapioca chips and molasses. Results indicated that the groups of animals fed with pellets containing 40% and 50% dried POME showed slightly better daily weight gains than those receiving 75% or control (around 35 g and 22 g/day respectively). In another trial, concentrate pellets containing 35% and 45% dried POME together with other high protein waste materials such as brewers yeast and chicken dropping showed better life weight gains than the trial mentioned above. Arising from these trials, the current practice is to feed the adult goats in the "Goat Breeding Project" in progress at the Institute to supply 50% of the dry matter requirement from pellets containing 35% dried POME + 35% brewers dry grain + 17.5% chicken manure + 7.5% brewers yeast + 5.0% molasses. Each adult animal receives about 1.0 kg of pellets and ad libitum grass. Pellet acceptability is excellent and the growth of hybrid as well as local goats is good (Mukherjee, 1983)[2]. In fact, the animals seem to prefer pellets over grass. In another trial at the Institute, it was found that goats could be fed with dried POME straight without pelleting or fortification with

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1 Ravoof, A.A. Annual Progress Report submitted to Inst. of Advanced Studies, U Malaya, 1983.

2 Mukherjee, T.K. Personal communication, 1983.

other ingredients. However, growth was better when supplemented with leucaena, a high protein tropical forage legume (Vadiveloo, 1983)[1]. In an experiment with broiler chicken, rations containing 5% to 10% dried POME were best for growth compared to higher levels (Kaur, 1983)[2]. In a trial conducted with cattle at the Dept. of Veterinary Services, Yusoff (1982) supplied growing heifers with 2 kg of feed concentrate per day containing 0%, 15%, 30% or 65% dried POME made isocaloric and isonitrogenous with other ingredients. From the results, he concluded that 15% level of POME may be optimal for daily weight gain, feed efficiency, energy efficiency and cost per kg weight gain. Ow (1983)[3] stated that feed rations containing dried POME at levels of 10% to 20% for swines, 5% to 10% for poultry, 15% to 30% for cattle and buffaloes, and 20% to 30% for goats and sheep were nutritionally acceptable and economical.

**Future Potential**

Malaysia has the largest number of palm oil mills, more than 200 in all, to help retain its number one position in the world palm oil industry. To produce the expected 4,000,000 tons of palm oil in 1983, the mills would have to process about 20,000,000 tons of FFB, a staggering amount by any standard. Although the area under oil palm cultivation experienced an explosive growth since the early 60's, and several breakthroughs were achieved in oil palm agronomy, very little change has come about either in the mill machinery or in the processing techniques since the dawn of the industry in Malaysia.

The processing of oil palm bunches is quite unique when compared to that of any other edible oil. The raw material viz. FFB is cut from the palm and allowed to fall on the ground during which time the bunches collect various yet considerable amounts of soil on the bunches depending on the wetness of the field. The bunches and loose fruits are collected from the field and transported to the mill. At the mill, they are loaded on to small railroad trollies, steam sterilized and then thrashed in the stripper. Separated

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1 Vadiveloo, J. Personal communication, 1983.

2 Kaur, A. Personal communication, 1983.

3 Ow, P. Personal communication, 1983.

fruitlets, which constitute about 67% of the FFB, are screw pressed to expel the oil trapped in the mesocarp tissue. Further processing in the mill leads to the production of end products such as crude palm oil, palm kernel, pressed fibre and the notorious POME.

At no point in the processing of FFB has any serious attempt been made to wash away the soil adhering to the bunches. With the result, it ends up almost entirely in the POME. In addition, the mesocarp tissue undergoes maceration in the screw press to liberate the entrapped oil in the cells. Thus, finely ground tissue also ends up as suspended solids in the POME. It is unique again that no other edible oil industry generates such massive amounts of effluents loaded with so much of organic matter as suspended solids. When fresh POME is dried, the end product is a solid rich in organic matter - notably carbohydrates, organic nitrogen (or crude protein), other plant nutrients (K, Ca and Mg etc.), residual oil, soluble organic ash and insoluble ash of soil particles.

Since the time POME has emerged as an useful by-product from a waste product, several techniques have been developed to utilize liquid POME after anaerobic/aerobic digestion, as a fertilizer substitute or to produce biogas or to dry it into a powder form for use in agriculture or in animal production. Perhaps the most recent and most promising breakthrough is the U.P.-Humbolt decanter/drier system as described elsewhere. There are other technological improvements at various stages of development relating to the production and processing of raw liquid POME. Also, in the utilization of the end product viz. dried POME, there are present problems and promising potential in the future, both in agriculture and in animal nutrition. An attempt is made below to consider the future potential in the production and utilization of dried POME.

**Technological Development**

**Solvent Extraction System:** This is a patented technique developed at the University of Malaya to treat fresh raw POME (Sutanto, 1981). In this system, hot fresh POME direct from the clarifier or nozzle separator may be fed into the pulsed column or rotating disc extractor, mixed with a stream of solvent immiscible in water (typically hexane) which dissolves the oil fraction completely giving rise to two phases, namely a water phase with suspended solids and a solvent phase with dissolved oil. The solvent phase is flashed and evaporated to separate the oil and the condensed solvent recovered is reused.

The water phase now is less colloidal probably due to the removal of oil. It is further treated in a scroll-type decanter to separate the solids and clear and reusable water. The wet solid cake has about 80% moisture which can be further dewatered by passing through a belt press to bring down the moisture to about 70% and dried in a rotary or other types of drier to a desired level of moisture. In this system, the suspended solids is thus subjected to a three-stage dewatering.

Typically, a 60 ton FFB/hr mill discharges about 500 to 600 tons of fresh POME/day. Under this system, it will only be necessary to install a 30 ton/hr decanter centrifuge, a 4 ton/hr, belt-press and 2.5 ton/hr drier. Such a small capacity drier will be sufficient because it is necessary to evaporate only about 1.8 tons of water/hr as opposed to 4.5 tons under the U.P.-Humbolt decanter/drier system. Under the solvent extraction system, it may be possible to produce better quality dried solids with ash and oil contents of as low as 8%. This product may be more suitable as animal feed than that from the decanter/drier system due to its low oil and ash contents.

With each recycling, the soluble solids load of water, particularly of K, Ca, Mg and other dissolved solids, increases to as much as 6% or more. Therefore, it is necessary to periodically purge this water and substitute it with fresh water. Alternatively, small quantities of process water may be purged continuously and compensated with fresh water. This purge-water being rich in soluble but low in suspended solids can easily be applied as a fertilizer solution.

**Controlling Product Variability:** Product variability of fresh POME and as a consequence of dried POME has been noted between different mills as well as between seasons within the same mill. Variations between mills can be controlled by modernization and proper mill maintenance. Since oil palm plantations are generally fertilized regularly and optimally, it is unlikely that the composition of soluble ash constituents of plants, FFB and fruitlets will change considerably during the year. Therefore, the variability in total ash content could conceivably arise from variability in the insoluble ash or sand and soil particles that come from the field with the fruitlets. It is plausible that during rainy seasons the heavy FFB that falls on the ground at harvest could pick-up varying amounts of soil. Since no serious attempt is made to wash the bunches at any time during processing, the extraneous soil component

ends up almost in its entirety in the POME produced at the clarification station and eventually in the dried POME. This insoluble ash content could be reduced by washing away sand particles either from the FFB prior to sterilization or washing the fruitlets after stripping but before screw pressing. If so, the dried POME would be low in insoluble ash and thus could become attractive as an animal feed and should fetch a better price.

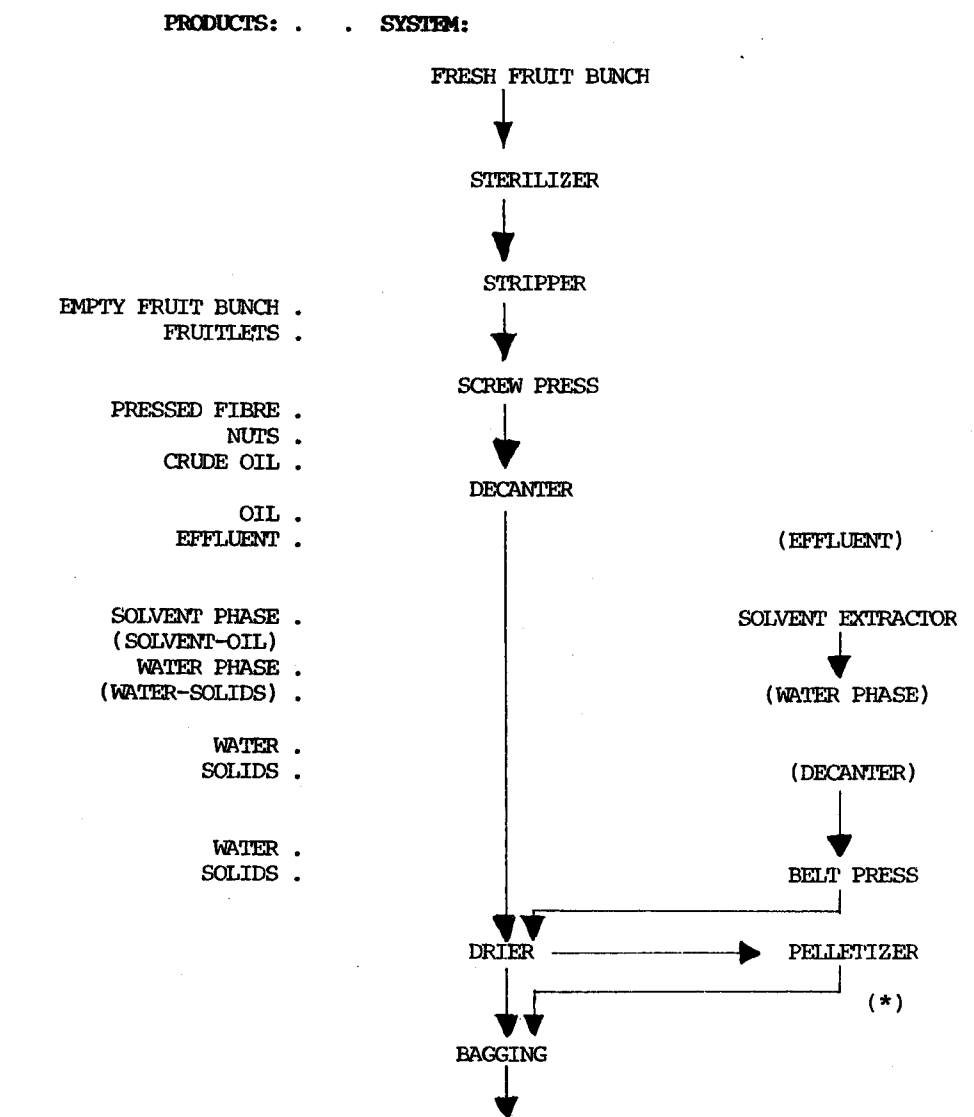
Dipping the FFB in water could also prove advantageous to get rid of the film of air trapped between fruitlets which has been known to resist considerable steam penetration and proper sterilization. As a consequence, boiler and sterilizer capacities and the sterilization system can be modified and scaled down considerably with substantial economic advantages in terms of installations and operation.

**Pelleting and Handling of Dried Pome:** Dried POME that is produced now (at about 8% moisture) has a sp. gr. of 0.52, after grinding it is 0.64 and if pelletized it is 0.80. The POME that comes out of the drier can be directly fed into the pelletizer; the pellets can be collected, cooled and packaged for storage or transport. Pelletizing reduces the volume by as much as 35% to 40%, and the total surface area exposed to microbial activity is also temendously reduced. In a preliminary study it was observed that these pellets when stored under room temperature in a tightly sealed plastic bag were relatively free from microbial degradation even after 16 months of storage. Therefore, pelleting which extends shelf-life and reduces bulk to help save costs of handling, storage and transportation can improve the dried POME's competitiveness in national and international markets.

In fact, it may even be of greater advantage to integrate all these changes into the existing system (Figure I). The addition of a washing unit, decanter, solvent extraction column, drier (with trap to filter away fly ash in the flue gas) and pelletizer will not only improve the overall economy of the mill operation (improved performance, reduced wear and tear, and enhanced oil recovery) but also will make it possible to produce high quality dried POME with low residual oil, low insoluble and total ash, improved shelf-life, and easy and economic handling, storage and transport. Perhaps such a product may command a premium price and have an excellent competitive edge in the national and international feed markets.

DRIED PALM OIL

FIGURE I: PROPOSED TECHNOLOGICAL CHANGES



## Agricultural Developments

The relative merits of dried POME in agriculture is given in Appendix I. Malaysia being in the humid tropics with a warm climate, receives regular and frequent rainfall; plant growth is generally vigorous. Concurrently, the soil microbial activity and consequently the degradation of soil organic matter is also high. In vegetable production where clean cultivation is practiced, especially with leafy vegetables, the application of dried POME can help restore soil organic matter losses. This will be even more of an advantage when vegetables are grown on sandy soils inherently poor in organic matter.

Both highland and lowland vegetable farmers in Malaysia generally apply heavy doses of chicken manure (20 to 30 tons) as a basal dressing. This practice has a few major problems, namely the breeding of flies on the chicken manure in the field. This is not nutritionally balanced and it has an offensive odour.

Dried POME can easily substitute chicken manure. However, it has a few problems of its own and, fortunately, these can easily be solved. Dried POME has a high C/N ratio of about 20 or more (Jorgensen and Singh, 1982). Typically any organic matter with a high C/N ratio when applied to the soil will tend to immobilize available soil-N making the existing plants suffer a transient N-deficiency. This is usually corrected by the application of a small dose of fertilizer-N. When the POME starts to decompose and the C/N ratio falls to about 8 to 10, there will be no more problem of N-immobilization. Some annual crops such as vegetables if transplanted immediately after POME application, tend to grow slowly, are unhealthy, and yield poorly even with the initial supplementary-N application. This could arise from several factors including the residual oil present in the POME which may be toxic to roots. During the period that is required for decomposition, all these factors may degrade rendering dried POME safe. Or, this may be related to K in the dried POME. Since K is not organically bound, it may become readily available while other nutrients are still organically bound and are unavailable until mineralization has proceeded to a reasonable extent. Also, in the lag phase between field application and sufficient mineralization, the readily available K may be leached out from POME and consequently from the soil. If a crop with small or sensitive seeds such as amaranthus is directly sown, seeds may fail to germinate. If the planting is done 5 to 6 weeks after POME application, these

symptoms do not appear. However, such a practice of waiting for a few weeks is highly uneconomical under the intensive vegetable farming systems, and the farmers will be reluctant to accept it.

Alternatively, dried POME can be composted for 5 to 6 weeks at a moisture content of 20% to 25%. At the end of this period the C/N ratio falls to the acceptable level of 8 to 10. Whatever be the reason, pre-treatment such as composting appears to be quite beneficial. Therefore, it seems essential that studies need to be initiated to look into developing composting techniques and their potential benefits. Possible areas of research could be, namely:

(i) Microbial Studies: Isolation and identification of all microbes involved; microbial succession and their relative contributions to the rate of decomposition; isolation of most important microbe/s responsible for decomposition; and the development of a possible "champion microbial culture" to accelerate decomposition under controlled conditions. The possibility of using composted POME as an innoculant, and bagging and storing it to see whether it would proceed to compost normally will be worthwhile. If so, this could be shipped out to national and international destinations for use at the end of the specific composting period. This would eliminate the need for expensive and extensive composting facilities, high labour expenses and a time lag in the present system.

(ii) Studies on Fortification of POME with Chemical Fertilizers: Dried POME is not nutritionally balanced. It is very high in K, moderate in N, low in P and probably high in Mg as shown in Table IIIB. Therefore, it appears necessary to fortify it to make it nutritionally balanced (e.g. N:P:K of 3:3:3) and competitive. Such a balanced POME could find a ready and receptive market with the vegetable growers and others who are plagued by the problem of fly breeding with chicken manure. For these growers even a higher N:P:K ratio (6:6:6) may be an advantage since this will reduce the volume that needs to be applied, and thus could be more economical in terms of both transportation and application costs. Similarly, it will be

possible to produce a variety of specific "custom-made" formulations to suit specific soils or crops. Also, such fortification would be specially advantageous since the chemical fertilizer incorporated will be readily available for the young plants to help establish and grow better initially. In addition, studies to determine as to when to fortify (before or after composting) would be beneficial. For example, almost all of the N in POME is organically bound, and the readily available N is low. Fortifying with N prior to composting could accelerate the microbial growth with the result that the rate of decomposition could be faster, and hence shorten the composting period.

(iii) Studies on Mineralization: Rates of mineralization during composting as well as after field application should be monitored to determine the rate of availability of nutrients, especially N, so that the rates of POME application necessary to suit specific soils and crops can be assessed. Composting may help retain K in POME which may otherwise be lost due to leaching before the mineralization of other nutrients. Since most of the nutrients except K are organically bound, their rates of availability depend directly on the rates of mineralization. Thus POME becomes a "slow and steady-release fertilizer", and hence it may not suffer the problem of fast solubility and rapid leachability associated with chemical fertilizers. This property may be an advantage for perennial crops which show nearly steady rates of growth during the major part of the year, and the rate of mineralization may be adequate to satisfy their nutritional requirements. This will be particularly true for oil palm in Malaysia with nearly constant rates of vegetative and reproductive growth almost throughout the year. However, this may be a distinct disadvantage for annuals which show definite patterns of fluctuations in growth, and consequently of nutrient requirements. This may be even more critical for crops like short duration leafy vegetables with an even shorter grand phase of vegetative growth lasting only a few weeks. Therefore, to satisfy the rapid and vastly

fluctuating nutritional needs of short duration crops, a larger amount of POME may have to be applied.

This had indeed been shown to be so in the experiment with annual crops (Jorgensen and Singh, 1982). Their data in Table IV are modified and presented here in Tables VA and VB. Table VA shows the amounts of POME that are required to match or exceed the yield under fertilizer control:

(a) without fortification, 3 tons of POME/ha for all crops except eggplant.

(b) with fortification at 1/3 NPK level, 10 tons for okra and long beans and 20 tons/ha of POME for grain sorghum and maize.

(c) for eggplant, only 30 tons POME + 1/3 NPK level was comparable with NPK control. It must be noted that eggplant received 50% more nutrients from fertilizer control than the other crops, hence confounding the results.

This table also provides strong evidence that it is essential to fortify POME for best results. Even a 1/3 level of fortified POME could produce comparable yields to a full dose without fortification. This also provides indirect evidence that fortification would confer several economic benefits in terms of cost of raw material, transport and labour for field application.

Table VB shows the relative amounts of nutrients supplied under various treatments. Perusal of the data indicates that the amount of nutrients supplied under POME treatments were substantially larger to the extent of several fold in some treatments, as compared to fertilizer control. Since POME may be a "slow and steady release" fertilizer, it is unlikely that all the nutrients may have been mineralized and used-up or leached-out at the end of the experiment. Assuming reasonable amounts of left-over nutrients, it would stand to reason to plant one more crop (relay cropping) in the plots which would be fertilized with an additional but reduced supplementary NPK fertilizer to exploit the residual

**TABLE VA: DATA IN TABLE IV MODIFIED TO SHOW INCREASES IN YIELD OF ANNUAL CROPS OVER CONTROL, TONS/HA.**

| TREATMENTS | EGGPLANT | OKRA | LONG BEANS | MAIZE | SORGHUM |
|---|---|---|---|---|---|
| INORGANIC FERTILIZER | 49.4 | 8.5 | 12.0 | 3.3 | 3.4 |
| POME 10 T/HA. | 4.7 | 4.4 | 4.2 | 0.6 | 1.3 |
| POME 20 T/HA. | 13.4 | 7.2 | 9.5 | 2.1 | 2.3 |
| POME 30 T/HA. | 23.5 | 9.6 | 14.0 | 3.5 | 3.6 |
| POME 10 T + 1/3 NPK/HA. | 25.7 | 9.7 | 13.5 | 2.7 | 2.8 |
| POME 20 T + 1/3 NPK/HA. | 31.5 | 18.1 | 18.2 | 3.6 | 3.2 |
| POME 30 T + 1/3 NPK/HA. | 48.2 | 12.2 | 15.9 | 4.0 | 4.0 |

TABLE VB: TOTAL AMOUNT OF NUTRIENTS SUPPLIED FOR EACH CROP BASED ON TABLE IV OVER CONTROL, KG/HA.

| TREATMENT | EGGPLANT | | | OTHER CROPS | | |
|---|---|---|---|---|---|---|
| | N | $P_2O_5$ | $K_2O$ | N | $P_2O_5$ | $K_2O$ |
| INORGANIC FERTILIZER | 300 | 150 | 212 | 200 | 72 | 102 |
| POME 10 T/HA. | 200 | 75 | 300 | 200 | 75 | 300 |
| POME 20 T/HA. | 400 | 150 | 600 | 400 | 150 | 600 |
| POME 30 T/HA. | 600 | 225 | 900 | 600 | 225 | 900 |
| POME 10 T + 1/3 NPK/HA. | 300 | 125 | 371 | 267 | 99 | 334 |
| POME 20 T + 1/3 NPK/HA. | 500 | 200 | 671 | 467 | 174 | 634 |
| POME 30 T + 1/3 NPK/HA. | 700 | 275 | 971 | 667 | 249 | 934 |

nutrients that may be present in the soil. Cumulative yield from two crops may prove to be even more economical than a single crop only. Unfortunately, such an attempt was not made by Jorgensen and Singh (1982).

In an experiment conducted at the University of Malaya farm, an attempt was made to assess the residual effects of POME. Three leaf vegetables - amaranthus, Chinese mustard and Ipomea aquatica - were grown at three levels of composted and uncomposted POME (2.5, 5.0 and 10.0 tons/ha) supplemented with bowl sludge to supply P. Results (Ravoof, 1983) showed that in the first crop (main effect), the yield of vegetables at the highest level of POME application was comparable to that of fertilizer control. The plots were replanted with the same crops following the harvest of the first crop with no additional fertilizer added. The yield of vegetables in the second crop (residual effect) was as much as 1.5 to 2.5 times that of the control. Comparison between the first crop and the second crop showed that the POME treatments produced nearly as much yield in both crops while the control showed only about one third of the yield in the second crop. The cumulative yields showed that POME treatments were superior over fertilizer control. From this, it may be concluded that POME does show residual effects, and provides substantial amounts of left-over nutrients for the second crop while the inorganic fertilizer is almost exhausted within a few weeks through plant uptake and possible leaching losses. The nutritional requirements of perennials are relatively small as compared to those of the fast growing annuals and vegetables per unit of cultivated areas on an unit time basis. Therefore, the amount of POME applied and systems of cropping such as relay cropping should be borne in mind while using POME.

**Aggregation and Stabilization of Soils:** This is essential in erosion prone areas such as land clearings and embankments (water erosion); and sandy soils and deserts (wind erosion). The Rubber Research Institute of Malaysia (RRIM) has developed and successfully field tested natural rubber latex spray formulations containing between 5.0% and 10.0% dry rubber content + 2.0% mineral oil + 0.5% emulsifiers + 0.1% stabilizers for aggregation and stabilization initially so that vegetative covers could be easily established for permanent protection subsequently; or the sandy soils could be cropped economically (Yew and Pushparajah, 1983). Inclusion of fresh or dried POME could improve the beneficial effects of these formulations. For example, POME is added to provide about 5.0% dry matter to the formulation, it could add about 0.5% to 0.8% oil to the formulation. In addition, it would add valuable organic matter and plant

nutrients to replace or partially substitute the supplementary fertilization that is required with the RRIM formulations. Particularly, the addition of organic matter through POME could be valuable to improve the soil microbial activity; and the microbial activity in itself and its metabolites will improve soil aggregation and stabilization. Such a new formulation could help improve the problem faced by Malaysian soils such as sandy tintailings and coastal sandy bris soils.

The proposed new formulation could also benefit considerably the desert soils of the Middle East in helping to establish and maintain: lawns and other ornamental plants around housing and office complexes; trees bordering avenues and motor ways; parks and recreational areas; and vegetables with the aid of supplementary sewage water. This proposed formulation could also help control or minimize desertification. However, research on desert soils must be conducted on location, rather than in Malaysia and then extrapolating the results, for it is extremely difficult to simulate agro-climatic conditions; and the results may not necessarily reflect the true conditions of the Middle East.

**Development In Animal Nutrition**

Research reports on the utilization of dried POME in animal nutrition are few, sketchy and largely preliminary. However, available information seems to indicate that dried POME is acceptable to and even liked by animals, safe to use, and easy to formulate into feed concentrate pellets. A particular point in its favour is its high crude protein content (12%) as compared to the low (8% to 10%) levels in the traditional cereal feed grains; additionally too are its characteristics of high energy and low cost. Particular disadvantages include product variability in composition, high total ash contents and rapid deterioration due to moulds. The factor of high crude fibre content needs to be considered when it is used as feed for monogastrics such as poultry and swine. Probably due to these considerations and above all lack of satisfactory experimental evidence on the suitability or otherwise of dried POME in animal nutrition, the feed millers are reluctant to incorporate dried POME into their feed formulations. However, it is probable that these may easily be solved:

(i) high variability in total ash is mainly due to insoluble ash, and its presence in the feed is not known to be toxic, but would

depress the biological efficiency of feed. If the ration has only 20% to 30% of dried POME, the "harmful" effects will be diluted. If the fruit is washed prior to processing as suggested under "Technological Developments", this problem may be minimised.

(ii) with regard to high crude fibre content, the inclusion of POME at less than 10% level in poultry and swine rations is unlikely to create problems; and for ruminants a high fibre content may indeed be an advantage.

(iii) with regard to mouldiness, proper handling and storage as suggested under "Technological Developments" may reduce the problems.

(iv) one area of research that may be useful is the study of possible changes such as the denaturing of crude protein that might take place at the time of drying of raw POME at very high temperatures of more than 300$^{o}$C.

It is reported (Jorgensen and Singh, 1982) that an European feed miller bought dried POME from the United Plantation and found the material satisfactory as a feed ingredient. According to Ow (1983), an Australian company is interested in importing dried POME for use in feed formulations. However, the overseas markets for dried POME may be limited because of transportation costs. If it is pelletized or at least ground as a powder, the bulk will be reduced (as much as 40%), and the resultant reduction in transportation cost will make it attractive even in foreign markets. It is unfortunate that while foreign millers are showing interest in dried POME, local millers are extremely reluctant to even try it.

In conclusion, we wish to add that:

(i) production of POME is inevitable with the present technology;

(ii) production of dried POME appears to be a reasonably good alternative;

(iii) dried POME has a good potential in agriculture, especially after composting and fortification; and

(iv) POME has a good potential in animal nutrition, especially if the product is made following the technological modifications suggested.

Any amount of substitution of imported and expensive cereal grain supplement in feeds and fertilizers will help save valuable foreign exchange directly and indirectly. It will also help keep the palm oil industry afloat rather than drown in the ocean of effluent that it has to necessarily generate in order to produce palm oil for export to make Malaysia affluent.

**Acknowledgement**

Generous and continuous free supply of dried POME for both agricultural and animal nutrition experiments at the Institute of Advanced Studies, University of Malaya by M/s. United Plantations is gratefully acknowledged. Special thanks are due to Mr. Hans Jorgensen and Dr. Gurmit Singh of the United Plantation for their tireless help. Thanks are also due to Mr. Paul Ow of Flumech Sdn. Bhd. for the supply of useful information. Valuable assistance rendered by Mr. S. Vythilingam, Lab. Assistant at IPT in the conduct of field experiments at the University of Malaya farm is also acknowledged and appreciated.

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## APPENDIX I: RELATIVE MERITS OF DRIED POME

1. REDUCTION IN BULK. THIS MAKES DRIED POME:
   - . EASY TO HANDLE
   - . EASY TO STORE
   - . EASY TO TRANSPORT

2. EASY TO SPREAD ON THE FIELD. DOES NOT REQUIRE:
   - . EXPENSIVE FIELD PREPARATIONS
   - . SPECIALIZED EQUIPMENT OR MACHINERY TO SPREAD

3. ENRICHES SOIL ORGANIC MATTER WHICH:
   - . ENHANCES SOIL MICROBIAL ACTIVITY AND MINERALIZATION
   - . IMPROVES PHYSICAL PROPERTIES OF SOIL
   - . IMPROVES CHEMICAL PROPERTIES OF SOIL
   - . IMPROVES WATER AND NUTRIENT HOLDING CAPACITY OF SOIL

4. IMPROVES SOIL FERTILITY THROUGH:
   - . ADDITION OF MACRO NUTRIENTS
   - . ADDITION OF MICRO NUTRIENTS

5. RELEASES PLANT NUTRIENTS SLOWLY WHICH:
   - . REDUCES LEACHING LOSS OF NUTRIENTS

6. CAN EASILY BE COMPOSTED WHICH:
   - . REDUCES C/N RATIO
   - . MINIMIZES NITROGEN IMMOBILIZATION

7. CAN EASILY BE FORTIFIED WITH CHEMICAL FERTILIZERS TO:
   - . CORRECT NUTRITIONAL IMBALANCES
   - . PRODUCE "CUSTOM-MADE" FORMULATIONS TO SUIT SPECIFIC SOILS AND/OR CROPS.

DRIED PALM OIL

## APPENDIX II: EXISTING TECHNIQUES OF SOIL AGGREGATION AND STABILIZATION

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**THIS IS IMPORTANT IN:**

1. HIGH RAINFALL AREAS
   - . TO CONTROL WATER EROSION

2. LOW RAINFALL AREAS (DESERTS/ARID ZONES)
   - . TO CONTROL WIND EROSION
   - . TO CONTROL DESERTIFICATION

**PRESENT TECHNIQUES INVOLVE:**

- . SPRAYING SYNTHETIC OR NATURAL POLYMERS MIXED WITH MINERAL OIL OR OTHER EMULSIFIERS AND STABILIZERS.
  EG. SYNTHETIC RUBBER
  NATURAL RUBBER (RRIM)
  ORGANIC POLYMERS.

**DISADVANTAGES OF THIS TECHNIQUE:**

- . PROVIDES LITTLE OR NO NUTRIENTS FOR PLANT GROWTH
- . ADDS LITTLE OR NO ORGANIC MATTER TO THE SOIL
- . DOES NOT IMPROVE WATER OR NUTRIENT HOLDING CAPACITY OF SOILS.

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## APPENDIX III: SUGGESTED NEW TECHNIQUE OF SOIL AGGREGATION AND STABILIZATION

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**SPRAY MIXTURE CONTAINING:**

. NATURAL RUBBER

SKIM LATEX

FIELD LATEX

LATEX CONCENTRATE

. PALM OIL MILL EFFLUENT (POME)

FRESH

DRIED

. EMULSIFIERS AND/OR STABILIZERS.

**EXPECTED ADVANTAGES:**

. IMPROVED SOIL AGGREGATION AND STABILIZATION

. IMPROVED SOIL PHYSICO-CHEMICAL PROPERTIES

. IMPROVED BIOLOGICAL PROPERTIES OF SOIL

. IMPROVED CEC OF SOIL

. IMPROVED WATER HOLDING PROPERTIES OF SOIL

. IMPROVED NUTRIENT HOLDING CAPACITY OF SOIL

. ADDITION OF ORGANIC MATTER TO SOIL

. ADDITION OF MACRO AND MICRO NUTRIENTS TO SOIL (FROM POME).

**THEREFORE,** SANDY SOILS CAN BE EXPECTED TO IMPROVE WITH THIS AND HELP SUPPORT VIGOROUS AND PRODUCTIVE PLANTS.

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# THE TECHNOLOGICAL REVOLUTION IN THE MASS MEDIA

by

Massimo Rendina*

I think that we can take it for granted that technological innovation of the mass media is a phenomenon of extraordinary importance. Some people compare it to the revolution triggered off by the invention of printing or even when men began to use language.

Warning signs are emerging at all levels of society, private and public, in industry and the organization of labour, and in the relations among geo-political areas and among peoples.

The distinction between the mass media and the other information media is becoming increasingly artificial since there is only one benchmark for all of them today: the use of electronic data processing in every sphere, from the press to radio broadcasting. But above all, since man attributes to communications technology the very properties of his own senses and fundamental faculties of which they are an extension, he is the real and most important "terminal" in the system, if suitably equipped, and the centre where the messages are channelled. Man is the unifying component in a process for which he has the prime management responsibility.

Even personal computers, which used to be seen as individual instruments par excellence on account of the fact that they managed a closed circuit, or belonged to a very restricted circle of users, can now be considered to be a mass media, because they are now able to be operated by telesoftware systems. Connected to the television set, they can access cable networks, and also broadcast messages, uniting teletext-type digital signals with analogic signals which are (still) used in broadcasting. They are linked to the normal TV channels, and soon they will be able to link up with FM radio-channels, too. I am referring to programs radio diffused to be picked up and stored in the terminals for the user to utilize himself with additional software. We may,

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therefore, properly speak about mass telematics[1] which will be boosted very soon by direct broadcasting satellites. When this happens, millions of people in different countries will be able to manage telematics processes at one and the same time; this is much more of a viable prospect for Europe than any other continent in view of the high concentration of people in countries that are pieced together like a mosaic.

Telematics, with its standardized languages, makes it easy to overcome national frontiers, and language and cultural barriers. I wish to mention this particular example because radio-broadcast telematics is opening up new, exciting avenues towards the computerized society which is going to revolutionize our whole way of life[2]. As I was saying, this is going to have very far-reaching effects, and is undergoing continual development as technological innovation moves forward; but it is characterized by profound imbalances and increasing contradictions.

While it is considered to be a major step forward, and duties are entrusted to it for the formation of that universal awareness that is vital for understanding among the peoples of the world, and while it is acknowledged that communications technology is also capable of involving the whole of mankind in world events by providing them with an extraordinary amount of information that is disseminated capillarily and immediately, people are nevertheless questioning the path that is being taken by technological process which, as we shall be seeing, creates four times more marginalization than involvement, and makes social divisions even more profound. People are also wondering who is behind it, who is guiding it, who is dominating it, and with what ends in view.

These are not trifling questions, by any means. Increasingly today, one wonders how much weight the military challenge between the major powers has on science, applied to electronics and space technology - the kingpins of communications systems; and one questions the strategy of the financial,

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1 The world telematics market is forecast to develop as follows: 1986, US$54,490 million; 1990, US$45,000 million.

2 In **Euronet Diane News**, dated July 1983, it was reported that databases are growing by 30% at the present time, with Europe's growing at a rate of 20% compared with the USA's 38%, which is strengthening its influence since it provides 60% of the world's total databases produced.

industrial and commercial multinationals in fostering increasingly efficient and sophisticated individual and collective systems. Any discussion on the development of communications facilities and systems always and inevitably leads to the social repercussions, strongly challenging the theory of "free flow" (of which we shall be talking shortly). And the negative repercussions are emerging with increasing gravity, causing serious concern.

It is, therefore, not an easy task to set about appraising the development of the mass media with one's eyes fixed mainly on the future, for three major reasons: firstly, it is a complex phenomenon which appears in different ways, despite the common underlying trends; secondly, the development process is moving ahead very rapidly and often in a contradictory manner; and lastly, because of the legal, moral and political implications, as I mentioned earlier.

We cannot attempt to provide a comprehensive analysis of the subject. Indeed, we shall merely provide a summary examination with particular reference to the European situation, because apart from anything else, it is this environment which is being increasingly influenced by the American model to which everyone is looking as a harbinger of things to come and also because of America's role as the main pillar of the whole worldwide communications system.

But how can we avoid the temptation to make hasty moralistic judgements, or free ourselves from a certain naive trust in the belief that freedom of information equals human development, which is too simplistic to be accepted as an axiom without examining it in depth?

We think that the best way is to forecast, objectively and with detachment, the way in which communications systems and facilities are likely to develop, adopting the scenario methodology; without going into too much fine detail, particularly if it is breathtaking, such as happens all the time in the technological literature that anticipates the future. Some examples are seen as wrist-held satellite-receiver TV sets, or eye-glass which can replace the TV screen by working on the retina. We would like to try to identify the trends that are already present in the transformation process, provided that the connotations and the constant involved are there without any doubt. We shall then see that the technological and organizational process is aiming at two apparently contrasting objectives: to enlarge the audience by concentrating them around the most attractive medium (television) to create a huge viewing

public for major entertainment and popular events; but at the same time, to segment the audience by providing it with flexible media and a great variety of informational and entertainment sources.

All the industrial countries share these features. It would appear that the main reason why countries associate to manage their facilities and lay down universal standards for communications (protocols) is to unify the plethora of communications networks throughout the world by creating a modular apparatus for them so that, whenever required, the apparatus can be extended wider and wider from limited cover zones with a very high concentration of population to reach global coverage. This is so that the same message can be offered on every point of the planet and, hence, be retransmitted to the middle and micro-users.

The first step towards global communication was taken on 11 February 1972. On that day, the President of the United States, Richard Nixon, replying to Chou En Lai's toast at the "House of the People" in Peking, said, "The world is looking at us". This customary phrase expressed a reality at that particular moment, thanks to the third generation Intelsat satellites. With three geostationary satellites in orbit, the system had managed to cover the whole world for the very first time.

Today, we already have the fifth generation Intelsat satellites. The former 120 telepone circuits now number 18,000 so that 36,000 telephone subscribers can speak at one and the same time; two are permanent TV circuits which can be increased in number using the telephone circuits. The sixth generation of Itelsat satellites in a couple of years' time will double the communication potential. The infrastructural facilities use 300 earth stations throughout the world, which are able to transmit, receive and route telephone, data, image and facsimile messages, and also electronic mail, as well as transmit signals to enable computers to communicate. This is the backbone of the global system, parallel to the Soviet Intersputnik system managed by the USSR, Hungary, East Germany, Bulgaria, Poland and Czechoslovakia.

"Intervision", jointly set up by the UER (Union Europea di Radio-diffusione or EBU - European Broadcasting Union) and the association of Eastern European countries for certain major events, particularly sport, integrates the two systems and, thereby, has a greater number of inputs to the earth network. These networks can access the head station via airwave links or coaxial cables.

Technology is making enormous strides forward in this sector of cable systems, mainly thanks to the development of optical fiber technology.

Cable is going to provide an alternative system to space communications, even in the field of intercontinental communications.

Optical fiber cables are about to cross the oceans. The optical fiber cable across the Atlantic from Europe to the United States - TAT 8 - will come into operation before 1990. It will make it possible for 80,000 (and perhaps 100,000) people to speak at the same time (using time-sharing techniques), but it will also provide the facility for many TV programmes to be broadcast simultaneously. And this raises all kinds of problems. Although the development of high capacity communications, incorporating continental and national space systems (for communication and the distribution of conventional networks by airwaves, cable, and the optical fiber-renewed cables coupled with satellites) provide an enormous range of linkages (gradually cutting down the cost of using them), the broadcasting centres with the largest capacity to impose themselves on the national audiovisual consumer markets because of the quality, the attraction and the selling price of the information and entertainment "product" will be at an advantage.

Perhaps, this is the topic which most dominates the debate accompanying the growth and transformation of the mass media facilities and systems. The other is the potentialities made available to the public.

It is the user - as a consumer - who is the recipient and arbiter of the choices and incentives offered by the communications system, in the ultimate analysis.

Attention is now shifting from the technology to the ways in which the messages are exploited by the users. Mediologists, who have been so long engaged in examining the passivity conditions created by the absorbing power of the TV, are now adjusting their sight by aiming at the abundance of communication which is commonly seen to be the necessary condition before genuinely free choice can exist (synonymous with freedom of information and a necessary condition for human dignity).

We shall be seeing later how all of this entails the risk of remaining purely in the field of philosophical speculation. Now we will examine a number of scenarios, to see the aspects of environmental structures and physiognomies as they emerge and adapt to the growing supply of individual and household communications.

To understand the terms of the problem, we have to look back at the development of the television set as an intelligent terminal and, as we have already said, a multifunctions apparatus. We have to transfer this concept to the distribution of the flow of information to households and certain working environments. In Italian we have used the French neologism "Peritel" to invent the neologism "Peritelevisione".

"Peritel" stands for the regulations laid down a few years ago in France (which are now accepted by nearly every European country) for the TV set to be built around a basic complex to which many other modular multipurpose devices can be added by low frequency inputs: to reproduce images and sounds received from stations by air or by cable (and in the latter case, even interactively) from Direct Broadcasting Satellites, videocassettes and videodisks; to process videotext and teletext information, to link up with data banks, and adapt to other mass telematics operations. Appropriately integrated, the television set can also become a home-computer, as we have already said.

If we think of the way all this can be managed by a small exchange continuously receiving information flows, just as electricity is received in the home to be distributed and used for different purposes, we can see the full significance of the term "peritelevision". It is a system which "involves", based on the central device which channels information and entertainment to one or more TV screens in several rooms. The exchange receives programming instructions, can memorize information and programmes, and when required can act as a meter (when a charge is made for the services) and decode, and can also transfer encrypted messages into plain language, whether it comes from a Pay-TV system, or whether it is a "dedicated", personalized and protected signal.

The partnership between peritelevision and telematics is even more obvious when one considers the way in which the users' sophisticated systems have developed - systems already present in the joint communications - computer facilities in local telephone networks (inside an organization, company,

factory, etc.). EPABX (Electronic Automatic Branch Exchange), which has been designed for telephony, which telematics uses as a support and network, is a multiform, flexible switching and processing exchange for different types of traffic (even at the household level).

If the network has a sufficiently broad band to take television signals, the EPABX functions can be designed not only for voice, text, data but also for image transmission.

When the network offers these technical prerogatives so that many diverse services can be routed and processed, it is called "transparent". Also in Europe it began the rush for the development of transparent networks, that is multiservices[1].

This involves the mass media, precisely because it enables voice, data and images to be transmitted. Telephone networks will flank the television distribution systems within 20 years (in certain highly populated urban "islands" this will be done in the short range or even immediately).

This is one of the most hotly debated issues today, because the broadcasting companies are determined to develop High Definition procedures (HDTV, High Definition TV) which Japan (NHK and SONY) have shown to be possible with their first experiments made known four years ago.

The obective is to attain the quality and effect of a 35mm film on cinema screen. To do this on an electronic screen, the existing TV standards have to enhance definition at least fourfold. The Japanese have doubled the scanning lines. The result is remarkable, but there is still room for improvement. Then, there are many practical difficulties.

Firstly, the users have to change their TV sets because the new system is not compatible with those currently in use. Secondly, the HD signal cannot be

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1 France is investing 12,000 million francs in cabling with new technologies during the biennium 1983-1985; Federal Germany is investing 1,000 million marks to wire up the most highly populated areas immediately; and Britain has scheduled an initial investment of 3 million dollars, using private capital as well. France expects to link 30% of all the households within 10 years; Germany's figure is double this. Italy plans to replace the whole telephone network within 20 years, although the metropolises will be given priority attention.

transmitted using the existing broadcasting networks. Direct Broadcasting Satellites (DBS) are needed, because they use broader frequency bands and channels which can be coupled. This is a great problem, especially in Europe. At the 1977 conference, where the DBS frequencies were planned in Europe, no forecasting was made for HDTV. The conference held this year for the USA and Japan was able to take them into account. If Japan will have HDTV probably next year - the first Japanese DBS will be launched in February, 1984 - and the United States will have it between 1985 and 1986 (using the three DBSs it will then have available); Europe intends to leave things alone for the time being, until conditions improve.

New techniques could be used to transmit on two channels, even if they are not adjacent, and this would overcome one of the obstacles that the Japanese and USA plans do not present. But for the time being no-one intends to do this.

It is felt that HDTV can only be successful when large flat wall screens are on the market. This will take several years yet; and it is possible that before this happens the standards may be improved further.

A boost to the marketing of HDTV might come from the cable broadcasters or the videogram industry[1]. The problems caused by airwave broadcasting do not then arise.

The question of HDTV, which is already a major issue, becomes even more interesting when one thinks of videotheatre circuits, namely motion picture theatres using the TV medium with large screen projection systems. At the moment, they cannot provide the quality required, but tomorrow, once the images arrive electronically, they will be able to compete with film for quality (and certainly cost less), and the whole sector of the motion picture theatres, which is going through a crisis today, could undergo a revival. And this will give a boost to "teletheatre".

From the financial point of view, one of the major costs today is reproducing films in hundreds, and often thousands, of copies, accounting for

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1 Japan is developing a system with High Definition from videodisk and projection on a large screen by means of a six-tube video reproductor.

60% to 70% of the unit production investment costs. Using cable, this cost could be sharply reduced.

It is more difficult to believe that the projection systems are likely to arrive in households before the large electronic screens. The projection system requires the room to be as dark as a motion picture theatre (which the TV viewer rejects). The real turning-point will only be reached when large plasma, gas discharge or liquid crystal screens are available, as we said earlier, provided that - we repeat once again - the definition of the image is considerably better than the 1125 lines HDTV system available at the present time (which is up to 16mm standards at most).

The difficulties and perplexities relating to the adoption of HDTV have not had any repercussions on the DBS projects in Europe, however. The first launching (a 3-channel German satellite) will take place in the autumn of 1985, followed with a French satellite built jointly by the two countries and, therefore, with the same features. Nearly at the same time that the French satellite is launched (although everything will depend on the availability of the Ariane launching system) a British satellite will be placed in orbit with two TV channels and other telecommunications channels. Immediately after this it will be the turn of the ESA (European Space Agency), which is building an experimental satellite to work in various telecommunication fields, but also with two channels for TV: one of these will serve Italy alone, and the other will be available to broadcasting bodies belonging to EBU so that they can carry out technical and programming experiments in turn.

It has been observed that if the same programme is transmitted using both the ESA satellites' channels (L-SAT, or Large Satellite, which will perhaps be christened Olimpo), it can be received by all the population around the Mediterranean.

This is how the idea of joint programming between different TV companies came into being.

Technology has solved the language problem by providing a system which can flank with six or eight voice channels at least each video channel (even more, though the quality will not be optimal). Furthermore, there are teletext systems that can be used to supply captions, even in real time, in at least 15

languages (the TV viewer will have selectors to choose the preferred language in sound or in writing).

The EEC (or European Economic Community) Commission has immediately shown interest in this perspective. Even though the ITU's (or Interntional Telecommunication Union) planning session in Geneva did not take broadcasting of this kind into account, there is nothing to prevent several satellites broadcasting the same programme each on one channel. The EEC officials, therefore, think that this could strengthen Europeistic idea. On their part, the television companies are interested in cooperation solely to share programme costs.

In fact, while technical costs are showing trends of falling, programme production costs are rising sharply. This imbalance is particularly evident in the case of the new medium - direct satellite TV - whose management costs are at least two-thirds less than ground networks; but the principle also applies to cable-TV since the technology employed, and particularly optic fibers, mutiplies transmission on one single support medium. It is reckoned that the whole technological costs of DBS (including depreciation and management costs) account for just over 15% of the total: the remaining 85% covers programme costs. And this is to cater for a public which will expand step by step and whose growth will depend on the programmers' capacity to offer better and more popular and spectacular programmes than the other media have to offer. Furthermore, the programmes have to be suitable for a heterogeneous and international audience. This is the peculiar feature of the DBS audience, particularly in Europe where satellite broadcasting is going to ignore national borders because of the composition of the geopolitical areas.

DBSs are considered to be national media for all intents and purposes. It is as if each country had hung a powerful repeater station in the sky to broadcast programmes throughout its own territory.

The 1977 planning session in Geneva established the orbital position of each satellite, and the capacity appropriate to each service zone.

These zones are much wider in reality. Potentially, each satellite can reach 100 million viewers, using 5 channels. Theoretically speaking, they could each reach more than 300 million viewers. Individual and community receivers

could use sophisticated technology to receive from several satellites, even those in distant orbits; cable TV stations both those using copper connections and others have even greater possibilities open to them (linked to the new digital facilities and with integrated technologies and services) will increase exponentially the supply of offspace programmes using DBS and Point-to-point communications satellites distributing them to their subscribers.

Transmitters, systems and videograms will, therefore, find themselves in open competition. There is already a great discrepancy between the potential demand and the actual supply. We are dealing with a communications system which is much more powerful than the European capacity to produce informational and entertainment products for rational use.

The EEC experts submitted a report to Parliament (Brussels, 15 June 1983) in which they began by stressing the development of satellites, optic fibers cables and intelligent terminals, and forecast that by the end of the 80's, every country in Europe would have an average of 30 cable-TV channels, three DBS channels, and three conventional TV channels (in Italy today there are at least 15 conventional channels, and in the large cities there are twice this number).

Let us say that each channel broadcasts 10 hours a day. Europe will need between 1 million and 1.5 million hours of programmes each year. There are just not enough human resources, and financial resources above all, to keep up. We shall, therefore, have to increase our imports from the large international entertainment and information producers, which means the American market, which is already producing and selling the highest number of entertainment programmes in the world. The American entertainment and information industry alone is able to substantially increase its output, to internationalize it in terms of entertainment and audience appeal, and to sell its products at competitive prices, because its costs are largely amortized by its domestic market and because the commercial distribution system is so efficient that it now accounts for 80% of the world's telefilm market.

The only way to envisage a different scenario is to consider the possibility of Europe's major TV companies setting up joint production ventures able to meet the domestic demand of each country, and to deal with other markets to exchange programmes, particularly with the United States. In this way, if their programmes are popular with the American public, their balance of payments will

be much less in the red than it so obviously is today. A substantial share should be left to the film producers, since the cinema will have to provide at least 500,000 hours' viewing a year, according to the EEC forecasts, whereas at the present time, West Germany, France, Italy and the United Kingdom are only producing about 1,000 hours between them.

It must, therefore, be stressed yet again that the DBS satellites could become a means of establishing cooperation between European producers, but at the same time, and by the same token, they could raise doubts about their function as national broadcasters since if the programmes coproduced in several languages are pooled, we should need at the most three satellites to cover the whole of the Mediterranean Basin, if appropriately coordinated, and this would fully comply with the planning laid down in Geneva.

European countries have so far approached the space broadcasting problem in a piecemeal fashion, since the industrially more powerful countries have been more attentive to their domestic interests than to the general problem and the interests of the viewing public above all.

DBS television is, therefore, something of a paradox. The system was designed some 20 years ago to be the most appropriate system for large countries with a scattered population, since it can cover huge areas and serve everyone in an optimal fashion, independently of the terrain, or physical obstacles such as skyscrapers in the large cities which cause interference with conventional TV broadcasting. It was also seen to be an advantage to the developing countries because it is much cheaper than ground networks, as we have already said, and once the satellite is in orbit, it functions immediately.

Yet, the strongest boost has come from Europe, where the population is densely concentrated, where cable TV is expanding rapidly, now that its potential has been greatly enhanced by the use of the optical fiber technology (in Belgium, the Netherlands and Switzerland, 80% of TV viewers are now cabled); and the market is expected to be much more promising than the American market in the videogram field.

This was borne in mind by the broadcasting companies who felt that DBS could be used more appropriately not as an addition to, but as an alternative to the

ground networks once the latter had given up their frequencies to enhance other public utility services (however, after the year 2000).

For these reasons, a space agency was created (the ESA, European Space Agency) to carry out research and experiments, financed by West Germany, Belgium, Denmark, Spain, France, Italy, the Netherlands, the United Kingdom, Sweden and Switzerland.

The first programme for broadcasting was scheduled to be concretized in an experimental common satellite called H-SAT, but then, quite suddenly, four years ago, the German companies convinced their government to advance the date when they saw the experiments carried out in Canada (with US cooperation) and in Japan, where DBSs are being used to meet real needs already. China was thought to be interested in purchasing satellites from Germany; and Germany, following its policy of working very closely with France, thought that it could leave its other ESA partners to go their own ways. From then on, the race to build DBS satellites started (even though China very quickly pulled out of the race as a potential customer). The idea that the system could be ideal for the developing countries soon fell through too, because what was saved on transmission costs was laid squarely at the doors of the users who need receiving equipment costing between 800 and 1,000 dollars in addition to the costs of the TV set. All these problems are making it very difficult to make any forecasts about the growth in the DBS viewing public, not only in Europe but even in the United States and Japan. Nevertheless, the ESA estimates that between 1985 and 2000, 35 heavy DBS satellites (weighing over 1,500 kgs) and 16 light DBS satellites (weighing less than 800 kgs) will be built in Europe, between executive, standby and replacement satellites (kept on the ground).

This, I repeat, is the state of the technological development of the mass media. Even though there is still much to be said, the situation is very complex and in a constant state of flux, and is very exciting. But if we look further below the surface, there are all kinds of unknowns. Some of them can be clarified by looking at the statistics.

The statistics tell us, for example, that 95% of the 34,000 TV broadcasting companies that exist in the world are in the industrial countries: Europe, the United States, Canada, the USSR, Japan, Israel, Australia, South Africa. The United States and Canada alone account for 35% of the world's total viewing

public, while Europe has 34% and the USSR has 13%. In the industrial countries, there is a tendency to have more than one TV set per household. In the United States there are over 600 TV sets per 1,000 head of population, while the average for Europe is 350-400:1,000. In Latin America, the figure is 90:1,000; in Asia 30:1,000; and in Africa 11:1,000.

But these figures do not tell the whole story because even in the developing countries there are some families with several TV sets. This says much more about the discrepancies that exist not only between different areas, but even within the same areas.

These discrepancies also emerge as far as the programmes themselves are concerned. Let us see what is happening in Europe. Statistics of Eurovision - the organization created by the EBU for the exchange of news and programmes using an exclusive network that now operates through two satellite channels - say that a major news event that takes place in one of the "powerful" countries (West Germany, the UK, France or Italy) has more chance of being screened in every country than equally important events that take place in less "powerful" countries, unless they are highly dramatic.

We all know about some French literary prize, or the Venice film Festival; but we know precious little about any Spanish literary prize, or any Portuguese film festival. These are fairly trivial examples, but they are useful to help us foresee what might happen when we have DBS broadcasting. Is it not likely that acculturation will increase at greater intensity within given areas as well as between different areas (as is increasingly the case today in respect to the United States)? This becomes even more dramatic when we think of the great variety of peoples around the Mediterranean coasts, and the powerful cultural and commercial vehicle that the DBS satellites are. They have a direct effect through advertising, but also a strong indirect influence through the message of entertainment which propagates habits and lifestyles.

This is one of the two major topics that are being discussed in relation to the doctrine of "free information flow". It has to do with freedom, social progress and cultural advancement resulting from the rapid and wide circulation of ideas and information in every field using the information system as a whole. This being so, the first thing one notices is that (as we have seen from the statistics on TV broadcasting stations and terminals) it is limited merely to

the industrialized areas of the world, with the more than likely risk that there will only be a small minority of people able to become increasingly better informed, while the vast majority of the people in the world will become increasingly less informed about what is happening, because of the gradual widening of the economic and cultural gap between the industrialized countries and the Third and Fourth World countries which was recently documented in surveys conducted by the United Nations.

Secondly, as we already mentioned, one wonders who manages and directs the information flow, and with what aim. Let us take the example given by Herbert Schiller (in the "Prix Italia" report at Capri, September 1983). In his report he maintains that the world information network is indispensable to the economic might of the great multinational corporations whose headquarters are in the United States. He said that the largest of them derive a considerable percentage of their profits from foreign operations: 20% to 60%. They can only carry out their managerial duties by intense and flexible communications. The system is becoming managerial on the one hand, while the medium is becoming increasingly necessary for the marketing of commodities. According to "Advertising Age", one half of the huge advertising investments by the United States construction companies in the year 2000, totalling some 780,000 million dollars, will be spent abroad. In this way, information has become an integral part of the American multinational industry. According to Schiller, the American multinational industry tends to depend entirely on extending the communications technologies and information flows, both to direct the strategies of their subsidiaries and associated companies, and to receive and process all kinds of data for industrial and financial ends, and to ensure themselves of a constant, diffuse, punctual and persuasive presence in world markets.

We do not want to go into this problem any more deeply here, except to say that the upgrading of the communications networks and the whole of the mass media industry in general, is run through with interests of all kinds, such as the sale of products directly connected with the development of electronics at all levels, beginning with components engineering - and at this point we ought to insert a section on microelectronics[1] - systems, networks, hardware,

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1 The world market for semiconductors alone is worth some 15,000 million dollars. It is controlled mainly by Japanese and American companies, and is expanding at an annual average of 15%.

satellites, infrastructures, terminals and even software which also comprises management methods. Then there are true and proper programmes, including data (enhanced by added value software), and audiovisual entertainments. This is not to mention sport events and entertainment created specially for TV. These make up a greatly expanding market. But, they are also a way of giving back to TV the specific prerogatives of being able to reproduce events simultaneously - a quality that TV serials and series seemed to have pushed into the background. This is a potential that DBS promises to spread beyond all bounds.

We cannot underestimate the political and cultural aspects of the changes we are witnessing taking place today; firstly, because certain kinds of cultural and economic domination - as we have already said - are taking place through the media; secondly, because the repercussions of the expansion of communications systems in terms of freedom in certain parts of the world where the people live under oppressive regimes. But even more importantly, we can see the socio-cultural splits that this process might give rise to, and the contradictions it could aggravate.

One final remark on telematics as a system which, since it offers immediate solutions to cultural surveys or educational problems, runs the risk of making it unnecessary to perform mental processes, just as pocket calculators have made it unnecessary to solve arithmetical or mathematical calculations.

This is an area that requires very careful thought about the procedures which would take on a cultural value by making knowledge methods as important as knowledge itself.

Educationalists and psychologists are also studying other fields opened up by "real-time culture" in contrast to the more usual "off-line culture" to which we are all accustomed.

Real-time culture, due to the widespread application of telematics, would inevitably lead to making the moment information is received coincide with the moment of decision, without leaving time for reflection. Telematics is seen as a medium which incorporates all history into the present moment, and even drawing in the future by forecasting future events that are united in a given space determined by the computer and the collective memory systems.

This enormous file on yesterday, today and tomorrow is growing all the time as the potential capacity of magnetic memories increases (and we have now reached astronomic figures in the amount of information that can be memorized on one square millimetre of a chip or bubble).

A final comment on language. On the TV screen, telematics makes language extremely synthetic. If this became habitual, it could have a substantial influence on cultural processes, on modes of interpersonal communication, and on customs and habits that have already been greatly influenced by advertising language and sensational headlines in the press. This is a corollary where events are overlapping and multiplying. We have merely mentioned them here in passing. We have no solutions for them. We do not think that restrictive regulations are likely to make the problems any less serious. We think that this opportunity to discuss them at such a distinguished gathering as this, comparing our expriences and scenarios, without prejudices and reservations or ideological constraints, is already a positive result, and we should not let this opportunity slip by.

# TECHNOLOGY TRANSFER AND DYNAMISM IN TECHNOLOGY EDUCATION IN JAPAN

by

Takeaki Shimizu*

## Introduction

Japan introduced technology from the developed West in an ingenious way and became one of the most industrialized countries in the world.

Technology can be transferred in the form of both capital and labor. In the case of manufacturing automobiles, machinery and equipment used in manufacturing can be bought. But workers who have the necessary techniques and knowledge in manufacturing cannot be purchased with money.

One of the most important factors in Japan's success seems to be in how Japan ingeniously trained such engineers. So, in this report, the writer focuses on technology education and describes the historical process.

## Social Needs For And Transfer Of Technology

Modernization and industrialization in Japan got into stride after the Meiji Restoration (in 1868). The Government introduced aggressively science and technology from the advanced western nations in order to construct a modern country and lay the foundations of modern industries.

At that time, Japan's economic power was very weak, and it could not introduce at once the great amount of technology (machinery and equipment, etc.) necessary for modern industries. Thus, it decided to introduce effectively the technology that suited its social needs, because the introduced technology could not become the motive power for industrial development unless it was allowed to take firm root and be put to practical use. Neither could Japan obtain the capital necessary to introduce new technology. A market for manufactured products is necessary for industrialization. Accordingly, it should introduce technology understanding fully the social needs for it.

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Changes in the social needs for technology since the Meiji Restoration to the present day, are described briefly in the following pages. (Refer also to Figure I and Figure II).

**Period I - 1868 To 1900:** During this period Japan was on the threshold of establishing itself as a modern nation and introduced various western systems including the legal and educational systems. Also, under the slogan of "Industrialization and Increased Production", Japan introduced aggressively science and technology.

In order to develop the immature monetary economy, mining and printing technologies were introduced. Moreover, since the development of communications is indispensable for a modern country, there was the need for paper manufacturing and communications technologies, and railroad and shipbuilding technologies for transportation.

For the purpose of industrialization and increasing production, the social needs such as development of energy resources, industrialization of power generation and electricity, and machinery and equipment for mass production, were promoted.

Also in order to replace imported goods with domestic manufactured ones, there was an urgent necessity to modernize the filature and textile technologies.

In this period, there was a need for Japan to possess its own military technology. Moreover, Japan had an urgent need for its own weapons production and gunpowder technology, for it had experienced civil wars and the Sino-Japanese War, and there was military friction with Russia.

**Period II - 1901 To 1918:** In this period, Japan was at the stage of early heavy industrialization. Also, in this period, Japan experienced two big wars, the Russo-Japanese War (1904 to 1905) and World War I (1914 to 1918).

After the experience of the Sino-Japanese War, Japan drew up a plan for large-scale expansion of armaments. With this as a turning-point, heavy industrialization was accelerated. In order to increase production of various weapons including ships, there was a need for Japan to provide itself with

FIGURE I: TREND IN THE GROSS NATIONAL PRODUCTIONS AND THEIR CLASSIFICATIONS, (1890-1980),(REAL GNP AT 1970 PRICES)

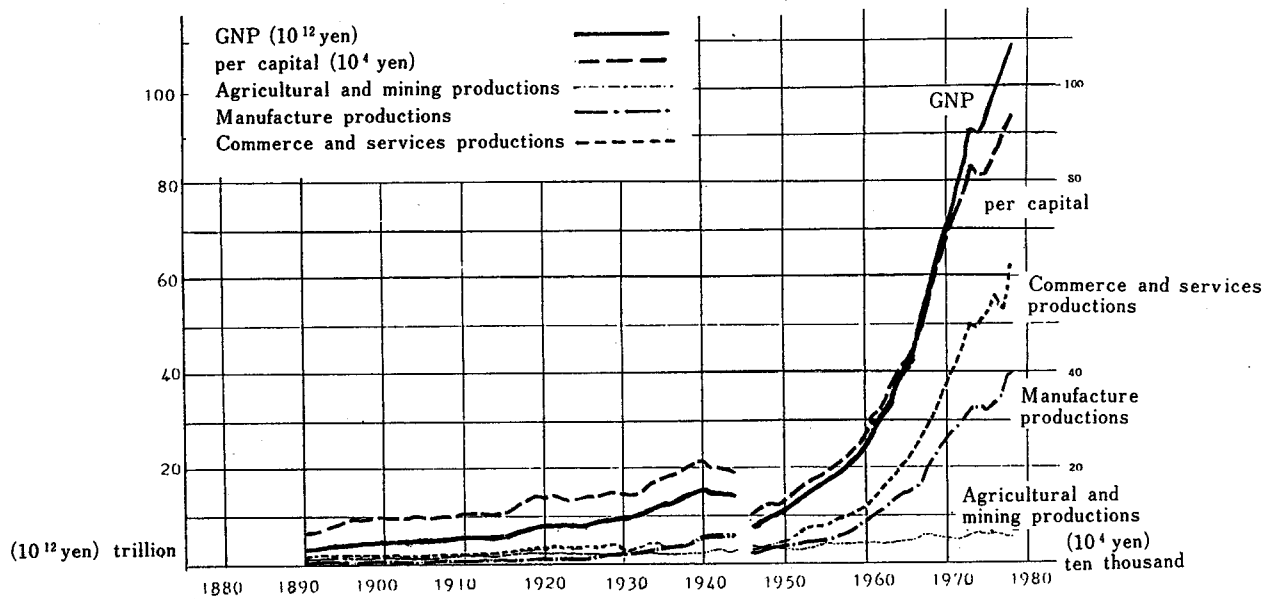


FIGURE II : KIND AND PERIODS OF INDUSTRIES INTRODUCED TO JAPAN

| Period | Average years from invention in foreign countries to introduction to Japan | | Proportion of main transferred industries | Percentage of each period's numbers of transferred industries (Total number of transferred industries: 312) |
|---|---|---|---|---|
| | A | B | | |
| Before the Meiji Restoration (1550 to 1867) | 95.4 | 130 | Optical equipment technology (36%)<br>Textile machinery technology (18%)<br>Printing and Office machinery (18%) | 5 |
| From the Meiji Restoration to Japanese industrialization age (1868 to 1900) | 64.7 | 68.8 | Transportation facilities and Power (17%)<br>Inorganic chemistry technology (14%)<br>Mining technology (13%)<br>Textile machinery technology (9%) | 24 |
| Japanese heavy industry era (1901 to 1914) | 39.2 | 39.8 | Organic technology (21%)<br>Transportation facilities, Communication technology, Steel manufacturing technology, Textile machinery technology (9%) | 16 |
| Era between World War I and World War II (1915 to 1940) | 34.9 | 36.6 | Inorganic chemistry technology (14%)<br>Communication technology (13%)<br>Transportation facilities and Power, Steel manufacturing technology, Organic chemistry technology, Plastics (9% each) | 26 |
| From World War II to the end of post-war reconstruction era (1941 to 1952) | 27.7 | 26.1 | Plastics (25%)<br>Organic chemistry technology (13%)<br>Fiber technology, Transportation facilities and Power (11 % each) | 11 |
| High growth era (1953 to 1966) | 23.4 | 25.3 | Transportation facilities and Power (26%)<br>Communication technology (16%)<br>Plastics (13%)<br>Civil engineering technology, Atomic energy technology (10% each) | 18 |

Notes:

1. Average of total years (from the year of the invention in foreign countries to the beginning of industrialization in Japan).

2. Calculated figures taking the difference between the year of utilization and the year of invention into account, plus A, in case the year of industrialization is not clear but the year of utilization is clear.

Source:

Saito, Suguru. Theory of industries transfer. Annual Report of Chuo University, Economic Research Institute, No. 1, 1970.

materials such as steel. Also, the advancement of the heavy electric equipment technology, in addition to the generators and shipbuilding technologies with priority on steam turbines, were important tasks. The improvement of productivity in agriculture was important for capital accumulation in order to promote industrialization, and the development of organic chemistry laying stress on synthetic fertilizers was demanded.

**Period III - 1915 To 1945:** In this period, Japan tried to catch up with the advanced countries and encouraged domestic production of major industrial products. In the latter part of this period, Japan promoted science and technology for military uses. Japan, promoting its heavy industrialization policy constructed integrated steel plants and even encouraged domestic production of automobiles and aircraft. Most of these were connected with the international situation at the time and the progress of military technology.

With the depression after World War I and the worldwide financial panic, rationalization of industries and management in the form of cost reduction, standardization of products and parts, and mass production became necessary. As a result of these measures, development of quality control and management technology including production technology was promoted.

Also, with the invention and discovery of new materials, development of chemical technology laying stress on synthetic fibers and such metallurgical technologies as aluminium and new magnetic steel became necessary. These were necessary not only for solving the problem of lack of raw materials and resources in Japan, but were strongly connected with military needs.

**Period IV - 1945 To 1955:** In this period, there were strong requirements for such mainstay industries as the coal, electricity, steel and fertilizer industries and for industrial reorganization, attaching importance to reconstruction after World War II.

**Period V - 1956 To 1970:** This period was generally the era of high growth, and there was a positive need for technological innovation chiefly in the export industries.

**Period VI - After 1971:** Owing to the energy problem represented by the oil shock, the Japanese industrial structure has undergone a great change with the need for technology intensive industries laying stress on electronic technology.

**Technology Transfer And Infrastructure**

Success in technology transfer means that the introduced technology is industrialized or put to practical use. For this purpose, various conditions and the consolidation of the infrastructures forming the foundation are important. For example, roads are not only the foundation related to our daily lives, but the foundation related to production for transporting raw materials and finished products.

Thus, industrialization without a social infrastructure is difficult. Statistics on the Japanese economy, society and education over the past 100 years since the Meiji Restoration are shown in Figure III. The base year of these indexes is 1965 as 100. GNP per capita as the economic index has increased in almost a straight line. On the contrary, the percentage of specific age groups enrolled in higher education as the education index has lagged behind. Total kilometerage of railroads increased greatly at an early stage. The railroads performed an important role in the establishment of the infrastructure in the course of Japan's industrialization.

Education functions as part of the infrastructure for modernization and industrialization. Figure IV shows the Japanese historical trend in the proportion of the respective age groups enrolled in elementary, secondary and higher education. The proportion of age groups enrolled in elementary education rapidly reached the saturation point at an early stage, but that for the higher education level increased very slowly. Elementary education, or elementary schools, became compulsory in 1880. The period of compulsory education was 3 years at first, but it was increased to 4 years in 1882, 6 years in 1908, and 9 years in 1949 when lower secondary education became compulsory. Elementary school enrolment was 81.5% in 1900 and 91.6% in 1902. Enrolment at the secondary education level began to increase from about that time. This shows that as the industrial level rose, the level of study and techniques required for the nation became higher, and it is understandable that this is reflected in the enrolment rate. That is to say, as the industrial level becomes higher, the

FIGURE III: THREE PATTERNS OF INDEXES OF JAPANESE MODERNIZATION

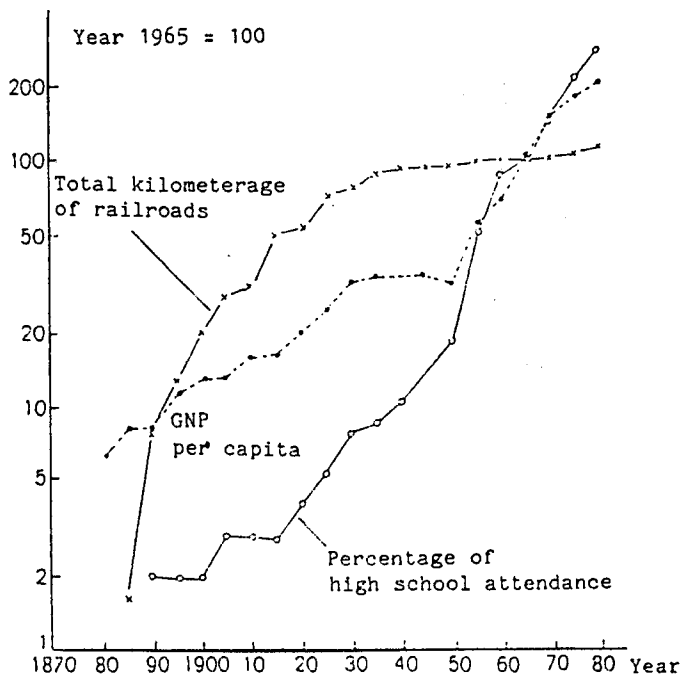
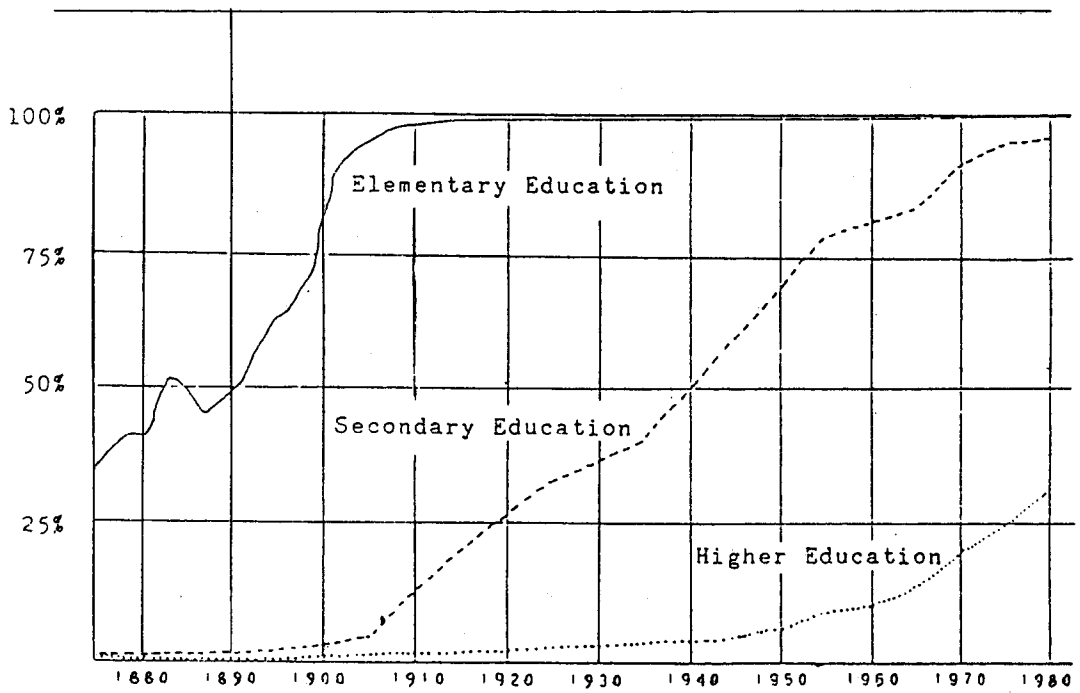


FIGURE IV: THE HISTORICAL TREND IN THE PERCENTAGE OF THE RESPECTIVE AGE GROUPS ENROLLED IN EACH SCHOOL LEVEL



human capability increases as the infrastructure evolves. Figure V shows the component ratio of workers by each school career in this period.

**Dynamism In Development Of Technology Education**

Success or failure of technology transfer depends largely on the assimilation capability of technology on the recipient side. Technology cannot be transferred without human intervention. Even if excellent machinery is available, it will not be useful if there is no engineer who can operate it. And, even if excellent foreign engineers are hired, technology will not be established by the mere fact of their existence. The cultivation of engineers is an important factor in technology transfer.

The history of Japanese engineering education over 100 years is shown in Figure VI. Figure VI shows the number of students of each level enrolled in the public educational system (under the jurisdiction of the Ministry of Education). It can be seen at a glance that the higher the level of industrialization attained, the higher the educational courses gradually selected at the lower secondary level, upper secondary level, and then technical college level. The enrolment rate in universities increased after World War II. Namely, as industries grew prosperous and the level of techniques necessary for them became higher, the level of technological education advanced.

I shall now briefly review the process of engineering education in Japan.

**Engineering Education In Early Industrialization Stage:** Japan, attempting to introduce aggressively advanced science and technology from the west after the Meiji Restoration, at first invited many excellent technicians and teachers from those nations. At the same time, Japan dispatched students to those countries aiming at cultivating future Japanese leaders.

The foreign technicians and teachers or "Hired Foreigners" introduced the western advanced technology and knowledge freely in various fields and made a big contribution to Japan's industrialization and modernization. Also, they made efforts to nurture the Japanese leaders who were to take over from them. But the number of "Hired Foreigners" was large as shown in Figure VII, and the remunerations for them were a heavy burden for the Government at that time. It was necessary for Japan to absorb their technology and knowledge as soon as

FIGURE V: COMPONENT RATIO OF WORKERS BY SCHOOL CAREER

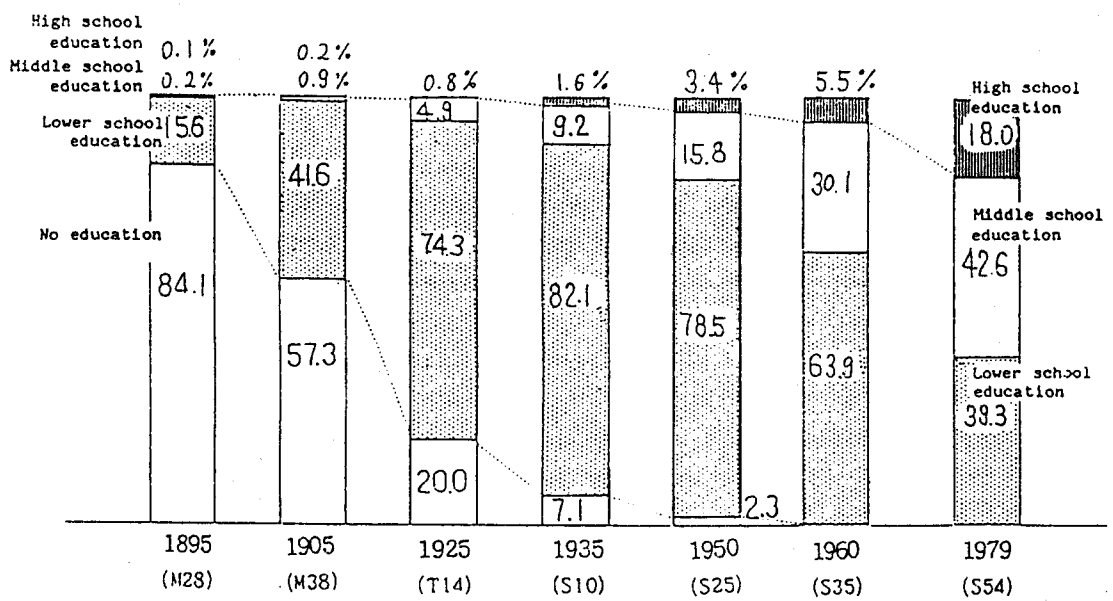


FIGURE VI: TREND IN ENGINEERING SCHOOL ENROLMENT (1890-1980)

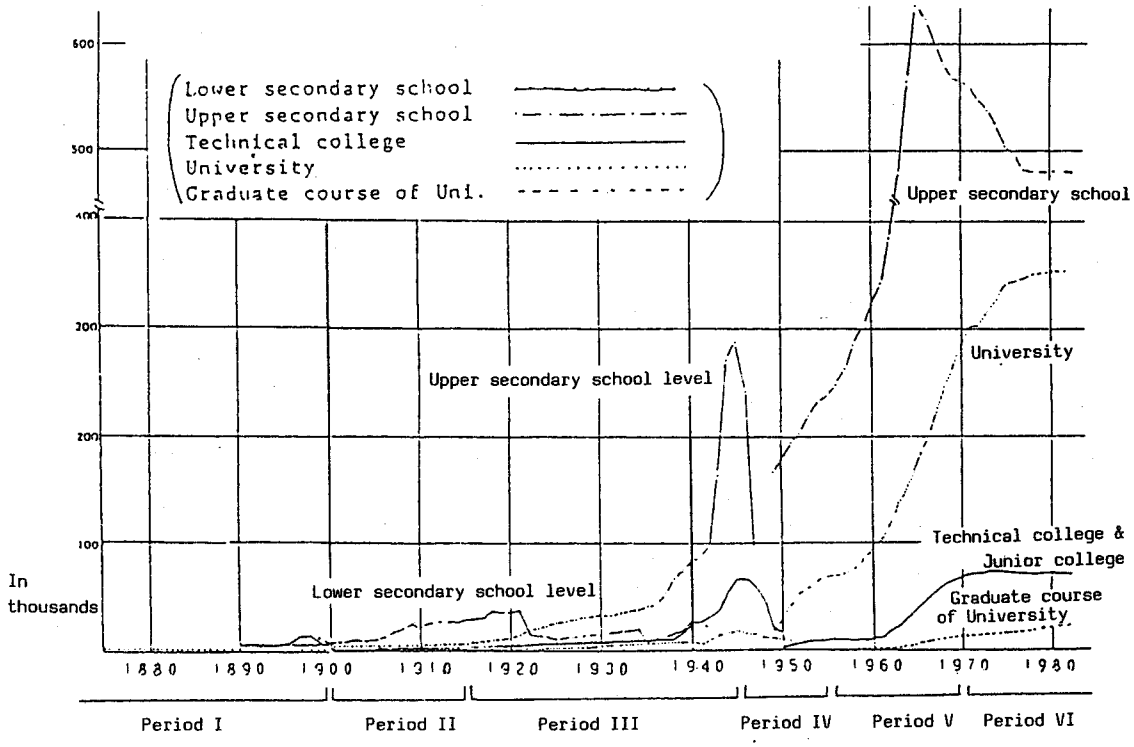


FIGURE VII: TOTAL NUMBER OF FOREIGNERS IN EACH PERIOD OFFICIALLY OR PRIVATELY EMPLOYED

(PROFESSIONWISE)

(Unit : Person)

| Profession | Teachers | | Technologists | | Clerks | | Workers | | Miscellaneous | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Period | Officially employed | Privately employed | Officially employed | Privately employed | Officially employed | Privately employed | Officially employed | Privately employed | Officially employed | Privately employed | Officially employed | Privately employed |
| 1870's (Meiji 5,6-12) | 974 (100) | 353 (100) | 1,294 (100) | 916 (100) | 453 | 140 | 199 | 109 | 466 | 924 | 3,359 | 2,442 |
| 1880's (Meiji 13-22) | 692 (73) | 1,006 (284) | 513 (40) | 2,100 (229) | 481 | 416 | 36 | 60 | 75 | 1,073 | 1,797 | 4,656 |
| 1890's (Meiji 23-31) | 626 (66) | 2,940 (833) | 140 (11) | 1,930 (211) | 253 | 313 | - | - | 18 | 259 | 1,037 | 5,442 |

Note:

The period in parentheses is the actual statistical period expressed by Japanese calendar corresponding to the Gregorian calendar.

Sources:

Umetani, Noboru. The hired foreigners.
The Kajima Research Institute Printing Group, 1968: 54

possible, for some of them obtained higher remunerations than the ministers of the Government. Thus, the Governmental organizations hiring them made efforts to cultivate engineers, founding their own educational institutes for official engineers.

Japan dispatched students to the western countries to replace the "Hired Foreigners". The number of students dispatched by the Ministry of Education reached more than 550 in total from 1868 to 1873 (Figure VIII). Those students returned after two to three years study, and played leading roles in various fields.

Also, public institutions to educate promising engineers, namely the universities, were founded at an early stage. These were the Industrial University and the College of Technology in the Imperial University founded by the Ministry of Industry, which were later amalgamated. They employed many "Hired Foreigners" as teachers and they educated high level technologists. In those days, it was rare for the universities to produce their own lecturers in engineering.

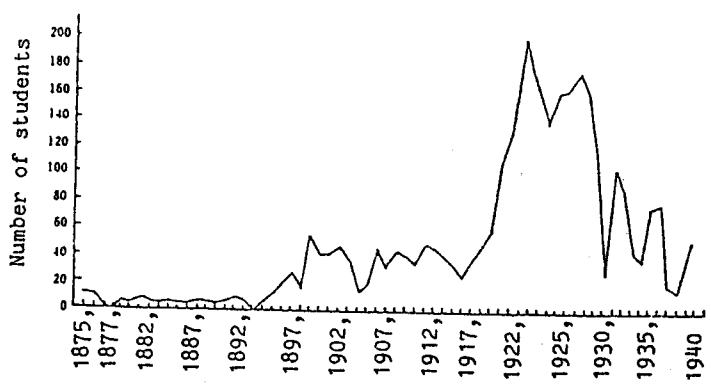
**Nurturing Engineers:** There were supplemental schools at the upper elementary school level and apprentice schools at the lower secondary school level, as public institutes for technology education following compulsory education. These schools cultivated engineers.

The supplemental schools were established in 1893 in order to supplement the lower elementary school education, and were for vocational training. The education period of this type of school was less than three years and many of them were part-time schools. Agricultural, commercial and technical courses were provided, and the adoption of courses was decided taking into consideration the actual circumstances of each area.

This type of supplemental school spread in the form of vocational education institutes, but agriculture remained the main subject and technology courses did not expand as much as had been hoped. There were 166 supplemental schools offering technology courses in Japan in 1909.

The apprentice schools were founded in 1894 with the purpose of updating the old apprentice system and nurturing technologists and beginner engineers on a

FIGURE VIII: TREND IN NUMBER OF STUDENTS DISPATCHED ABROAD BY THE MINISTRY OF EDUCATION




Source:

Nakayama, Shigeru. Government managed science. In Sugimoto, Isao. Science History. Yamakawa Printing, 1967: 369.

full scale through school education. The minimum entrance qualification was graduation from ordinary elementary school, and the education period was between 6 months to 4 years. The curricula comprised such basic subjects as mathematics and physics, and subjects and practices directly related to vocations.

The number of apprentice schools in Japan in 1917 was 136, which were classified into two broad categories. One was founded in the local areas where the traditional industries predominated, and the other was founded in the urban industrialized areas. In the former schools founded in the traditional industry areas, subjects were taught attaching importance to local industries such as textile fabrics, dyeing, Japanese pottery, china and woodcrafts. But, as industrialization progressed, many of these types declined. The latter, the apprentice school in urban areas, cultivated engineers necessary for modern industries. The main subjects were architecture and metalwork, etc., and the subjects changed in compliance with the demand of modern industries. This type of apprentice schools became popular backed by rapid industrialization, and most of these grew to technical school status of the upper secondary school level.

The process of foundation of these apprentice schools was varied. School associations were formed, in some cases mainly by manufacturers of each area; in other cases by such local selfgoverning bodies as prefectures, sub-prefectures and cities, towns and villages. But as the need for engineering education became more pressing because of rapid industrialization, the Government supported them financially under the Law relating to the National Treasury Subsidy for Vocational Education Expenses of 1894.

The cultivation of engineers was carried out by others besides public education institutes as supplemental schools and apprentice schools. They were the so-called "factory schools" established in companies, mainly large corporations, to educate engineers from about 1899. The employees were taught basic subjects and techniques, and were cultivated to be skilled engineers to meet the corporations' needs.

**Beginner Class Engineers Education:** The light industries such as cotton yarn, textile, paper manufacturing, sugar refining, and so on, were modernized in Japan after the Sino-Japanese War (1894 to 1895); and the heavy industries, centering around the machinery industry, reached the developing stage. Engineers skilled in machinery became necessary in place of the former engineers

skilled in handicrafts, and it became an urgent necessity to cultivate them systematically. Therefore, the Government changed the educational policy attaching importance to vocational education in place of ordinary education. And repletion and consolidation of technological education was implemented, with the promulgation of the Law relating to the National Treasury Subsidy for Vocational Education Expenses of 1894. Under the Law, technical schools at the middle high school level and higher vocational technology schools at the college level, were founded.

Technical schools were gradually founded everywhere in Japan. This type of school was founded for the purpose of engineering education for beginners. The graduates of upper elementary schools were qualified to enroll, and the education period was 3 years. Subjects initially were mainly woodcrafts, metalwork, dyeing and textile fibers, etc.; but as industrialization progressed, they were changed to satisfy such needs of modern industries as machinery, electricity, chemistry, architecture, and so on. The contents of education were basic subjects such as mathematics and physics, etc., and a combination of the study of basic theory and practice in each student's specialized field; but priority was given to each student's specialized subjects and practices.

The above mentioned apprentice schools in urban areas were gradually elevated to technical school status under a law revised in 1902. These technical schools increased to 54 in 1920, 90 in 1930, and 583 in 1944, and played a major role as technical education institutes together with the higher vocational technology schools which will be mentioned later. After World War II, these were developed to technical high schools.

**Education Of Middle And High Grade Engineers:** Middle schools and vocational schools were consolidated and increased as educational institutes up to the upper secondary level until about 1900. As a result, it became necessary to enlarge the higher level educational institutes accepting the graduates of these schools. Also, the need for higher level education arose from heavy industrialization with progress at the technological level.

There were only two universities as higher educational institutes at that time. They were Tokyo Imperial University and Kyoto Imperial University, founded in 1897. The technologists educated by these institutions were very

few, and the number of students enrolled in the faculty of technology of both universities was not more than 500 in 1900. Thus, professional schools with a shorter educational period were founded in response.

The enrolment qualification for the vocational schools founded in 1903 was graduation from middle high school, and the educational period was more than 3 years. Vocational schools not requiring 3 years high school education were less expensive than the universities which required three years education in addition to middle high school education. There were vocational schools offering agricultural, commercial, medical and other courses, not to mention technology; and they supplied trained minds useful for the society immediately upon graduation.

Higher vocational technical schools were virtually the driving force behind Japan's industrialization. The graduates of these schools were fully active as on-the-scene engineers or research and development engineers.

The schools were the main centers educating and supplying the front-line engineers in pre-war days and their number was 3 in 1903, 21 in 1925, and 59 in 1944. After World War II, the schools, both public and private, were elevated to university status.

Tokyo and Kyoto Imperial Universities were the only ones educating higher technologists at the university level, but later, the Tohoku and Kyushu Imperial Universities were founded. As a result of revision of the relevant law in 1920, private universities were also founded.

The universities having Faculties of Engineering were gradually increased, the number being 6 in 1925, and 13 in 1944, but they became the nuclei of technological education immediately after World War II.

**Summary**

Development of technology education in Japan has kept pace with development of the nation's industrialization and technological level. It can be summarized as follows:

(i) The technology transfer in the early stage of the Meiji Era (from the 1870's to the 1880's) was carried out chiefly through western technologists, or so-called "Hired Foreigners", and Japanese students were dispatched to western countries to study technology.

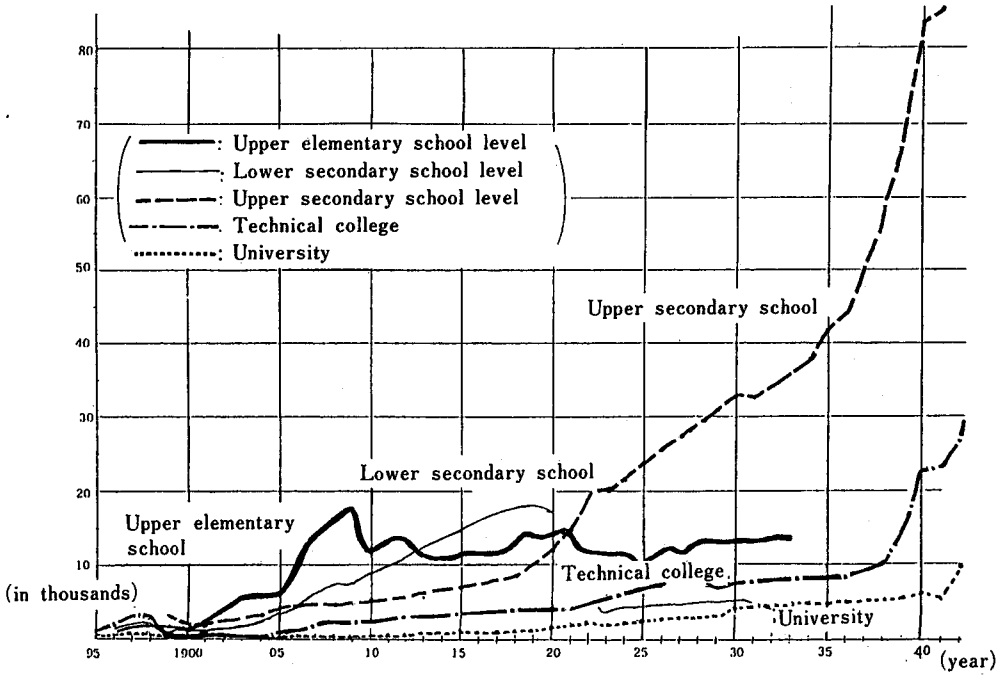
(ii) Universities, as the institutes for educating higher level technologists to replace "Hired Foreigners", were founded at an early date.

(iii) Various kinds of technological-educational institutes were founded at the time when the Japanese light industries were being modernized, and the shift to heavy industries was beginning (1890's to the 1900's).

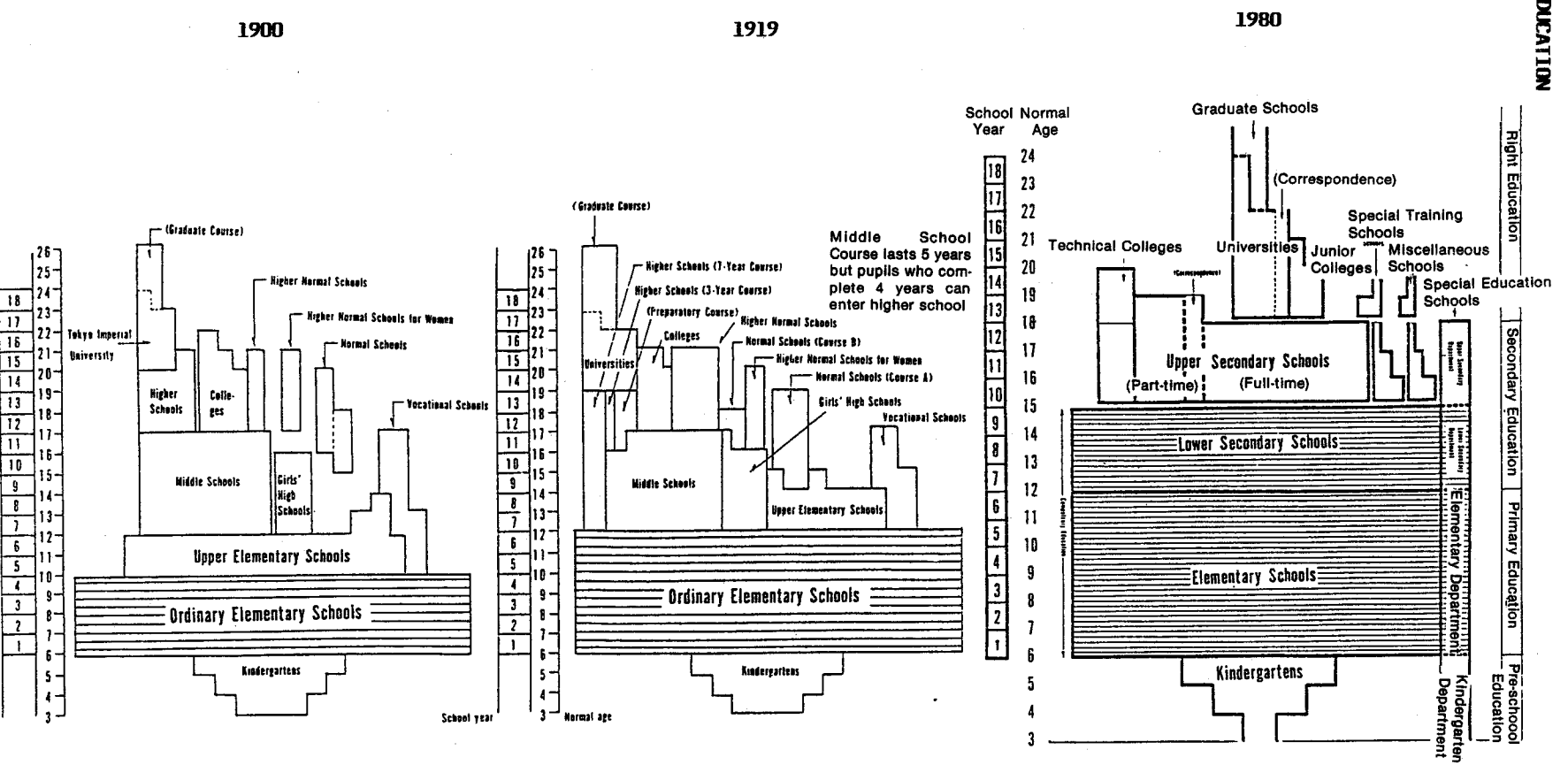
(iv) The increase in enrolment in the schools of each level shifted from the low to the high, namely as shown in Figure IX, from the supplementary schools of the upper elementary school level to apprentice schools of the lower secondary school level, to the technical schools of the upper secondary school level, and to higher vocational technical schools of the college level.

(v) Also in the post-war period, the number of students in technical high schools of the upper secondary school level increased greatly, but began to decrease after 1965 as a turning point. Instead the number of students in universities began to increase. Now, the number of students in graduate courses at universities and special training schools, has greatly expanded (Figure X).

FIGURE IX: TREND IN ENGINEERING SCHOOL ENROLMENT, (1895-1942)



# FIGURE X: HISTORICAL REVIEW OF THE SCHOOL SYSTEM



# TECHNICAL, SCIENTIFIC AND HIGH-LEVEL MANPOWER DEVELOPMENT IN THE MALAYSIAN UNIVERSITY SYSTEM: THE ROLE OF PUBLIC SCHOLARSHIP POLICY

by

Ozay Mehmet*

Yip Yat Hoong**

## PART I: INTRODUCTION

Malaysia is currently experiencing rapid technological and structural changes as part of the industrial and economic development process. She is also experiencing another form of industrial restructuring induced by the New Economic Policy (NEP) inaugurated in 1970 and designed to restructure employment patterns in the country more in line with the population distribution (Government of Malaysia, 1981). Within this restructuring framework, the Malaysian government has assigned top priority to the task of producing the required technical, scientific and other high-level manpower (HLM), and large amounts of public resources have been reallocated in the education budget for this task.[1]

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1 Thus, looking at reallocations of educational recurrent expenditures since mid-1970s, we observe that:

(i) the share of Primary and Secondary education declined significantly during 1976-79 from 77% of the total education (recurrent) budget to 68.7%;

(ii) on the other hand, the share of higher education remained virtually the same at about 12-13%;

(iii) the most dramatic change was in the share of overseas education: its share rose from 0.3% in 1976 to 8.7% in 1979; and

(iv) combining (ii) and (iii), we see that during 1976-79, the share of post-secondary education rose from 13.6% to 21% - a truly astonishing rise.

Source:

MINISTRY OF EDUCATION, MALAYSIA, Educational statistics of Malaysia, 1976-1979. Kuala Lumpur, National Printing Department, 1982 : 128 (Table V).

## PUBLIC SCHOLARSHIP POLICY

There is something unique about the Malaysian reliance on manpower development through the higher education system. Unlike most developing countries, public scholarships have been utilised on a major scale for the task of producing technical, scientific and high level manpower. Thus, the 1973 Manpower Survey conducted by the Economic Planning Unit for the Third Malaysia Plan, which provided detailed occupational and educational requirements through to 1990, predicted higher than average growth of demand for professional and technical manpower. Accordingly, it called for "a sizeable expansion in the production of scientific and technical personnel" and a "vast expansion of personnel and facilities for education and training at the secondary and tertiary levels of education in the sciences and technologies".[1]

As a result of these forecasts and expectations, there has been a rapid expansion of the Malaysian university system: the number of universities increased from 1 to 6, and enrolments rose fourfold during 1969 and 1980 (Yip, 1983). At the same time, the amount of public expenditure for scholarships rose sharply. Thus, currently about 2 out of every 3 students in Malaysian universities are on public sholarships at an average cost of $3,300 per year per scholar. In addition, there are almost 50,000 students (i.e. more than double the number of degree students enrolled in the five universities) undergoing post-secondary education overseas at an estimated annual cost of $855 million (New Straits Times, 30 Jan. 1983: 4).

### The Emerging Mismatch In High-Level Manpower (HLM)

One question that now needs to be asked is whether the educational system of this country is fulfilling its HLM needs. This question is all the more pertinent with regards to higher education not only because it is more expensive but also because of the more urgent needs of high level technical and professional manpower to meet the demands of an expanding economy and the restructuring of the Malaysian society under NEP.

Evidence to be presented below suggests that there is a lack of coordination between high level manpower planning on the one hand, and economic planning on

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[1] The report of the manpower survey in Malaysia, 1973. Kuala Lumpur (undated). Pp. 91-2, Para. 264.

the other. Consequently, there are signs that development needs for certain types of technical and professional trained manpower are not being met; that graduates in certain fields of specialisation are unemployed or underemployed, and that the mounting costs of university education are showing decreasing rates of return in terms of overall national development. This, therefore, poses the question as to the purposes for which this country's higher educational system is designed, and whether it is being developed in the right direction.

The following recent developments have tended to add to the urgency of the problem of mismatch in the HLM field:

(i) the increasing cost of higher education, especially in capital and overhead costs with the creation of five new universities since 1969 (Yip, 1983);

(ii) the ongoing financial constraint faced by the universities as a result of the current recession which has led to shrinking budget allocation for universities in relation to other forms of public expenditure;

(iii) the saturation of the civil service as the traditional employer of the arts and social science graduates, particularly in the light of the present "freeze" of positions in the public sector; and

(iv) increasing emphasis on privatisation and the policy shift in the direction of training for the private sector rather than the public sector.

All of these factors, along with an excess demand for university places in this country, point to the urgency of the need to achieve greater and more effective co-ordination between the university system, on the one hand, and the labour market, especially the private sector, on the other. The scholarship policy provides a potentially highly effective policy instrument for promoting such co-ordination. For example, scholarships can be utilised as incentives in order to encourage students to specialise in certain fields of study rather than in others. Therefore, the overall purpose of this paper is to examine,

empirically, the role which Malaysian scholarship policy has played in the past in HLM development, and to inquire whether more efficient alternatives exist for reforming this traditional system.

## PART II: AN EMPIRICAL ANALYSIS OF MALAYSIAN SCHOLARSHIPS

### Scholarships As Subsidies For High-Level Manpower Development

Government scholarships to students in universities represent a form of public subsidy from tax revenues - similar to, for example, agricultural subsidies extended to farmers. Just as agricultural subsidies reduce the cost of production of the farmers and retail prices paid by the consumers, so scholarships reduce the **private** cost of human capital formation for university students and their parents. Put differently, higher education subsidies increase the **private** rate of return on investment in human capital formation. In social or national terms, subsidies through scholarships are conceived as **public** investments in producing HLM for economic and social development. As a public good (i.e. financed by tax revenues), higher education is expected to generate social or national benefits.

Who are the recipients of higher education subsidies? Are the scholarships distributed efficiently and consistently with the HLM needs of the country? Do they democratise access to higher education? We now begin to examine these types of questions.

### The IPT Survey Of 1982/83 University Graduates

Our analysis is based on data generated through a large-scale survey of university graduates of 1982/83, financed under a research grant from the Canadian International Development Research Centre, Ottawa. A total of 2,046 questionnaires were completed through direct enumeration of first-degree graduates of all five universities in Malaysia during the convocation ceremonies over June-September 1983. The survey coverage represented 45% of the total graduating class with bachelor degrees (Table I), as compared with a pre-survey objective of 50% sample size. This large sampling ratio was chosen as a substitute strategy for multiple stratification (i.e. by race, discipline, etc.) which, owing to time and information constraints, could not be done. As can be seen from Table I, we were more or less successful in meeting our 50% coverage objective, except in the case of UTM where delays in securing the necessary official permission to conduct the survey were encountered, causing only a 13.4% coverage. For this reason, certain adjustments had to be made in the data

TABLE I: SURVEY SAMPLE SIZE, BY UNIVERSITY AND SCHOLARSHIP STATUS

| Scholarship Status & University | | No.. | % | Sample Size | |
|---|---|---|---|---|---|
| | | | | No. | % |
| 1. | Scholarship Holders | 1,244 | 60.8 | | |
| 2. | Non-Scholars | 802 | 39.2 | | |
| 1+2 | Total Survey | 2,046 | 100.0 | | |
| 3. | Total Bachelor Degree Graduates 1982/83 | 4,551 | 100.0 | 2,046 | 45.0 |
| | Universiti Malaya | 1,840 | 100.0 | 933 | 50.7 |
| | Universiti Sains | 790 | 100.0 | 363 | 45.9 |
| | Universiti Kebangsaan | 1,258 | 100.0 | 511 | 40.6 |
| | Universiti Teknologi | 238 | 100.0 | 32 | 13.4* |
| | Universiti Pertanian | 425 | 100.0 | 207 | 48.7 |

Note:

* Under-coverage due to problems of securing official permission to conduct the survey at the Convocation ceremonies.

processing stage (see following section on: Under-Enumeration of UTM Graduates) in order to compensate for this under-coverage.

**Focus On Scholarships (Table I)**

The results reported in this paper are focused on only one variable in the IPT Survey, viz. **government scholarships.** It should be noted that the term 'government scholarships' includes those awarded by statutory bodies as well as those granted by government departments and includes bursaries and grants which are non-repayable. Thus, our central objective is to determine empirically the extent to which the scholarships policy in Malaysia is succeeding in developing HLM required by the economy and how efficiently and equitably the socio-economic restructuring objectives of NEP are being met. It will be seen from Table I that a total of 1,244 of the surveyed graduates, or 60.8% were on government scholarships.

**Distribution Of Scholarships By Race And Value Of Award (Table II)**

Almost 4 out of every 5 government scholarships are awarded to Malay graduates. The Chinese share is only 14.4%; the Indian share 4.3%; and that of the East Malaysians 2.9%.

Moreover, the value of Malay scholarships, as a general rule, is somewhat higher than those for non-Malays, with the exception of East Malaysian scholarhsips (which are numerically insignificant). Thus, 36.8% of the Chinese scholarships, and 43.4% of those for the Indians were worth less than $3,000, as compared with 26.3% in the case of Malay graduates. On the other hand, almost 3 out of every 4 Malay scholarship holders carried awards worth more than $3,000, as compared with 63.2% and 56.7% in the case of Chinese and Indians, respectively.

Clearly, the distribution of government scholarships predominantly favour the Malays. This is valid both in terms of number of scholarship awarded as well as in terms of value of awards.

**TABLE II: DISTRIBUTION OF SCHOLARSHIPS BY RACE AND VALUE OF AWARD**

| Value of Award | Total Scholars | | Malays | | Chinese | | Indians | | East Malaysians | | Others | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| $1 - 1,000 | 43 | 3.5 | 31 | 3.2 | 9 | 5.0 | 3 | 5.7 | - | - | - | - |
| 1,000 - 2,000 | 31 | 2.5 | 14 | 1.5 | 9 | 5.0 | 6 | 11.3 | 1 | 2.7 | 1 | 6.7 |
| 2,001 - 3,000 | 274 | 22.0 | 207 | 21.6 | 48 | 26.8 | 14 | 26.4 | 2 | 5.4 | 3 | 20.0 |
| 3,001 - 4,000 | 862 | 69.3 | 686 | 71.5 | 111 | 62.0 | 26 | 49.1 | 29 | 78.4 | 10 | 66.7 |
| 4,000+ | 34 | 2.8 | 22 | 2.3 | 2 | 1.2 | 4 | 7.6 | 5 | 13.5 | 1 | 6.7 |
| TOTAL | 1,244 | 100.0 | 960 | 100.0 | 179 | 100.0 | 53 | 100.0 | 37 | 100.0 | 15 | 100.0 |
| % | 100.0 | | 77.2 | | 14.4 | | 4.3 | | 2.9 | | 1.2 | |

Note:

Percentages may not add to 100.0 owing to rounding.

**Distribution Of Scholarships By Total Household Income And Race (Table III)**

Although the scholarships are allocated in a heavily pro-Malay way, this does not mean that all Malay households have an equal opportunity for getting a scholarship; nor, for that matter, do the other racial groups. There are significant intra-racial differences in the opportunity for getting a scholarship.

The most important fact is that scholarships are regressively distributed favouring the richer households, and this is true for all races. The scholarship share of the poor households (i.e. those having a total monthly income of less than $300) is only 12.3% versus their population share of 49.4%. On the other hand, the richest 10% of the population accounted for 25.5% of scholarship awards.

When we consider the distribution of scholarships within given races, at first sight it appears that the distribution is least regressive among the Malays, and most regressive among the Chinese, since 14.2% of the total scholarships awarded to Malays have gone to poor Malay households, whereas the comparable Chinese share is only 3.4%. However, when we standardize for population shares, the situation is altered drastically: the intra-Malay inequality of opportunity is far greater than for non-Malays. For every chance that the poor Malay households have for being awarded a scholarship, the richest group of Malay households have 21 chances, as compared with 13 and 10 for the richest Chinese and Indian households, respectively.

Therefore, our evidence shows, very strongly, that the present method of awarding government scholarships, apart from being heavily pro-Malay, is even more heavily biased in favour of the richer Malay households, and to a lesser extent, in favour of the richer Chinese and Indian households.

**Distribution Of Scholarships By Field Of Study And Race (Table IV)**

In this analysis, the field of study was determined on the basis of degree received. The data was classified into 8 principal groupings consolidating a total of 47 specific degrees granted in the 5 universities. A listing of these specific degrees, and their allocation within the eight principal groupings, is contained in Table V.

TABLE III: DISTRIBUTION OF SCHOLARSHIPS BY TOTAL HOUSEHOLD MONTHLY INCOME AND RACE

| Total Household Monthly Income* | Total Scholars | | Population Share** | Race | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Malays | | Chinese | | Indians | |
| | No. | % | | Scholarship Share | Population Share | Scholarship Share | Population Share | Scholarship Share | Population Share |
| $0 - 300 | 153 | 12.3 | 49.4 | 14.2 | 63.2 | 3.4 | 26.0 | 9.5 | 39.7 |
| 301 - 500 | 377 | 30.3 | 22.1 | 32.5 | 19.0 | 20.7 | 26.2 | 26.4 | 29.4 |
| 501 - 1,000 | 394 | 31.7 | 18.2 | 30.1 | 12.9 | 41.9 | 27.7 | 39.6 | 20.5 |
| 1,000+ | 317 | 25.5 | 10.3 | 22.9 | 4.9 | 34.0 | 20.1 | 24.5 | 10.4 |
| Missing Cases | 3 | 0.2 | - | 0.3 | - | - | - | - | - |
| TOTAL | 1,244 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Note:

* From all sources including remittances from family members, relatives etc., farm income, dividends, interest, pension and rental income.

** From 1977 Agriculutral Census, Appendix Table 13.

TABLE IV: DISTRIBUTION OF SCHOLARSHIPS BY FIELDS OF STUDY AND RACE

| Fields of Study | | Total | | Racial shares | | | |
|---|---|---|---|---|---|---|---|
| | | No. | % | Malays | Chinese | Indians | Others |
| I. | Arts, Humanities & Soc. Science | 388 | 29.7 | 78.9 | 14.2 | 3.6 | 3.3 |
| II. | General Science* | 430 | 32.9 | 77.2 | 13.2 | 4.7 | 4.9 |
| III. | Economics and Bus. Admin. | 183 | 14.0 | 77.1 | 15.3 | 6.0 | 1.6 |
| IV. | Law | 20 | 1.5 | 85.0 | 0 | 10.0 | 5.0 |
| V. | Health Science | 48 | 3.7 | 83.3 | 10.4 | 0 | 6.3 |
| VI. | Agricultural Sciences | 89 | 6.8 | 73.0 | 16.9 | 1.1 | 9.0 |
| VII. | Architecture, Surveying, Urban & Regional Plan.* | 64 | 4.9 | 92.2 | 6.3 | 0 | 1.5 |
| VIII. | Engineering* | 84 | 6.4 | 69.1 | 20.2 | 8.3 | 2.4 |
| IX. | Missing Cases | 2 | 0.1 | | | | |
| TOTALS | I-IX | 1,308 | 100.0 | | | | |
| Generalist | I-III | 1,001 | 76.6 | 77.9 | | 22.1 | |
| Professional | IV-VIII | 305 | 23.3 | 78.4 | | 21.6 | |

Note:

* Categories affected by under-enumeration adjustment(see text).

## TABLE V: LISTING OF SPECIFIC DEGREES UNDER THE EIGHT PRINCIPAL GROUPS OF STUDY FIELDS

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I. **Arts, Humanities and Social Sciences**

B.Arts
B.Arts(Hons.)
B.Arts with Education (Hons.)
B.Islamic Studies
B.Islamic Studies (Hons.)
B.Social Science
B.Social Science (Hons.)
B.Science (Human Development)
B.Education (Agric.Sc.) (Hons.)
B.Education (Home Tech.) (Hons.)
B.Education (Physical Educ.) (Hons.)

II. **General Science**

B.Science
B.Science with Education
B.Science with Education (Hons.)
B.Science (Hons.)
B.Applied Science (Hons.)

III. **Economics & Business Administration**

B.Business Administration
B.Business Administration (Hons.)
B.Economics
B.Economics (Hons.)
B.Accounting(Hons.)
B.Science (Resource Economics)

IV. **Law**

B.Law (Hons.)

V. **Health Science**

B.Medicine
B.Pharmacy
B.Dental Surgery

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TABLE V (CONT'D)

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VI. **Agricultural Sciences**

B.Agricultural Science (Hons.)
B.Food Science & Technology (Hons.)
B.Science (Fishery)(Hons.)
Doctor of Veterinary Medicine
B.Science (Agriculture Business)
B.Science (Forestry)

VII. **Architecture, Surveying, Urban & Regional Plan**

B.Surveying
B.Surveying (Hons.)
B.Architecture (Hons.)
B.Surveying (Property Management)(Hons.)
B.Urban & Regional Planning
B.Urban & Regional Planning (Hons.)
B.Science (Housing, Building & Planning)(Hons.)
B.Science (Environment)(Hons.)

VIII. **Engineering**

B.Engineering (Agriculture)(Hons.)
B.Engineering (Civil)
B.Engineering (Civil)(Hons.)
B.Engineering (Petroleum)(Hons.)
B.Engineering (Electrical)(Hons.)
B.Engineering (Mechanical)(Hons.)
B.Engineering (Chemical) (Hons.)

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## PUBLIC SCHOLARSHIP POLICY

Our 8 principal groupings of field of study was further sub-divided into two main categories:

(i) "Generalist" degree holders comprising degrees in Arts, Humanities and Social Sciences; General Science; and Economics and Business Administration; and

(ii) "Professional" degree holders comprising graduates of Law; Health Sciences; Agricultural Sciences; Architecture, Surveying, Urban & Regional Planning; and Engineering.

As will be observed, Table IV is also tabulated by race since, under the NEP, this is of major importance.

### Under-enumeration Of UTM Graduates

During the enumeration stage of the IPT Survey, there was a delay in obtaining the necessary official permission from the UTM authorities in order to survey the graduating class at the convocation ceremonies. As a result, it was only feasible to enumerate 32 or 13.4% of the total graduates, as compared with our objective of 50% coverage which was, more or less, achieved in the other 4 universities. Since UTM specialises in professional fields (e.g. engineering), it was obvious that it was necessary to compensate for the relative under-enumeration so as to avoid a distortion[1] which would otherwise affect our results in Table IV. Accordingly, it was decided to enlarge (or "blow-up") the UTM sub-sample of graduates by a weighting factor of 3 in order to make its sampling ratio comparable with that for the other 4 institutions. This is why the total number of graduates as reported in Table IV (viz. 1308) is larger by 64 as compared with the other tables.

The results are quite startling. First and foremost, the government scholarships in the Malaysian university system are **not** geared to the development of professional-type of manpower, but rather to the production of generalists. No less than 76.6% of the total 1982/83 graduates on scholarships,

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[1] Such a distortion is not evident in other aspects of our study.

held degrees in Arts, Humanities, Social Sciences, General Science, Economics and Business Administration. On the other hand, only 23.3% were in professional fields.

Looking at the racial distributiuon of HLM manpower developed, Malay graduates dominated in every field. In both the generalist as well as the professional-type of manpower development, Malay graduates on scholarships accounted for about 78% of total graduations. However, the Malay share in Engineering was significantly below this average, while being significantly higher in Architecture, Surveying and Urban and Regional Planning.

**Scholarship-holders By Labour Force Status And Race (Table VI)**

Our Survey was conducted some six months after the date at which the graduates had completed their requirements for graduation. Thus, we were able to collect information about their success, or lack of it, in the labour market during the six months following their entry into the HLM job market.

It is evident that the 1982/83 graduates have been experiencing the severe negative effects of the recession, and particularly the freeze of public service hirings. Thus, only 58% of the graduates with scholarships were fully employed, and a further 5.5% were employed part-time. The employment ratio was highest among the Chinese, and lowest among the Indians, with the Malay graduates in between.

On the other hand, more than one-third of the graduates on scholarships were still unemployed, and looking for jobs, some six months after effective graduation. This is a particularly surprising figure in view of the fact that about 90% of scholarship holders are bonded (Table VII). The unemployment incidence was slightly less among the Chinese, otherwise it was pretty uniform for all races.

**Employed Scholarship-holders By Sector Of Employment And Race (Table VIII)**

One of the most important results revealed by our Survey is the fact that government scholarships used for HLM development in the Malaysian university system are almost exclusively intended for the public sector. The private sector utilised only 16.2% of the 1982/83 scholarhship graduates who were

TABLE VI: DISTRIBUTION OF SCHOLARSHIPS BY LABOUR FORCE STATUS AND RACE OF GRADUATES

| Labour Force Status | Total Scholars | | Race | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Malays | | Chinese | | Indians | | Others | |
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Employed, Full-Time | 722 | 58.0 | 553 | 57.6 | 113 | 63.1 | 30 | 56.7 | 26 | 50.0 |
| Employed, Part-Time | 69 | 5.5 | 46 | 4.8 | 12 | 6.7 | 5 | 9.4 | 6 | 11.5 |
| Unemployed | 441 | 35.5 | 351 | 36.6 | 54 | 30.2 | 17 | 32.1 | 19 | 36.5 |
| Missing Cases | 12 | 1.0 | 10 | 1.0 | 0 | 0 | 1 | 1.9 | 1 | 1.9 |
| TOTAL | 1,244 | 100.0 | 960 | 100.0 | 179 | 100.0 | 53 | 100.0 | 52 | 100.0 |

TABLE VII: DISTRIBUTION OF SCHOLARSHIPS BY LENGTH OF BONDING AND RACE

| Length of Bonding | Total Scholars | | Race | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Malays | | Chinese | | Indians | | Others | |
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| 0 years | 142 | 11.4 | 101 | 10.5 | 23 | 12.8 | 10 | 18.9 | 8 | 15.4 |
| 1 - 4 years | 28 | 2.3 | 26 | 2.7 | 0 | 0 | 2 | 3.8 | 0 | 0 |
| 5 - 6 years | 144 | 11.6 | 72 | 7.5 | 38 | 21.2 | 9 | 17.0 | 25 | 48.1 |
| 7 years | 803 | 64.5 | 649 | 67.6 | 109 | 60.9 | 28 | 52.8 | 17 | 32.7 |
| 8 - 9 years | 6 | 0.5 | 5 | 0.5 | 1 | 0.6 | 0 | 0 | 0 | 0 |
| 10 and over | 121 | 9.7 | 107 | 11.1 | 8 | 4.5 | 4 | 7.5 | 2 | 3.8 |
| TOTAL | 1,244 | 100.0 | 960 | 100.0 | 179 | 100.0 | 53 | 100.0 | 52 | 100.0 |

TABLE VIII: EMPLOYED SCHOLARSHIP HOLDERS BY SECTOR OF EMPLOYMENT AND RACE

| Employer | Total Scholars | | Race | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Malays | | Chinese | | Indians | | Others | |
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Government | 530 | 67.0 | 421 | 70.3 | 66 | 52.8 | 16 | 45.7 | 27 | 84.4 |
| Stat. Body | 115 | 14.5 | 95 | 15.9 | 12 | 9.6 | 5 | 14.3 | 3 | 9.4 |
| Private Sector | 128 | 16.2 | 71 | 11.9 | 42 | 33.6 | 13 | 37.1 | 2 | 6.2 |
| Self-employed | 5 | 0.6 | 3 | 0.5 | 2 | 1.6 | 0 | 0 | 0 | 0 |
| Missing Cases | 13 | 1.6 | 9 | 1.5 | 3 | 2.4 | 1 | 2.8 | 0 | 0 |
| TOTAL | 791 | 100.0 | 599 | 100.0 | 125 | 100.0 | 35 | 100.0 | 32 | 100.0 |

employed at the time of our Survey, and a negligible percentage entered self-employment. Thus, more than 4 out of 5 graduates with scholarships worked for the public sector - 67% for the government, and another 14.5% for statutory bodies. The ratios are slightly higher in the case of the Malays, and lower for the Chinese and Indians.

Evidently, the Malaysian scholarships policy is a tool of monopsony power in the HLM market designed to serve the staff requirements of the public sector. Under this system, the HLM needs of the private sector are effectively ignored. Furthermore, given the current signals of a continued freeze on government hirings and a greater emphasis on privatisation, this system, if not changed very rapidly, will result in a growing problem of over-production and mismatch in the HLM market in Malaysia.

**Scholarships And Bonding (Table VII)**

In fact, the traditional system of bonding scholarship-holders symbolises the central paradox in Malaysian policies with regard to HLM development through the universities. No less than 90% of the graduates on scholarships are bonded - two-thirds for 7 years service, and about 10% for 10 years or more. The typical indemnity imposed to discharge the bond is $50,000 to $75,000. In past years, the bonded scholarship system was relied upon to perpetuate the government as a monopsonist in the HLM market: the universities were monopolised to serve the staffing needs of the government departments and agencies, while ignoring the private sector's requirements. Now, with the saturation point apparently having been reached in the civil service, the bonded scholarship system is rapidly creating a serious over-production and mismatch problem. It is in fact reducing the mobility of bonded graduates in the HLM market (New Straits Times, 1983: 1). This problem is unlikely to be a passing phenomenon; in fact, it can be expected to get increasingly worse unless the role of universities is quickly and dramatically reversed from servicing the public sector to meeting the HLM needs of the private sector.

There is a second fundamental shortcoming of the bonded scholarship system. It is the fact that it represents a bargain method of developing HLM for the public sector, in a way which is especially burdensome on the lower income households. This follows from the fact that in Malaysia, as elsewhere, the investment in university education is a joint-investment between three partners:

(i) the student himself who bears the major cost in the form of foregone earnings while attending university plus other expenses;

(ii) the parents who provide supplementary funds; and

(iii) bonding agencies in the public sector which provide bonded scholarships.

Our survey findings indicate that, as a crude estimate, these scholarships represent about one-third of the total cost (undiscounted) of acquiring a bachelor's degree.[1] Thus, through the bonded scholarship system, the bonding agency is able to retain the services of a graduate for 7 years or more at a considerable cost-saving. In fact, the cost-saving realised by the sponsoring agency amounts to a higher proportion of the household income for a graduate originating from a lower-income household than the proportion for a higher income household, hence, the bonded scholarship system may actually represent a form of regressive tax burden on the poor households.

For these reasons, it is evident that the bonded scholarship system has become obsolete as a method of staff recruitment in the public sector, and it should speedily be phased out.

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[1] Excluding capital costs. This estimate is based on foregone earnings of $500/month for 4 years, $1,000 supplementary funds per year from parents, and scholarship funds of $3,300 a year.

## PART III: CONCLUSIONS AND POLICY IMPLICATIONS

In conclusion, our survey findings can be summarized as follows:

(i) The government scholarships are not utilized to produce technical and professional manpower needed in the economy. Instead, they are distributed in a manner to encourage "generalist" graduates who are bonded under their scholarship awards to work for the government for typically seven years. Thus, the existing scholarship policy works, essentially, as an instrument of monopsony power for the government in the HLM market.

(ii) Our findings lead to the conclusion that the Malaysian system of bonded scholarship is now obsolete and should be terminated. In particular, it is a system which reduces the mobility of graduates in the HLM market, and it is in real danger of worsening the problem of over-production and mismatch which has already emerged in the Malaysian universities. In future, the university system should attempt to produce HLM for employment in the private sector.

(iii) On grounds of equity and equality of opportunity as well, the Malaysian scholarship policy fails badly. Thus, although in accordance with the NEP most of the government scholarships are allocated to Malays, our evidence shows that the distribution of these scholarships is regressive, being heavily biased in favour of the upper and richer income groups. Accordingly, the scholarship policy as presently administered promotes intra-ethnic inequality, benefiting those who do not need public subsidy, while failing to remove financial barriers for the relatively disadvantaged income groups to increase their access to university education.

(iv) Finally, our evidence shows that the scholarships are not efficiently and uniformly administered. There are significant variations in the value of awards for same courses in the same universities, and there are discretionary criteria relating to

the length and other aspects of the awards. But, perhaps, the single most important administrative deficiency is the existence of so many different scholarship-granting agencies and bodies each working quite independently, and often in competition with other agencies, in granting scholarships. Thus, it is quite possible for one student to be awarded scholarships by more than one agency.

## A Proposal: The National Student Loan Bank

For all these reasons, we believe the time has come when the Malaysian system of bonded scholarships should be phased out. It should be replaced by a new and single financial institution: the National Student Loan Bank (NSLB) which would provide repayable loans to all students[1], both for overseas as well as local university and higher education studies. These loans would be repaid, in full, out of the future incomes of the graduates. Even poor students will, thanks to their education, ultimately emerge as relatively rich members of the society, and, therefore, they should discharge their social accountability to the next generation by repaying their loans. For this reason, the supply of student aid should be in the form of repayable loans rather than grants.[2] However, to ease access for students from poor households, their loans should be guaranteed by the state, whereas in the case of other students (i.e. those from families able to afford the cost), the parents or guardians should act as guarantors. In this way, the NSLB would function as a self-financed, revolving fund, helping successive generations of students to benefit from university education in a socially responsible way.

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1 This is not an original idea. It was originally proposed by Professor Ungku A. Aziz. Penubuhan tabung siswa untuk menggantikan sistem biasiswa hadiah kerajaan. Kuala Lumpur, Memo kepada Kerajaan Malaysia, 2 Mei 1973

2 As a general rule, there should be no remission in these loans (i.e. they should not be written off), except in real and demonstrated cases of financial hardship.

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# CROSSBREEDING FOR IMPROVEMENT OF LOCAL GOATS USING A MULTI-DISCIPLINARY APPROACH

by

T.K. Mukherjee*

## Introduction

The Asian continent is characterized by various types of climate, topography, people, culture and farming systems. Apart from Japan and to some extent South Korea and Taiwan, livestock farming (excluding pigs and poultry) is rural based. The optimum size of these labour-intensive rural farms is approximately one hectare of land. Inefficiency in resource management, low productivity and income per farm worker, and weak bargaining power in buying and selling are some of the most typical disadvantages of these farms. In order to assist in the development of small farms and the farmers, various Governments of Asian countries have initiated programmes to accelerate the rates of productivity growth, to introduce desirable changes in technology and organization, to create more employment opportunities for rural labourers, and to achieve an equitable distribution of development benefits among small farmers.

In spite of the above attempts, in most of the Asian countries, the development of the ruminant sector of animal farming is apparently found to be negligible as compared to some cash crops and perennial crops, or for that matter poultry and pig farming. Significant attributes that are responsible for such difference are lack of consistent genetic improvement programmes, absence of pasture lands, and lack of seriousness amongst the rural farmers to adopt new technologies involving management, health, nutrition and breeding programmes.

Furthermore, amongst the ruminant species, the genetic improvment of goats has received least attention from the planners of Asian countries, although according to an F.A.O. statistic (1982), 56.8% of the total world population of goats are found in Asia, and goats account for about 6% of total meat production, 2% of milk production (mainly produced in Western countries), and 4%

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of hides and skin production. In Malaysia, although the population of goats is quite substantial (approx. 312,000), yet the demand for goat meat in the market exceeds the supply. Like many other countries of the developing world, goat meat in Malaysia is priced at a premium over beef and mutton, but goat milk seldom enters commercial channels in significant quantity or with sufficient regularity.

However, recently countries of the ASEAN region are beginning to realise the contribution of goat to meet human demand. This is mainly because of the fact that goats have a short generation interval, a wide ecological adaptability, or ability to utilize efficiently, and abundantly available low quality vegetation in small holdings. Furthermore, the increasing demand for goat meat worldwide and the preference of peasant farmers of tropical and subtropical regions in integrating a mixed species of small number of animals with their cultivated crops, make goats a suitable species for meat production in the tropics and subtropics (Raun, 1982; Devendra, 1981; Horst, 1981), and also possibly for milk production.

The poor development of a goat industry in Malaysia is attributed to lack of capital investment by the small holders of rural areas and estate workers of rubber plantations, and the absence of a proper planning for the genetic improvement of Katjang goats which possess the natural characteristics of heat and tick tolerance, high fecundity under harsh circumstances, and ability to survive with sub-optimum nutrition. However, the alarming state of high extraction rate (approximately 10% annually), high kid mortality, and inbreeding depression in the villages have continuously decreased the size of the Malaysian goat population during the past two decades (Peters et al.,1979). The poor rate of growth of these animals and the antagonistic property of high fecundity and high kid mortality (Mukherjee et al., 1982) necessitate a cross-breeding strategy that will include utilization of dominance and overdominance through heterozygosity, cumulative productive genes of merit, and use of breeds or lines or strains in crosses which are very much genetically divergent. Husbandry techniques for improvement, which will run parallely with the genetic improvement methods include better management, nutrition, reproduction and hygiene so as to ensure a probable niche of new genomes with the ecotype in which these are subjected.

## CROSSBREEDING OF GOATS

Keeping the above points in mind, a crossbreeding project has been jointly sponsored by the Institute of Advanced Studies, University of Malaya, Institute for Animal Production, Technical University of Berlin and German Agency for Technical Cooperation (GTZ). The objectives of this multi-disciplinary project are as follows:-

(i) To improve the growth, reproductive and carcass traits of local animals by crossbreeding the local animals with dual purpose German Improved Fawn goats. Artificial insemination procedure for matings involving German Fawn Males is practised using frozen semen.

(ii) To investigate the changes in adaptability and behaviour traits of crossbred animals.

(iii) To compare the levels of progesterone in lactating and non-lactating goats using a radio-immuno assay technique.

(iv) To investigate whether there are differences between semen characteristics of local and $F_1$ animals.

(v) To investigate the performance of various genotypes of the nucleus herd station at the University of Malaya, in rubber, oil palm and coconut plantations, an orchard, and in villages. (This will not be reported in the paper).

(vi) Apart from integrating goats in the plantation crops where the undergrowth could be exploited for goat feeding, vast resources of locally available agro-industrial byproducts and wastes, e.g. palm oil sludge (POS), poultry manure, brewer's dried grain are being investigated as potential ingredients of a goat concentrate feed. Some of the findings of this section will be partially reported in another paper of the Symposium.

## Materials And Methods

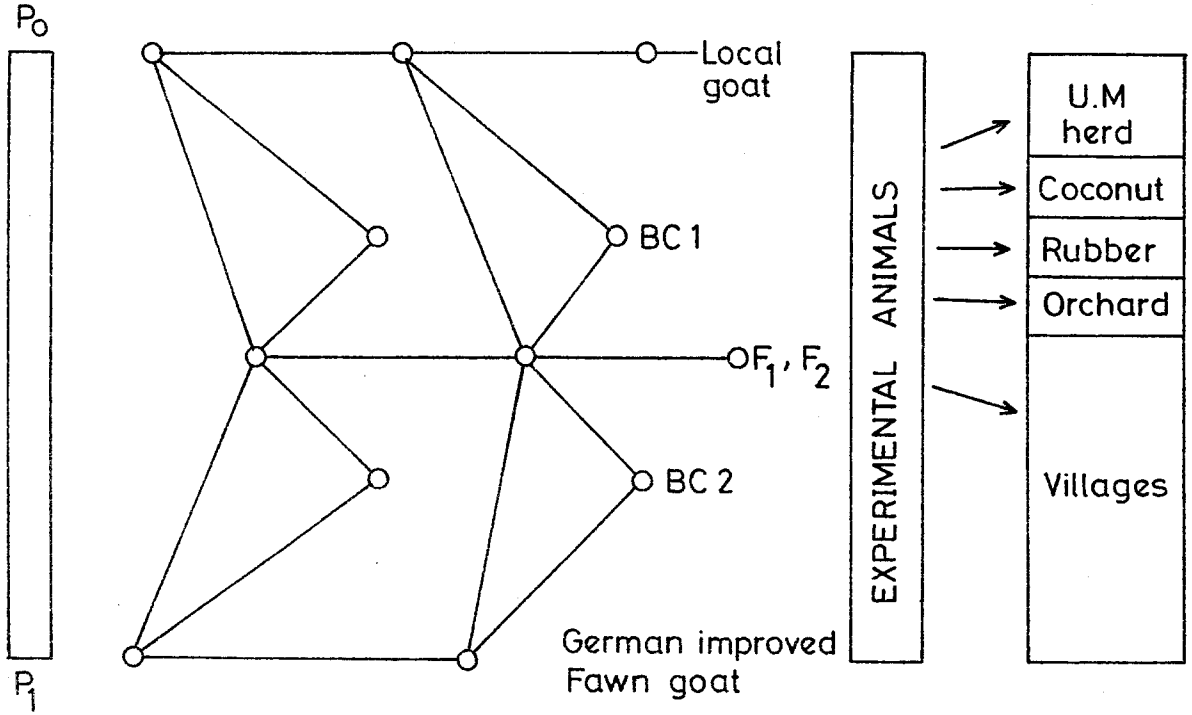
**Crossbreeding Of Goats - Growth Study:** A schematic diagram of the breeding programme (Figure I) reveals the method of production of the various genotypes ($F_1$, $F_2$, BC1 and BC2), and the testing of the experimental animals of these genotypes in different locations.

The programme involving the artificial insemination of local females with German Improved Fawn Semen was initiated in January 1980, to produce $F_1$ animals. The foundation stock of local females purchased during 1980 from various village farmers in the States of Selangor, Perak and Johor included pure Katjang goats and goats of mixed ancestry involving Anglo-Nubian, Jamanapari, Alpine and Sannen breeds. For the purpose of the present report,all these animals are designated as local. Since the project is still in progress, the data included in this study involved records from 1980 till mid-1982. The number of animals involved in the growth study were 220 local and 139 $F_1$ (Table I). Since the number of animals produced in the various field stations and villages was small, these goats were excluded from the present analysis. Similarly, back-cross animals of the nucleus herd were not included for analysis as their numbers were also very small.

**Management Of Animals:** Management procedures in the nucleus herd involved confinement of animals in three stages:

(i) Late pregnant (4 months usually) does and early lactating (up to three months) does with their kids were kept in individual maternity pens and fed with concentrate up to a maximum of 500 gms till mid-1982. The ingredients of the concentrate varied from time to time during the earlier months, but since 1981, a concentrate consisting of 35% palm oil sludge, 18% poultry manure, 35% brewers dried grain, 7% yeast and 5% molasses has been fed (Lim et al., 1981). Napier grass grown in the University farm has been fed to meet the 50% dry matter requirements of these does. Weaker kids, usually from multiple birth, were bottle fed with reconstituted milk powder. Due to the irregular supply of Napier grass occasionally, a total of up

FIGURE I: SCHEMATIC DIAGRAM OF GOAT BREEDING PROGRAM




BC 1: BACKCROSS 1 (75% Local, 25% German Fawn)
BC 2: BACKCROSS 2 (25% Local, 75% German Fawn)

TABLE I: NUMBER OF ANIMALS INVOLVED IN THE GROWTH STUDY

| Local | | | | $F_1$ (Local x German Pawn) | | | |
|---|---|---|---|---|---|---|---|
| Male | | Female | | Male | | Female | |
| S | M | S | M | S | M | S | M |
| 61 | 25 | 82 | 52 | 28 | 23 | 48 | 40 |

Note:

S : Single birth

M : Multiple birth

to 1 kg of concentrate has been recommended recently for late pregnant does, lactating does and breeding bucks. This ensures an optimum supply of dry matter to breeding animals.

(ii) Growing kids, separated from their dams after weaning (usually at 3 months), were kept in colony pens in a growing stall where they were mass fed with Napier grass and concentrate pellets as per their average dry matter requirement. Female kids are transferred to doe pens when they attained maturity. Uncastrated male kids, after a growth performance test in the growing house, are either selected for breeding purposes of the project or usually sold as breeders to farmers. Castrated kids are slaughtered for measurement of carcass traits at approximately 12 months or 15 months or 18 months.

(iii) Early pregnant does (before 3-4 months), empty does and young matured heifers are kept in group pens or doe stalls where regular checking for heat detection using teaser bucks is made. Confirmation of heat in these does is followed by either two subsequent artificial inseminations or natural mating depending on whichever is necessary according to the breeding programme. A similar procedure is also practised for lactating does, usually 2 months and above, in maternity stalls if the does are in oestrus.

(iv) Animals in doe pens are provided with Napier grass only.

**Health Programmes:** Salt lick and ad lib water is provided to all the above three categories of animals. Disease prevention programmes include bimonthly drenching of anti-helminthic drugs, occasional spraying of anti-tick/louse insecticides, vaccination against contagious ecthyma and foot and mouth disease, and an agglutination test for the presence of Brucella antigen amongst the breeders. Goats were regularly hoofed, and weighed once a month, and their body condition was scored (Thangavelu, 1982; Deichert, 1980).

**Oestrus Synchronization:** In some cases, artificial insemination has been preceded by oestrus synchronization which involves insertion of progestin impregnated vaginal pessaries, followed by withdrawal of sponges accompanied by

either a priori or post PMSG injection, and subsequent multiple inseminations with frozen semen (usually two). Certain experiments involving the determination of the optimum period of insemination, site of insemination, thawing time and thawing duration etc. are being conducted at present, but this report does not touch on the results of these experiments.

**Study Of Physiological Traits As A Measure Of Adaptability:** Physiological traits such as pulse rate, rectal temperature and respiration rates have been chosen for this purpose, since maintenance of the optimum parameters of the above traits are of importance in the adaptation of goats to its environment. In this study, measurements on the above traits were taken in the morning (0830 to 1030 hrs) and in the afternoon (1300 to 1500 hrs) from 5 adult males and 5 adult females from each of the local and $F_1$ animals. The pulse rate was obtained by counting the beats of the femoral artery for 1/2 minute. The rectal temperture was measured by inserting a clinical thermometer into the rectum for 1 minute. A count of flank movement while the animal was lying down for 1/2 minute was the procedure for obtaining the respiratory rate. All the measurements were standardized to per minute measurements.

**Behaviour Traits:** The behaviour study involving 10 local lactating dams with their single local kids or twin local kids, and 10 local dams mated artificially to produce single and twin $F_1$ kids, focused on the following:

(i) The general behaviour of the female katjang goats and $F_1$ kids. Traits observed were ingestion, elimination, resting, scratching and other activities; and

(ii) dam-kid interaction in locals and $F_1$'s.

Two observers were involved in taking the above measurements from 9.00 a.m. to 4.30 p.m. with a break of one hour at 1.00 p.m. Before the experiment began, observers sat outside the pens for two days to allow the goats to be familiar with the observers. The observers recorded measurements of each animal for at least two days, each observer recording one dam and her kids at the same time. Two or three stopwatches were used to time the various behavioural traits, depending on the number of animals observed. Altogether, measurements were recorded for a period of 43 days.

**Radio-immuno Assay For Plasma Progesterone And Oestradiol Levels Of Goats:** Since the length of the oestrous cycle in local goats varied from 5 to 49 days with an average of 21 days (Thangavelu, 1982), it is necessary to devise method(s) to optimize correct ovulation time, which in turn will help the inseminator to determine the proper insemination period for greater success in conception rate. Thus, a study involving 10 lactating does and 10 non-lactating does was made to determine the level of progesterone and oestrogen during different periods of the oestrous cycle in the above does. Radio-immuno assay techniques for the quantitative analysis of plasma progesterone has been earlier outlined by Naidu (1982).

**Comparison Of Semen Characteristics Of Local And $F_1$ Breeding Males (Bucks):** Ten $F_1$ bucks and 3 local bucks were selected on the basis of their growth within the sire group. The selected males were subsequently trained to serve an artificial vagina, prepared according to Nelson and Lin (1983), by putting an oestral doe in a specially constructed holding crate next to a fence. After training for one week with an artificial vagina, semen was collected from the above bucks for 3 subsequent weeks. During each week of the trial, two ejaculates were collected from each buck. The washing and dilution was made using the tris-citric acid-egg yolk buffer solution and skim-milk extender, respectively. The following semen quality characteristics were noted: volume, concentration of sperm, percent motility of neat semen, pre-freeze semen, post thaw semen and post thaw stress semen. The freezing procedure was according to the method described by Nelson and Lin (1983). Motility estimates were made by averaging the records of three observers.

**Results And Discussion**

**Birth Weight And Body Weight At Different Ages:** Body size is an important trait in goat breeding because of its relationship with the reproductive rate of does, and the growth and survival rate of kids. Therefore, an adequate rate of growth from birth up to first mating is of great importance.

A summary of the least square analysis of variance for birth weight, and subsequent monthly body weights up to 9 months is presented in Table II. A fixed model using genotype, sex, litter type and year as fixed sources of variation, and genotype x litter type interaction effect were considered. For genotype effect, litter type effect, and genotype x litter type interaction

TABLE II: A SUMMARY OF LEAST SQUARE ANALYSES OF VARIANCE FOR BODY WEIGHT AT BIRTH AND MONTHLY BODY WEIGHT UP TO 9 MONTHS

| Source of variance | Significant variances found for different traits ($P < 0.05$) |
|---|---|
| Genotype (Local vs $F_1$) | For all measurements |
| Sex | For birth weight only |
| Litter type (LT) | For all measurements |
| Year | For all measurements except birth weight |
| Breed x LT | For all measurements |

effect, significant ($P < 0.05$) variances were found. Significant variations between sex were found to be for birth weight only, males showing higher body weights than the females. Year effect was found to be significant for all measurements except birth weight. This is probably due to the gradual improvement of housing, feeding programme, feeding system, and disease prevention programme during the progress of the project.

**Breed Effect:** Table III reveals the superiority of $F_1$ crosses over their local contemporaries in terms of growth rate. Starting from birth weight, $F_1$ animals of various categories have maintained significantly higher body weight (40% to 50% higher than locals) till maturity (Figure II). This is mainly due to the general increase in heterozygosity, and the introduction of beneficial genes responsible for the higher rate of growth. Diversity in the parental populations may also explain the higher rate of growth of $F_1$ goats. These results demonstrate that $F_1$ crossbred goats in which 50% of the genotype is of exotic type, are perhaps more adaptable to the humid tropical climate. Compared to this, crossbred superiority over locals for growth has been found to be only 10% to 20% in cattle (Sivarajasingam and Mukherjee, 1974). A recent experiment conducted at the Rubber Research Institute of Malaysia (unpublished report - personal communication) on crossbreeding of local sheep with imported Dorset Horn, has also demonstrated results comparable to the present experiment with goats. Thus, small ruminants in the tropical regions, which have a large surface area relative to body weight, may be metabolically more efficient than large ruminants although detail investigations are necessary to study the specific additive effects of both genotypes, heterotic effects, maternal effects and environmental conditions in relation to the performance of genotypes before making any conclusion in this regard. The percentage of single birth was found to be slightly higher than that for multiple birth in locals and $F_1$, but this difference was found to be much higher in $F_1$.

**Sex Effect:** As revealed in Table III and Figure III, the higher body weight of the males as compared to the females of the same mating and age group, is a widely recognized fact; but the higher means of uncastrated males over their contemporary castrated males (Table III) present contradictory evidence. Most of the studies with large animals record results which reveal contrasting evidence with regard to castrated vs uncastrated effect on growth. Hence, further studies are required to confirm the findings of the present study with

TABLE III: SEX AND BREED X LITTER TYPE INTERACTION EFFECT FOR CERTAIN GROWTH TRAITS (LEAST SQUARE MEANS)

| Trait | Sex effect | | | Breed & litter type interaction effect | | | |
|---|---|---|---|---|---|---|---|
| | Uncastrated male | Castrated male | Female | Local single | Local multiple | $F_1$ single | $F_1$ multiple |
| Birth wt. (kg) | 1.82 (114)* | 1.81 (67) | 1.72 (67) | 1.60 (92) | 1.36 (166) | 2.37 (60) | 1.81 (83) |
| 1-month body weight (kg) | 3.58 (98) | 3.54 (67) | 3.46 (205) | 3.50 (80) | 2.76 (130) | 4.54 (59) | 3.30 (81) |
| 3-month body weight (kg) | 6.67 (78) | 6.69 (67) | 6.31 (182) | 6.08 (67) | 5.11 (1.27) | 8.74 (53) | 6.29 (80) |
| 6-month body weight (kg) | 11.05 (57) | 10.66 (67) | 10.31 (143) | 9.09 (57) | 8.39 (100) | 14.13 (38) | 11.09 (72) |
| 9-month body weight (kg) | 15.84 (51) | 14.66 (64) | 15.84 (51) | 12.43 (49) | 12.19 (93) | 19.65 (28) | 16.72 (59) |

Note:

* Figures within parenthesis are the number of animals involved

FIGURE II: GROWTH CURVES OF KIDS FROM DIFFERENT BREEDS UP TO 9 MONTHS OF AGE

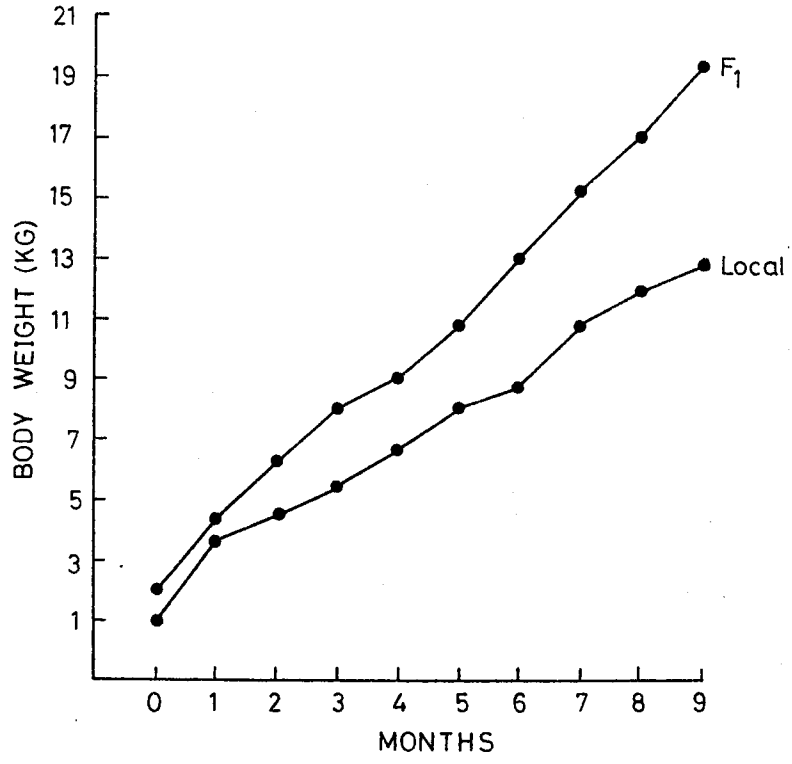
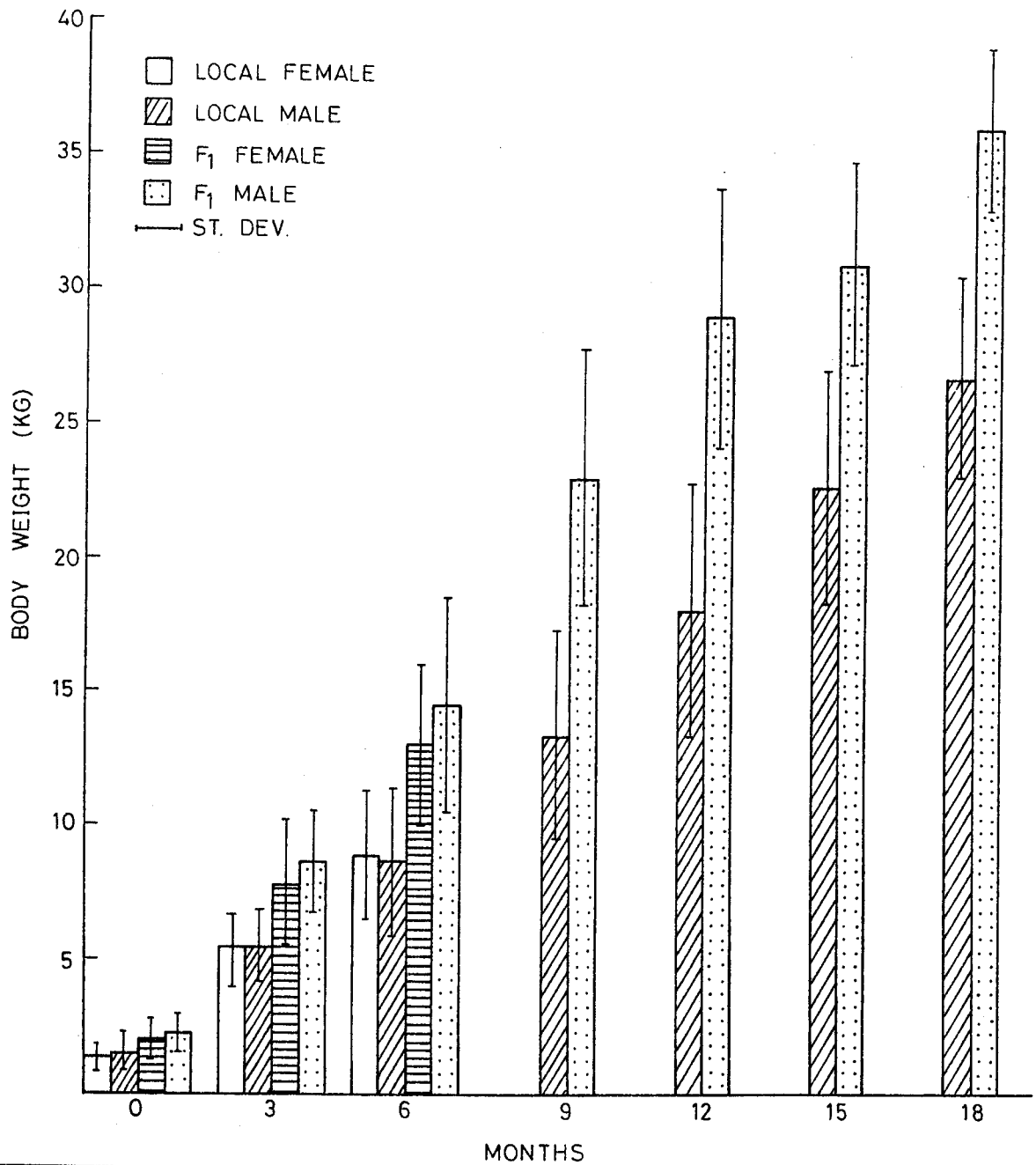


FIGURE III: MEAN AND STANDARD DEVIATION OF BIRTH WEIGHT AND BODY WEIGHT AT DIFFERENT MONTHS



goats. A study of sex x genotype effect and sex x litter type effect, is also desirable to obtain meaningful information in this regard.

**Interaction Effect Of Genotype x Litter Type:** Table III also reveals the interaction effect of breed and litter type (single birth or multiple birth). This is characterized by a higher percentage reduction in birth weight and subsequent body weight due to multiple birth in $F_1$ as compared to locals. This is due to the mother's partial inability to provide sufficient milk to multiple kids, particularly crossbreds. In such cases, a higher plane of nutrition for dams and foster feeding of multiple kids, both $F_1$ and local, is highly desirable. The percentage reductions in local due to multiple birth were 15%, 14%, 16%, 8% and 6% for birth weight, 1-month body weight, 3-month body weight, 6-month body weight and 9-month body weight, respectively. Similar figures for $F_1$ were 24%, 26%, 28%, 20% and 15%, respectively. A gradual decline in percentage reduction of body weight due to multiple birth is expected since the kids start eating grass and concentrate as early as at age one-month, and continue to depend on grass and concentrate with age.

**Effect Of Litter Type:** Analyses involving comparison between kids born single and kids born multiple (twins, triplets and quadruplets) demonstrate superior birth weight of singles (about 12% to 15% over others). (Figure IV). While this gap has been narrowed down for locals during subsequent body weights, it was found to be increasing in $F_1$. These observations are in line with some of the previous reports published by tropical workers (Devendra, 1970). Thus, a proper foster feeding programme has to be implemented for multiple kids, especially in case of crossbreds involving local maternal goats.

**Study of Physiological/Adaptability Traits:** A preliminary study involving 2 males and 2 females from each group of local and $F_1$ goats did not show any marked sex difference for pulse rate, rectal temperature and respiration rate. This suggests that male and females have almost similar thermo-regulatory mechanisms. Hence for this study, 10 locals and 10 $F_1$ goats have been considered regardless of sex.

Analysis of variance for the above traits did not show any significant ($P < 0.05$) breed difference and breed x period interaction difference, but period effect was found to be highly significant for pulse rate and rectal temperature. The magnitude of this difference could be obtained from Table IV.

FIGURE IV: GROWTH CURVES OF SINGLES AND MULTIPLES UP TO 3 MONTHS OF AGE

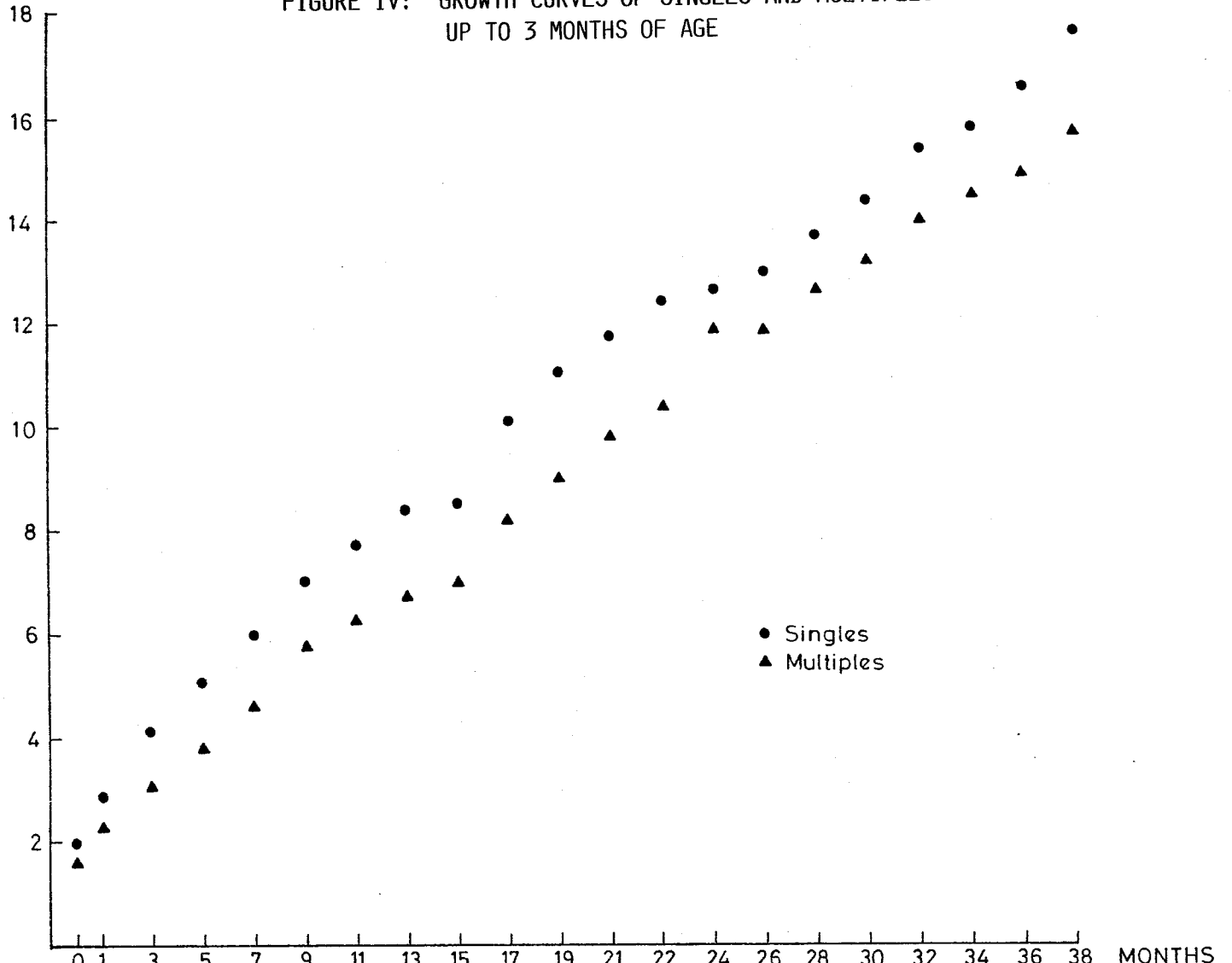


TABLE IV: AVERAGE AND (STANDARD DEVIATION) OF PHYSIOLOGICAL PARAMETERS IN LOCAL AND $F_1$ GOATS

| Trait | Local (N = 10) | | $F_1$ (N = 10) | |
|---|---|---|---|---|
| | Morning | Afternoon | Local | Afternoon |
| Pulse rate | 109.4(5.7) | 120.0(7.1) | 107.8(4.0) | 125.3(5.1) |
| Rectal temp. | 102.2(0.4) | 103.1(0.6) | 101.9(0.5) | 103.3(0.5) |
| Resp. rate | 31.7(4.4) | 52.2(13.7) | 32.7(6.3) | 71.9(8.2) |

Mullick (1960) suggested that with increased humidity, pulse rate increased significantly in cattle. The present results suggest that the pulse rate increases despite a decrease of humidity in the afternoon. Perhaps, temperature is a more important factor than humidity in determining pulse rate.

High humidity also tends to lower rectal temperature (Mullick, 1960). Thus, results of the present experiment suggest that both low temperature and high humidity decrease rectal temperature in the morning.

High respiration rate in the afternoon is due to heat load, higher activity of the animals, and disturbances. Since goats use respiration as one of their thermoregulatory mechanisms (Quartermain and Broadbent, 1971), the increase in respiration rate is to increase the rate of cooling. Higher values of respiration rate in the crossbreds during afternoon might be attributed to their larger body size, smaller relative surface area, and also a different genetic constitution.

In general, $F_1$ goats were found to react almost in similar ways as locals when their physiological traits were measured in the morning and afternoon.

**Relationship of Certain Environmental Factors And Number Of Kidding:** One of the most important traits in goat reproduction is kidding rate, which is a joint function of conception rate, maternal ability of the dams, nutritional and environmental factors. This kidding rate along with conception rate is also a measure of the reproductive adaptability of the animals.

Meteorological data such as temperature, humidity, rainfall and wind-velocity, collected from the University station at the time of possible conception of dams were investigated for their relationship with the kidding rate, which is usually observed five months after conception. Correlation estimates between the above variables and partial regression coefficients of kidding rate on average temperature, range of temperature, humidity percentage, rainfall and wind velocity at conception are presented in Table V.

The above table shows that only rainfall had a significant positive effect on the kidding rate when the other independent variables are held constant. Other climatic factors were not found to have any significant effect on the

TABLE V: PARTIAL REGRESSION OF NUMBER OF KIDDING (Y) ON AVERAGE TEMPERATURE ($X_1$), RANGE OF TEMPERATURE ($X_2$), HUMIDITY ($X_3$), RAINFALL ($X_4$) AND WIND VELOCITY ($X_5$).

| Variable No. | Simple correlation X vs Y | | Partial regression coefficient | | Computed T-value | |
|---|---|---|---|---|---|---|
| | Local | $F_1$ | Local | $F_1$ | Local | $F_1$ |
| $X_1$ | 0.15 | -0.06 | 0.74 | 1.20 | 0.25 | 0.09 |
| $X_2$ | 0.02 | 0.09 | -1.07 | 8.17 | -0.96 | 0.55 |
| $X_3$ | -0.67* | 0.09 | 0.00 | 3.02 | 0.04 | 1.18 |
| $X_4$ | 0.43* | 0.48* | 0.51 | 2.09 | 3.57* | 2.09 |
| $X_5$ | 0.00 | 0.42* | 1.34 | 3.54 | 0.26 | 1.29 |

Note:

* Significance at $P < 0.05$.

number of kidding directly or conception rate indirectly. A similar influence of rainfall has been found earlier in Black Bengal goats (Devendra, 1970). Significant rainfall lowers the environmental temperature, which stimulated the receptivity of oestral dams towards either natural mating or artificial insemination.

The response of $F_1$ and local animals to the above climatological factors were not significantly different from each other. Higher activity due to the hybrid vigour of $F_1$ animals may have compensated for whatever disadvantages the $F_1$ may have when compared to the locals for their adaptability in local environments.

**Behaviour Traits - Drinking Water and Suckling:** From the analyis of variance depicted in Table VI, the average suckling and drinking time between $F_1$ and local kids were found to be significant ($P < 0.05$); the average time taken by the $F_1$ in both traits were found to be higher than that of the local kids.

The average suckling time of the kids decreases gradually as the day progresses. With this decrease, a marked increase in water consumption is observed. The maximum average suckling time of $F_1$ kids was 24.1 seconds, and the minimum average time taken was 16.6 seconds. For drinking time, maximum and minimum was 12.8 and 2.0 seconds, respectively. In the local kids, the above activities were found to be approximately 30% less than that for the $F_1$ kids.

**Behaviour Traits - Playing:** The average playing time of the $F_1$ kids is significantly ($P < 0.03$) higher than that of the local kids. Towards the latter part of the day, the $F_1$ kids were found to be more active and playful, but the local kids were found to be more passive as the day progressed. This also explains the necessity of a longer drinking period among the $F_1$.

When the dams were found to be resting, the $F_1$ kids were not found to be resting with their dams; instead they entered the kid nests provided and played together. They also played around their dams and persuaded the dams to stand up to let them suckle their teats.

TABLE VI: ANALYSIS OF VARIANCE OF DIFFERENT BEHAVIOURAL TRAITS OF THE KIDS

| | Degree of Freedom | Resting Freq. | Average Resting Time(Sec) | Mean - Squares: Scratching Freq. | Aver. Time Of Scratching (Sec) | Drinking Water Freq. | Average Drinking Time (Sec) | Defaecation Freq. | Aver. Defaecation Time (Sec) |
|---|---|---|---|---|---|---|---|---|---|
| Between Periods | 2 | 3.19 | 342.62 | 89.67 | 2.66 | 0.94 | 24.20 | 0.34 | 0.59 |
| Between $F_1$ and Locals | 1 | 14.18 | 1.54 | 108.34 | 0.64 | 2.13 | 119.33* | 0.02 | 0.15 |
| Between Sex | 1 | 0.59 | 212.55 | 75.17 | 3.64 | 0.00 | 0.83 | 0.59 | 2.67 |
| Between Single & Twins | 1 | 1.51 | 207.21 | 905.33* | 5.01 | 0.02 | 43.18 | 1.51* | 27.76* |
| Error | 51 | 5.93 | 107.70 | 138.16 | 2.41 | 0.90 | 22.68 | 0.28 | 0.91 |
| Total | 56 | | | | | | | | |

| | Degree of Freedom | Urination Freq. | Aver. Time of Urination (Sec) | Feeding Grass (Freq.) | Average Time of Feeding Grass (Min) | Freq. of Resting Together With Dam | Aver. Time of Resting Together With Dam (Min) |
|---|---|---|---|---|---|---|---|
| Between Periods | 2 | 0.45 | 81.84 | 23.49* | 1259.63* | 4.31 | 183.95 |
| Between F1 & Locals | 1 | 0.10 | 35.96 | 3.24 | 50.24 | 1.83 | 0.07 |
| Between Sex | 1 | 0.88 | 219.03* | 0.04 | 865.97* | 0.66 | 0.16 |
| Between Single & Twin | 1 | 0.42 | 97.46 | 5.21 | 65.43 | 1.69 | 0.67 |
| Error | 51 | 0.59 | 28.08 | 3.47 | 200.33 | 1.40 | 209.76 |
| Total | 56 | | | | | | |

Note:

* Significance at $P < 0.05$.

TABLE VI (CONT'D)

| Source of Variation | Degree of Freedom | Mean - Squares | | | | |
|---|---|---|---|---|---|---|
| | | Bleating Freq. | Playing Freq. | Aver. Playing Time (Sec) | Suckling Freq. | Aver. Time of Suckling (Sec) |
| Between Periods | 2 | 380.20 | 14.87 | 189.25 | 32.64 | 144.11 |
| Between $F_1$ & Locals | 1 | 744.40 | 5.42 | 656.48* | 15.10 | 435.89* |
| Between Sex | 1 | 748.85 | 2.58 | 693.45* | 38.43 | 1.19 |
| Between Single & Twins | 1 | 229.82 | 25.15* | 1024.04* | 0.10 | 729.41* |
| Error | 51 | 196.32 | 4.02 | 122.43 | 13.95 | 65.47 |
| Total | 56 | | | | | |

Note:

* Significance at $P < 0.05$.

The $F_1$ were not found to be significantly different from the local for other behaviour traits. This suggests that there is no significant change in the behaviour pattern of the $F_1$ as compared to their local contemporaries. Period, sex and litter type effect (Table VI) is not discussed here.

**Correlation Between Behaviour Traits Of Dams and Their Kids:** Table VII clearly shows no correlation between the behaviour patterns of dams and their kids. A number of factors may be responsible for this. Differences in age between dams and their respective kids, type of kidding of different dams, body conditions and parity of dams are some of these factors along with physical or environmental factors. Moreover kids may be still in the process of learning from their mothers and investigating their surroundings as well as adapting themselves to the environment.

In general, the correlation pattern was found to be the same between dams - local kids interaction, and dam - $F_1$ kids interaction, suggesting once again a similar behaviour pattern of these two groups of animals.

**Radioimmunoassay Of Plasma Progesterone And Oestradiol-17β in Non-lactating and Lactating Goats:** The detection of oestrus and approximate ovulation period is very important for the success of a genetic improvement programme, particularly where artificial insemination is used for matings. Oestrus is defined as the period of time when the female is sexually receptive to the male, whereas ovulation is invariably associated with oestrus.

Thangavelu (1982) while working in this cross-breeding project observed varying lengths of the oestrus cycle (5-49 days) with an average of 21 days for the local goats. Purebred katjang goats had an average length of 19.66 $\pm$ 0.04 days whereas local goats of mixed ancestry were found to have an average length of 22.81 $\pm$ 0.75 days. Occurrences of long cycles and short cycles were very common. The average duration of heat symptoms was approximately 34 hours with a range of 30-40 hours.

Because of the varying lengths of the oestrus cycle, it seems that a deeper understanding of the role of sex hormones in regulating the various events associated with the oestrus cycle would improve the reproduction efficiency through more effective detection and synchronization of oestrus.

TABLE VII: CORRELATIONS OF BEHAVIOUR OF DAMS WITH LOCAL KIDS AND $F_1$ KIDS FOR DIFFERENT BEHAVIOURAL TRAITS AT DIFFERENT PERIODS

| Traits (time) \ Periods* | 1 | | 2 | | 3 | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Local | $F_1$ | Local | $F_1$ | Local | $F_1$ | Local | $F_1$ |
| Resting | 0.02 | 0.02 | 0.06 | 0.03 | 0.05 | 0.07 | 0.04 | 0.05 |
| Scratching | 0.48 | 0.36 | 0.48 | 0.02 | 0.18 | 0.06 | 0.34 | 0.19 |
| Feeding grass | 0.44 | 0.08 | 0.08 | 0.03 | 0.02 | 0.01 | 0.11 | 0.02 |
| Urination | 0.07 | 0.02 | 0.01 | 0.01 | 0.04 | 0.03 | 0.02 | 0.01 |
| Defaecation | 0.21 | 0.09 | 0.01 | 0.01 | 0.00 | 0.01 | 0.06 | 0.03 |
| Drinking water | 0.01 | 0.02 | 0.01 | 0.03 | 0.02 | 0.04 | 0.01 | 0.02 |
| Bleating | 0.04 | 0.03 | 0.05 | 0.03 | -0.02 | 0.01 | 0.02 | 0.02 |

Note:

* Period 1 : 8.30 - 10.30 hrs

Period 2 : 10.30 - 12.30 hrs

Period 3 : 14.00 - 16.00 hrs

Results of radioimmunoassay of plasma progesterone and oestradiol-17β (Table VIII) showed continuous higher levels of oestradiol and lower levels of progesterone among anoestrus goats. Non-lactating goats exhibited a peak progesterone level 11 days after oestrus, and peak oestrogen level during oestrus. A similar hormone profile was observed for the only lactating goat which demonstrated a typical oestrus cycle, although the levels of hormones were lower.

An exact comparison cannot be made between the non-lactating and lactating goats with regard to their hormone level because of the variety of phenomena exhibited and the small sample size. On the whole, the non-lactating goats showed a higher percentage of typical cycles. Only one lactating goat showed a typical cycle. There might be pituitary gonadal stabilization after parturition before the normal cycle is resumed in lactating goats.

The plasma progesterone levels in local goats showed a definite and clear pattern in all the animals studied, but the plasma oestradiol-17β levels were found to be inconsistent. As such, the plasma progesterone rather than the oestradiol-17β was found to be a more reliable criteria for the assessment of ovarian activity of local goats. Plasma progesterone levels could also be used for the early diagnosis of pregnancy in goats.

A recent study conducted by Thangavelu (1983; personal communication) suggests that local and $F_1$ goats exhibit similar phenomena of the oestrus cycle. Assay of levels of the above hormones in local and $F_1$ goats is being conducted by Thangavelu.

**Semen Characteristics Of Local And $F_1$ Goats:** With the hope of transferring germ plasm to community herds in villages, and to facilitate this transfer, a semen production unit has been developed where collection, evaluation, processing and freezing of semen is occasionally done.

Table IX gives the summary of the results of two collections for the comparision of the local and $F_1$ bucks concerning their semen characteristics.

Since the volume of semen and concentration of spermatozoa are negatively related, the increase in the volume of $F_1$ semen over locals is expected to be accompanied by a decrease in spermatozoa concentration.

TABLE VIII: AVERAGE AND (STANDARD DEVIATION) OF PROGESTERONE AND OESTRADIOL-17β LEVELS IN LOCAL GOATS

| Level of hormones | | Progesterone (ng/ml) | Oestradiol-17β (pg/ml) |
|---|---|---|---|
| Non-lactating goats showing anestrus | (7) | .114 ± .094 | 8.9 ± 5.2 |
| Non-lactating goats during oestrus | (5) | .090 ± .170 | 32.0 ± 10.0 |
| 11 days after oestrus | (5) | 3.40 ± 0.47 | 26.0 ± 3.34 |
| 15 days after oestrus | (5) | 2.40 ± 0.20 | 20.0 ± 1.25 |
| *Lactating goats during oestrus | | 0.02 | 30.0 |
| 11 days after oestrus | | 2.64 | 18.5 |
| 15 days after oestrus | | 2.24 | 19.4 |

Note:

* Standard deviation was not calculated because only one goat showed typical oestrus.

( ) : Number of animals.

TABLE IX: AVERAGE SEMEN CHARACTERISTICS OF LOCAL AND $F_1$ MALE GOATS FOR TWO CONSECUTIVE WEEKS' COLLECTION

| Traits | Local (N = 3) | | $F_1$ (N = 10) | |
|---|---|---|---|---|
| | Week 1 | Week 2 | Week 1 | Week 2 |
| Volume (c.c.) | .50 | .66 | .76 | .98 |
| Spermatozoa conc. ($\times 10^9$) | 5.30 | 5.07 | 4.17 | 4.74 |
| Percent motility | | | | |
| Neat | 49.00 | 55.66 | 60.75 | 70.95 |
| Pre-freeze | - | 62.33 | 75.00 | 76.60 |
| Post-thaw | 35.00 | 20.00 | 25.25 | 31.50 |
| Post-thaw stress | 28.33 | 22.30 | 16.10 | 15.66 |

Evaluation of the freezing ability of semen was made on the basis of changes in percentage motility from initial measurement through processing. Post-thaw and post-thaw stress of 3 hours in a 35°C water bath were the final two measurements.

There was an average decrease of about 58% in the motility estimates from neat semen to post-thaw (extra-polation from Table IX) using tris-citric acid-yolk, and only 55% when skim milk is used. The percentage motility loss from neat to post-thaw stress was 66% and 67% for tris-citric acid-yolk and skim milk, respectively; while the post-thaw stress motility values when compared to those for the post-thaw stress were 66% and 67%, respectively. The results, therefore, indicate that the skim milk diluter was more effective in protecting goat spermatozoa through freezing. However, the tris-citric acid-yolk appeared to maintain through the stress period slightly more effectively than did the skim milk.

The percentage motility of $F_1$ semen (neat and pre-freeze) was found to be higher than that of the locals, but there was no difference observed between locals and $F_1$ with regard to their post-thaw motility. Thus, there are no significant differences in the freezing ability of local and $F_1$ semen. However, the higher percentage motility due to post-thaw stress in locals may be accounted for by the ability of the local breed to resist heat stress. Confirmation of this finding can be made by repeating the experiment with a larger sample size.

**General Discussion**

A general discussion at this stage is necessary to relate some of the experimental results discussed earlier in the various sections.

The central theme of this project is the development of local goats through genetic means. However, for a successful genetic improvement and breeding programme, the first and foremost requirement is a sound multi-disciplinary as well as an inter-disciplinary approach. It is well recognised that the breeding success of a programme needs healthy animals which are fed well and possess a greater reproductive capacity and adaptability. Thus, the studies involving oestrus cycle, hormone analysis, semen characteristics are supplementary to the

breeding programmme of this project. Nutritional and agronomical studies are also in progress to obtain an optimum package deal for the development of goats.

Most of the information that relates to the genetics of production in goats deals with milk production. This is because interest in Western Europe and North America, which produce enormous literature concerning goats, lies mainly with dairy goats. Literature obtained from South Asian and South-East Asian countries are mainly production oriented. Thus, the present project is very timely in the sense that in future a whole range of queries involving various disciplines of the study of goats could be answered from the results of this project. These answers will particularly be directed to breeders and producers of tropical and subtropical countries where meat production from goats receives priority. Reliable estimates of genetic parameters for growth and reproduction characteristics are very scanty but necessary for formulating plans for improvement programmes. Similarly, the performance of various genotypes in different management complexes are required for the possibility of keeping commercialised herds of goats as well as for the investigation of the ecological adaptability of genotypes under sub-optimal nutrition, which is a frequent occurrence when poor farmers in tropical regions are involved. Future results of this project will attempt to suggest suitable answers to these questions as well.

A quantitative analysis of the data concerning goats kept in various substations and villages, described in the methodology section, has not been made yet. However, few general observations could be presented here.

The rate of growth of the goats in the experimental station of Rubber Research Institute was comparable to that of the nucleus herd of the University. This was mainly due to abundant undergrowth in a large area of land which was available to the animals for grazing a variety of local grass such as Panicum maximum, Paspalam conjugatum, Axonopus compressus and Imperate gylindrate, a range of broad leaves such as Mikania cordata and Mimosa pudica, and ferns e.g. Glychaenia, Nephrobpsis and Lygodium species. A proper assessment of the performance of goats in rubber areas is required by assessing the stocking rate of animals per unit area in commercial plantations as well as in small holder holdings. Further studies are also necessary to investigate whether goats in rubber plantations should be confined only to areas covered with matured trees (usually above 5 years), since on certain occasions goats destroyed the bark of

young rubber trees. In two other substations of the project, where goats have been integrated with coconut or tall orchard trees, the rate of growth was comparatively poor, mainly due to the non-availability of feed, and also partially due to certain management problems. Increasing feed resources through mixed planting of grass and leucaenea has been planned in these substations to optimize the rate of growth.

Extension programmes in Bukit Kuching Village and Vallambrosa Estate had been well accepted by the participant farmers. Surprisingly, the growth rate of animals at Bukit Kuching Village was found to be comparable to, or even higher in some months, than that for the nucleus herd. One of the reasons for this is the mixed ancestry of parental females used in this programme. Attention given to individual animals by rural farmers, better management through extension education programmes by the researchers and field investigators of the projects, occasional visits by the representatives of the village community to the University farm are some of the other reasons for this successful growth rate. However, improvement of the growth rate has been accompanied by a poor rate of reproduction among females subjected to oestrus synchronization and subsequent artificial insemination. Hence, research on oestrus synchronization and artificial insemination, particularly at the village level should be further intensified.

A multi-disciplinary approach using genetic, physiological, nutritional, biochemical and management methods to improve the performance of local goats is being followed in this project to optimize a total package deal suitable for local farmers. This approach has been described briefly in this paper.

A study of aspects of behaviour, adaptability, oestrus cycle, methods of heat detection, nutritional regimes, semen quality of various genotypes in this project is in progress. Only partial results of the findings have been presented here with a view of presenting detailed results for each aspect in future reports.

## CROSSBREEDING OF GOATS


### Summary

A crossbreeding programme involving artificial insemination of local female goats with frozen semen of German Improved Fawn was initiated in 1980 to produce $F_1$ animals. Subsequent production of $F_2$ and backcross animals ($F_1$♀ x German Fawn♂; reciprocal crosses of $F_1$ with local) are in progress. Testing of these various genotypes along with contemporary local animals in the nucleus herd at the University of Malaya, in villages involving small-holders, and in different types of plantations (rubber, coconut and an orchard of mixed fruits) is being made. This paper presents the comparative performance records of local and $F_1$ (Local x German Fawn) animals of the nucleus herd for various morphological, behaviour, physiological and reproductive traits.

A total of 220 local and 139 $F_1$ goats in the nucleus herd was studied for birth weight, weaning weight at 3 months and subsequent monthly body weights until 18 months. The $F_1$ animals were found to be significantly ($P < 0.01$) higher in body weight than the locals (approximately 40% or more) at different periods. Of the 20 other traits studied, significantly higher activity ($P < 0.05$) was observed for the following traits: respiration rate of adults, average drinking, suckling and playing time of kids, semen volume, and pre-freeze semen concentration. The superiority of these $F_1$ animals is mainly attributed to the increase in general heterozygosity and the improvement in the additive genetic complex of the animals.

A multi-disciplinary approach using genetic, physiological, nutritional, biochemical and management methods to improve the performance of local goats is being followed in this project to optimize a total package deal suitable for local farmers. This approach has been described briefly in this paper.

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# AN APPROPRIATE PLASTIC HANDPUMP FOR RURAL WATER SUPPLY IN MALAYSIA

by

Goh Sing Yau*

Low Kwai Sim**

## Introduction

The population of Malaysia is approximately 13 million, and about 70% of the population live in rural areas. At present more than half of the rural households are not served with piped water supply. Although it is the government's intention eventually to provide piped water supply to all its population, it is unlikely that this ambition can be achieved in the next few decades. In the meantime, one of the cheapest and simplest methods of supplying reliable potable water to the rural population is to install handpumps to extract ground water from tube wells.

In the early sixties, the Ministry of Health initiated a programme to install handpumps for rural households. All the handpumps installed by the Ministry of Health have to be imported, and they are all of the traditional cast metal designs. Although some of these handpumps are relatively cheap, the experience of the Ministry is that they rarely last more than a year. Moreover, spare parts especially of the cast metal components are not readily available. This has led to the practice of cannibalising parts to keep some of the handpumps in operation while others have to be abandoned for lack of replacement parts.

In order to overcome some of these difficulties, the Department of Mechanical Engineering, University of Malaya in collaboration with the Ministry of Health and with funding from the International Development Research Centre, Canada conducted a research project (from 1979 to 1981) to develop an "appropriate" handpump for rural use in Malaysia. The handpump must be

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relatively inexpensive, simple to operate and maintain, and must be capable of manufacture using locally available materials. During the first phase of the project lasting approximately one year, an analytical and laboratory investigation was carried out to optimise the critical parameters of the handpump design (Goh, 1983). In the following two years, 17 prototype handpumps were fabricated and tested in two rural areas (Goh, 1982). A sociological survey on the acceptability of the handpump was also carried out.

## The UM-IDRC (University Of Malaya - International Development Research Centre) Handpump

Although handpumps have been in existence for a long time, there has been much recent interest in its development for economic and other reasons. It appears to be the only practical way to achieve the declared objectives of the United Nations Water Decade (1981-1990), which is to provide "an adequate drinking water supply and basic sanitary facilities for all by 1990". Field trials are currently being carried out in 20 countries to test a variety of handpump designs under a UNDP/World Bank Global Project (World Water, 1983). Most of the handpumps in the above project are improvements of the traditional cast metal designs. The present paper describes a UM-IDRC plastic handpump which has been developed based on technology which is considered appropriate to Malaysia.

The main features of the UM-IDRC handpump are:

(i) A PVC plastic cylinder fitted with a sliding PVC piston, and a stationary but removable PVC footvalve. The piston is equipped with two polyethylene ring seals.

(ii) A leverage system consisting of timber linkages and galvanised iron/oil-impregnated timber bearings.

The main advantages of the plastic handpump over the traditional cast metal designs are:

(i) Simple fabrication procedure because PVC parts can be solvent-welded together. Also PVC parts can be worked on using light hand tools.

(ii) Maintenance by users at the village level becomes feasible because PVC is light, and removal of the handpump assembly from the well for inspection and repairs is relatively easy.

(iii) Plastic parts are free from corrosion and rust.

The leverage system is designed to eliminate the requirement of metal journal or roller bearings which are not readily available in rural areas and which are prone to rust when exposed to the weather. Also, the replacement of timber parts can be carried out by the villagers themselves using locally available timber as replacement parts.

The detailed results of the laboratory and field tests are reported in the original references (Goh, 1982 & 1983). More recent studies showed that the life of the handpump cylinder may be extended by four times if the width of the piston ring seals is halved and the thickness of the hand pump cylinder is doubled.

**Acceptability Of The UM-IDRC PVC Handpump**

The 17 UM-IDRC prototype PVC Handpumps were installed for testing at two areas, namely in Kuala Pilah (Negri Sembilan) and at Malim Nawar (Perak). Perception Studies were carried out in Kuala Pilah to determine the acceptability of these handpumps by the users.

The study area where these handpumps are installed is in the vicinity of Kampung Tallang, Kampung Tallang Ulu and Kampung Sawah Liat. These are traditional agricultural villages consisting of 169 scattered houses over an area of 1,000 ha. Altogether there are 869 settlers from 237 households. Most of them are padi farmers, and sundry crop cultivators, although a few of them are rubber smallholders. At present, only 59 of the houses are served with potable piped water, while 21 houses have common wells, and 69 have handpumps of various types including the UM-IDRC PVC Handpumps. The rest of the houses which are not served with the above forms of water supply, have to rely on traditional sources such as the river and rain.

The perception study is structured to take cognizance that acceptability of the UM-IDRC PVC Handpumps may vary within the area, and from area to area. Also

within an area variations may also occur between males and females. For this reason, the series of five focus group interview surveys, conducted in August 1983, divided the sample into male and female:

(i) Users of UM-IDRC Handpumps;
(ii) Users of non UM-IDRC Handpumps;
(iii) Users of UM-IDRC Handpumps and other types of handpumps; and
(iv) Control - with no handpumps at all.

Furthermore, stratifications based on parity (respondents must have at least one child), age (males from 30-55 age group, and females from 25-55 age group), and educational level (all must have at least some form of primary education) were delineated whenever possible.

The questionnaires are designed to eliminate interviewer bias and to encourage spontaneous responses from the users and non-users of the handpumps. For example, the next question asked is based on the answer to the previous question, and the question need not necessarily be answered by the same respondent, but by other members in the focus group. As a result of this, the questions are respondent-generated rather than interviewer-generated, and so the answers are likely to be more comprehensive.

**Views Of The UM-IDRC PVC Handpumps:** From the survey, it was found that the most perceptive view with regard to the UM-IDRC PVC Handpumps is that they are provided for free, and the water obtained from it is also free. This is an advantage over piped water supplied by the government for which monthly water rates have to be paid. The supply of water from these handpumps has been consistent, since their installation except on one rare occasion of prolonged dry spell. The handpumps are also conveniently located near to the users' homes, and hence saves considerable time, effort and energy compared to using river water which is generally located some distance away from their homes.

Great satisfaction is noted from all the users with regard to the UM-IDRC PVC Handpumps. All of them reiterated that since the installation more than two years ago, these handpumps have never needed any repairs except for replacement of broken pins attached to the leverage system. Since the handpumps are regularly checked by the personnel from the Mechanical Engineering Department, University of Malaya and the local Health Office in Terachi and Kuala Pilah

which ensure their efficiency, they are also highly regarded by all the villagers.

The UM-IDRC PVC Handpumps are relatively light and easy to operate especially by children who often help in pumping out the water. The water obtained from these handpumps is considered by the users to be of higher quality than from the metal handpumps because the water is free from rust and the water colour is often "pure" rather than "yellow".

Negative views of the UM-IDRC PVC Handpumps are relatively absent, except in the form of complaints with regard to the volume of water expected from the tube wells. There is insufficient water for festive occasions and for multiple usage such as bathing, laundering and cleaning purposes. Most of the users believe that the tube wells are not deep enough to tap the groundwater. Some even suggested that alternative locations of the tube wells be carried out to obtain more water. Others complained that water shortage from the UM-IDRC PVC Handpumps occurs because too many households share the same pump, and they requested for more to be installed.

**Factors Promoting The Acceptability And Desirability Of The UM-IDRC PVC Handpumps:** From the surveys, it was found that there are many factors which collectively promote the acceptability and desirability of these handpumps. These are:

(i) In areas where there are government installed pipes, the water supply is cut off during the rainy season for reasons unknown. Therefore, the handpumps are considered by many to be more reliable and less sensitive to the vagaries of weather conditions and governmental water supply policies. Traditional sources of water supply such as rivers and streams are often highly polluted, and could only be used for washing or bathing.

(ii) The water obtained from the pumps is clean, clear, tastes good, always cool, and has no unpleasant smell. No ill effects have been experienced from the consumption of water from the handpumps. There are no incidences of diarrhoea and skin infections.

(iii) The handpumps have the capacity to supply adequate water for drinking and cooking purposes for 3-4 households daily.

(iv) Occasions for use of the handpumps provides the women especially, with the opportunity to meet, talk and gossip with their friends even while performing daily household chores. It, therefore, encourages social gathering, and is a nodal point for dissemination of local news.

(v) While the consensus was that the handpumps would be a major expense if the users had to make cash payments for its installation, it was generally agreed that piped water supplied by the government would cost even more both in the short term and long term bases. Piped water costs more than M$500 to M$700 to install, especially for families located in hilly terrain and far from the main water supply grid. After the installation, monthly water rates have to be paid. The handpump on the other hand, is seen as a one-payment item after which there are no more follow-up payments to be made. This is thus seen by many to be more advantageous than piped water.

(vi) The appreciation of the handpumps can also be seen by the fact that the male users are very keen to learn more about the handpumps from installation to maintenance. A few even requested that they be given a special course on the technical details of the handpumps by the staff in the University. All the users indicated their willingness to work out a maintenance scheme both at the household and community level, so that there is no necessity to run to the local Health Office or the University for help should the pumps need repairs.

**Views Of Non UM-IDRC Handpumps:** Compared to the UM-IDRC PVC Handpumps, most of the other types of handpumps are constructed of metal materials which corrode, causing the "yellow" colour in the water. These pumps are viewed as being harder for the women and children to operate, and they consistently malfunctioned. In fact, in a separate survey in Kuala Selangor, 100 km. northwest of Kuala Lumpur, all these metal pumps have not been functioning for several years and the villagers have to rely on rain, and drainage canals for

their water supply. In general, there seems to be a consensus that the non-UM-IDRC PVC Handpumps are inferior in quality.

**Views From Respondents Who Have No Access To Handpumps:** For comparative purposes, it was felt necessary to conduct a series of separate group interview surveys in an area where the villagers have no access to the handpumps. By showing them a series of photographs of the UM-IDRC PVC Handpumps, they were asked questions of what they think of these handpumps, and whether they would like to have them installed in their villages.

The area chosen for these surveys is the Parit Empat Village in Kuala Selangor. This is a linear village situated alongside the drainage canal in the Tanjong Karang Padi Scheme. In this village, rain water is used chiefly for drinking purposes to supplement the water from the drainage canals. Occasionally, the Jabatan Kerja Raya water supply van delivers potable water through filling the jugs and containers put near the roadside by the villagers. This situation has existed for the last 15 years. Since there are no other reliable sources of water except from the drainage canals, this water is used for everything including cooking, drinking, washing and bathing. During the surveys, it was found that the water in the canals is highly polluted, turbid, foul smelling and contain a large amount of flotsam and garbage. Contamination is also through seepage in the form of insecticides, weedicides and fertilisers sprayed onto the said areas, and there have been many cases of stomach upsets, diarrhoea and skin diseases among the villagers.

Thus, when asked whether they are interested in having a handpump installed, all the respondents reacted in the affirmative, induced perhaps by their desperation for good quality water. One respondent whose son studied in the local school even showed the interviewer a picture of the UM-IDRC PVC Handpump from his school magazine, and indicated that she wanted the same type to be installed. Although all the respondents have never seen the UM-IDRC PVC Handpump except when the photographs were shown during the survey, all of them wanted to learn more about the handpump and how to install and use it. There was a request made for one handpump to be installed on an experimental basis so that they could learn about the advantages and disadvantages related to the use of the pumps and the volume of water it is able to extract from the ground.

All the respondents indicated that they are willing to pay on a cost-sharing basis with a few households per pump, even though when it was suggested that the cost is as high as M$300/- per handpump. Some female respondents professed that they could afford to pay as much as M$50/- per rice harvesting season. Others suggested that if the handpumps are as reliable as they think, then they would try to find the money required from the co-operatives, because water is the most crucial necessity in their daily living. All of them also indicated that once installed, they are willing to maintain the pumps themselves.

## Conclusion

There is general agreement that the UM-IDRC PVC Handpump is a boon to the local water supply situation chiefly because it is free and reliable. The water obtained is comparatively clean, clear and without smell. These rationale were provided alongside with rather adverse opinions of piped water which is reported to be turbid, exudes a smell and is highly chlorinated, which they could not get used to. Supply is frequently disrupted when most needed and installation costs are prohibitively expensive. Thus water from the handpumps is generally perceived to be more satisfactory than piped water.

In Kuala Selangor, where there are no handpumps, there is a general consensus to have these installed as soon as possible since good reliable water is absent. The fact that they are so willing to pay for the handpumps is indicative of their desperation. This is in contrast to Kuala Pilah area where the respondents seem reluctant to purchase the handpumps despite their obvious satisfaction with the performance of the pumps. For some of them, the claim that the handpumps are expensive may be genuine; but for others the reluctance to pay for the handpumps may be due to non-economic reasons. Installing the handpumps free during the pilot testing by the University, might have given the impression that the handpump is one of the free social benefits which does not need any reciprocal actions on the part of the receivers. Hence, they and others in the area may not feel obliged to pay.

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# EXTENDING THE USE OF TIN VIA ORGANOTIN CHEMICALS

by

V.G. Kumar Das*

## Introduction

Organotin compounds have an astonishing diversity of applications unsurpassed among organo-element derivatives. Of an annual world production estimated around 30,000 tonnes, almost two-thirds are consumed in chemical applications, principally as stabilizers for rigid PVC (Davies and Smith, 1980 and 1982). Biological applications, both as industrial biocides and crop protectants, account for the remaining one-third and constitute a fast-growing commercial outlet for tin. Before I embark upon a discussion of these applications and, particularly, the biological aspects which form the theme of this paper, a few preliminary remarks are in order concerning the chemistry of the compounds in question.

Organotin compounds are characterised by the presence of at least one tin-carbon bond and are of the type $R_nSnX_{4-n}$, where R represents an organic group such as an alkyl or aryl, n is 1 to 4 and X represents a monofunctional group such as chloride, fluoride, acetate, etc. So far the structural types $R_3SnX$ and $R_2SnX_2$ comprise the largest part of practical organotin applications; those of the type $RSnX_3$ being much smaller. The tetraorganotins, $R_4Sn$, have no significant commercial outlets at the present time but are important as intermediates in the manufacture of other organotin derivatives. A further point to note particularly in respect of the organotin halides is their tendency, in contrast to the tetraorganotins, to expand their covalency beyond four. This leads typically in the case of $R_3SnX$ and $R_2SnX_2$ to the formation of five- and six-coordinate organotin complexes respectively, with ligands which are dominantly oxygen and nitrogen donors. This is depicted in Figure I, where, for reasons of simplicity, only one stereochemical isomer is shown in respect of the five- and six-coordinated structures (L = ligand, including halide and pseudohalide).

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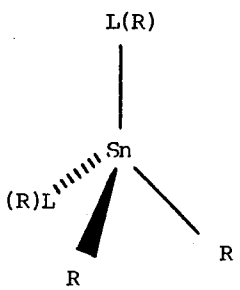
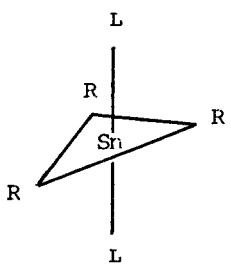
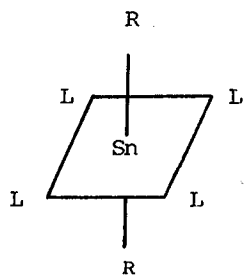
**FIGURE I: STRUCTURES ACCESSIBLE TO Sn(IV)**

| 4-coordination | 5-coordination | 6-coordination |
|---|---|---|
|  |  |  |
| Tetrahedral | Trigonal bipyramidal | Octahedral |

The observation of chemical and biological properties among a range of such coordination complexes in recent years (Das and Chan, 1975) has extended the scope for further potential developments in the organotin industry, and of discovering yet a large scale unique application that is comparable, for example, to that enjoyed by tetraethyllead as an antiknock additive in gasoline.

For the purpose of convenience, this paper is organised into two parts: Part 1 reviews some established as well as potential applications of organotin compounds; and Part 2 presents some empirical studies from our on-going research programme on biologically active triorganotin compounds.

## PART 1

### Chemical Applications: Stabilization of PVC[1,2]

Some of the most effective PVC stabilizers known are the dialkyltin compounds, $R_2SnX_2$, where R = methyl(Me), butyl (Bu), octyl (Oct), $BuOCOCH_2CH_2$ ("estertins"), and X = alkylthio (SR') or carboxylate (OCOR') group (R' = heavy alkyl group such as iso-octyl, octadecyl, 2-ethylhexyl, etc.). When added to the extent of 1% - 1.5% during processing, they inhibit thermal dehydrochlorination of the polymer (the cause of discolouration and embrittlement of the plastic) and, moreover, serve to protect it during its service life from degradation by both heat and light. A consequence of this is the increasing demand for PVC in the building industry for such applications as flooring, cladding for building exteriors, window profiles, cables, pipes and clear sheets for roofing. The sulphur containing compounds (organothiotins), in particular, are unsurpassed in conferring heat resistance on the plastic; the organotin carboxylates, on the other hand, have generally superior light-stabilizing properties. In derivatives such as the dialkyltin bis (S,S'-iso-octyl thioglycollate), $R_2Sn(SCH_2CO_2Oct^i)_2$, both these functions are combined. The dioctyltin (Evans, 1971) and several estertin stabilizers also possess low mammalian toxicities (Lanigan and Weinberg, 1976), a feature which has been

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1 See, Ayrey, G.; Head, B. C. and Poller, R.C. The thermal dehydrochlorination and stabilization of polyl(vinylchloride). Macromol. Rev., 8, 1974: 1-49.

2 See, Brecker, L.R. Structure-performance relationships in organotin mercaptide stabilizers. Pure & Appl. Chem., 53, 1981: 577-582.

largely instrumental in securing a rapid growth market for food, drink and drug-packaging grades of PVC as well as for PVC potable water piping. In most cases, up to 60% of the corresponding monoalkyltin compound $RSnX_3$, is added to the dialkyltin stabilizer for synergistic enhancement of the stabilizing effect (Davies and Smith, 1982).

**Homogeneous Catalysts**

**For the Manufacture of Polyurethane Foams[1]:** Dialkyltin esters such as dibutyltin acetate, -laurate and -2-ethylhexanoate have proved to be very efficient catalysts for the manufacture of polyurethane foams, especially flexible foams. Complexes of alkyltin trihalides with dimethylformamide have also been reported (German Patent 1,249,833, 1967; U.S. Patent 3,274,134, 1966) to be useful catalysts yielding foams with increased resistance to oxygen and moisture. Prior to the advent of these catalysts, the foams had to be produced by a two-stage process. In use, the organotin catalyst (at about the 0.3% level) is combined with a tertiary amine, since this allows a synergistic enhancement of activity of each component. Although only small quantities of tin chemicals are incorporated in these foams, the size of the polyurethane market makes this a sizeable outlet. It has recently been estimated[2] that the demand for the dibutyltin catalysts for polyurethane foam manufacture in the United States alone would reach about 2.5 million pounds by 1984.

**For Room-temperature Vulcanising (RTV) Silicones[3]:** The same dialkyltin catalysts used for polyurethane foam manufacture have been found to be very effective in bringing about the cross-linking of oligomeric siloxanes to produce silicone polymers. Although in amount the tin chemicals used here are at or below the 0.5% level, it takes tin into a wide range of applications, from dentistry to shoe making, from art casting to electronics. Consumption demands

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1 See, Karpel, S. Tin catalysts in polyurethane production. Tin and Its Uses, 125, 1980, 1-6.

2 Source: The manufacture and use of selected alkyltin compounds. Task II, Final Report, U.S. Environmental Protection Agency, Washington, 15 Jan 1976: 1-123.

3 See, Knoll, W. Chemistry and technology of silicones, New York, Academic Press, 1968.

for the organotin catalysts are anticipated to parallel the production of the silicone elastomers.

## Glass Strengthening Applications[1]

At high temperatures (500°-600°C) and in an oxidising atmosphere (air), dimethyltin dichloride has found use as a precursor for stannic oxide in the surface coating of glass. The thickness of the coating depends on the use to which the glass is put, for example, a coating thickness of less than 100 nm for strengthening of glasses, bottles and jars; 100-1000 nm thickness for iridescent, decorative coating; μm thickness for conferring electrical conductivity (as in deicing aircraft windscreens).

## Miscellaneous Applications[2]

These include a range of smaller uses which have not reached commercialization in which all types of organotin compounds are involved. Among the claims that exist particularly in the patent literature are the following:

(i) as esterification catalysts for the preparation of terylene and related polymers (U.S. Patent 3,297,651, 1967);

(ii) as anti-oxidants/stabilizers for polyolefins (Japanese Patent 3,012, 1968), polyethers (U.S. Patent 3,245,907, 1966), polyamides (Japanese patent 1,102, 1968), acrylic fibres[3] and phenol-formaldehyde resins (U.S.S.R. Patent 174,354, 1965);

(iii) as catalysts for the hydrolysis and gelation of organic silicates used as binders for refractory materials (Emblem and Jones, 1980);

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1 See, Fuller, M.J. Industrial use of inorganic tin chemicals. Tin and Its Uses, 103, 1975: 3-7. Evans, C.J. In Glass, 51, 1974: 303.

2 See, Poller, R.C. The chemistry of organotin compounds. London, Logos Press, 1970, Chapter 15 and references therein.

3 See, The manufacture and use of selected alkyltin compounds. Task II, Final Report, U.S. Environmental Protection Agency, Washington, 15 Jan 1976: 1-123.

(iv) as curing agents for rubber (U.S. Patent 2,967,167, 1961), and urethane coating systems (Evans, 1975) etc.;

(v) as water-proofing agents for paper, textiles and brickwalls (van der Kerk et al., 1958; Hobbs and Smith, 1982);

(vi) as additives in flame-proofing polyesters (German Patent 1,266,477, 1968), and in improving the natural flame resistance of wool (Cusack et al., 1980);

(vii) as corrosion-inhibiting additives to lubricating oils of mineral hydrocarbon origin (British Patent 994,167, 1965);

(viii) as agents for the chemical modification (British Patent 1,138,261, 1968) and molecular weight reduction (Japanese Patent 6,915,185, 1969) of polymers, and as catalysts for the depolymerization of synthetic rubbers (U.S.S.R. Patent 763,358, 1980).

A growing, although not widely appreciated application is in organic synthesis (Das and Chu, 1984), where several organotin compounds have found unique use for the chemo-, regio-, and stereo-selective synthesis of organic compounds. Included in this class of organotin reagents are the **organotin hydrides** which have found wide use as selective reducing agents (Pereyre and Pommier, 1976; Negishi, 1980) in organic synthesis (e.g. RCl ---> RH; ROH ---> RH via thio derivatives; $RNH_2$ ---> RH via isocyanides); **vinylstannanes** which have proved valuable precursors for vinyl group transfer (Milstein and Stille, 1978), and for the establishment of angular ethynyl group in fused ring systems (Corey and Wollenberg, 1974); **allyltin reagents** which in the presence of suitable catalysts such as $BF_3.OEt_2$ have, for example, engendered high regioselective allylation of quinones (Naruta, 1980) and high stereo- and chemo-selective aldol additions to aldehydes and ketones (Maruyama et al., 1979 and 1980); **enolstannanes** which afford highly chemoselective allylic alkylations in the presence of Pd(0) catalysts (Trost and Keinan, 1980); and **tetraalkyltins** which undergo a mild and selective reaction with acid halides in the presence of Pd(II) catalysts to give ketones in good yields (Milstein and Stille, 1979), and which also usefully mediate in carbocyclisations as when, for example, the

tetraalkyltin function is in proximate arrangement to an allylic alcohol function (MacDonald and Mahalingam, 1980 and 1981).

## Biological Applications

**Toxicity And Environmental Considerations:** Although there were reports of the biological activity of organotin compounds as early as 1929 (U.S. Patent 1,744,633, 1930), it was not until the early 1950's that van der Kerk and Luijten at the Organisch Chemisch Instituut TNO in Utrecht, systematically explored the *in vitro* fungicidal and antibacterial properties of organotin compounds. Their work clearly established that among organotin compounds the triorganotins, $R_3SnX$, were the most toxic and that the nature of the R group rather than the anionic radical X in these compounds largely influenced their toxicity. Subsequent work also revealed a species dependency of activity with respect to the R group as shown in Table I (Davies and Smith, 1983). The mammalian toxicity of trialkyltin compounds reaches a maximum when R = ethyl group, and then falls off rapidly with further lengthening of the alkyl chain. As indicated in Table II, variation of the X group does not significantly affect the toxicity for $Bu_3Sn$ compounds as it does for the $Ph_3Sn$ derivatives.

The two most important classes of compounds are the $Bu_3Sn$ and $Ph_3Sn$ derivatives. Both these combine high biological activity with low mammalian toxicity, and constitute together with tricyclohexyltin hydroxide the principal organotin compounds currently in biocidal application (Table III). A further factor favouring their application is that they are broken down in the environment by photolytic and microbial cleavage of the tin-carbon bonds to inorganic tin residues (Blunden and Chapman, 1982) which besides being non-toxic also appear to be non-susceptible to biomethylation (Ridley, Dizikes and Wood, 1977 and 1978). Available information also indicates that the *in vivo* and *in vitro* metabolic fate of triorganotin compounds in mammals involves similar sequential Sn-C cleavages but that these proceed via carbon-hydroxylated intermediates (Fish, Kimmel and Casida, 1976).

Toxicity of triorganotin compounds *per se* as well as the mode of toxic action have been the subject of several studies (Aldridge, 1976; Elliott, Aldridge and Bridges, 1979; Tan, Ng and Das, 1978). It appears that in mammals these compounds are able to inhibit mitochondrial oxidative phosphorylation, and the blocking mechanism probably involves their binding to certain amino acids

**TABLE I: DEPENDENCE OF THE BIOLOGICAL ACTIVITY OF TRIORGANOTIN COMPOUNDS ON THE NATURE OF THE ORGANIC GROUP FOR VARIOUS SPECIES.**

| R in most active $R_3SnX$ compound | Species |
|---|---|
| Methyl (Me) | Insects |
| Ethyl (Et) | Mammals |
| n-Propyl (Pr) | Gram-negative Bacteria |
| n-Butyl (Bu) | Gram-positive Bacteria, Fish, Fungi, Molluscs |
| Phenyl (Ph) | Fish, Fungi, Molluscs |
| Cyclohexyl (cyclo-$C_6H_{11}$; Neophyl ($PhMe_2CCH_2$) | Mites |

**TABLE II: MAMMALIAN TOXICITY OF TRIORGANOTIN COMPOUNDS**

| Compound | Acute oral $LD_{50}$ (rats, mg/kg) |
|---|---|
| $Me_3SnOAc$ | 9 |
| $Et_3SnOAc$ | 4 |
| $Pr_3SnOAc$ | 118 |
| $Bu_3SnOAc$ | 125-136 |
| $(Bu_3Sn)_2O$ | 193 |
| $Bu_3SnF$ | 200 |
| $Oct_3SnOAc$ | >1,000 |
| $(cyclo\text{-}C_6H_{11})_3SnOH$ | 540 |
| $[(PhMe_2CCH_2)_3Sn]_2O$ | 2,630 |
| $Ph_3SnOAc$, $Ph_3SnCl$ | 124-150 |
| $Ph_3SnOH$ | 240-360 |
| $Ph_3SnF$ | 1,170 |

Source:

Smith, P.J. Toxicological data on organotin compounds. Intl. Tin Res. Inst. Pubn. No. 538, 1978.

TABLE III: BIOCIDAL APPLICATIONS OF TRIORGANOTIN COMPOUNDS

| Compound | Applications |
|---|---|
| $Ph_3SnOAc$ ("Brestan"); $Ph_3SnOH$ ("Duter") | ... Agrochemical fungicides |
| $Cy_3SnOH$[a] ("Plictran"); $[(PhCMe_2CH_2)_3Sn]_2O$ ("Vendex"); 1-$Cy_3Sn$(1,2,4-triazole) ("Peropal") | ... Agrochemical miticides |
| $Bu_3SnOCOPh$ ("Incidin", contg. HCHO) | ... Disinfectant |
| $Bu_3SnF$, $Ph_3SnX$ (X=Cl,F,OH,OAc); $(-CHMeCHCO_2SnBu_3-)_n$; $(Bu_3Sn)_2O$ | ... Biocides in marine antifouling paints |
| $(Bu_3Sn)_2O$; $(Bu_3SnO)_3PO$; $Bu_3SnOCO(Napth)$[b] | ... Wood preservative fungicide |
| $(Bu_3Sn)_2O$ | ... Eradication of moss, algae and lichens on stonework; |
| | ... Moth-proofing of wool, rot-proofing of cellulose containing fibres; |
| | ... Slimicide in paper industry; |
| | ... Biocide in antifouling rubbers; |
| | ... In-can fungicide for emulsion paints; |
| | ... Biocidal additive to industrial cooling water and to adhesives for vinyl wall paper and tiles |

Notes:

(a) Cy = cyclohexyl

(b) Napth = napthenyl

(Elliott, Aldridge and Bridges, 1979). For diorganotin compounds a distinct mechanism has been advanced, involving reaction with vicinal thiol groups of enzymes or coenzymes (e.g. reduced lipoic acid) disrupting α-ketoacid oxidation (Aldridge, 1976; Barnes and Magos, 1968). The only commercial biological application of diorganotins, in particular dibutyltin dilaurate, is as antihelmintics for control of tapeworms in poultry and young turkeys (Davies and Smith, 1982; Ascher and Nissim, 1964). The same compound has also been claimed in the patent literature to exert a useful sustained action (Koike, 1961) against the rice borer, Chilo Suppressalis, while dimethyltin oxide and sulphide applied as aqueous sprays or wettable powders appear to be effective in the control of army worm, cotton leaf perforator and bean aphids (U.S. Patent 3,105,000, 1961). Recent work at the International Tin Research Institute (UK) has raised the possibility that certain dialkyltin compounds may have a role to play in cancer chemotherapy (Crowe, Smith and Atassi, 1980). Thus several dialkyltin dichloride complexes with bidentate ligands such as 1,10-phenanthroline and 2,2'-bipyridine have shown in vivo therapeutic activity towards the P-388 lymphocytic leukaemia in mice. These complexes containing trans organic groups and cis halogens bear a close structural resemblance to the platinum anti-tumour drug, cis- $Pt(NH_3)_2Cl_2$.

**Organotins as Industrial Biocides:** Among the triorganotin compounds, tributyltin derivatives have found commercial outlet principally as industrial biocides and the triphenyltins as agricultural chemicals. Bis(tributyltin) oxide, commonly referred to as TBTO, in particular, finds major use as the active ingredient in antifouling marine paints. Appreciable quantities of this material are also used in timber preservation, and as a mildew preventative and fungicide in water or emulsion paints, particularly those based on vinyl acetate and copolymers.

Marine fouling[1] results from the attachment of marine organisms, whether animal or plant types, to a surface immersed in sea water. There are about 5,000 types of fouling species known, with sea grass and barnacles being the most common forms. Fouling increases hull friction as a vessel moves through water, fuel consumption goes up and the maximum speed is reduced. TBTO and $Bu_3SnF$ are now firmly established as major biocides for use in marine

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[1] See, Evans, C.J. and Hill, C.R. Organotin-based antifouling systems. Rev. Si. Ge. Sn. and Pb. Compds., 1983: 57-125.

antifouling paints. Copper oxide gained acceptance for this purpose a century or so ago. Galvanic corrosion, an inherent disadvantage with copper oxide-based paints on aluminium and steel hulls, is completely eliminated when tributyltin-based paints are used. Such compositions may be achieved by the addition of TBTO (20% by wt.) into paints, or better by the use of polymers incorporating tributyltin groups as paint resins. Very sophisticated paint formulations based on the latter approach are already in the market, with a leaching rate of the organotin moiety between 1 and 2 μg/sq.cm./day. The estimated antifouling service life of organotin polyacrylate coatings, for example, is 5 years compared to 2 years for currently used formulations based on copper oxide. An alternative approach has been to introduce the tributyltin biocide in a rubber matrix, and this is the case for antifouling rubber sheets marketed for use as long life protective coating for ships' hulls and sonar buoys. The subject of polymers for the controlled release of organotin toxins has been recently reviewed (Subramaniam and Somasekharan, 1981).

As timber preservatives tributyltin compounds are highly active against fungi which cause Brown Rot, White Rot and Dry Rot, as well as against insects which attack wood (Richardson and Cox, 1974). Furthermore, they do not increase inflammability, do not impart undesirable odours or colours, and they are very resistant to leaching. They can be applied to timber by dipping, spraying or by vacuum impregnation methods, a suitable organic solvent system being used. Amounts of 0.5-2 kg TBTO per $m^3$ of wood are quite effective against fungal decay. Much higher concentrations are required to protect wood against wood-boring insects such as the common furniture beetle and termites. Efforts to promote tributyltin biocides as water-based preservatives have also borne fruit. These involve admixtures of quaternary ammonium salts with TBTO and such formulations (Richardson and Cox, 1974) have also been used for the successful eradication of moss, algae, lichens and bacterial slime on buildings, monuments and paving. A new development in the long term protection of wood against biodegradation envisages the in situ formation of organotin polymers in the wood. This is accomplished by impregnating the wood with an organotin vinyl monomer (Subramaniam and Somasekharan, 1981).

A significant development in the exploitation of favourable pesticidal properties of poorly water soluble tributyltin and triphenyltin compounds has been their incorporation into rubber pellets which can be immersed in water. The biocide is slowly released in the water from these pellets at a controlled

dosage rate (Cardarelli, 1976). The molluscicidal activity of TBTO has, thus, been employed to kill the snail vectors of bilharzia. Although at dosages of 1-3 ppb, TBTO does not harm fish or plant life (Evans, 1981), it is nevertheless toxic to other non-target marine organisms such as lobster larvae (Laughlin and French, 1980). Several other triorganotin compounds have also been evaluated in recent years for their molluscicidal property. Table IV summarises the structure-activity patterns observed in one such study (Smith, Crowe, Das and Duncan, 1979). Snail mortality conceivably arises from the binding of the organotin with active sites on the snail protein.

**Organotins In Agriculture:** In crop protection, particularly as agricultural fungicides, triphenyltin compounds have found a growing use, and are more and more replacing those fungicides which have a tendency to inhibit growth of treated crops (Gitlitz, 1976). The biologically active lower trialkyltins are unlikely candidates for agricultural fungicide use because of their high phytotoxicity.

Triphenyltin acetate was introduced as the first organotin agricultural fungicide in Europe in 1960 by Hoechst as 'Brestan' to control phytopthora in potatoes and cercospora in sugar beets at rates of a few ounces per acre. Shortly thereafter, triphenyltin hydroxide was introduced as 'Duter' by Philips-Duphar with about the same spectrum of disease control as 'Brestan'. Both these materials do not penetrate into the plant, and their action is thus purely protective. In application, these preparations are diluted with water (for example, to a 0.3% suspension) and sprayed in a quantity of 1.2-2.4 kg/ha, sometimes in combination with maneb. They have also been successfully used to combat powdery mildew in sugar beets and fungal attack on coffee, cocoa, groundnuts, bananas and rice (Das and Chan, 1975). Several pentacoordinated triphenyltin halide complexes such as $Ph_3SnCl(DMSO)$ and $Ph_3SnCl$ (Quinoline 1-oxide) have also recently been shown (Schike, Appel and Schroeder, 1968) to be effective fungicides and to possess a lower mammalian toxicity relative to $Ph_3SnOH$ or $Ph_3SnOAc$. Interestingly, 'Brestan' and 'Duter' strongly exhibit an antifeedant effect (Ascher, 1979). An antifeedant, usually in very low concentration, prevents the insect from recognising its normal host plant gustatory stimulus by inhibiting its taste receptors. The potential of this unique property, however, has not been fully explored.

TABLE IV: BIOASSAY RESULTS[a] FOR ORGANOTIN COMPOUNDS AGAINST THE ADULT SNAIL, Biomphalaria glabrata

| Compound | $LC_{50}$ (mg/l) |
|---|---|
| $(Bu_3Sn)_2O$ | 0.05-0.1 |
| $Bu_3SnOCO$-(3-pyridyl) | 0.01-0.05 |
| $Bu_3SnOCO$-(2-pyridyl) | 0.01-0.05 |
| $Bu_3SnO(CH_2)_2NEt_2$ | 0.1 -0.25 |
| $Bu_3SnSCH_2COO$-(2-ethylhexyl) | 0.05-0.1 |
| $Bu_3SnOSO_2Me$ | 0.01-0.05 (0.025-0.05)[b] |
| $[Bu_3Sn(Ph_3PO)_2]^+.BPh_4^-$ | 0.05-0.1 |
| $[Bu_3SnCl_2]^-[PhCH_2PPh_3]^+$ | 0.1 |
| $Bu_3SnNCS.Ph_3AsO$ | 0.05-0.1 |
| $Bu_3SnOCOMe$ | 0.1-0.3 |
| $Ph_3SnOCOMe$ | 0.05 |
| $BuPh_2SnOCOMe$ | 0.05-0.1 |
| $[BuPh_2Sn(Ph_3PO)_2]^+.BPh_4^-$ | 0.1 -0.2 |
| $BuPh_2SnOH$ | 0.05-0.1 |
| $BuPh_2SnBr$ | 0.05-0.1 |

Notes:

(a) The compounds were formulated as solutions in DMSO and dispersed in an artificial hard-water medium to which the snails were exposed for 24h. Mortality was noted after 48h recovery in clean water.

(b) Aqueous solution.

The next major agricultural application of organotins was realised in 1968 when M & T Chemicals and Dow Chemical Co. jointly introduced tricyclohexyltin hydroxide under the name 'Plictran' for the control of phytophagous (plant-eating) mites on apples and pears. It is now also registered for use on citrus and stone fruits, hops, nuts and ornamental plants at rates of 2-3 oz active ingredient/100 gallon of spray (Hunter, 1976). In a number of countries it has become the product of choice for controlling resistant mites on many crops. Three other organotin miticides have also recently appeared in the market manufactured by Shell, Chemagro and Stauffer.

Notwithstanding these successes, little has appeared in either the chemical or biological literature since the early work of van der Kerk and Luijten (1954 and 1956) bearing on the relationship of structure to biological activity which includes consideration of phytotoxicity. The importance of such work cannot be overemphasised if indeed triorganotins are to make a significant impact on the agricultural scene. Given the tremendous potential for organotin biocides in tropical areas, indigeneous work has now been initiated at the University of Malaya which seeks to examine in depth the influences manifested on overall toxicity by modifications in both the organic and inorganic groups on tin. This includes consideration of the steric and polar effects of substituents, the use of biologically active organic and inorganic groups, and solubility effects such as may be introduced by remote substituents in the R groups (Bulten, 1980), or by glycosidic linkages (Parkin and Poller, 1977) in the anionic moiety. Together with consideration also of pentacoordinated triorganotin compounds, these studies aim to provide a better basis to address the problem of biological activity from the standpoint of specificity, that is, specificity of action against the predator and not against the host or other non-target organisms. We outline below two studies which reflect the above approach. The first deals with the evaluation of triorganotin compounds as larvicides against the mosquito vector of dengue fever, and the second examines the antifungal properties of a range of organotin compounds against some tropical fungi.

## PART 2

### Insecticidal Evaluation Of Organotin Compounds

**Introduction:** Whereas the efficacy of triorganotin compounds in the control of snails, fungi and mites has been demonstrated, the insecticidal properties have

been less well exploited on account of the commercial availability of a wide range of effective insecticides which include organochlorines, organophosphates, carbamates and pyrethroids. In recent times, the use of broad-spectrum insecticides has led to a number of serious problems such as insecticide resistance, recurrence of outbreaks and ecological imbalances in the environment (Metcalf, 1980). These difficulties have generated interest in the search for chemicals which are effective against resistant insects, and which would additionally manifest such properties as disruption of the normal maturation processes, reduction in fertility and alteration in the behavioural patterns through modifying the sensory input of the pests (Haynes, 1981).

The literature on the insecticidal activity of organotin compounds has been reviewed by Ascher and Nissim (1964) and Luijten (1972). Although trimethyltin compounds are usually the most active against insects (Barnes and Magos, 1968; Ascher and Nissim, 1964), this was not found to be the case in a recent study which we conducted on a susceptible strain of the oriental housefly, Musca domestica vicina (Wang, Sudderuddin and Das, 1982). The most active compounds appeared to be the tributyltins. Some selected data from this study are presented in Table V which gives $LD_{50}$ values expressed in moles. The molar values compensate for differences in the molecular weights of the compounds and permit a more accurate measurement of the inherent toxicity of the molecule. It is seen that in compounds 7 and 8, the presence of a benzene ring in the anionic moiety confers lower toxicity on the tributyltin compounds. The lower toxicity of triphenyltins relative to the tributyltins may well be due to differences in permeability of the insect cuticle. Indeed, previous studies on insect larvae have suggested that triphenyltins function more as stomach poisons than as contact insecticides (Gardiner and Poller, 1964). $Ph_3SnOAc$ is seen to be significantly less toxic than $Ph_3SnCl$. A possible reason for this is that whereas $Ph_3SnCl$ is a tetrahedral molecule even in the solid state, $Ph_3SnOAc$ is only so in dilute solutions so that evaporation of the solvent (acetone) on the insect cuticle leads to a self-associated polymer which is less permeable through the cuticle, and therefore less toxic. Treatment of adult flies with sub-lethal doses of $Bu_3SnOAc$ and $Pr_3SnOAc$ showed that, in general, they did not significantly affect the reproductive potential of the flies. The percentage hatch and survival rates from the larval to the pupal stages of treated flies were similarly unaffected, although the survival rate between pupal and adult stages was about 3% less for the $Bu_3Sn$-case. This increase in mortality of treated flies so late in the life cycle could be due to the latent toxicity of

TABLE V: ACUTE TOXICITIES OF SOME TRIORGANOTIN COMPOUNDS TESTED AGAINST THE ADULT ORIENTAL HOUSEFLY, Musca domestica vicina MAC

| | Compound | $LD_{50}^{a}$ ppm | $LD_{50} \times 10^{-10}$ moles |
|---|---|---|---|
| 1. | $Pr_3SnOAc$ | 1841.6 | 60.1 |
| 2. | $(Bu_3Sn)_2O$ | 1133.1 | 19.0 |
| 3. | $Bu_3SnCl$ | 1012.8 | 31.1 |
| 4. | $Bu_3SnOMe$ | 884.5 | 27.6 |
| 5. | $Bu_3SnOAc$ | 761.6 | 21.8 |
| 6. | $Bu_3SnOCH_2CH_2NEt_2$ | 1190.1 | 29.3 |
| 7. | $Bu_3SnOCOC_6H_4Cl$-4 | 1902.5 | 42.7 |
| 8. | $Bu_3SnOCOC_6H_4OH$-4 | 2946.8 | 69.0 |
| 9. | $Ph_3SnCl$ | 1442.4 | 37.5 |
| 10. | $Ph_3SnOAc$ | 3149.6 | 77.1 |
| 11. | Malathion | 1329.0 | |
| 12. | DDT | 136.9 | |

Note:

(a) 1 µl of a solution of the test compound in acetone was applied to the dorsum of each fly, and mortality assessed after 24 h at $24^{o} \pm 1^{o}C$.

these compounds. However, studies on the larvae of the flies clearly showed that this stage was the most susceptible. Flies from $Bu_3Sn$ - and $Pr_3Sn$ - treated larvae (3rd instar, $LD_{10}$ concentration) produced 43.5% and 42% fewer eggs respectively than the control flies. This may probably be due to damage of the gonial cells which adversely affects the formation of gametes in the adult, but other unknown factors may also play a part.

**Toxicological Studies Against The Mosquito, Aedes Aegypti:** We next turned our attention to the mosquito larvae of the Culicine species Aedes Aegypti, which is known to be a carrier of both dengue fever and dengue haemorrhagic fever. The other Culicine species, A. albopictus is believed to carry only dengue fever. Both species of mosquito are fairly ubiquitously distributed throughout South East Asia and West Asia, Africa, and South America between the latitudes 45°N and 35°S (Christophers, 1960). In Peninsular Malaysia, the number of reported cases of dengue fever and dengue haemorrhagic fever for the period 1976-1982 can be seen in Table VI.

Resistance of mosquito vectors to DDT with cross-resistance to pyrethroids has been reported (Priester and Georghiou, 1980), while resistance to organophosphates is also not uncommon (Brown and Pal, 1971). We were thus interested in evaluating the potential of organotin compounds as control agents for mosquitoes. Twenty five triorganotin compounds and three commercial insecticides were initially evaluated against the early fourth instar larvae of the susceptible Liverpool Red-eye strain of A. aegypti. Subsequently, a selected number of the compounds were tested against the second instar larvae as well as against the adult mosquito and the fourth instar larvae of the local DDT- tolerant strain of A. aegypti. The results are summarised in Tables VII to X. The $LC_{50}$ value, which is the concentration that causes 50% mortality of the species, is calculated by the probit analysis method and corrected for control mortality. In the case of fungicidal activity, previous studies (van der Kerk et al., 1954 and 1956) using unsymmetrical and symmetrical trialkyltins had established that maximal activity is obtained when the total number of carbon atoms in the three alkyl groups is between 9 and 12. However, this empirical result seemingly does not extend to insecticidal activity. Thus, for the four $C_{12}$ compounds tested, the order of activity observed (Table VII) is as follows:

$$Et_2OctSn >> Bu_3Sn > Bu_3{}^{i}Sn >> (\alpha\text{-}C_4H_3S)SnBu_2$$

TABLE VI: NUMBER OF CASES OF DENGUE FEVER AND DENGUE HAEMORRHAGIC FEVER REPORTED IN PENINSULAR MALAYSIA FOR THE PERIOD 1976-1982[a]

| Year | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|
| Dengue fever | 336 | 395 | 475 | 438 | 366 | 289 | 2109 |
| Dengue haemorrhagic fever | 438 | 393 | 450 | 396 | 302 | 269 | 781 |

Note:

(a) Weekly epidemiological report. Kuala Lumpur, Ministry of Health, Government of Malaysia.

TABLE VII: BIOASSAY DATA[a] OF TRIORGANOTIN COMPOUNDS TESTED AGAINST THE 4TH INSTAR *A. aegypti* LARVAE, LIVERPOOL RED-EYE STRAIN

| | Compound | $LC_{50}$(mg $l^{-1}$) | $LC_{50} \times 10^{-6}$(moles $l^{-1}$) |
|---|---|---|---|
| 1. | $Me_3SnCl$ | 1.15 | 5.77 |
| 2. | $Et_3SnOAc$ | 2.86 | 10.80 |
| 3. | $(Bu_3Sn)_2O$ | 0.38(0.31)[b] | 0.63 |
| 4. | $(Bu_3Sn)_2S$ | 2.21 | 3.61 |
| 5. | $(Bu_3Sn)_3BO_3$ | 0.31(0.50)[b] | 0.33 |
| 6. | $Bu_3SnCl$ | 0.39 | 1.20 |
| 7. | $i\text{-}Bu_3SnBr$ | 1.60 | 4.33 |
| 8. | $Bu_3SnOAc$ | 0.43 | 1.23 |
| 9. | $Bu_3SnOCOC_6H_4OH\text{-}4$ | 0.38 | 0.89 |
| 10. | $Bu_3SnOCOCH_2OC_6H_4Cl\text{-}4$ | 0.43 | 0.90 |
| 11. | $Bu_3SnOCOC_6H_4CO_2$-Sucrose | 0.21(0.21)[b] | 0.26 |
| 12. | $Bu_3SnOCOCH_2CH_2Co_2$-Sucrose | 0.35 | 0.47 |
| 13. | $Bu_3SnOCOCCl_2Me$ | 0.51 | 1.16 |
| 14. | $(4\text{-}MeC_6H_4)_3SnCl$ | 0.12(0.12)[c] | 0.28 |
| 15. | $(4\text{-}MeC_6H_4)_3SnCl.Ph_3PO$ | 0.19 | 0.27 |
| 16. | $(4\text{-}MeC_6H_4)_3SnCl.PyO$ | 0.11 | 0.21 |
| 17. | $Ph_3SnCl$ | 0.42(0.46)[b] (0.41)[c] | 1.09 |
| 18. | $Ph_3SnCl.Ph_3PO$ | 0.48 | 0.71 |
| 19. | $Ph_3SnCl$.Acridine | 0.62 | 1.09 |
| 20. | $(4\text{-}ClC_6H_4)_3SnNCS$ | (0.55)[c] | (1.40)[c] |
| 21. | $Ph_2BuSnBr$ | 1.80 | 4.39 |
| 22. | $PhMe_2SnCl$ | 3.98 | 15.23 |
| 23. | $OctMe_2SnOAc$ | 0.088(0.21)[b] | 0.27 |
| 24. | $OctEt_2SnOAc$ | 0.095 | 0.27 |
| 25. | (α-thienyl)$SnBu_2Cl$ | 5.96 | 16.97 |
| 26. | DDT | 0.033(0.27)[b] | 0.09 |
| 27. | Malathion | 0.092(0.12)[b] | 0.28 |
| 28. | Temephos | 0.004(0.002)[b] | 0.008 |

Notes:

(a) The test compounds (in 1ml acetone unless otherwise indicated) were dispersed in 250ml distilled water and mortality of the larvae in this medium was counted after 24h.

(b) Corresponding bioassay data for 4th instar larvae of local DDT-tolerant strain.

(c) 2ml DMSO were used as solvent for the test compound.

attesting to the influence of both electronic and steric factors. A clearer manifestation of the electronic factor is seen in the relative activities of the triaryltin compounds:

$$(p\text{-}MeC_6H_4)_3Sn > Ph_3Sn > (p\text{-}ClC_6H_4)_3Sn$$

Although nearly similar activities were shown by $Bu_3SnOAc$ and $Ph_3SnCl$, $Ph_2BuSnCl$ was much less toxic. A similar observation was also made in respect of $Me_2PhSnCl$ as compared to $Me_3SnCl$ and $Ph_3SnCl$. The latter result contrasts markedly with the high activity of $Me_2OctSnOAc$ relative to $Me_3SnCl$ and the biologically inactive $Oct_3SnOAc$. Indeed, dimethyloctyltin and diethyloctyltin acetates were among the most active compounds tested against the larvae. Tributyltin sucrose phthalate also appears to be a powerful toxicant based on tin content. In this case, it is conceivable that the glycosidic linkage present in the molecule permits a greater degree of permeability into the cells of the organism under test and, hence, greater availability of the toxicant at the site(s) of toxic action. An evaluation of tritolyltin sucrose phthalate is currently in progress. Against the fourth instar larvae of the DDT-tolerant strain of A. aegypti, the triorganotins investigated showed a similar pattern of activity (Table VII). Not surprisingly, second instar larvae proved to be more susceptible than the fourth instar larvae (Table VIII), but toxicity tests on the adult mosquito (topical application) reveal some reversals in trends (Table VIII) which are probably explicable in terms of differences in the method of administering the toxicant. The pattern of activity observed in the delayed effect studies conducted on the fourth instar larvae of the Liverpool Red-eye strain is as follows (see Table IX):

$$Ph_3Sn > Me_3Sn > Bu_3Sn > Et_3Sn$$

From the point of view of their lower mammalian- and phyto-toxicities and their favourable environmental properties, the greater activity observed for the triphenyltin compounds is significant and indeed becomes even more so taking into consideration the results on residual activity (Table X). The residual activity of a compound is concerned with its persistence once released into the environment. Some compounds such as organochlorines are known to have residual activities in excess of a year, others such as pyrethroids have a very short residual activity. Ideally a pesticide should persist long enough to complete its intended mission, and then degrade to harmless products. Little attention

**TABLE VIII: COMPARISON OF TOXICITY DATA FOR 2ND INSTAR LARVAE, 4TH INSTAR LARVAE AND ADULTS OF A. aegypti (LIVERPOOL RED-EYE STRAIN)**

| Compound | $LC_{50}$ (mg $l^{-1}$ & moles) | | | | | |
|---|---|---|---|---|---|---|
| | 4th instar | | 2nd instar | | adults[a] | |
| | mg $l^{-1}$ | $\times 10^{-6}$ moles $l^{-1}$ | mg $l^{-1}$ | $\times 10^{-6}$ moles $l^{-1}$ | mg $l^{-1}$ | $\times 10^{-10}$ moles per mosquito |
| $(Bu_3Sn)_2O$ | 0.38 | 0.63 | 0.017 | 0.030 | 18.57 | 0.31 |
| $(Bu_3Sn)_3BO_3$ | 0.31 | 0.33 | 0.018 | 0.020 | 24.10 | 0.26 |
| $Ph_3SnCl$ | 0.42 | 1.09 | 0.017 | 0.045 | 10.30 | 0.13 |
| $Me_2OctSnOAc$ | 0.09 | 0.27 | 0.008 | 0.027 | 14.68 | 0.45 |
| DDT | 0.03 | 0.09 | - | - | 14.10 | 0.40 |

Note:

(a) female mosquitoes; 0.035µl of an ethanol solution of the test compound was applied to the thorax of each mosquito, and mortality assessed after 24h at $25^{o}\pm1^{o}C$.

TABLE IX: TWENTY FOUR HOUR EXPOSURE MORTALITY, POST-TREATMENT MORTALITY AND TOTAL MORTALITY OF 4TH INSTAR *A. aegypti* LARVAE EXPOSED TO TRIORGANOTIN COMPOUNDS AND 3 STANDARD INSECTICIDES.

| Compound | Approx. $LC_{50}$ (ppm) | 24h exposure mortality (%)[a] | Post-treatment mortality (%)[b] | Total mortality (%)[c] |
|---|---|---|---|---|
| $Me_3SnCl$ | 1.10 | 48.5 | 49.0 | 97.5 |
| $Et_3SnOAc$ | 2.90 | 46.0 | 20.0 | 66.0 |
| $(Bu_3Sn)_2O$ | 0.30 | 55.5 | 27.0 | 82.5(84.0) |
| $(Bu_3Sn)_3BO_3$ | 0.32 | 49.5 | 27.5 | 77.0[d] |
| $(Bu_3Sn)_2S$ | 2.24 | 50.5 | 30.5 | 88.5(80.0) |
| $Bu_3SnCl$ | 0.35 | 55.0 | 25.0 | 80.0 |
| $i\text{-}Bu_3SnBr$ | 1.60 | 50.0 | 44.5 | 94.5 |
| $Bu_3SnOAc$ | 0.43 | 54.0 | 21.5 | 75.5 |
| $Bu_3SnOCOC_6H_4OH\text{-}4$ | 0.40 | 47.0 | 41.5 | 88.5 |
| $Bu_3SnOCOCH_2OC_6H_4Cl\text{-}4$ | 0.40 | 45.0 | 29.0 | 74.0[e] |
| $Bu_3SnOCOC_6H_4CO_2$-sucrose | 0.21 | 44.0 | 8.5 | 52.5(63.0) |
| $Bu_3SnOCOCH_2CH_2CO_2$-sucrose | 0.34 | 49.5 | 12.0 | 61.5 |
| $Ph_3SnCl$ | 0.40 | 54.0 | 46.0 | 100.0(100.0) |
| $Ph_3SnCl.Ph_3PO$ | 0.45 | 46.0 | 52.5 | 98.5 |
| $Me_2PhSnCl$ | 3.80 | 46.0 | 34.5 | 70.5 |
| $Ph_2BuSnBr$ | 2.80 | 51.5 | 43.0 | 94.5[f] |
| $Me_2OctSnOAc$ | 0.09 | 42.5 | 25.5 | 67.5(82.0) |
| $Et_2OctSnOAc$ | 0.09 | 53.0 | 21.5 | 74.5 |
| DDT | 0.03 | 50.0 | 0.0 | 50.0 |
| Malathion | 0.09 | 43.0 | 14.0 | 57.0 |
| Temephos | 0.004 | 50.0 | 12.0 | 62.0[g] |
| Control | - | 0 | 0 | 0 |

Notes:

(a) 200 larvae were used for each of the triorganotin compounds and 100 larvae for each of the standard insecticides.

(b) This was computed using the formula 100 A/N, where N=no. of larvae used and A=no. of larvae and pupae dying after transferring the larvae to clean water following 24h exposure to the toxicant.

(c) Values within parentheses are for the local DDT-tolerant strain.

Pupal mortality: (d) 7%; (e) 5%; (f) 1%; (g) 4%.

TABLE X: RESIDUAL ACTIVITY[a] OF SELECTED TRIORGANOTIN COMPOUNDS AND STANDARD INSECTICIDES AGAINST THE 4TH INSTAR LARVAE OF A. aegypti (LIVERPOOL RED-EYE STRAIN)

| Compound | Approx. $LC_{95}$ (ppm) | Percentage Mortality 0 day | 14 days | 28 days | 42 days | 56 days | 70 days |
|---|---|---|---|---|---|---|---|
| $Me_3SnCl$ | 2.40 | 93.5 | 99.0 | 93.0[b] | 96.0[b] | 100.0[b] | 100.0[b] |
| $(Bu_3Sn)_2O$ | 0.60 | 92.0 | 100.0 | 96.0 | 93.0 | 95.0 | 17.0[b] |
| $(Bu_3Sn)_3BO_3$ | 0.77 | 99.0 | 97.3 | 100.0 | 93.0 | 96.0[b] | 23.0[b] |
| i-$Bu_3SnBr$ | 4.40 | 99.0 | 87.0 | 16.0 | 6.6 | 6.6[b] | 4.0[b] |
| $Bu_3SnOAc$ | 1.20 | 95.0 | 100.0 | 95.0 | 100.0 | 97.0 | 58.0[b] |
| $Ph_3SnCl$ | 1.70 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0[b] | 100.0[b] |
| $Me_2OctSnOAc$ | 0.50 | 96.0 | 100.0 | 76.0 | 8.0[b] | - | - |
| $Et_2OctSnOAc$ | 0.44 | 95.0 | 100.0 | 40.0 | 0.0[b] | | |
| DDT | 0.16 | 100.0 | 95.0 | 58.0[b] | 0.0[b] | | |
| Malathion | 0.19 | 97.3 | 100.0 | 52.0[b] | 0.0[b] | | |
| Control | 0.00 | 0.0 | 0.0 | 0.0[b] | 0.0[b] | 0.0[b] | 0.0[b] |

Notes:

(a) Tests on the insecticide solutions were performed at two-weekly intervals, each test involving exposure of fresh larvae to 24h.

(b) Presence of algae observed in the test-solutions.

has to-date been paid to the residual activity of organotins once released into the aquatic medium, although several tributyltin compounds have been proposed as controlled - release agents against molluscs as well as against mosquito larvae (Cardarelli, 1977 and 1978). The results in Table X show that triphenyltin compounds have the greatest stability among the compounds tested to secure a 100% kill even after the 10th week. By contrast DDT and Malathion appeared to be effective only up to 6 weeks, being broken down thereafter by algal species formed in the water. Exposure of the pupae of A. aegypti for a period of 1 hour at 50 ppm concentrations of $Ph_3SnCl$ and $(Ph_3Sn)_2S$ only caused low mortality and did not delay emergence to the adult stage. When differentiated into sexes and mated with untreated partners, it was found that generally fecundity (number of eggs laid per female) was not affected but the fertility (i.e. percentage reduction in hatching) was significantly affected. Based on preliminary observations, $Ph_3SnCl$ exerted a high chemosterilizing effect than $(Ph_3Sn)_2S$ and male mosquitoes appeared to be more susceptible than females. More detailed studies including morphological effects are currently being pursued.

**In Vitro Antifungal Studies On Organotin Compounds**

Although the screening tests on more complex organotin structures are still pending, preliminary results at hand on a range of simpler organotin compounds are assembled in Tables XI and XII. The values, based on the radial growth method, indicate the effective dosages required to arrest the growth of the fungi (fungistatic action) rather than to kill them (fungicidal action). Fungal diseases, it may be remarked, constitute the bulk of all plant diseases. The fungal species selected for this study include several tropical plant disease-causing fungi, a wood destroying fungus and two cellulytic soil fungi (see footnotes to Table XII). The $ED_{50}$ values in Table XII indicate the concentrations required to cause 50% inhibition of growth, and are derived from probit-log concentration analysis of the data. For compounds with minimum inhibitory concentration values greater than 100 ppm (Table XI), the relative antifungal activities are indicated by their $ED_{50}$ values. An antifungal spectrum of the range of compounds investigated may be discerned from Table XIII which shows percentage inhibition of growth at a toxicant concentration of 10 ppm. It is seen that the tributyltins possess a broad-spectral activity, whereas the triphenyltins and mixed alkyl aryltins while having a lower order of activity are more selective. Thus, both the soil fungi, Aspergillus niger and Trichoderma viride and the two pathogenic fungi, Botyrodiplodia theobromae and

TABLE XI: MINIMUM CONCENTRATION (PPM) OF ORGANOTIN COMPOUNDS REQUIRED TO INHIBIT COMPLETE RADIAL GROWTH (MALT EXTRACT AGAR; pH 7; 25°±2°C)

| | FUNGI / COMPOUND | Trichoderma viride[a] | Botyrodiplodia theobromae[b] | Ulocladium botrytis[c] | Fusarium moniliforme[d] | Pestalotiopsis guepini[e] | Curvularia lunata[f] | Curvularia eragrostidis[g] | Phaeotrichoconis crotalariae[h] | Aspergillus niger[i] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $(Bu_3Sn)_2O$ | 5 | 5 | 5 | 7 | 6 | 5 | 5 | 5 | 0.5 |
| 2. | $Bu_3SnOCOC_6H_4OH$-4 | 10 | 10 | 5 | >25 | 10 | 10 | 15 | 10 | 1-5 |
| 3. | $Bu_3SnOCOC_6H_4CO_2$-sucrose | 5 | 10 | 5 | 10 | 15 | 10 | 5 | 5 | 0.5 |
| 4. | $(Bu_3Sn)_3BO_3$ | 10 | 15 | 7 | 25 | 6 | 10 | 9 | 10 | 1 |
| 5. | $Bu_3SnOAc$ | 12 | 15 | 7 | 25 | 10 | 10 | 12 | 8 | 1 |
| 6. | i-$Bu_3SnBr$ | 50 | 25 | 25 | >25 | 10 | 25 | 25 | 25 | 15 |
| 7. | $Bu_3SnOCO$-(2-thienyl) | 25 | 25 | 15 | 25 | 15 | 25 | 25 | 10 | 3 |
| 8. | $Ph_3SnOAc$ | 15 | >50 | 10 | 15 | 50 | 10 | >25 | 50 | 10 |
| 9. | $(4\text{-}ClC_6H_4)_3SnCl$ | >50 | >100 | 50 | >25 | >50 | >25 | >50 | >50 | >25 |
| 10. | $Ph_3SnCl.Ph_3PO$ | 100 | >50 | 50 | >50 | 50 | 50 | 50 | 50 | >15 |
| 11. | $(4\text{-}ClC_6H_4)_3SnCl.Ph_3PO$ | 100 | >100 | >50 | >25 | >50 | >50 | 100 | >100 | >100 |
| 12. | $(4\text{-}MeC_6H_4)_3SnCl.Ph_3PO$ | 100 | >100 | >50 | >50 | >50 | >50 | 50 | >25 | >100 |
| 13. | $(Ph_3Sn)_2S$ | >100 | >100 | >50 | >50 | >50 | >50 | >50 | >50 | >15 |
| 14. | $[(4\text{-}MeC_6H_4)_3Sn]_2S$ | >100 | >100 | >50 | >50 | >50 | >50 | >100 | >100 | >100 |
| 15. | $Ph_2BuSnBr$ | >25 | 50 | 15 | >25 | 10 | 10 | >10 | >50 | 6 |
| 16. | $(4\text{-}MeC_6H_4)SnPh_2OAc$ | >25 | >50 | 50 | >25 | >25 | >25 | >25 | >25 | 9 |
| 17. | (2-thienyl)$SnBu_2Cl$ | 100 | >100 | 50 | >50 | >50 | >50 | >50 | >50 | >50 |
| 18. | (5-Me-2-thienyl)$SnBu_2Cl$ | 100 | >50 | 50 | >50 | >50 | >25 | >25 | >25 | >25 |
| 19. | $(MeOCOCH_2CH_2)_2SnPhCl$ | 100 | 100 | >50 | >50 | 100 | 100 | 100 | >50 | >25 |
| 20. | $Et_2OctSnOAc$ | 1-5 | 7 | 5 | 2 | 0.5 | >25 | >25 | >25 | 0.4 |

Notes:

(a) cellulytic soil fungus; used as biological control of plant pathogens
(b) causes black pod rot in cacao, post-harvest diseases in fruits
(c) wood-destroying fungus
(d) causes seedling blight and wilt and bakanae disease in rice
(e) causes leaf spots in cereal crops, tea etc; and lesions on tropical fruits
(f) causes black kernel rice
(g) causes leaf spot in maize, seedling blight in oil palm and coconut
(h) causes cereal diseases, for example, stack burn in rice
(i) cellulytic soil fungus; causes post-harvest storage diseases and crown rot in peanuts; black mold in citrus fruits, pineapple and onion bulbs.

TABLE XII: CONCENTRATION OF ORGANOTIN COMPOUNDS REQUIRED TO INHIBIT 50% RADIAL GROWTH[a]

| FUNGI/ COMPOUND[b] | T.Viride | B.theobromae | U.botrytis | F.monoliforme | P.guepini | C.lunata | C.eragrostidis | P.crotalariae | A.niger |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.63 | 0.57 | 0.59 | 0.61 | 3.1 | 0.09 | 0.12 | 3.38 | 0.08 |
| 2 | 0.29 | 0.50 | 2.16 | 2.19 | 0.58 | 0.84 | 0.63 | 3.35 | 0.16 |
| 3 | 1.15 | 0.46 | 1.79 | 1.05 | 0.51 | 0.43 | 0.30 | 2.18 | 0.27 |
| 4 | 1.57 | 1.00 | 1.55 | 2.29 | 1.16 | 1.00 | 0.44 | 2.76 | 0.19 |
| 5 | 1.96 | 1.58 | 2.08 | 2.76 | 1.35 | 0.94 | 0.79 | 3.39 | 0.39 |
| 6 | 4.10 | 1.18 | 6.97 | 8.70 | 26.9 | 2.01 | 1.73 | 8.14 | 0.54 |
| 7 | 2.34 | 2.61 | 2.57 | 3.81 | 1.66 | 1.10 | 0.84 | 3.23 | 0.45 |
| 8 | 1.91 | 2.26 | 5.82 | 5.64 | 2.23 | 0.86 | 1.52 | 24.7 | 0.39 |
| 9 | 4.43 | 34.0 | 53.5 | 6.60 | 5.19 | 4.57 | 4.04 | 55.5 | 3.74 |
| 10 | 8.31 | 16.6 | 9.67 | 22.9 | 12.8 | 2.27 | 2.56 | 27.4 | 1.04 |
| 11 | 42.7 | 103 | 244 | 9.61 | 9.15 | 13.8 | 22.4 | 229 | 1069 |
| 12 | 12.5 | 37.3 | 35.4 | 39.9 | 38.4 | 6.41 | 13.3 | 25 | 1048 |
| 13 | 45.3 | 34.3 | 135 | 77.2 | 114 | 3.41 | 4.52 | 247 | 4.28 |
| 14 | 1745 | 47.8 | 451 | 251 | 47.3 | 137 | 545 | 673 | 239446 |
| 15 | 1.05 | 3.12 | 4.32 | 2.23 | 1.89 | 0.34 | 0.80 | 15.4 | 0.31 |
| 16 | 1.52 | 55.54 | 5.22 | 6.48 | 5.27 | 0.93 | 1.18 | 140 | 6.9 |
| 17 | 19.6 | 10.50 | 30.6 | 30.7 | 30.1 | 8.98 | 5.25 | 88.0 | 223 |
| 18 | 12.3 | 5.10 | 48.4 | 21.6 | 11.6 | 7.39 | 3.99 | 130 | 5.87 |
| 19 | 61.9 | 473 | 137 | 801 | 105 | 18.1 | 96.6 | 195 | 145 |
| 20 | 0.44 | 0.25 | 0.68 | 1.51 | 0.21 | 0.84 | 2.29 | 0.21 | 16.0 |

Notes:

(a) $ED_{50}$ values (ppm); plain 2% malt extract agar.

(b) See Table XI

TABLE XIII: THE ANTIFUNGAL SPECTRUM[a] OF TRIORGANOTIN COMPOUNDS TESTED AGAINST NINE FUNGAL SPECIES AT 10 ppm

| FUNGI/ COMPOUND[b] | T.viride | B.theobromae | U.botrytis | F.monoliforme | P.guepini | C.lunata | C.eragrostidis | P.crotalariae | A.niger |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ++++ | ++++ | ++++ | ++++ | ++++ | ++++ | ++++ | ++++ | ++++ |
| 2 | ++++ | ++++ | ++++ | +++ | ++++ | ++++ | ++++ | ++++ | ++++ |
| 3 | ++++ | ++++ | ++++ | ++++ | ++++ | ++++ | ++++ | ++++ | ++++ |
| 4 | ++++ | ++++ | ++++ | +++ | ++++ | ++++ | ++++ | ++++ | ++++ |
| 5 | ++++ | ++++ | ++++ | +++ | ++++ | ++++ | ++++ | ++++ | ++++ |
| 6 | +++ | ++++ | +++ | ++ | ++++ | +++ | ++++ | +++ | +++ |
| 7 | ++++ | ++++ | +++ | +++ | ++++ | +++ | +++ | ++++ | ++++ |
| 8 | +++ | +++ | ++++ | +++ | ++++ | ++++ | +++ | - | ++++ |
| 9 | +++ | + | ++ | +++ | ++ | +++ | +++ | - | +++ |
| 10 | ++ | + | ++ | - | ++ | +++ | +++ | - | ++++ |
| 11 | + | - | + | ++ | ++ | ++ | - | - | - |
| 12 | + | - | + | - | ++ | +++ | ++ | - | - |
| 13 | - | + | + | - | + | +++ | +++ | - | +++ |
| 14 | - | - | + | - | + | + | + | - | * |
| 15 | +++ | ++++ | ++ | +++ | ++++ | +++ | +++ | ++ | ++++ |
| 16 | ++++ | +++ | +++ | +++ | +++ | ++++ | +++ | + | ++++ |
| 17 | - | - | + | - | - | ++ | ++ | - | - |
| 18 | ++ | +++ | ++ | - | ++ | +++ | +++ | + | +++ |
| 19 | - | - | - | - | - | + | - | - | - |
| 20 | ++++ | ++++ | ++++ | ++++ | ++++ | +++ | +++ | + | ++++ |

Notes:

(a) All results are the mean of three replicates, and are expressed as follows: 90-100% inhibition (++++); 61-89% inhibition (+++); 41-60% inhibition (++); 26-40% inhibition (+); 0-25% inhibition (-).

(b) See Table XI.

* Undetermined.

Phaeotrichoconis crotalariae are least susceptible to triaryltin compounds. In all cases, however, inhibition of sporulation was observed with noticeable morphological changes of mycellial growth and pigmentation of media. Reduction of sporulation is important as spores form the principal source of infective propagules of most fungal pathogens.

Initial results on secondary screening tests using in vitro spore germination studies on 2% malt extract agar and mycellial dry weight studies by the poisoned food technique using modified Czapek Dox Liquid Medium indicate that generally lower concentrations of the organotins are required for inhibition of germination as well as mycellial growth. In the spore germination studies marked reductions in germ tube length as well as considerable morphological changes in the germ tube were observed.

The pentacoordinated triaryltin compounds are generally seen to be as active as the uncomplexed parent compounds toward the pathogenic fungi. $(Ph_3Sn)_2S$, previously reported (van der Kerk, 1961 and 1969) to be less phytotoxic than $Ph_3SnOAc$, is seen to exhibit a somewhat lower order of activity than $Ph_3SnOAc$. With bis (tritolyltin) sulphide, a significant drop in activity is observed particularly against soil fungi (Table XII). This draws attention to an important point, namely that consideration of only the most active of the organotin compounds to the exclusion of others in in vitro tests is not often a gainful approach in studies of this nature. In consonance with this view, it is proposed to explore a wide array of aryltin structural types individually also for their phytotoxicity so that features influencing a balance between fungicidal activity and phytotoxicity may be better discerned, and suitably designed compounds thereby synthesised for further investigations.

**Evaluation Of Organotin Compounds As Pesticide Synergists**

A concomitant biochemical study involving butyl and phenyltin compounds has enquired into their potential role as pesticide synergists. Extremely promising results have been obtained which indicate that this new and inherent feature of the organotin compounds may significantly contribute towards increasing their applications in agriculture.

Whereas the phenomenon of the development of resistance in fungi is not common, this is not the case for insects as has already been pointed out. One

form of detoxification pathway whereby insects metabolise the toxicant and excrete it as harmless product(s) involves the conjugation of the tripeptide glutathione, which is present in all living cells, with the toxicant. This conjugation step is aided by the presence of GSH - dependent enzymes. Compounds that serve to inhibit the conjugation step by blocking the detoxifying enzyme are called synergists. For the purpose of this study, the enzyme GSH-S-transferase was secured from the snail kidney (Achatinafulica), and separated by DEAE-sephadex chromatography into an acidic and a basic form. At a fixed protein concentration of 50 ppm and at pH 8.3, the inhibition by added organotin compounds of these two forms of the enzyme in catalysing the conjugation of reduced Glutathione with dinitrochlorobenzene was followed spectrophotometrically (Booth, Boyland and Sims, 1961). The results are shown in Table XIV. It is seen that organotin compounds inhibit the enzyme competitively and that the acidic form, which contributes approximately 60% to the total detoxification activity, is inhibited more than the basic form. The efficacy of $Et_2OctSnOAc$ and $Ph_3SnX$ compounds is worthy of special note in the light of the results reported herein on their larvicidal and fungicidal properties.

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**TABLE XIV: INHIBITION OF GSH-TRANSFERASE (ACIDIC & BASIC FORMS) BY ORGANOTIN COMPOUNDS**

**(pH 8.3; 28°C)**

| Glutathione (reduced) Conc. (mM) → | Acidic enzyme fraction[a] % inhibition | | | | | | Basic enzyme fraction[a] % inhibition | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.5 | | 1.0 | | 2.0 | | 0.5 | | 1.0 | | 2.0 | |
| Organotin Inhibitor ↓ Inhibitor Conc. (μM) → | 13 | 33 | 13 | 33 | 13 | 33 | 13 | 33 | 13 | 33 | 13 | 33 |
| $Ph_3SnCl$ | 68 | 74 | 60 | 67 | 46 | 49 | 20 | 40 | 12 | 20 | 2 | 13 |
| $Ph_3SnOAc$ | 65 | 90 | 55 | 83 | 55 | 75 | 11 | 45 | 7 | 23 | 0 | 8 |
| $Ph_3SnCl.Ph_3PO$ | 50 | 70 | 50 | 58 | 40 | 45 | 15 | 48 | 5.5 | 15 | 0 | 8 |
| $(4\text{-}MeC_6H_4)_3SnCl$ | 78 | 85 | 62 | 75 | 63 | 73 | 22 | 48 | 15 | 32 | 5 | 17 |
| $(4\text{-}ClC_6H_4)_3SnCl$ | 57 | 65 | 50 | 55 | 30 | 37 | 15 | 30 | 8 | 17 | 0 | 8 |
| $Bu_3SnOAc$ | 65 | 75 | 55 | 60 | 40 | 50 | 15 | 46 | 8 | 22 | 2 | 12 |
| $Bu_3SnOCOC_6H_4OH\text{-}4$ | 55 | 70 | 50 | 58 | 30 | 40 | 13 | 45 | 7 | 20 | 0 | 10 |
| $(Bu_3Sn)_2O$ | 50 | 77 | 45 | 60 | 35 | 55 | 20 | 40 | 10 | 25 | 0 | 2 |
| $Et_2OctSnOAc$ | 88 | 95 | 80 | 85 | 75 | 80 | 55 | 85 | 45 | 75 | 20 | 68 |
| $MePhSnCl_2$ | 55 | 69 | 50 | 60 | 40 | 55 | 12 | 30 | 10 | 20 | 4 | 15 |
| $Me_2SnCl_2$ | 30 | 45 | 20 | 30 | 15 | 25 | 5 | 20 | 3 | 15 | 0 | 10 |
| $Bu_4Sn$ | 5 | 32 | 4 | 23 | 1 | 26 | 0 | 6 | 0 | 3 | 0 | 1 |

Note:

(a) The total protein concentration was held constant at 50 ppm.

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## CLOSING REMARKS
by
## DELEGATIONS

**Dr. Alfonso Alfonsi On Behalf Of The Italian Delegation**

Dr. Alfonsi praised the Symposium for its diversity and range of coverage. He also pointed out that the Symposium had fostered mutual understanding, at especially the international level.

He highlighted three conclusions, namely:

(i) Methodology:

The variety in the coverage during the Symposium had included both theoretical and empirical approaches of analyses. This combination of different methodologies has helped to enrich the mix which resulted from the deliberations. The different approaches have also fortunately worked in complementary ways.

(ii) Content:

The content areas covered and the relationship between them have contributed to a better comprehension at both the technological and technical levels. This is especially important in the full appreciation of technological and cultural changes geared towards development in different contexts.

(iii) Deeper Awareness:

The Symposium has also nurtured an increased sensitivity for the need of interdisciplinary approaches to the study of man, his work and the society in which he lives. This deeper awareness of the complexities of the different variables in society and the changes that it undergoes, is important for the understanding of the issue of transfer of technology. In this

setting, he stressed the continued importance of international collaboration as exemplified in the exchange of technology, research findings and teaching.

Finally, he reiterated that the Italian delegation is most willing to contribute to the growth of this mutual international understanding. He again drew attention to the role of multilateral ventures for the good of all the countries involved, in particular, Malaysia.

**Professor Masaki Koshi On Behalf Of The Japanese Delegation**

Professor Koshi measured the success of the Symposium through the stimulation that it provided for the participants. He concluded that the participants were stimulated to recognise the importance of mutual exchange in the field of technology, culture and development. This, according to him, is an important indicator of the Symposium's success.

He also praised the Symposium for having promoted and emphasised similarities in different international settings. Some examples of these similarities that were pointed out were in the field of problems, value systems, ways of thinking, research methodology employed, and even the structure of the different societies.

As much as he was concerned for mutual exchange geared towards international understanding, he however, had a note of advice. He drew attention to the importance of the factor of time in fostering effective international exchange which can take roots. He cautioned that we cannot be in too much of a hurry in this domain. Time must be given due importance and play for communication across nations and the changing of attitudes towards new development.

He was, nevertheless, very encouraging in that he argued for the continuance of what has been sowed in the Symposium. The significant steps taken towards international understanding could be buttressed in different ways. He proposed a concrete suggestion towards this end. On behalf of IATSS he extended an invitation to a local expert in the field of transportation engineering in the University of Malaya to visit Japan for a span of about two months in 1984. This is for the purpose of exchanging experiences with the Japanese counterparts. Hopefully, this type of cooperative research and development

efforts will bloom in the future. He substantiated this approach by drawing attention to what the Prime Minister of Malaysia had stressed in his opening address to the Symposium concerning the importance of international exchange and transfer of technology based on goodwill.

**Royal Professor Ungku A. Aziz On Behalf Of The Malaysian Delegation**

The Royal Professor began his summary by saying that the Symposium practised the theme of unity in diversity. It is patently clear that though there was diversity in the approaches and research topics, there was unity in that all of them were addressed to the issues of technology, culture and development.

He continued with an explanation of his interest in the Renaissance Man. He acknowledged the contributions of the Italians in this field of his interest. He also connected the theme of the Symposium with the concerns of the Renaissance Man. He even expressed the opinion that the theme, Technology, Culture and Development reflected in essence Renaissance ideas. This is most clearly seen by the breadth and scope covered in the symposium. These reflected counter trends to the narrow and specialist trends promoted by micro experts.

The Symposium and its activities besides mirroring Renaissance ideas, also stressed that knowledge is universal. Besides this focus, there was also the dominant stress on multi-disciplinary approaches to knowledge and its relevance to the problems of society.

Many scholars in their wisdom with reference to their particular fields, have not fully understood the nuts and bolts of development. According to him, this understanding must have its foundation in grass root experiences. He illustrated the importance of this by citing real and concrete experiences through the handpump innovation (Professor Goh and Dr. Low's paper on Handpumps). Only through this approach can we hope to counter-balance the ivory tower type of approaches towards development. Lastly, he pointed out that the Symposium was a great educational experience for all those involved. Like the ancient mariner, he added that the enriched experiences of the participants should make them happier and wiser.

## CLOSING ADDRESS

by

Datuk Dr. James P. Ongkili
Minister In The Prime Minister's Department

This international gathering of eminent scholars from diverse background has brought great honour to Malaysia. For this, I must thank, on behalf of the Government of Malaysia, the sponsors of the Symposium. I am, indeed, moved by your motivation to invest so much time and money to ensure the success of this Symposium.

The theme of this Symposium, too, has not failed to capture my attention. Issues of technology, culture and development have occupied the attention of the government and scholars in our country in the recent past. Consequently, the hosting of this symposium in the capital of Malaysia is most relevant since it refocuses and draws national attention to issues which have preoccupied us for some years. More importantly, it brings to our attention what we have been engaged in, with deeper international perspective and understanding.

I am sure one of the underlying forces energizing the sponsors is the factor of the sense of shared responsibility and shared concern for our future. It must have been the sensitivity towards this symbiotic well-being of all nations and peoples that has generated the organization of this Symposium and its implementation up to its present level of fruition. I am glad that in the last few days, you have concerned yourselves with a wide range of issues spanning many levels of interest. I notice that you have not confined your explorations to what is only theoretical. I am impressed with the manner and intensity of involvement you have shown in grappling with the realities of everyday life, as seen in common but important topics like road safety and even the quality of goat meat on the table for the people. The meaningfulness of this theoretical and applied exercise in the last few days must have also been very enriching and rewarding in that it sought to combine, interface and integrate technology, culture and development within a humanistic framework.

I agree totally with this approach that reminds us of the importance of man and his well-being in a rapidly developing field of technological changes and development. I am most troubled by approaches that dehumanizes man with also the consequent neglect of his beliefs and spiritual values. I do not believe

that a nation can be great if it chooses to set aside these weighty considerations to pursue development and progress. It only does this at its own peril with grave consequences.

It may be profitable for us to be reminded that human needs and problems have necessitated and often dictated technological changes. However, these impelling human needs and urgent problems, coupled with the technological changes generated, have in many ways interacted to create new problems and needs. Together they propel us into a future full of uncertainties and challenges. From certain viewpoints, these challenges are very invigorating. But in the midst of our enthusiasm for the future, we may be forced to admit that our world has in fact become a more hazardous place with risks which are rather perplexing and growing in complexity.

It is time for us to seek clearer directions and a larger measure of control of our future. If we fail or are ineffective in this venture, we may be pushed into a future where we have little direction or control. It would indeed be a sad day for us to declare that we are merely reactive to short term problems rather than directing, planning and controlling our future.

It is in this context that I warmly welcome and appreciate the presence of all of you at the end of this Symposium. This is because you have applied yourselves most energetically to an increased understanding of many of the problems and challenges created by rapid and complex changes. You have also sought a deeper understanding of factors, both human and technological, which underlie these problems and challenges. Very commendably, too, you have searched for solutions which are meaningful and effective in a variety of specific contexts. I must also congratulate you for the high quality of the cross-fertilization of ideas which have resulted in this Symposium. I am confident that all of you feel more enlightened. In this enlightenment, you will surely have a clearer world vision balanced by a national vision which is sharply addressed to the well-being of peoples and nations.

I must therefore take this opportunity to encourage you to continue to think about the price and scale of trade-offs of technological and cultural changes. This continued intellectual venture and thinking must, however, spur you to promote and be involved in research of excellence addressed to these issues. Some of you must continue to conceptualize while others will follow through with

meaningful theoretical analysis; and, hopefully, many others will seek opportunities to carry out applied research to enrich the lives of the people they serve. It is in this type of service to people and nations that the best research workers must find a higher purpose for their lives. Unless we have this vision and commitment, we may be accused of being selfish glory-seekers.

With this futuristic orientation of service, we would be in many ways better equipped than the multitude of other research workers who have restricted themselves to just intellectual issues insulated from the realities of life and the needs of their neighbours, both within national and international boundaries. Our research workers with the over-arching purpose of service will most certainly possess a broader and deeper perspective of the ultimate direction and goals for research of excellence. Truly satisfying academic and research fulfilment must, indeed, find expression in this transcending dimension of service to one's fellow-beings and nation.

It is with this note that I would like to persuade you to persevere in the most generous support and effort that you have invested up to this point. I am most certain that the outcome in the future can only be decided by the commitment, dedication and investment of scholars and concerned people like you.

On behalf of the Government and the people of Malaysia, I must record again our many thanks to you for enriching our intellectual environment and lives with your presence and deliberations. You most certainly must have left an indelible impact on the lives of many here.

With great pleasure, I now officially close the Symposium. Thank you.

# PART III

# SUMMARY AND DISCUSSION

# OF

# KEYNOTE ADDRESSES

# AND

# PAPERS

## SUMMARY OF KEYNOTE ADDRESSES

### Harmony Between Rigorous Empiricism And Creative Insight Leads To Excellence In Research For Development: An Overview.

by

Royal Professor Ungku A. Aziz

Royal Professor Ungku A. Aziz drew attention to the fact that the complexities of the problems of the real world must entail an interdisciplinary or a multi-disciplinary research strategy. Whilst some research work will be oriented towards theory, there is a need for research work of excellence that is empirical. This type of vigorous and rigorous empiricism is needed to balance the theoretical orientations of the more philosophical or theoretical research. A combination of the deductive approach balanced by the inductive approach will produce a picture that is more in consonance with the demands of reality.

He also stressed that research of excellence must be geared to and serve the goals of national development.

The Royal Professor Ungku A. Aziz then gave an overview of the type of empirical research that is going on in the University of Malaya. He illustrated this concept of creative, rigorous and vigorous empiricism through a number of research projects which are captured in several papers in the Symposium.

KEYNOTE ADDRESS - SUMMARY

## Knowledge, Society and Technology

by

Professor Paolo Ammassari

Professor P. Ammassari stressed that a greater understanding of the different impacts of advanced technology on culture and societal development must begin with an understanding of the structure of knowledge. The understanding of the structure of knowledge that is sought must have its beginning in a proper theoretical perspective of a sociology of knowledge.

He made a distinction between "knowledge-of-acquaintance" and "knowledge about". He also presented another point of view of knowledge through its cognitive structure. Based on the cognitive structure of knowledge, we obtain two types of knowledge, namely "knowledge-why" and "knowledge-how".

"Knowledge-of-acquaintance" and "knowledge about" crossed with "knowledge-why" and "knowledge-how" produces four types of knowledge.

| | Acquaintance | About |
|---|---|---|
| Why | Type 1 | Type 2 |
| How | Type 3 | Type 4 |

He also laid emphasis on experiential knowledge which is rooted in personal experience. Some examples of this type of knowledge is the knowledge obtained through on-the-job training.

He explained that technological acceptance does not necessarily mean technological adaption.

Lastly, he clarified that the impact of technological innovations and technological transfer must depend on social interactions. These impacts are mediated and carried through by social interactions.

## Some Considerations On Technology Transfer

by

Professor Shuhei Aida

Professor S. Aida postulated that the 21st century demands a new kind of technology. This new technology that is needed must be based on a proper balance between human considerations and technological innovations. Such a balance that is sought is found in a process called "eco-technology".

Transfer of technology has its own unique objectives and methods. It must have as its main focus at the conceptualization and implementation stages an appropriate technology. This appropriate technology is created or adapted dynamically by a country that is based on its culture.

Transfer of technology must be in harmony with the culture, society and governmental structure. It must rest on a foundation of the support and participation of the people. It is also basically a form of inter-cultural exchange and communication. Consequently, it must be bilateral in its nature.

One of the greatest obstacles to the transfer of technology from Japan to the Asean countries has been the structural framework in Japan. Some examples which have resulted from the impediments of the structural framework of Japan have been the lack of efficient consultations. Another concrete example is found in the Japanese attitude to aid programmes to Asean countries. These aid programmes are designed and drafted in the offices of the administrators of the Government. Insufficient attention has been given to opinions of the field experts.

Professor Aida expounded what he considered as paramount factors in promoting transfer of appropriate technology, namely:

(i) Transfer of technology must be based on the development principles of the recipient country. It must work through and be in consonance with a total strategy that covers every phase that is conceivable.

(ii) Transfer of technology must give more emphasis to the human factor rather than material factors. The incentives for

personnel involved in the transfer of technology has not encouraged the best to be involved in a sustained manner.

(iii) Transfer of technology embraces concepts of the modernization of the society. Implied also are the possibilities of resistance to the introduction of technological innovations. This resistance could result from cultural barriers.

(iv) The training of personnel is an important factor in the transfer of technology.

(v) Effective transfer of technology must be cultivated on the appropriate cultural soils with the proper seeds of technology. It must never be unilateral but must always be bilateral and interactive.

## DISCUSSION OF KEYNOTE ADDRESSES

The Chairman of the session, Tan Sri Hamzah Sendut suggested that because of the shortage of time, discussion of the three keynote addresses be dispensed with. Instead of the discussion, he chose to focus attention on issues which he considered as important.

The main issue that he selected for attention was on the theme: transfer of technology. He began his summary with a call for an appropriate definition of technology. Technology according to him encompasses the sum total of knowledge found in a particular society. This cumulative aspect of technology ranges over many different levels of knowledge. It could be knowledge expressed in hardware and also software. Besides these important aspects, he also chose to include conceptual areas which cover marketing, manufacturing, management, and indeed almost all aspects that concern living in a society.

After this attempt at a holistic and global definition of technology, he then proceeded to focus attention on the issue of transfer of technology. He stressed that in the understanding of the issue of transfer of technology, it is important to focus on the needs of the transferer and transferee, especially as they inter-relate to each other.

The Chairman then proceeded to highlight the situation in Asean countries with reference to the issue of the transfer of technology. He felt that the problem of transfer of technology is most significant in the context of Asean countries attempting to modernize and close the gap between themselves and the more advanced countries.

He pointed out that the transfer of technology may not take place automatically, as may often be assumed naively. There is the necessity to create the right and appropriate environment and conditions for the transfer of much needed technology in the Asean region. In this context he lay emphasis on, namely:

(i) training programme;

(ii) back-up organization, personnel, infrastructure facilities, and even policies;

(iii) creativity in identifying what is important, and seeking ways of transferring technology in effective ways; and

(iv) research and development programmes of excellence.

Tan Sri Hamzah Sendut also raised a number of issues related to the theme which he chose to develop further. He felt that these issues could facilitate or hinder the transfer of technology. The first issue pertains to frictions that may arise in the transfer of technology. An understanding of the nature of these frictions would be considered as important and necessary. The second issue is in regard to the profit motive of the donor and receiver. This must be given sufficient emphasis in the understanding of the driving impetus underlying transfer of technology. The third issue focuses on the ownership and participation of equity that may facilitate the transfer of technology. This again is related to the concept of bilateral relationship and interests in the transfer of technology. Lastly, he stressed the need to understand the variety of impacts of transfer of technology. The effects and impacts of transfer of technology must be both measured and understood. This need to measure accurately the various aspects of the transfer of technology must constitute an important portion of the activities to promote transfer of technology.

## SESSION 1

### Italian Technological Development And Its Contribution To International Cooperation

by

Professor Bruno Grassetti

Professor Grassetti described the Italian technological development process; lessons derived from the approach that was adopted; and the present Italian approach to development for other countries. He pointed out that problems facing southern Italy are similar to that faced by Greece, Spain, Portugal, other Mediterranean countries, as well as other developing countries.

Professor Grassetti listed the lessons derived from the Italian experience as:

(i) Development process needs a global and diffused approach.

(ii) Agricultural sector and natural resources play a primary role in sustaining development.

(iii) An associated investment for infrastructure, education, etc. is needed for capital expenditures in manufacturing industries. He suggested the figure of 3 to 3.5 times of the main capital expenditures.

(iv) Investment on technology should be on human resources rather than material.

Based on these lessons, Professor Grassetti indicated that the present Italian approach to the development process in Southern Italy and other countries as:

(i) Emphasis on a catalytic role in the development process.

(ii) Emphasis on monitoring the economic and social behaviour of the development process.

(iii) Emphasis on a network for connecting diffused distributed structures of productive units.

(iv) Emphasis on the "interdependence" factor in actions geared towards development.

# International Transfer Of Manufacturing Technologies And Corporate Culture

by

Professor Yoshihiro Tsurumi

The paper began by asking how the Japanese firms succeed in manufacturing operations in unionised factories in the United States when their former American owners have abandoned them as uneconomical.

Professor Tsurumi stressed that the choice facing the developing country is not only on the selection of foreign direct investments which is beneficial but also the selection of useful corporate culture which the host countries could emulate. Without flexible and human resource oriented corporate culture, firms may well find themselves saddled with dead end operations which have little prospect for economical and technological growth.

The paper compared the manufacturing system of Suzuka Plant of Honda Motors with that of Lordstown Plant of General Motors U.S.A. both of which have a comparable scale of productions. Suzuka plant easily came on top in number of cars produced per hour, as well as impeccable workmanship. The difference between the two plants is in the flexible manufacturing system (FMS) practised by the Japanese. The flexibility enables the Japanese to eliminate the need for quality inspectors, by holding production workers responsible for product quality, as well as inventories to cover for uncertainties of market demand, delivery and product quality.

The paper asserted that FMS based system is not wholly mechanical automation but rather automation best utilised when applied to the existing FMS corporate culture. When the production cost of Mazda (Toyo Kogyo) and Ford Motors are compared, it was found that 83% of the production cost differences were due to the institution-related technology of FMS, such as quality control, workers absenteeism, broader job categories; and only 17% were due to automation and product engineering.

**SESSION 1 - SUMMARY**

The Corporate Culture adopted by the Japanese is the Model J type (Tsurumi, "Two Models of Corporation and International Transfer of Technology", Columbia Journal of World Business, 1979). Unlike the Model A type, Model J has the following characteristics:

(i) Management is committed to employee job security.

(ii) Corporate goals are shared throughout the firm.

(iii) Lateral and informal communication is freer across functional boundaries within the organisation.

(iv) Management promotion from within is normal.

(v) Longer time horizons are common at all levels of the firm.

The paper is of the opinion that institutional technology of the FMS based corporate culture can best be transferred to developing nations by developers of such technology, namely through many Japanese as well as a selected few American and European multinational companies.

The paper concluded by discussing appropriate government policies necessary. The policies must nudge firms away from Model A culture to Model J type of behaviours. In this policy formulation, the educational system must encourage students to think that they do not join business to make money but to contribute to make products and services. The government assistance to industry must be explicitly linked to the proven behaviour of firms such as increased R and D, stable employment, continuous retraining and export performance. Lastly, the government must involve business, labour and academic sectors in discussing and formulating the economic goals of the nation.

## The Transfer Of Technology In The Iron And Steel Industry Of Malaysia

by

Professor Mohamed Ariff

(Presented by Associate Professor Paul Chan)

The paper gave a broad introduction to the Iron and Steel Industry in Malaysia by presenting the performance of three large local mills and highlighting the transfer of technology in hardware as well as software areas. Prof. Ariff commented that the industry owes its existence to the overall role of government in providing the appropriate infrastructure and incentives for the successful transfer of technology.

The first case mill is the Malayawata Sdn. Bhd. It is quite a small plant by modern international standards, even though it is the largest steel mill in Malaysia. The plant hardware is Japanese machinery and equipment. The first mill was installed by Japanese personnel while the second mill's installation was carried out by MSB's own employees. The number of expatriate personnel was reduced from 92 in 1967 to 2 in 1978. This indicates a successful transfer of technology.

The above success was done with due regard to local materials such as iron ore, limestone and charcoal (from rubber wood). Although the local materials are not of the best quality, they nonetheless resulted in beneficial spin-offs to the nation.

The second mill that was studied is the Associated Steel Mill (ASM) which acquired its hardware technology from multiple sources. It initially, had no expertise to unbundle the technology and, therefore, had to purchase the first rolling mill as a complete package. Since then, it has developed the unbundling expertise for its second mill, and since 1981 ASM has no more need for expatriate personnel.

The third mill is Antara Steel Mills Sdn. Bhd. (ASMSB). It is a joint venture with foreign equity participation. ASMSB's rolling mill is less automated and relatively more labour intensive. ASMSB's acquisition of technical know-how was different from that of MSB and ASM. ASMSB employs 3 expatriates, who occupy top positions. They will train the local personnel to take over.

SESSION 1 - SUMMARY

The paper noted the following as prospects and problems in the Iron and Steel Industry:

(i) The government must play a greater role in industrial technological development by providing various fiscal incentives; establishment of a skill development fund; and formation of government to government agencies for technology transfer.

(ii) Spin-offs for auxiliary and component industries are non-existent.

(iii) Expansion in the industry needs careful thought as world demand is on the decline.

(iv) There are problems in the export market because of protectionist policy as well as because other ASEAN countries are also moving towards the same direction.

(v) Industry may face shortage of local resources such as iron ore, as well as the problem of rising energy cost.

## SESSION 1

## DISCUSSION

There was no question from the floor after the three speakers had presented their respective papers. The Chairman then invited the speakers to give their additional comments.

**Human Factor In The Field Of Technology Transfer**

Professor Grassetti emphasised the importance of the human factor as exemplified in human motivation, involvement and responsibilities, in the field of technology transfer. He related his experience in Peru when he was carrying out a feasibility study. He did not have much knowledge of the area. By enlisting the cooperation and involvement of the local people, three books on natural resources; analysis of the existing and potential industrial activities; recommendations for the management, organization and finance of the development of the country, were produced. These captured the important principles in transfer of technology.

**Manpower Development**

Associate Professor Paul Chan commented that the search for and development of needed manpower is demanding. Malaysia being a major primary producer needs time for the development of manpower resources geared to industrial needs.

Referring to an earlier remark by Professor Tsurumi, Assoc. Professor Chan agreed that the rate of labour turnover in Malaysia is high, especially in the textile industry. He remarked that Malaysian manpower development has so far been on an ad hoc basis. Industrial manpower is induced from a rural economy, and Malaysia is presently at the stage of an immature capitalistic system.

Professor Tsurumi believed that management should be committed to treating human-beings as the most valuable and renewable resource.

Human resources must be given incentive, training and reward for longevity in service.

## SESSION 1 - DISCUSSION

Professor Tsurumi observed that Malayawata Steel (M) Bhd. reduced its expatriate personnel from 92 to 2 in 10 years. This he commented is a good record. He disproves the common fallacy that the number of expatriates must be limited from the beginning because of considerations, such as political. He maintained that this fallacy is disastrous because expertise is actually transferred through examples and learning by doing.

### Corporate Culture

Professor Tsurumi commented that in technology transfer, corporate culture is important. Equity and other considerations are incidental and not as important.

Successful corporate culture is that of the Model J type (Tsurumi, "Two models of Corporation and International Transfer of Technology", Columbia Journal of World Business, 1979). In this model, the management is committed to the job security of employees by treating them as valuable resources and not as disposable costs or assets. The corporate goal is shared by the management and employees. This model is also committed to productivity but not at the expense of product quality. He remarked that productivity is not synonymous with the emphasis on mechanisation. Desirable corporate structure cannot be substituted by mechanisation.

Assoc. Professor Chan commented that the search for the appropriate corporate culture is on in Malaysia. A number of small companies has been corporatised into big corporations. An example is the plan for the establishment of the second stock exchange.

Professor Tsurumi commented that effective corporate culture must be adopted at the very beginning. One cannot hope to develop from one corporate culture and then change over easily to another model.

## SESSION 2

### An Important Viewpoint Regarding The Technical Transfer Of Transport

by

Dr. Namiki Oka

Important factors affecting the successful transfer of technology in the field of transportation in South East Asia were discussed. The author felt that the most important factors are those that affect the pedestrian refusal distance, which is a term used to measure the distance over which pedestrians are unwilling to walk. This distance was found to vary from country to country, for example it is 400 meters in Europe, 300 meters in Japan, and about 200 meters in South East Asia. Even in Europe or Japan, it was found to change with changing traffic conditions and weather. In South East Asia, it was felt that the tropical climate or the hot weather is the main cause for the short pedestrian refusal distance. This factor was also thought to be the cause for the unpopularity of the pedestrian crossing bridges, and not due to the supposed bad manners of the pedestrian. The author suggested that this factor should be taken into account when transferring technological innovations with reference to a transportation system in South East Asia, as the factor of the people's acceptability is very important for the success of such a transfer. It was mentioned that a project to investigate the people's acceptability to some technological innovations in a transportation system has been undertaken in Manila. The analysis of this study is not yet completed.

SESSION 2 - SUMMARY

## Research And Development In Computer Applications At Universiti Sains Malaysia

by

Professor Kamal Salih

Four areas of the development of computer applications at Universiti Sains Malaysia were discussed. These were:

(i) Development of a national integrated data system.
(ii) Computer aided translation.
(iii) Computer aided instruction.
(iv) Development of a university management information system.

These development emerged out of the needs of education and administration in especially a university context, except for the development of a national integrated data system which was commissioned by the Malaysian Government in 1976.

This was an attempt by the Government to centralise all information from its various agencies such as land records and integration of personal data. The details of this project were referred to in the paper under the section of the NIDAS Project.

The development of computer aided translation was due to the need for translated texts in Bahasa Malaysia in the light of the national education policy. There is currently, a lack of texts in Bahasa Malaysia. It was thought that the present information and knowledge explosion would make computer aided translation very attractive. This development was based on the ARIANE-78 system developed in Grenoble, France. At the moment, it is fairly successfully, achieving about 70% understandable translation. A few computer translated examples were shown. It was hoped to improve this achievement in the second phase of the development (1984-1986).

The development of computer aided instruction (CAI) emerged from the need to reinforce the knowledge of weaker students due to the weaknesses of proper preparation at the lower levels. This work was started in 1980, and the current plans and activities were restricted to the development and research of the related softwares.

The development of a university management system was carried out under Project Sismap. This is an on-going project, primarily for the needs of university administration and management.

SESSION 2 - SUMMARY

## New And Modified Form Of Natural Rubber

by

Dr. Sekaran Nair

The author emphasised the importance of natural rubber to Malaysia from the economic aspect as well as the employment point of view. It was noted that the rubber industry in Malaysia is still experiencing a growth rate of 3-5% in spite of heavy competition from synthetic rubber. It was also pointed out that the country is a small producer of rubber products although it is the world's largest producer of natural rubber. To keep abreast with synthetic rubber competition, and to increase the usage of natural rubber, modification efforts have been carried out at the Rubber Research Institute Malaysia (RRIM). Two methods of modification have been established:

(i) Physical modification.
(ii) Chemical modification.

The physical modification resulted in the SMR rubber, 50% of which goes to export. Chemical modification is relatively new. It involves the introduction of an epoxy group to the natural rubber molecule to give a new material with attractive physical properties. This new material is known as epoxidised natural rubber (ENR). Three types of ENR have been developed by RRIM through a process which it claimed to have low side branching formation. The three ENR rubber developed are ENR10, ENR25 and ENR50. The numbers correspond to percentage of epoxidation, for example ENR10 means 10% epoxidised natural rubber. ENR10 has improved damping and high strength qualities which are suitable for constructional application, such as in bridges and for earthquake protection of buildings. ENR25 gives good traction and low rolling properties which makes it a better material for making tyres compared to synthetic rubber such as SBR. ENR50 possesses good resistance to swell and gas impermeability and, therefore, suitable for applications as gas tubes and in oily conditions. The process of epoxidation at RRIM is performed in the latex condition in a batch operation pilot plant. This new area of natural rubber modification is hoped to improve the country's usage of natural rubber, especially in the tyre products.

## SESSION 2

## DISCUSSION

### A Comment on Road Crossing Habits

Mr. Mineo Nakajima commented that the improper road crossing habits of the Chinese in particular were due to their nature, beliefs and culture. This, he said, was based on his long experience in China. Mr. Namiki Oka disagreed with this comment. Moreover, he felt that the Chinese in South East Asia would not have this peculiar habit, especially after a long interaction with local cultures.

### A Comment On People's Behaviour And Attitude On The Road

Prof. Ammassari commented that people's attitude on the road depended on their roles. For example, a motorist would feel that he has the highest priority, but when he becomes a pedestrian, he would feel that a pedestrian should have the highest priority. This situation was obtained in Italy.

### A Question On Response And Acceptance Of Computer Programmes

Prof. Bruno Grassetti asked Prof. Kamal Salih about the response from the public administration and the acceptance of the public concerning the computerization of personal data and other records. Prof. Kamal Salih said that the response from the Government bodies was over enthusiastic with high expectations without the appreciation of the level of staff technical expertise needed, and the readiness for such an innovation. He was, however, not sure of the public response to this project. The public does not seem to be aware of related issues, as the principle of privacy.

### A Question On The Properties Of Modified Natural Rubber

Prof. V.G. Kumar Das asked Dr. Sekaran Nair about the relationship between the structural and mechanical properties with respect to the degree of epoxidation.

He also asked about the special property of 100% epoxidation. Dr. Sekaran Nair answered that there are no known correlations but the choice of the three types of ENR (10%, 25%, 50%) was based on their appropriate physical properties which are empirically discovered. A 100% epoxidation was found to be unsuitable because of the unprocessability of this product.

## SESSION 3

### An Overview Of Urban Traffic Management

by

Professor Masaki Koshi

Urban Traffic Management was defined as a concept of comprehensive and co-ordinated application of conventional measures for traffic operation. Problems related to urban traffic management were outlined, and a broad range of measures presented to solve them. Of these, the following were highlighted: measures influencing the time and place of trip generation; the choice of mode of travel; street usage allocation; intersection; and parking control and measures for environmental protection. The use of microelectronics in traffic control was encouraged, and a call was made for more attention to urban traffic management in developed and developing countries.

### Toward The Establishment Of A Comprehensive Traffic Safety Program

by

Mr. Minoru Kobayashi

The paper drew attention to the large increase in motor vehicles in Kuala Lumpur and Selangor, and the consequent increase in road accidents. Comparative figures were presented (Table I) for fatality rates in the countries and capital cities of ASEAN and Japan. These showed that Malaysia and Kuala Lumpur recorded the highest rate/100,000 persons. By vehicle type, the highest fatalities in Malaysia were recorded from motorcycle accidents. The need to collect and analyse data on various traffic phenomena was emphasized; the establishment of an Integrated Traffic Institute was suggested. Safety campaigns conducted with the co-operation and support of the public and private sectors were recommended.

SESSION 3 - SUMMARY

## The Effects Of Road Construction On The Environment

by

Dr. Low Kwai Sim

The paper, supported by excellent slides, compared the effects on the environment of road construction in a forest (Hutan Simpan Setul, Kuala Pilah) and an urban (Federal Highway) area. In the forest area, three types of logging roads were identified - main roads, cut tracks and skid tracks. Their impact on the terrain through landslides and slumping, the disruption of river flows and the destruction of vegetation and wildlife, was discussed. In the urban area, road construction produced problems of traffic noise, flooding and negative change in the visual character of the surrounding areas. An environmental-impact-matrix (Table I) which showed the cause-effect and affected relationships in the two areas, was presented.

## SESSION 3

## DISCUSSION

### Street Usage And Intersection Control

Prof. Kumar Das commented that a combination of one-way traffic and reversible lane systems, widely used to reduce congestion and meet highly directional traffic demands, would be useful in Kuala Lumpur. He posed three questions on mircoprocessor-controlled traffic signals:

(i) whether they were still at an experimental stage;
(ii) if they would respond to highly unpredictable traffic flows; and
(iii) what was their control distance.

Prof. Koshi replied that if no traffic control system existed at a particular intersection, a microprocessor system could be installed immediately and that it would be effective, even in Kuala Lumpur. He added that the system was highly responsive to changes in traffic demand and could defer or delay the build-up of excess capacity. It was definitely more effective than the conventional control system of hand signals. He added that the control distance through the use of microprocessors had no practical limits.

### Consequences Of Technological Change on Social and Cultural Parameters

Dr. Alfonsi considered that the range of new measures recommended by Koshi and Kobayashi to improve urban traffic management and traffic safety as representing a new technology which was likely to provoke a package of social and cultural changes. He enquired if these changes could be measured.

Mr. Kobayashi replied that presently there was no measures of these changes although they were significant in technology transfer. Prof. Koshi added that only short-term solutions could be prescribed for the variety of social and cultural problems brought about by the widespread use of cars. Some areas of concerns indicated were the impact of new means of transportation on family life, landuse pattern, commuters, and growth of satellite towns.

## SESSION 3 - DISCUSSION

### Traffic Safety And Safety Belts

A participant enquired about the effects of the use of safety belts on traffic safety and accidents. He was also interested in the factor of enforcement. The answer indicated that the use of safety belts was important and had an effect. Enforcement which is effective is of value.

Dr. Circerchia reported that Centro Febbraio '74 studied the effects on social and cultural change, created by road construction in Italy. In Brazil and the Sudan, these studies included environmental effects. She enquired if in Dr. Low's studies, social and cultural changes were considered. Dr. Low replied in the negative though conceding that this point was important.

### Alternative Views On The Consequences Of Increased Urban Traffic

Prof. Ho considered that the motorised two wheeled vehicle was intrinsically unsafe. This explained why the highest percentage of traffic deaths was from motorcycles. He enquired if a motorised tri-or tetra-cycle would be more effective than the range of safety measures proposed.

In his reply, Mr. Kobayashi said that whilst Japanese manufacturers were trying to make the motorcycle safer, what was more important was to provide training on road safety to motorcyclists. Prof. Koshi contended that the Japanese experience was that motorcycles were not intrinsically unsafe. In Japan, the death rate from motorcycle accidents was low relative to the number of these vehicles. Further, although Japanese manufacturers have designed and tried to sell 3-wheelers and small cars (220-250 cc), this has not been successful because the mix of low and high speed vehicles is likely to retard traffic flow and reduce safety. Prof. Das added that the role of proper traffic attitudes is probably a very important factor.

Prof. Yip remarked that a major consequence of rapid urban traffic growth is air-pollution. He enquired if car manufacturers and assemblers had a social responsibility to reduce the pollution level of cars. Did IATSS conduct research on how to manufacture low cost, low pollution vehicles, and did it also carry out publicity campaigns on the effects of pollution?

Prof. Koshi in his reply said that car manufacturers and assemblers do not have the responsibility of installing anti-pollution devices on cars independent of government legislation to this effect. However, if anti-pollution devices were to be installed, manufacturers should keep costs down. He added that whilst there is technology available to reduce the pollution level of motorcars, there is presently inadequate technology to reduce pollution by heavy vehicles, especially those with diesel engines, which are mainly responsible for the problem. He considered that the role of the mass media must be effective in keeping the general public aware of the harmful effects of pollution.

## SESSION 4

### Cultural Impact Of Technological Change In Italy: Reflections On Three Case Studies

by

Dr. Alfonso Alfonsi

Italy since the end of the Second World War has transformed itself from a predominantly agricultural to an industrial country, adopting the Keynes neo-capitalist model which led to cultural and socio-economic implications such as:

(i) the development of mass society and communications;

(ii) the development of individualism and the break with traditional communities and joint family:

(iii) the growth and assertion of the nuclear family; and

(iv) the ever widening affirmation of a radical and libertarian mentality, notwithstanding the presence of two forces such as catholicism and communism, which is defined as anti-liberal.

From this, an Italian model which is almost the opposite of a business corporate culture developed, which integrated the catholic and communist traditions whose influences though still very strong had incorporated into it the culture of modernisation and the assertion of the individual and his value system.

Five major researches were carried out between 1977 and 1982 by the Centre for Research and Documentation February '74 to show that the development of Italy is not a mere technical change but a process which is both material and cultural.

**Young People:** Research on young people fell into two categories, namely, aiming at discovering the social role of the young; and secondly at clarifying the relationship between catholic youth and the process of modernisation. In general, the working base had contracted and the number of young people unemployed increased substantially.

At the family level, the dependence of children on the parents increased instead of decreasing, leading to less development at individual levels and a lower capacity of associate life on their own.

At the educational level, because of state and strong popular demands, illiteracy has almost completely disappeared. Compulsory school attendance is up to the age of 14, and high school attendance has increased to 56% in 1981 while at University level it went up to 18%. However, because of this sudden mass school attendance, there has been a lowering of quality in school performances and an inadequacy of teaching personnel. It has also failed to bridge the gap between rising expectations of education with job opportunities available.

On the relationship of youth with the catholic tradition, there has been a substantial decrease in numbers from 1,800,000 in 1950 to 120,000 in 1978. Many have been found to embrace not traditional catholicism, but systems of values associated with the Italian Model of development which gives maximum preferences for friendship, community, self-achievement and service to the Church last. Thus, attributes of humility, obedience, chastity and political unity of catholics, all catholic traditions have been accorded low preferences compared to values of modernisation.

**Elderly:** The elderly constitutes 20% of the population. Research showed that there exists a wide gap between the high self-image of the elderly and the low level of their actual conditions in life. In the labour market, there is a constant aspiration to work, and many elderly placed work among the top priority. A high priority is also placed on the family system, but in reality the development of the nuclear family has marginalised the elderly resulting in half of them living alone or with their spouse or relegated to baby sitting. There has also been a paucity of social services for the elderly, ranging from entertainment through radio and television to welfare care. They seem to be isolated, and their possibility of re-entering the labour market or the family unit becomes a myth.

**Health:** In the process of modernisation, health facilities, although improved substantially, has remained at pre-industrial levels. Two researches carried out in the City of Rome, and at Umbria, of Central Italy show that although during the late 1960s, there had been restructuring of the health scheme, there

had been delays in admitting and treating patients and bad management which makes the health scheme in Italy a farce.

## The Planning And Development Of The Singapore Changi Airport

by

Mr. Peng Giok Beng

The paper traces the various development phases of the airport starting from site selection, land reclamation until the shift to the new airport itself. As far as site selection is concerned, a special Committee on Airport Development (SCAD), formed in 1975, was entrusted to collect data for that purpose and to recommend the best possible site. Changi was chosen, and 907 hectares out of 1663 hectares were reclaimed from the sea. In master planning the details of the airport, the major criterion taken was peak demands rather than the annual demands that determined the facilities required. Airport facilities were divided into three major categories, namely, Aircraft, Passenger and Cargo handling facilities. Surveys, and empirical data collected were used in experimentation at Paya Lebar Airport to determine the most efficient system. Simulation flights and public familiarisation were also conducted during and after construction. The actual shift to Changi was precisely planned to the last details, and the shift was carried out over three nights from 30 June to 2 July, 1981. Problems encountered ranged from user's space requirements, facilities planning, changes in schedules and coordination.

## SESSION 4

## DISCUSSION

### Communalism And Technological-Cultural Changes In Italy

On the question by Prof. K. Das as to whether the influence of communalism has been taken into account, Dr. Alfonsi replied that communalism, in the true sense of the word, does not exist in Italy. However, cultural differences, from North to South and from East to West exist very strongly which is a result of the different reactive modes to industrialisation. These have given rise to disconnection of family ties, assertion of the individuals, and a general decrease in productivity. Attempts to remove the economic and societal gap between the North and South have taken the form of programs to industrialise the South.

### Increasing Dependence On Parents: A Recent Trend In Italy

Prof. Yip Yat Hoong observed that Dr. Alfonsi's study is very interesting because some of the results run counter to observations found elsewhere. For example, there is an increased dependence on parents as development progresses. Related to this, between 1950 and 1960 the work force in agriculture decreased from 47% to 10%. Where could the work force have gone to? Perhaps the type of work, areal distribution of industries, income differentials etc. could have been important factors in explaining why they still stay with their parents. In Singapore, it is common for graduate children to stay with their parents because of the housing shortage.

Dr. Alfonsi replied that the question of dependence on parents to a certain extent coincided with the movement of rural-urban migration from South to North where the industries are located. However, the dependence on parents is not based on maintenance of authority in traditional ties, as this has completely broken down. The dependence is more psychological dependence which is tied to structural factors such as unemployment and housing. Moreover, by staying home with parents, there are significant social and cultural reflections of recent trends. The children do not obtain the status of grown-ups which is related to full employment and non-dependence financially.

SESSION 4 - DISCUSSION

**Hospitals and Waiting Time: A Problem In Italy**

Prof. Yip Yat Hoong noticed that the number of days of waiting to get into hospital in Italy is rather long despite the availability of hospital beds. Dr. Alfonsi replied that this is an institutional mismanagement which created the discrepancies. For example, many old people are admitted to hospitals, and stay there for a long time even though they are not sick because they have no where else to go.

**The Italian Experience Of The Rise Of Liberalism**

Prof. Ho Coy Choke referred to a statement by Dr. Alfonsi that "the ever widening affirmation of a radical and libertarian mentality, notwithstanding the presence of two forces such as catholicism and commmunism which could be defined as anti-liberal", and the title of the article which is "Cultural Impact Of Technological Change in Italy", implied that Dr. Alfonsi is suggesting that heavy industrialisation as causing a change in the mentality of the people in Italy. He questioned whether it could be possible that the liberal attitudes of the present generation of Italians have been the rejection of the recent past right-wing facism during World War Two. Dr. Alfonsi replied that there is some linguistic problem here. The word 'liberal' has many different meanings. In Italy the two main forces, communism and catholicism together with the historical, political liberals are all opposed to facism from different standpoints. This is not a political consensus on the part of the liberals but this process is related to value orientations typical of a liberal class which recognised the individual values towards a free economy. This is different from those in the catholic and communistic tradition which is tied more towards community based relationships. However, in the 1950s, the catholic young people and the communist groups also gradually changed towards the recognition of individual values, especially with the growing industrialisation and a free economy.

**Site Selection and Cost Recovery Of Changi Airport**

Dr. Firdaus Abdullah enquired about the reasons for the Changi Airport site, and how long would Singapore expect to recover the cost of the Airport. To this, Mr. Peng replied that the old airport, Paya Lebar Airport, has a lot of squatters around it whereas Changi Airport was once a military airport and half

of the land was recovered from the sea. Consequently, there were no social or political problems as faced in Narita or Bayan Lepas Airports in Japan and Penang respectively. Changi Airport costs about S$1500 million or US$700 million, and Singapore hopes to recover this back in 18 years.

**Airport Atmosphere**

To Prof. Ho Coy Choke's statement that Changi Airport is gloomy with artificial plants, Mr. Peng replied that manpower and high labour costs are major problems in Singapore. These necessitated the use of artificial plants. In fact, only half of all the plants in the Airport are artificial ones.

**Airport Runway**

Dr. Sekaran Nair questioned the compatability of using bitumen for the Changi Airport which he understood required resurfacing every night. Mr. Peng replied that this is not true. However, since the Airport was completed in record time, there is bound to be inconsistencies which require repair from time to time; and in Singapore, repair jobs are normally undertaken at night. There will be a complete resurfacing and restrengthening of the runway next year when the second runway is completed.

**Airport And Employment**

Dr. Annalisa Circerchia said that the building of the Leonardo da Vinci Airport in Rome created 30,000 jobs which is a great social benefit. She would like to know how many jobs were created with the building of the Changi Airport, and where did the employees come from. Mr. Peng replied that Changi Airport has 20,000 employees; and during any peak shift, that is, during the day shift, there are about 12,000 employees present. Most of the employees come from the nearby housing estates such as Marine Parade areas.

**Forecasting For Changi Airport**

Dr. Fong Chan Onn asked how had the projection of the forecasts turned out to be in 1981 as compared to the actual figures in traffic volumes. To this, Mr. Peng replied that the 1975 forecast was much higher and optimistic than what was achieved because of the 1979 oil crisis. However, forecasting is a

continuous process, and new parameters have since been added in for on-going forecasting. This is adjusted once every quarterly.

**Involvement Of The Public Sector Agencies In The Development Of Changi Airport**

Dr. Fong Chan Onn noticed that the public sector plays a very important role in the planning and construction of the Changi Airport as compared to other countries in the region. He asked to what extent would it be better if the private sector were to play a more important part. Mr. Peng replied that it is true that the public sector played a very large role in the planning and construction of Changi Airport. This is because the Department of Civil Aviation is a Government Department under the Ministry of Communications which is in charge of building and planning the Changi Airport. It, therefore, can effectively coordinate all the other Government departments such as drainage, sewerage, electricity, etc. whereas the private sector may not be able to do so.

SESSION 5

## Impact Of Modern Electronics Technology On Women Factory Workers In Malaysia: Some Selected Findings From The HAWA Project

by

Puan Jamilah Ariffin

This paper focuses on the impact of modern electronics technology on the employment conditions of the women workers as well as touching on social and cultural effects.

**The Development Of The Electronics Industry And Its Technological Development:** The technological structure in the electronics industry can be divided into either the high technology capital-intensive production which requires skilled assembly labour, or the labour-intensive assembly line production which employs a majority of female workers.

On account of the nature of the production system which entails refine wire bonding processes, women workers are preferred because of their gender attributes; dexterity, patience, docility, and willingness to be trained. Women are also more suited because of the high labour turnover. Producers prefer workers who are willing to work short periods because it has been found that the workers' productivity declines rapidly after a few years with failing eyesight. Cheap production costs and obsolescence in the home country constitute major factors in the motivation for off-shore sourcing activities of electronics firms; and several firms have relocated the assembly labour-intensive operations to Third World countries which can offer cheap and amenable labour.

**The Impact Of The Technological Requirements And The Characteristics Of The Labour Force:** Almost all factories are either owned by Americans, Japanese or Europeans. This has led to unprecedented employment opportunities for women workers.

About 90% of all employed are predominantly Malay women of between 16-25 years of age who are single, relatively educated and of rural origin. The young are preferred because they are managable; the single because this does not

entail maternity benefits; the relatively educated because they have been exposed to the discipline of education; and women of rural origin because they are easier to manage.

The management imposes strict supervision over the assembly line workers using existing cultural values of acceptance by the women workers of male leadership. The management also subscribe to the beliefs that Malay female workers accept their subservient role and work without complaining.

In order to promote high productivity, the management instills in the workers new behaviour values: individualistic competitiveness to increase output.

Workers are introduced to new forms of culture in their new environments in the way of dressing, and grooming. They participate in excursions and beauty contests.

Overall, the effect is reflected in new modes of behaviours and dressing, following in the American tradition of blue jeans, thick make-up and T-shirts, dancing and dating.

Consequently, factory girls are accorded low social status. The women's way of dressing and westernised behaviours are perceived as an indication of loose morals. Their work at night shifts aggravates and confirms the suspicion of the surrounding community, and deepens the gulf of communication and interaction between women workers and the members of the surrounding community.

**The Implications Of Technological Changes In The Electronics Industry For Women Workers:** Over the last ten years, there have been changes in the technological system from labour intensive to automation. This would have a significant effect on women factory workers. Where there is a shift from labour intensive to technology intensive production, there is a need for more skilled workers. The implication is that assembly line production would be displaced and, therefore, result in retrenchment. However, the study reveals that in Malaysia firms tend to retain some of their workers to mind the automated machines. There are indications to show that women's work conditions have improved.

The other implication is that with automation, more men may be employed than women, as they are considered more suitable for these tasks.

The paper suggests 2 main implications of the research findings:

(i) Technological requirements are affecting the women workers' behavioural and cultural orientations away from their cultural norms towards "multinational companies' culture", and westernization which serves to alienate them from the surrounding and home communities.

(ii) The shift from labour intensive to automated technology has led to a reduction in employment opportunities, particularly for unskilled women workers.

SESSION 5 - SUMMARY

## An Epidemiologic Survey On The Health Aspect Of A Hundred Female Factory Workers

by

Dr. Rokiah Ismail

The paper presents the findings of a survey carried out with 100 female Malay factory workers in 2 squatter areas in Kuala Lumpur to investigate their general health status in terms of their physical, social and psychological well-being. The paper presents 4 aspects of the workers' health status.

**Symptomatology:** The workers of between the ages of 17-38 were examined for various symptoms (Table I):

- for headache: to examine its relationship to problems at work (Table VIII). About 33.3% of the cases were found to suffer from headaches. This was found to be significant. About 18.2% of the cases (Table X) attributed their headaches to visual disturbance and 9.1% to epigastric pain.

- for visual disturbance: or blurring of vision which may be associated with the nature of their work.

- for dysmenorrhoea (period pains): which varied from mild backache to severe pains. 50% of the cases indicated having dysmenorrhoea.

- for skin disease: to find out whether the girls had any hazards from using chemicals that can cause reaction.

**Medical History:** The workers' past history is examined to discern signs (Table II) that may affect the work effectiveness of the factory women.

A routine family history indicates that 97% of the cases has had BCG as a child. There was one case suffering from tuberculosis. The percentage of cases who indicate having had polio vaccine is 38.4%, and DPT (triple/antigen) 30.3%. The statistics are rather low. Without external markers it is difficult to verify and compare these figures. It may be possible that they may have had the vaccines but not know about it.

In terms of family history diseases, 29.5% of cases had parents or siblings with hypertension and 9.5% with asthma. Only 1.1% had a family history of psychiatric illness. In the survey, one girl was found to resort to tranquillisers to help her sleep after every night shift.

**Psychiatric History:** 27% of workers in the sample had problems at work which is mainly related to interpersonal relations with colleagues and supervisors (Table VII). Depression and/or neurosis occur in 10.1% of the cases. Of the cases, 6.1% (Table IX) attributed this to period pains; and 2% to general malaise (Table IX).

**Physical Examination:** The thyroid swelling in 2% of the cases is benign. Hypertension occurred among 2% of the workers above 30 years of age (Table XII).

**Investigation:** Most cases were given full routine checks to establish occurrence of anemia which may relate to general malaise; loss of appetite etc.; stools to find out if there is any worm infestations because the workers have come from rural areas. Chest X-ray because tuberculosis is endemic in Malaysia, and electrocardiogram for chest conditions.

**Conclusion:** The majority of the women workers who were examined were found to be healthy.

SESSION 5 - SUMMARY

## Industrialization And The Squatter Phenomenon In The Kelang Valley: Case Studies Of Migrant Malay Women Workers' Living Conditions

by

Dr. Susan Lee

The paper reports on a case study of the living conditions of migrant women factory workers in the Kelang Valley. The investigation seeks to discover the relationship between industrialization and the squatter problem. The study mainly focuses on case studies.

**Accommodation Facilities Of Women Workers:** Only a small number of terrace houses and blocks of flats constructed by the Selangor State Development Corporation (PKNS) is allocated to the factories and this caters for 20% of the women workers. Because of the limited allocation, the factory management decided to limit the eligibility for flats only to workers with at least one year of seniority to ensure job commitment. Hence, fresh migrants are left stranded, as seen in the 80% of the workers who reside in squatter areas, usually within walking distance.

**Difference Between Squatter Areas And Non-squatter Areas:** Non-squatter areas for workers mainly comprise high rise PKNS flats which have electricity, pipe water and toilet facilities. For most parts, there are no problems with flooding, sanitation, security and other problems associated with squatter areas.

In contrast, squatter areas lack electricity and pipe water. Water is got from public standpipes which constitute a cause of perennial dissension among users. The squatter huts are wooden with no drainage; no safe play area; and is often flooded.

**Alternative Arrangements For Accommodation:** The failure of factory management and public agencies to take responsibility for the migrant workers' housing needs has thrown the burden on to the surrounding squatter communities. Several alternative arrangements utilized by the squatters are, namely:

(i) Workers reside with relatives who occupy PKNS flats or terrace houses near to the factories. This often in exchange for

domestic help which they provide during their leisure hours. This practice has left them with little time for recreation.

(ii) Workers rent rooms from PKNS residents. However, exploitative practices among landlords are common, as they are charged more for the room than PKNS charges for an entire flat.

(iii) 10 to 20 factory girls join together to rent two or three room PKNS terrace houses. This entails overcrowding.

(iv) Co-residential groups of 2 to 6 workers share smaller squatter huts.

In the final analysis, non-squatter low cost housing like PKNS flats is in short supply, more expensive and entail a greater degree of crowding than alternative squatter housing. Migrant workers' friends and relatives are more likely to reside in squatter settlements rather than in PKNS dwellings or other non-squatter housing. For this reason, seeking accommodation with friends or relatives often implies becoming a squatter.

**Squatting As A Strategy Of Adaptation To Urban Life:** Workers find squatting more effective for various social and economic reasons such as:

(i) economic reasons as exemplified in their frugal self-supporting status, and consequent ability to remit 44% of salary to parents.

(ii) accumulating sufficient cash to acquire consumer goods such as cabinet, wardrobe and dishes.

(iii) social process where the worker is encouraged to share a squatter hut with siblings or friends.

**Quality Of Life In Squatter Settlements:** Through squatting with relatives and friends, the women workers aspire to minimise the urban cost of living and, thereby, increase their purchasing power for consumer goods such as TV, radios and electric fans. However, this does not happen in reality. Their aspirations to acquire amenities and enjoy a sense of improved quality of life are not

easily attained. Factory workers find great difficulty in accumulating sufficient savings to purchase household amenities as radios and pyrex sets. There is little or no tangible evidence of the higher living standards which industrialization promises.

**Policy Recommendation:** The failure of factory management to take responsibility for the workers' housing needs has resulted in overcrowding in squatter areas in the vicinity of the free trade zones. It is suggested that the provision of hostels for factory girls would alleviate the strain on the local housing supply and relieve the extreme overcrowding in the squatter areas. Providing workers with hostels would also protect them from the exploitation of landlords, the effects of undesirable social influences, and health and safety hazards.

## SESSION 5

## DISCUSSION

### New Values In The Subculture Of The Factory Girls

Dr. Firdaus Abdullah asked Puan Jamilah Ariffin concerning the new values which have emerged as a result of the influence of multi-nationals in the electronics industry. He inquired whether the factory girls have abandoned their original subservient behaviours.

Puan Jamilah Ariffin pointed out that the multi-nationals have not changed the girls' behaviours radically. She illustrated that the traditional goals of these girls are still predominant. Some of these predominant goals are getting married, getting a good husband and helping to supplement the husband's income.

### Factors Which Have Attracted The Multi-nationals To Malaysia

A question related to the above was asked by Dr. Fong Chan Onn and was answered by Dr. Susan Lee and Puan Jamilah Ariffin. They pointed out that the important factors which have attracted multi-nationals to Malaysia are cultural factors with particular reference to its women who are known to be docile, easily trained and whose expectations are not too high.

Other factors included the availability of a good infrastructural network and such facilities as tax holidays. Many workers are also English educated, and the environment is receptive to English.

Another factor relates to the Singapore industrial experience which has spilled over to Malaysia. One can think of the transfer of technology from Singapore through migrants and through the relocation of many electronics industries from Singapore to Malaysia.

### Reaction Of Multi-nationals To Research Efforts And Findings

Dr. Sekaran Nair asked about the response of multi-nationals to research efforts concerning the factory girls. Dr. Susan Lee indicated that the multi-

nationals at the beginning were cordial and cooperative. However, when the findings were published they became more distant and uncooperative.

These findings cast unfavourable aspersions on the meagre contributions of the multi-nationals to the solution of the problems of the girls, particularly with the housing problem. As such, the multinationals reacted by being defensive. Access to the girls and factories became more difficult towards the later part.

**The Orientation Of The Multi-nationals**

Prof. Yoshihiro Tsurumi remarked that the multi-nationals should not be expected to solve all the problems with reference to technological innovation and worker welfare.

He indicated that the multi-nationals are at a disadvantage due to distance and increasing labour costs. These may affect adversely their competitiveness. The paramount concern of the multi-nationals is to maintain a reasonable margin of profit because of their commercial concerns and goals. He further reiterated that the multi-nationals are not political and welfare bodies.

Consequently, it may be unreasonable to expect them to solve wide ranging problems which span worker welfare or environmental problems. Following this line of argument, he also emphasised the importance of the role of government policies towards the solution of the technological and human problems. These policies are significant ways of influencing the private sector, in particular the multi-nationals to be more sensitive to the needs of the workers and the problems of the environment. The private sector response, however, is limited by the fear that their competitive position might be eroded. The multi-nationals may be more concerned with measures to husband their resources carefully, especially to promote their desired standards of productivity and profitability.

SESSION 6

## The Language Of The Female Factory Workers With Reference To Dialectical Change And Code Creation : A Case Study

by

Dr. Nik Safiah Karim

Nuwairi bin Haji Khazaai

The paper reports an on-going research which studies the nature of the language used by Malay female factory workers (Mffw) in the industrial areas of Malaysia, especially in the Kuala Lumpur-Petaling Jaya industrial area. The Mffw, a new phenomena in the Malaysian society brought about by industrialization and factories, originate from various parts of the country and have been speaking different dialects characteristic of their places of origin.

The purpose of the study was to explore the nature of the language used among the Mffw, both within and outside their working environment pertaining to dialectical changes, if any; and code switching and creation, in their everyday language.

The methodology used was that used by Labov (1966), known as the anonymous interview technique which required the researchers to observe and/or tape record conversations of the Mffw without their knowledge. This was followed by the second stage of the study which consists of formal interviews recorded on tape. Fieldwork was done mainly in the Kuala Lumpur - Petaling Jaya industrial areas, with some support data from Ipoh, Senawang and Kota Baharu industrial areas. Results reported here were mainly analysed from the data of the anonymous interview technique.

The findings of the research can be summarised as follows:

(i) With regard to general communication "language", there was an attempt among the Mffw to speak the "standard variety", thus deleting differences in pronunciations, especially in the pronunciations of vowels /e/ and /o/; the pronunciation of vowels /ə/ at the end of words instead of /a/, /ɔ/ or /ɛ/, as well as consonants /r/ and /l/. Sentence construction was also

found to be simple and easily comprehensible, again demonstrating a tendency towards the standard variety.

(ii) With regard to aspects of their working environment, it was found that the Mffw indulge frequently in "code switching" (alternate use of more than one language in one sentence construction). The words commonly used were English in origin, and they characterise the work situation, such as "production", "quality" and "schedule" among others. They include as well pronouns not commonly used in Malay, such as "then" and "so".

(iii) In addition, it was also found that the Mffw constantly create codes, which could either consist of original Malay words, English words, or a combination of both, into phrases or words which denote a new meaning unique to themselves, e.g. "hot" meaning "angry"; "Mat spanner" meaning "male factory worker".

In conclusion, the paper highlights the interesting phenomena of language usage of this new group, Mffw, in the Malaysian society. It demonstrates an inclination towards "being standard", both in order to communicate among themselves, as well as adapting to a mode of communication which is unique to themselves as a group.

# International Environment For Technological And Cultural Exchange In Asia

by

Prof. Mineo Nakajima

Professor Nakajima introduced the paper by putting forth ideas which comprise opposing views with regard to the possibility of technological and cultural exchange in South East Asian countries. They are especially with reference to the possibility of Japan exporting her technology and culture to South East Asian countries.

In the context of the present "cold war" between the super powers of the world, namely China, USSR and the United States of America, the Asian region is inevitably in the midst of those far-reaching interactions. However, the third world countries in general, and the Asian region in particular, are no longer easily exploited. On the other hand, international inter-dependence is expected to increase. At the same time, this very inter-dependence will result in aggravated tension and friction, due to increased awareness of cultural differences between the nations. However, this increased tension and friction will require effective prescriptions to weather the crisis and to survive. The urgent need is for mutual understanding. There must be an approach which would avoid exclusive nationalism and sectionalism, but instead promote bilateral and multilateral cooperation, especially in the field of economics.

The Asian and the Pacific Region will be very prominent in the 1980's, 1990's as well as the 21st Century. The cooperation in the Pacific region is a necessity. It will be both fascinating as well as problematic, due to the diversity and complexity of the member nations. But it can be the avenue for international peace, as it can counteract the effects of the "cold war". This process must not be expected to be realised immediately. It needs time, and a step by step approach towards international understanding and cooperation is needed. It must be a movement in the direction of prosperity and stability in the region. However, it has to contend with the problems of basic realities, such as differences in cultures, political priorities and national aspirations. There seems to be too much diversity and differences in the region. In addition, there is the added "shadow" of China. While the dominance of China is recognised by all, attitudes toward it differ. While Japan looks upon China with a feeling of intimacy and regards it as her "cultural home", the other

## SESSION 6 - SUMMARY

Asian countries look upon China with apprehension and with a fear of threat, especially in view of the many local Chinese in their own countries. Hence, there must be a full and better understanding between all the nations. Cooperation must and can be achieved. There must be concerted effort on the part of all nations involved, taking seriously the realities of their problems and differences with an ultimate vision of coexistence and cooperation.

In this respect, and in view of Japan's technological supremacy, Japan should endeavour to solve the problems relating to cultural and technological exchange with Asian countries. As a step towards this, an intensive "area study" with an aim to understand nations in the area, both to facilitate smooth exchange, as well as to clear away barriers of cultural differences between the nations must be made. This should enable each nation to look and appreciate the cultures of "other" nations and understand them. This will be the beginning, or "take off" point for eventual cooperation, which will then be followed with liberalisation of trade in agricultural products, and development of energy intended for the benefit of developing nations. While technological transfer is being emphasised, harmony between technology and culture as well as between local history and traditions in the face of technological development will be made possible. The result will then be wealth and development in the Pacific Region. Japan, on the other hand, must not fail to meet the expectations of the Asian nations, since within the last few years its image has greatly improved in the latter's eyes. It should take the lead in this effort to create deep rooted understanding between nations, by firstly understanding, and then coming to terms with the realities of their problems and complexities. This will then enable Japan to acquire a sense of realism in her recognition of Asia.

In summary, Professor Nakajima proposes that technological and cultural transfer between nations in the Asia and the Pacific region is possible though difficult. It needs a serious and concerted effort for international understanding and economic cooperation. This should eventually result in total cooperation and coexistence. The lead should, however, be taken by Japan to export its technology and culture to South East Asia.

## Adaptive Wage Incentive System

by

Prof. Gregory T. S. Thong

Professor Gregory Thong posits that contrary to Herzberg's (1960) thesis, money was found to be a motivator among factory workers in Malaysia. Findings of case studies in several factories from four industries, namely food products, timber products, electronics and non-metallic products, were reported. They have adopted the Wage Incentive System (WIS) successfully. The companies were earlier identified through a survey of 43 companies located in all the industrial areas of Malaysia.

**Food Products Industry:** Two companies, namely the food canning and bottled drinks factory, were using the WIS. Both reported success in terms of increasing worker productivity.

In the fruit canning industry the company studied employed about 700 workers, 60% of whom were women. The nature of the raw products required that they be processed immediately on the day they were brought in. Supply, on the other hand, was subjected to seasonal fluctuations. Hence, production rate could not be constant. Direct production workers needed to work according to supply of raw products. WIS was adopted in 1947. Incentives were calculated on the production of groups of workers above the standard rate, calculated by the company. Allocations to individual workers were made on a point system, whereby each worker was rewarded according to the ratio (based on the points allotted to each worker), of each worker to the group total. The system was reported to be highly successful. Each worker secured more pay during the peak season, and was satisfied with lower wages during the off-season. The system was further adaptive in that incentives for a year used as a measure officially approved leave days of the following year.

The bottled drinks factory researched employed about 700 workers, 80% of whom were women. Demand for the products of the factory far exceeded normal supply, especially during the festive season. Because the factory is located in an urban area, there is no room for expansion. Hence, there was a need for faster production and faster delivery to buyers. Both the direct production workers, and the delivery crew were on the WIS. The adpative WIS was only applied to the delivery crew, which covered 80% of them.

SESSION 6 - SUMMARY

The system incorporated the feature of incentive paid for time saved. Rates were calculated for time saved in terms of loading, unloading, travelling, including incentives for trips made in bad weather. The system was successful not only in terms of faster and more efficient time utilisation, but better cooperation among the crew also resulted.

**Timber Products Industry:** The WIS adopted by the three companies investigated was known as the "Pok Chow", whereby work was given on a contract basis to groups of workers. Incentive was paid based on output by the group. In-group arrangement was made by the group, and there was bargaining power with the company. Incentives paid were based on monthly productivity rate, and a 27% premium was added to after a certain target was met. Night shift workers were paid 50% higher. The success of the system was reflected in the average earning of each group member which ranges between $1,251 to $2,393.47 per month.

**Electronics Products Industry:** The company studied employed about 2,700 workers, 90% of whom were women. The adaptive WIS was adopted for workers in the bonding section of the integrated circuits department. This applies to 48% of the workers in the section. WIS was introduced as an effort to attract workers to work in wirebonding, which was unpopular due to belief that there could be loss of eyesight due to eyestrain in using microscopes. WIS here worked on the basis of incentives given to workers achieving 100% efficiency. Increments were given for efficiency above the incentive point, and these were calculated on a progressive rate of y, 3y, 6y, 9y, 14y cents an hour, for every increase of 5%. For efficiencies above 30%, they were paid a flat rate of 22y cents an hour. After a month's implementation, 10% of the workers were receiving incentive earnings, and after a year 30% of the workers qualified. As a further incentive, the company identified "high", "average", and "low" production workers with different coloured flags. The company found that with the WIS, they were not required to employ more workers in times of peak production, or "lay off" workers in times of recession. They could not only maintain production according to demand, but they also gained the reputation of being steady employers.

**Fabricated Metal Product Industry:** The company studied adopted a piece rate plan adaptive WIS to cope with an unusual and temporary need for high production to meet contract demands. To save costs of training workers, and the necessity of increasing workers for a temporary situation, the company adopted a piece

rate system whereby workers were paid incentives for the work done after the first batch was produced. At the end of 18 months, the company was able to supply the unusual demand, at no extra cost of training or increase in labour.

Another adaptive WIS was the indirect WIS, introduced to reduce absenteeism and tardiness. Penalisation was done by non-eligibility for bonus if a worker is absent more than a day in a month, or late more than three times. Leave taken over a certified number of days, even though approved, will also result in non-eligibility for bonus payments. The rate of bonus payments varies between companies. One company paid 5% of total earnings as bonus for a month; another paid a flat rate of $5 for a perfect attendance month, while yet another paid a progressive rate of $4 for a period of 7 days continuous working, $9 for a 14 day continuous period, and $15 for 28 days in a month.

In the plantation industry, a price bonus system was adopted whereby workers were not only paid incentives tied to production but a further incentive tied to market price of produce.

**Conclusions:** All the WIS cited show similar characteristics of adoption for satisfaction of specific demands of industries, and non applicability to all workers. All succeeded in achieving what the companies expected the system to deliver.

## SESSION 6

## DISCUSSION

### The Importance Of Studying Language Among Factory Workers

In answer to a question by Dr. Annalisa Circerchia, it was emphasised that studying language among the Malay female-factory workers, was an avenue to understand the sub-group (Mffw). Language reflects their thoughts, manners and way of life. This sub-group and its subculture is growing in importance to the society as a whole, by the very fact that the Mffw form a very big group in the new Malaysian contemporary society. That this sub-group is a new phenomenon, and directly linked to technological development of Malaysia (i.e. growing industries and growing number of industrial workers), must be considered in terms of societal problems and the efforts towards solving them. To understand them (in this case through their language) is the first step towards solving their problems.

### Dialectical Change And Change In Values

In response to Dr. Susan Lee, Dr. Nik Safiah reiterated that the fact that the study found a dialectical change among the Mffw, i.e. from the local variety to the standard variety does reflect a value change among the group. More specifically, they are changing towards being "the same".

Royal Prof. Ungku Aziz added that their language reflects their value change. This can be observed through the written language, vis-a-vis magazines printed and produced to capture the new "market" of readers which is the Mffw. Contents as well as language style reflect a change in their way of life and values. These bring forth their difficulty in handling new situations and expressions (such as "I love you"), or the use of the word "relax", which are foreign in the traditional culture. Both examples reflect a new phenomena - freedom of expressions, and the need to relax, a phenomena probably brought about by technological transfer which has affected their way of life.

**Emergence Of Subculture**

Prof. Yip Yat Hoong commented that the emergence of this subculture, is a phenomena which characterise all migrant groups. To this Dr. Nik Safiah agreed. However, it was emphasised that within the Mffw, this phenomenon is more prevalent due to the nature of their jobs which require them to interact and communicate in an informal manner. Because the situation is informal, they could choose to retain their local dialects, but they developed a common dialect taking on the characteristics of the standard variety.

To a question by Dr. Monoru Kobayashi, Dr. Nik Safiah agreed that the resultant language variety among the Mffw was due to the need to communicate among themselves, but at the same time to develop a group identity.

**Wage Incentive System And Quality Of Work**

In answer to a question by Prof. Masaki Koshi, Prof. Gregory Thong reported that the success of the Wage Incentive System (i.e. greater productivity of workers involved) did not result in a drop in quality of products. The study found that in considering the wage incentive system, quality was always a factor. The system not only ensured production increase, but also greater cooperation among workers in some factories studied.

**Technological Changes In Response To Social Problems**

Prof. Massimo Rendina commented that studies have found that technological advancement has created prototypes transferred to other countries, and these (prototypes) have resulted in processes of "robotisation". This could well be a response to social problems such as shortage of labour in the electronics industry. Prof. Gregory Thong reiterated that the results of his study was not limited to electronics industry alone. However, the major industry was electronics due to the fact that it is the biggest involved in technological transfer in Malaysia.

**Possibility Of Technological Transfer Through Inter-cultural Exchange**

In response to Dr. Alfonso Alfonsi, Prof. Nakajima stressed that although there are currently two opposing views on the possibility of transfer of

technology, particularly from Japan to other Asian countries. He believes that it can be done, though difficult. There must be a commitment, especially on the part of Japan. Appropriate measures must be taken to bring about understanding and inter-cultural cooperation between the nations involved, taking into account the reality of the situation. Then technological transfer will result. The universal elements in Japanese success could be emphasized. This could minimize or overcome cultural barriers in inter-cultural communication for the transfer of technology.

## SESSION 7

### Resistance To Technology Transfer: Remarks On Cultural Dynamics

by

Prof. Giancarlo Quaranta

In summarizing his paper, Prof. Quaranta made the following points:

(i) There is a need for fresh thinking on the concepts of technology, culture and development so as to bring about "new and operationally fruitful definitions".

(ii) The development experiences he observed in several countries in Africa, America and the Middle East convinced him of the urgency of such a need. Programmes introducing new technology in these countries have evoked resistance to them in an impressive manner basically because the human and cultural aspects of these programmes were never given due cognizance.

(iii) Two theoretical models were proposed as useful for explaining possible resistance to the introduction of new technology. The first model entails the application of the theory of living systems. This model suggests that a technological transfer could cause either a resistance ("a positive feedback"), on the part of the cultural system receiving it, or acceptance or absorption ("a negative feedback"). The second model is based on the new theories of evolutionistic structuralism. It conceptualises man as having to deal with two environments, the "operational environment" and the "cognized environment". The former refers to the relationship of man with his environment in connection with his survival while the latter is mainly collective and mental (i.e. the human aspect of the man - environment relationship). If an intended technological change takes account of only the "operational environment" without due regard also to the "cognized environment", resistance to the change is bound to be encountered.

SESSION 7 - SUMMARY

## Development Of Ingenuity In Engineering Education

by

Prof. Toshiro Terano

In his paper, Professor Terano called for efforts to develop creativity in various fields. He discussed as examples the courses given by the Control Engineering Department of the Tokyo Institute of Technology which were principally aimed at developing creativity among the students. In these courses, the students were trained to work in small teams to prepare engineering designs to deal with given problems and to present discussion papers on them. At the graduate school of the Institute, the students were, in addition, required to manufacture actual units based on their designs. The experience has brought forth very good results. He further stressed that much creativity could be stimulated from students if only appropriate initiative is exercised by their teachers and the obstacles hindering creativity within the education system are removed.

# Impact Of Japanese Investments On Economic Development In Malaysia

by
Dr. Lee Poh Ping
Dr. Chee Peng Lim

The paper by Dr. Chee Peng Lim and Dr. Lee Poh Ping discussed the impact of direct Japanese investment in Malaysia. The writers highlighted the following findings:

(i) Japanese enterprises in Malaysia accounted for only a small proportion of total employment. Furthermore, these enterprises were rather capital-intensive.

(ii) These enterprises have extensive training schemes for the local workers, especially training schemes located in Japan with the parent companies or machine suppliers.

(iii) Subcontracting, though a common practice in Japan, was not much in evidence in respect of the Japanese enterprises in Malaysia.

(iv) The transfer of technology through Japanese enterprises in Malaysia mainly took the form of transfer of machinery and equipment and skills. In this connection, Japanese machinery and equipment were found to be commonly used by the Japanese enterprises.

## SESSION 7

## DISCUSSION

### Creative Education

Professor Terano's description of the courses aimed at fostering creativity among the students of the Control Engineering Department of the Tokyo Institute of Technology raised some interest. Prof. Y. Tsurumi highlighted two aspects of the courses which were recognized as being useful and beneficial, namely:

(i) the students were trained to work as a group towards a shared goal; and

(ii) the courses involved learning by doing.

Prof. Y. Tsurumi observed that similar schemes were noted to be available in the United States for the training of business executives. It was felt that the principles underlying these courses could be applied with benefit to the training of groups other than engineers such as business executives and policy-makers. These training efforts for groups are in the context of achieving greater co-operation, communication and exchange of ideas.

It was also agreed that creative training schemes based on learning by doing could assist technological transfer, particularly in areas of maintenance of machinery and equipment or the adaptation of these to the local situation.

### Mass Training Of Workers In An Enterprise

Prof. Y. Tsurumi made a reference to the paper by Dr. Chee Peng Lim and Dr. Lee Poh Ping on the mass training programmes provided by enterprises with Japanese capital participation in Malaysia. These programmes involved sending a broad spectrum of workers, particularly the key personnel, in such enterprises for training in Japan. Both Dr. Chee and Prof. Y. Tsurumi pointed out that such training programmes were more characteristic of Japanese enterprises, and have proved beneficial to the host countries. However, it was also remarked that these programmes would be most appropriate in situations where life-long

employment is widely practised. Dr. Chee explained that in Malaysia where labour mobility from enterprise to enterprise can be high, the Japanese investors are increasingly finding such training programmes costly and are now attempting to modify them.

**Preference Of Japanese Enterprises For Japanese Machinery And Equipment**

Prof. Y Tsurumi drew attention to one of the findings of the paper by Dr. Chee Peng Lim and Dr. Lee Poh Ping which indicated a general tendency for enterprises with Japanese capital in Malaysia to use only equipment and machinery manufactured in Japan. The participant argued that such a practice was by no means common only to Japanese enterprises but was also widely followed by other foreign investors who imported machinery and equipment from their own countries. More important, he urged that this practice should not be viewed merely as a nationalistic bias. Familiarity with the machinery and equipment to be used should be considered an important requirement for achieving efficiency in production and for the proper maintenance of these machinery and equipment. Furthermore, it was felt that such familiarity should facilitate the transfer of skills to the local staff who would eventually take over from the expatriate staff.

**Application Of Systems Engineering**

Prof. B. Grassetti commented that the application of systems engineering in Italy for training managers in the field of technology transfer has not been without limitations.

In turn, it was pointed out that possibilities exist for this system approach methodology to be applied to produce a self-organizing system, as in the case of living bodies which could grow or repair themselves; or which can be up-graded; or which can be interactive with feedback. This could overcome some of the limitations noted.

Prof. Terano agreed with the comments, and he suggested that the system engineering approach aims at achieving an adaptable, organismic and dynamic system in relation to the challenges and needs.

## SESSION 7 - DISCUSSION

### New Technology: Resistance Or Acceptance

In response to Prof. B. Grassetti's comments about the limitations of the systems approach in training for purposes of transfer of technology, Prof. G.Quaranta referred to his paper for new technology not to be treated as a mere "material object" or "thing" but as a cultural system in itself, as prompted by the many cases of resistance in Africa to technology transfer raised the comment that elsewhere, as in Singapore and Taiwan, new technology has been viewed as a "thing" but yet there have been no resistance encountered. In elaborating his reply, Prof. Quaranta urged that such cases of easy absorption of new technology could also be easily explained away by the theoretical framework proposed in his paper. According to this framework, there could be two possible reactions from an existing cultural system in the event of a technology transfer - a "positive feedback" which involves the cultural system rejecting or resisting the new technology or a "negative feedback" which involves the cultural system absorbing the new technology. Examples of the successful absorption of new technology fall within the category of the second type of reaction. It is the possibility of encountering the first type of reaction (the "positive feedback") that necessitates the fresh thinking he advocated.

Prof. Quaranta again emphasised that successful transfer of technology involves the meeting and interaction of living cultural systems.

### Appropriate Technology For Less Developed Countries

Prof. M. Rendina expressed concern that the types of technology usually transferred to developing countries have been those that were relatively simple and of the kinds easily taken up. The electronics industry in Malaysia was cited as an example. Major activities in this industry entail simple processes of putting together components into final products, all located within a small area. With further advances achieved in technology, it was feared that the already large technological gap between the developed and developing countries could even widen, especially if the developing countries were just assigned these simple and mechanistic tasks.

Comment was, however, made that low technology is not necessarily the most appropriate technology for a developing country. Prof. Quaranta stressed that what is crucial is whether a particular technology is acceptable to a receiving

cultural system. There have been cases where low technology has been resisted against in developing countries for some reasons. On the other hand, high technology has been found acceptable even in developing countries because it has been compatible with the receiving culture. It was further pointed out that it would be difficult to foresee whether a new technology would be accepted or not.

**Cultural Resistance And Role Of Research**

In view of the possibility of cultural resistance to a new technology, Dr. A Alfonsi felt that research bodies and the universities could make a useful contribution. They could study and analyse how such cultural resistance could be overcome and thus mediate between the inputs from outside and the cultural system. He also pointed out that transfer of technology need not result in destruction of a cultural system, but could result in a new synthesis of the new and old.

**Technological Transfer And Technological Change**

In view of the importance of technological transfer, Mr. M. Kobayashi called for its meaning to be clearly defined and also for it to be distinguished from mere technical transfer.

Prof. Terano explained that this needed distinction between technology versus technical transfer is related to issues of mere imitation or creative adaptation in the achievement of objectives. He preferred to view these levels as hierarchical.

Dr. Chee clarified that technical or technology transfer is multi-level, namely as in buying a car; driving it; manufacturing it; and finally, adapting it for the manufacture of a new car.

Prof. Quaranta reiterated that transfer of technology and the changes spawned by it, could result in an integration of the traditional way of life and the new. He cited the case of the Navajo where the use of computers was interwoven into the fabric of traditional life patterns. This according to him is the measure of technological acceptance or acceptance of technological change.

## SESSION 8

### Research Towards The Development Of A Pharmaceutical Industry In The ASEAN Region

by

Prof. Ho Coy Choke

Dr. Chen Yee Foong

Dr. Tan Eng Lee

Miss Tan Kit Ping, Irene

Mr. Lim Kim Hock

The paper reviewed the scope and future development of industrial antibiotics fermentation industries in Malaysia. Malaysia needs to develop a high level of competence in research and development in biotechnology covering the disciplines of biochemistry, chemistry, genetics, microbiology, molecular biology, pharmacology and biochemical engineering in order to be able, firstly, to run fermentation plants for production of antibiotics for worldwide sale, and secondly, to develop new areas of research and development leading to the discoveries of new antibiotics and other pharmaceutical drugs which could be patented and produced locally.

From the preliminary results that were obtained from the research it seems very likely that agricultural raw materials and byproducts like palm oil and palm kernel meal which are produced abundantly in the ASEAN region will have the quantity, quality and consistency to provide raw materials for some antibiotics fermentation. It is hoped that this will provide a new outlet for the palm oil industry.

## Urban Planning And Transportation: Japanese Experiences Towards A Motorized Urban Society

by

Dr. Katsutoshi Ota

The paper discussed the problems and experiences of the Japanese motorized urban society. Their motorization was preceded by private decisions of owning and using car with little direct public interventions. The selective motorization as illustrated by the lower car use in large metropolitan areas is not the result of deliberate policy to contain motorization.

Although motorization provides for improved mobility for many who can afford the car, it has at the same time brought about difficult problems like environmental pollution and the transportation problems of the poor.

The provision of an adequate road network to keep in pace with motorization is another difficult task. The poor condition of the Japanese urban road is partly a result of the lack of an integrated transport/land use planning. Land use control, development control and other legal measures have been introduced for better urban expansion. But they have limitations to produce an urban area with an adequate road network. It is found that a land readjustment program is one of the most effective methods to solve this problem.

In developing countries, severe resource constraints will make it difficult to provide an efficient road network to meet with the rapidly increasing auto-explosion. In this context then, one should seriously examine the concept of selective motorization, or the demand management of car traffic through, for example, intensive urban development along transit corridor, traffic restraint, and traffic system management. The promotion of low-cost and convenient public transport modes including locally generated paratransit is, especially, important since car ownership is limited to those in the higher income groups.

SESSION 8 - SUMMARY

## Utilization Of Dried Palm Oil Mill Effluent: Present Status And Future Potentials

by

Dr. A. A. Ravoof

Dr. J. B. Sutanto

The paper highlighted that raw palm oil mill effluent is the environmentally disastrous high BOD/COD liquid waste ( < 5.8% solids ) that is generated daily by more than 150 mills producing crude palm oil throughout Malaysia. Of these, twelve mills in Peninsular Malaysia are currently producing about 12,000 tons of solid dried POME ( > 85% solids ) from viscous clarifier effluent (15% to 18% solids) harnessing waste boiler heat based on the recently developed United Plantation - Humbolt Wedag Decanter/Drier System. This dried POME has been tested as a source of organic fertilizer and as an animal feed with encouraging results.

Although dried POME is non-phytotoxic and is rich in organic matter and plant nutrients, the nutrient levels are neither balanced nor readily available when applied as a fertilizer. Problems encountered with dried POME as an animal feed include product variability, high ash content and short shelf life. The paper discussed the present status of the usage of dried POME as a fertilizer and as a feed concentrate. In addition, the future potentials of POME through technological improvements and process modifications; biological pre-treatment such as composting, fortification with chemical fertilizers to correct nutrient imbalances; production of 'custom-made' fertilizers and the development of techniques of aggregation and stabilisation of sandy soils; and the development of cheap but nutritive and acceptable animal feed concentrate were discussed.

## SESSION 8

## DISCUSSION

### Fermentation Process In Production Of Antibiotics

With reference to Prof. Ho's paper on the use of agricultural waste, especially as raw materials, to act as a medium for antibiotics fermentation, Prof. Das queried whether:

(i) the presence of metals is critical for the fermentation process, and if so what are these?

(ii) in the fermentation process, is there any co-production of compounds that are in fact carcinogenic?

In reply, it was stated that the presence of metals such as zinc and iron are essential and that in the fermentation process there is in fact a co-production of compounds that are carcinogenic and, as such, caution had to be exercised.

### Agrobased Effluent

With reference to Dr. Ravoof and Dr. Sutanto's paper, Prof. Das queried the suitability of agrobased effluent as a growth media. In reply, it was stated that fresh liquid POME at 50:50 dilution with water has been found to be an excellent medium for the growth of certain fungus. It is just as good or even better than commercially available growth media.

### Dissemination Of Information To Farmers

On the recommendation of Dr. Ravoof and Dr. Sutanto for the use of agriwaste as fertilizers and as feed concentrates, Prof. Tsurumi enquired as to the methodology they would suggest for the effective transfer of the findings and the spread of the information to farmers, who in the first instance are conservative or resistant to new technology, and at times even suspicious. Two examples which are illustrative are firstly, the slow acceptance of Napier grass as an animal feed; secondly, the continued wide use of the cast-iron water pipes

which illustrate that economic factors, personal gain and comfort do influence acceptability. The reaction was that initially, resistance should be anticipated for anything unusual such as agrieffluent functioning as animal feed and fertilizers.

**Issue Of Controllability Through Management Systems**

In trying to work out a systems approach for the transfer of technology in the domain of traffic problems, an interesting philosophical discussion was initiated by Prof. T. Terano on the following systems, namely:

(i) man-nature system;
(ii) man-machine system; and
(iii) man-man system

It was agreed that the more open type of system is the most difficult to control. The movement in this system is complex, and often man loses control because of its complexity. In such a situation, man is unable to forecast the outcomes to desired levels of accuracy.

Prof. B. Grassetti remarked that the man-man system is where the potential of transfer of technology is greatest, for example, in the use of antibiotics, fertilizer etc. There is room for control here since the factor of management or factor of controllability is dependent on the ability to predict the outcome. The problem here is to formulate appropriate policies and to provide the correct incentive for them to be convinced of the use of the technology. At the same time, there is the need to protect the existing system, for example, in the agricultural sector. This would require complex knowledge of the content, an interdisciplinary methodology and resources to conduct research, and an opportunity to carry out experiments. In this system the problem-solving approach should be used with caution since it needs only one failure for the system to be rejected.

**Problems Of Communication In the Transfer Of Technological Innovations**

Dr. T.K. Mukherjee suggested that for positive results, the transfer of technology has to be approached in two stages. The first is to motivate the recipient to adopt the technology; secondly, there has to be education on the

specifics of the technology involved in a social setting where problems such as poverty, ignorance and laziness coupled with myth and tradition exist. There is a need to convince the recipient of the benefits of the system in simple terms and not in complicated cost-benefit long term economics. Failure in this respect can be associated with poor communication on the specifics of the technology, and the lack of effective demonstration concerning the practicality of the technological innovation.

**Acceptance Of Technological Innovation And Involvement**

Royal Prof. Ungku Aziz commented that for the acceptance of technological innovation and for the involvement of farmers in its use, there must be effective communication and persuasion. There is evidence of the acceptance of technology as seen in the use of nylon nets in fishing and the use of motor-cycles even by women in rural areas. Thus, acceptance can be related to the degree of the benefits one sees in the innovation. This benefit is often perceived as improvement in their lives or in increased incomes; relative to the costs involved.

Dr. Mukherjee in support of this added that any hope for acceptance has to be substantiated in practical terms. The use of technology, such as in the rearing of goats, has to be demonstrated under both laboratory and field conditions. In this respect, extension education programmes in farming techniques are important to demonstrate to the farmers procedures that will ensure positive results when they actually implement it on their own.

## SESSION 9

### Technological Revolution In Mass Communication Media

by

Prof. Massimo Rendina

In this paper, the focus was on the technological revolution in mass media via telematics which has enabled the spanning of national boundaries, language and cultural barriers, with very wide-ranging and important repercussions on society and its way of life. Recent and future development in the field of mass communication were identified and their implications discussed; illustrations were drawn, especially from Europe which has been much influenced by the American experience and America's role as the leader in the global communication system. Among the trends surveyed was the growth of a centralising or modular system capable of global coverage serving various levels of users through cable communications and direct broadcasting satellite systems. While stressing the very complex and changeable situation in regard to the state of technological development in the mass media, Professor Rendina touched on various issues which included the prospect of largest broadcasting centres monopolising audiovisual consumer markets; the manner in which the media could and are being exploited by the consumer, ultimately the recipient and decision-maker of the choices offered by the communications system. In particular, the development, actual and prospective use of the television set as an intelligent terminal and multifunctional equipment was examined, as well as the sophisticated modes of linkages between television, computer and telephone systems, enabling the transmission of voice, data and images. Highlighted also were problems of programme development suitable for a heterogenous and international audience, and especially the anticipated growth in demand for video programmes stemming from the technological revolution in broadcasting. Reference was also made to very disparate levels of development in the mass media between developing and developed countries. In addition, the former have been subject to the lopsided flow of information concentration from Western countries dominant in the field of news dissemination and broadcasting at the expense of other countries which are being culturally influenced by the media, especially advertising, originating in the West. Only a minority living in industrialised countries enjoy freedom of information flow. The world information network also appears to be indispensable to the economic position of multinational corporations concentrated in the United States. Cultural and economic domination is thus

occurring through the media, with unequal access for those living in countries with restricted freedom of communications. Finally, reference was made to the educational implications, effects on cultural processes and behaviours from telematics as a system.

**Technology Transfer And Dynamism In Technology Education In Japan**

by

Dr. Takeaki Shimizu

The paper, presented with the aid of slides of graphs, examined the adoption over time of western technology by Japan in its industrialization and industrial development, focusing especially on technological education. The needs of Japanese society at various stages since the Meiji Restoration period to the present day were outlined, as also the kind of responses by the educational system in providing particular types and levels of training. Altogether six periods were identified; from 1868 to 1900, a period marked by the introduction of science and technology; from 1901 to 1914, the stage of early heavy industrialization; from 1915 to 1945, a period when Japan attempted to compete with the advanced industrialized countries, by developing domestic production of major industrial products and by improving on the efficiency of its technology; the period from 1945 to 1955, industrial reorganization and reconstruction and emphasis on mainstay industries; from 1956 to 1970, a high growth era and technological innovativeness; and finally, after 1971, stressing high technology industries, especially electronics. The manner in which the educational system adjusted to the varying needs of the economy were then analysed, and it was concluded that the system of technological education in Japan, as shown in student enrollment at various educational levels, had managed to keep pace with the rates of industrialization and types of industrial development required, a key factor in Japan's economic success.

SESSION 9 - SUMMARY

## Technical, Scientific And High-Level Manpower Development In The Malaysian University System: The Role Of Public Scholarship Policy

by

Prof. Ozay Mehmet
Prof. Yip Yat Hoong

Prof. Yip explained the structure of the joint-paper, comprising the introduction, an empirical analysis of the survey which formed the basis of the paper, and finally the conclusion in the form of policy implications and a remedial proposal.

He prefaced his presentation by referring to earlier discussions in the symposium which supported the view that the transfer of technology does not automatically take place because of the presence of various constraints, e.g. cultural, economic, religious, etc. In the process of technological transfer, technological education was important. It was important to create the correct atmosphere for technological transfer to occur, and in this regard, education for high level manpower development was very important, a need recognised by the Malaysian government as part of its industrialization drive and part of the socio-economic restructuring under its New Economic Policy. Despite the great number of scholarships awarded and the heavy expenditure on post-secondary education, he was concerned whether the government was succeeding in its aims at creating high level manpower, scientific and technical, consistent with the needs of the economy.

Prof. Ozay took over to explain the background, nature and coverage of the survey, and highlighted the correlation between the distribution of scholarships by race and the value of scholarships (Table II), attributable largely to the New Economic Policy with its racial restructuring emphasis. While there was an obvious pro-Malay bias in the award of scholarships, intra-racial differences in the prospects of being awarded scholarships exist, with the greatest variation among the Malays. A correction was made to the text, where the richest Malay households were incorrectly reported as having 22 chances, instead of 21 chances.

Prof. Ozay then considered the role of the universities in promoting high level manpower development, as indicated by the degrees received which were broadly categorized into 'generalist' and 'professional'. The results indicated

that there was a predominance of generalist type degrees (76.6% of the total surveyed). Malays also tended to dominate in the racial distribution of high level manpower trained. A post-graduation survey showed that the graduates were severely affected by the effects of the economic recession, with a resultant high level of graduate unemployment (over one-third), and this was despite the fact that over 90% of the scholarship holders were bonded. Regarding the bonded scholarship system, it was felt that the effects were regressive on all parties involved, and a situation was rapidly created in which there was serious over-production and aggravating the problem of mis-match between supply and demand of such graduates.

He concluded that the government scholarship system was not being used effectively to produce high level manpower, and that it was obsolete and required termination in view of the problems it created. There was also need for equity in the present system of scholarship awards as well as improved administration of the scholarships to avoid such problems as the duplication of awards to individuals. It was thus suggested that the present system be replaced by a single coordinating body, in the form of a National Student Loan Bank.

## SESSION 9

## DISCUSSION

### Mismatch Between High-Level Manpower Needs And Planning

Prof. Y. Tsurumi initiated the session by commenting that the problem of mismatch between high level manpower needs and planning was not isolated to Malaysia but was also encountered in a highly developed country as the United States where there is a surplus in certain professional fields. In addition, he observed that until recently the trend in the U.S. has seen a progressive improvement in the quality of education.

### Intra Versus Inter-Ethnic Differences In Malaysia With ReferenceToSecuring Scholarships

A clarification was sought by Dr. Firdaus concerning the comparison in the prospects of scholarship awards between the richest and poorest within the Malay group, or between the Malays and other racial groups in Malaysia. Prof. Mehmet then clarified that the differences were intra-racial rather than inter-racial. In response to a point made by a member of the audience that the richest Malays were not necessarily rich when compared to other racial groups, Prof. Mehmet further reiterated that he was merely concerned, as shown in the empirical evidence recorded in the text and Tables, with a comparison of the chances that poor households within each racial group had in securing government scholarships compared to the rich households.

### Scholarships For External Study

To an inquiry by Prof. Das as to whether the study took into account scholarships awarded for study abroad, especially those given by non-Malaysian bodies which may have their own peculiar features or conditions, Prof. Mehmet answered in the negative, and indicated interest in pursuing this line of inquiry if further research funds were made available. Prof. Yip also clarified that this aspect was not being studied for the time being.

**Appropriateness Of Sample In The Manpower And Scholarship Study**

Another participant, Dr. Fong, felt that the tendency for the rich to benefit most from the award of scholarships was a global phenomenon, and was not one unique to Malaysia. He also felt that it was not appropriate to give weight to the income indices. He suggested that a more valid sample could have been drawn from all those eligible to enter the universities rather than only from those who have succeeded in gaining admission and have subsequently graduated.

**Shifts In Educational Allocations In Malaysia**

Prof. Mehmet commented that the development of the Japanese educational system, as outlined in Dr. Shimizu's paper, indicated that over time there was a proportional decline in primary school education vis-a-vis higher levels of education, and this reminded him of the situation now being experienced by Malaysia. He drew attention to a portion in the paper which referred to the reallocations in educational expenditure since the mid-1970s, and this reminded him of an inverted pyramidal situation in which the proportion of total allocations for post-secondary education showed the greatest increase while the share distributed to lower levels of education, primary and secondary, declined.

**The Scholarship System In Improving Malay Prospects In Malaysia**

Prof. Aziz came out in support of the scholarship loan system mentioned in the paper. In fact, he had earlier raised this issue but was unsuccessful in getting it adopted as a policy. He also felt that findings relating to the relative opportunities of securing scholarships by poor and rich Malays respectively must be viewed in a global context. He also reminded the audience that the situation was vastly different as recent as ten years back when the bulk of the Malay population were rural dwellers and concentrated in the less developed states in the north and east of the peninsula. Until after the mid-1960s, none of the Malay schools in those states had science streams, a situation discriminatory to the educational interest of the Malays. But with the shift in government policy coinciding with the New Economic Policy, there has developed a new Malay middle class who are better placed in securing scholarships than their counterparts 10 years previously. As part of the New Economic Policy, he mentioned the sending of government sponsored Malay students

to several overseas countries, e.g. the United States, in addition to Britain which had until recently been receiving the bulk of Malaysian students. Indeed, the manner in which the government has used the scholarship system as a means of improving the prospects of the rural Malays was quite different to that under the Meiji in Japan.

Prof. Yip began by admitting, with apologies, that he should have mentioned Prof. Ungku Aziz's contribution in mooting the idea of a scholarship loan system.

He also admitted that his study was not global in scope but was concerned with a sample of 2,046 students. Though limited in range and number, he would consider increasing the scope of his study by another survey to include the students studying overseas.

He also remarked that the batch of graduating students in the 1982/83 session surveyed were also those who had first entered the universities in 1978/79. These were, therefore, representative of the children from the new Malay middle-class families of poor rural origins who had benefited from and were better able to utilise the opportunities offered by the change in government policy.

Prof. Y. Tsurumi then terminated the round of discussion on the paper by commenting that subsidies in education, as practiced in Malaysia, were not uncommon even in developed countries. He also stressed that attention could also have been given to the question of whether the final products of the Malaysian educational system were relevant to the high level manpower needs of the society, and the present study had clearly demonstrated that there was indeed a mismatch between high level manpower needs and manpower planning.

**Re-evaluation Of Learning, Educational Development, Telematics And Knowledge Dissemination**

One of the participants, Dr. Annalisa Circerchia inquired about whether there has been a re-evaluation of learning as it related to the rapid development of the educational system in Italy, especially with reference to telematics and knowledge dissemination. In additon, Dr. Circerchia also asked

the other speakers whether they had considered the influence of the mass media in bringing about change in the educational system.

Prof. Rendina referred to the situation in Italy where there have been attempts to provide audio-visual equipment or aids in the schools, but the results, e.g. provision of television sets and computers, have not yet achieved the desired objectives. He stressed that together with an awareness of the needs there must be a culture of modernisation present at the level of the entire society. Serious problems could arise if technological progress occurs in the absence of changes in customs, habits and thinking of the people concerned.

**Interlinkages Between Communication, Technology, Culture And Development.**

Another participant, Mrs. (Dr.) Ammassari commented upon the re-evaluation of education in Italy because of the rapid development of the mass media. She was also happy that the topic of communication was included in the Symposium because of its interlinkage with technology, culture and development. The first paper had, for instance, touched on mass communication as it related to the larger issue of socialization of the young in society in their various modern forms. She mentioned that Royal Prof. Ungku Aziz had also dealt with the importance of communication when in a previous discussion he referred to the differing degrees of receptiveness to innovation among peasants, which was essentially a problem of communication. Returning to the paper by Prof. Rendina, she felt that it was very important that attention be given to the issues relating to underlying dysfunctions and conflicts in the society. These are expressions of communicating information dysfunctions and conflicts at the collective and individual level. She also emphasised the importance of remembering that culture and language are related in various forms, as well as the importance of language as a reference frame, and how it fits into one's world view, as part of the larger concept of communications. An example of this occurring in a social and cultural context is children learning several languages simultaneously. Finally, she wanted to hear, if time permitted, about the Malaysian experience of multi-lingualism.

## SESSION 9 - DISCUSSION

### Chairman's Concluding Remarks

The Chairman, Prof. Y. Tsurumi, in ending the discussion session, indicated that the spread of the Japanese educational system was indeed much influenced by radio broadcasting before World War II and by television in the post-War period.

## SESSION 10

### Crossbreeding For Improvement Of Local Goats Using A Multidisciplinary Approach

by

Dr. T. K. Mukherjee

Dr. T.K. Mukherjee's presentation focused on key issues contained in his printed paper. In essence, the argument was that goat-breeding is an ideal form of animal husbandry within the Third World at large and, more particularly, within the ASEAN region for goats most readily and economically fit into the patterns of polyculture that have already evolved in these areas. Dr. Mukherjee argued that goats - as both milk and meat producers, although primarily as the latter - could play a pivotal role in the rural economy of Malaysia and, more broadly, throughout the ASEAN region. To this end, his project had entailed the genetic improvement of local goats (mainly Katjang goats) by artificial insemination with German Improved Fawn semen accompanied by a range of physiological and behavioural studies on the resulting animals, and a goat management training scheme for farmers. Although the project was still in progress, it was already clear that the $F_1$ animals are conspicuously superior to uncrossed, local ones and that their integration into Malaysian farming could be a significant contribution to the Malaysian economy at several levels.

The author emphasized, however, that further studies and improvements were still needed: the genetic manipulation of the local goats needed further refining, the provision of balanced animal-feed had still to be ensured especially in rural areas; cost-benefit analyses had yet to be undertaken; and one had yet to study the social changes that would occur within those rural communities which took in the improved goats on a large scale.

**SESSION 10 - SUMMARY**

## An Appropriate Plastic Hand Pump For Rural Water Supply

by

Prof. Goh Sing Yau

Dr. Low Kwai Sim

The presentation of this topic by Prof. Goh Sing Yau, described a new type of hand pump recently developed in the University of Malaya, specifically for rural Malaysian conditions. The presenter described the design of the hand pump and the field-trials that had been conducted over a period of two years. A large number of slides were used by him to illustrate the innovative features of the pump, such as its leverage system and plastic cylinder-and-piston feature. Field studies had shown that this new hand pump is far superior to all the other pumps available in Malaysia, and the presenter expressed his belief that it would be a significant Malaysian contribution to the United Nations Water Decade (1981-1990) whose objective is to provide "an adequate drinking water supply and basic sanitary facilities for all by 1990".

## Extending The Use Of Tin Via Organotin Chemicals

by

Prof. V. G. Kumar Das

Prof. V. G. Kumar Das focused on the biocidal applications of organotin compounds. It was much more technical than the other two papers but it, nonetheless, displayed a clear potential for practical benefit to rural societies. The author described research in progress at the University of Malaya and elsewhere which was already promising considerable benefits for agriculture via such measures as pest-control (such as the control of Aedes aegypti, a carrier of dengue fever and dengue haemorrhagic fever), fungus-control, etc. One of the newest and most interesting roles discovered for certain organotins seems to be as metabolic synergists, i.e. as agents which inhibit the detoxification mechanisms that many insects have developed to metabolise conventional toxicants (such as D.D.T.).

This paper did not discuss in any detail the economic and social aspects of a programme for the large-scale application of organotins in a rural economy. Clearly, the project had not yet reached that stage.

# SESSION 10

# DISCUSSION

## Context Of The Interest In Research On Uses Of Tin

In opening the discussion, Prof. Yip Yat Hoong drew attention to one important feature of the last paper on the use of tin. He reminded the audience of the tough competition currently facing the tin industry; and he pointed out that the University of Malaya project is an all-too-rare attempt at looking at tin as a chemical, and not primarily as a user-commodity.

## Hand Pump And Some Related Factors In Usage

The questions from the audience and the subsequent discussions were entirely about the hand pump. The first questioner, Dr. Rokiah Ismail, asked about the source of the water for the pump-installations. She wished to know to what depth the bores are sunk and whether the water is generally surface-water or ground-water. The questioner also pointed out that in Malaysia much ground-water contains rather high concentrations of arsenic, and she wished to know what monitoring procedures were being implemented. Prof Goh Sing Yau and Dr. Low Kwai Sim replied that most of the bore-holes are sunk to a depth of about thirty feet and that the water so far obtained with the plastic hand pump seemed to be good. They added that the sites are selected by the Ministry of Health and that it is their responsibility to test the water. They gave the impression, however, that such testing is not carried out as methodically as it should be.

## Hand Pump And Its Acceptability As An Innovation

Dr. Nik Safiah Karim inquired about the responses of the villagers to the new hand pump. So far, it was well-liked. In reply to a further question on the pump's price, Prof. Goh Sing Yau admitted that a price had not yet been fixed but he expected it to be relatively expensive. He added, however, that its clear advantage over other pumps should make it highly acceptable.

Prof. Quaranta, President of Centro di Ricerca e Documentazione Febbraio '74, offered his congratulations to the University of Malaya team on this highly

promising innovation. He pointed out that a lamentable number of similar projects in Africa had failed simply because technical problems had not been anticipated. The University of Malaya project had apparently anticipated such problems and seemed to him to be full of promise. He expressed a wish to study it in greater depth.

Prof. Goh Sing Yau again emphasized (as he had in his paper) the crucial role that hand pumps would have to play in achieving the objectives of the U.N. Water Decade, and he repeated his conviction that European pumps would not be up to the task since they were seldom designed to suit the conditions of the areas to which they were sent. Only locally produced pumps, in his opinion, could perform the task reliably. And, the new Malaysian hand pump was showing the way.

# APPENDICIES

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## ITALY

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