SEMINAR

Technology and social change Japan and Italy: a comparison between two experience

THE HONDA FOUNDATION AND
THE G. AGNELLI FOUNDATION
Turin, 19-20-21 September 1983

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Opening Session

Schedule

Monday, September 19, 1983

15:00 Technological modernisation and its socio-economic effects, Dr. Umberto AGNELLI.

Address of hon. Bruno Orisini MP, Undersecretary, Department of Industry.

16:15 Technology and culture:

a) Western culture and Japanese culture,
- Dr. Shuji TAKASHINA, Professor, University of Tokyo;

b) The Japanese debate on technology and culture,
- Dr. Shuhei AIDA, Professor, University of Electro-Communications, Tokyo;

c) The Italian debate on technology and culture, with reference to recent major international contributions
- Prof. Vincenzo CESAREO, Director, Institute of Sociology, Catholic University of Milan.

17:45 DISCUSSION

18:45 End of session

20:30 Reception given by Dr. and Mrs. Umberto AGNELLI at the Accademia Filarmonica

Mr. Shuji TAKASHINA

Tuesday, September 20, 1983

9:00 Presentation of research projects:

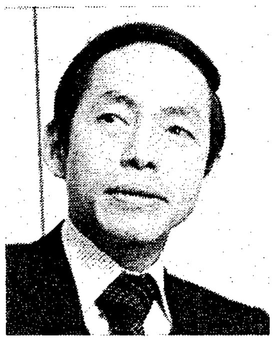
a) The impact of microelectronic revolution in Japanese industry,
- Dr. Hideichiro NAKAMURA, Professor, Senshu University.

b) The state of conventional automation in Italy and its effects on work organization:
- in the workshop: Ing. Franco UBERTO, Head of Work Organization Dept., FIAT Auto, Turin;
- in the office: Dr. Giorgio FARDIN, Managing Director, Telos Managements Consultants, Milan.

11:15 Coffee Break

11:30 DISCUSSION

13:00 Lunch (in the premises of the G. Agnelli Foundation)



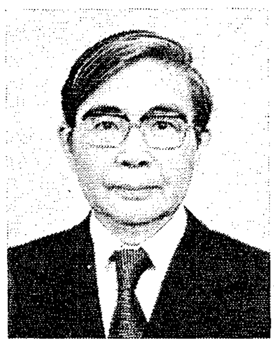
Mr. Shuhei AIDA

15:00 Automation and Corporate policy in Japan;
- Dr. Shigeru SHINOMIYA, Executive Vice President Honda Motor, Co.
- Dr. Taizo UEDA, Managing Director, Honda Foundation.

16:15 Coffee Break

16:30 Round table, with the participation of Italian management experts and operators on:
- Motivations of corporate policies in the development of conventional automation;
- Impact of automation on either white and blue collars – and their Unions –: at its beginnings and now;
- Problems and prospects of conventional automation.

Panel members:



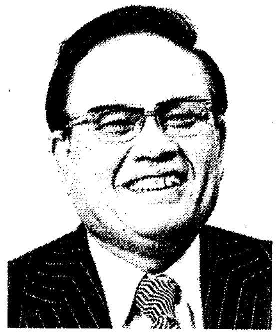
Mr. Hideichiro NAKAMURA

- Dr. Giuseppe MEDUSA, Director Corporate Strategies Dept., Alfa Romeo Co., Milan,
- Dr. Carlo VERRI, Managing Director, RIV-SKF, Turin
- Ing. Carlo BESUSSO, Head, Work Organization Dept., FIAT Corporate, Turin,
- Dr. Bruno LAMBORGHINI, Head, Economics Dept., Olvetti Co., Ivrea,
- Dr. Fredmano SPAIRANI, Vice General Director, SIAI Marchetti S.p.A., Sesto Calende.

Chairman: Prof. Giorgio PELLICELLI, Director, School of Business Administration, University of Turin.

17:45 DISCUSSION

18:45 End of session



Mr. Shigeru SHINOMIYA

Wednesday, September 21, 1983

9:00 The social and economic effects of conventional automation:

The Italian demographic developments – at 1990 and 2000 – as a framework to the country's socio-economic problems, with special reference to employment:
- Dr. Marcello PACINI, Director Angelli Foundation.

10:00 Technological innovation, automation, social development: the Japanese point of view:
- Dr. Akinobu KOJIMA, President, Nihon Short Wave Broadcasting Co.

10:45 Coffee Break

11:00 DISCUSSION

13:00 LUNCH (in the premises)

15:00 Round table on: Technological innovation and society; "the Italian point of view".

Panel members:
- Ing. Sergio PININFARINA, Chairman, Industrialists' Association of Turin.
- Prof. Umberto PELLEGRINI, Professor of Electronics, State University of Milan.
- Prof. Umberto COLOMBO, Chairman ENEA, Rome (the National Research Board of Integrative Energies, Inc. Nuclear).

16:30 DISCUSSION

18:15 Conclusions and suggestions to be drawn from the Seminar: Prof. Umberto COLOMBO and Prof. Shuhei AIDA.

20:30 Dinner given by Mr. and Mrs. Shigeru SHINOMIYA at the Del Cambio

Mr. Taizo UEDA

Mr. Akinobu KOJIMA

WESTERN CULTURE AND JAPANESE CULTURE

Prof. Shuji Takashina
Professor, University of Tokyo.

1.

The linguist Ōno Shin says in Nihongo no Nenrin (Growth Rings of Japanese, Yūki Shobō, 1961) that the Japanese word utsukushi originally did not mean "beautiful," as it does now. For example, when the Man'yōshū poet Yamanoue no Okura (?660-?733) said his wife and children were utsukushi (poem no. 800), he meant they were loved. During the Heian Period (794-1185), the use of the word in the Taketori Monogatari (The Tale of the Bamboo Cutter, 9-10th century) and Sei Shōnagon's Makura no Sōshi (Pillow Book, early 11th century) suggest that the word came to convey affection for small, fragile things. In was only during the Muromachi Period (1392-1568) that utsukushi acquired its current meaning.

What word, then, initially stood for "beautiful"? Ōno says that in the Nara Period (710-794) it was kuwashi and, in the Heian Period, kiyoshi. Of the two, kiyoshi is still used today more or less in its original sense: "unsoiled," "unclouded." The original meaning of kuwashi is retained in the word kaguwashi, "fragrant," but as its current meanings may suggest, originally the word also meant "detailed," "delicate." As for kirei, another word widely used today to mean "beautiful," "pretty," it came into being during the Muromachi Period. But it, too, originally meant "unsoiled," "clean." From this, Ōno concludes that in their perception of beauty Japanese people have tended to sympathize with things that are clear, clean, or small, rather than with things that represent goodness or abundance.

This etymological analysis points to two characteristics of the Japanese sense of beauty. First, as the original meaning of utsukushi suggests, the Japanese sense of beauty may have more to do with emotion than with intellect. Second, in matters of beauty Japanese have shunned what is large, powerful, and abundant. In this second point, Japan contrasts with ancient Greece, where the Western concept of beauty originated, and where powerful and abundant things were thought to be beautiful. For the ancient Greeks beauty was an idealized value like truth and goodness, and belonged to the gods. It was, therefore, easily associated with other idealized values, as in the story of the "beauty contest" in Greek mythology. In the "Judgment of Paris," Hera and Athena promise the young prince power, wealth, or wisdom for selecting either as the most beautiful. The association of beauty with other ideals is also manifest in actual art works. Most of the sculptures representing male bodies show gods, mythological heroes, or victors in the Olympic games, indicating the Greek equation of the ideal of beauty with that of strength. Indeed, it may be said that the beauty as embodied in these sculptures derives from the unstinting Greek admiration for powerfulness. (In China, too, the preference appears to have been for things big. The ideograph for mei, "beauty," consists of parts meaning "large" and "sheep," and the ideograph for li, "elegance," is composed of parts which, in sum, represent a stag with magnificent antlers.)

The Japanese somehow seem to have lacked in the ability to see beauty in large and powerful things. In his essay, "Kiyōsha no Sekai" (The World of the Dexterous, Kawakita Michiaki tells a revealing story in this regard. Once, when an exhibition of classical Japanese art was held in Rome, he was shocked to discover that even the screen and sliding-door paintings of the Momoyama Period (1568-1600), which is often characterized as the age of grandeur and splendor, looked "gentle" and "demure" in the Roman environment.

In addition, in the West, at least until Romantic aesthetics came on the scene, beauty was also linked to rational approaches, such as mathematics, geometry and dynamics. The Greeks tried to explain the beauty of the human body from the standpoint of mathematical porportion, while during the Renaissance attempts were repeatedly made to reduce beauty to geometrical principles. The belief in the same rationalist tradition was expressed by the neo-classical painter of the nineteenth century Jacques-Louis David (1748-1825), who observed that beauty could be realized only by making the "light of reason" its guide.

His friend and theoretician Quatremère de Quincy also argued for "treating art in the same way as science."

When compared with this classical approach of the West (before Romanticism) that attempts to understand beauty on some kind of objective principle, the contrasting Japanese approach to beauty that stresses emotion and feelings may be placed in sharper focus. No attempts to reduce beauty to a rationalist rule–symmetry, proportion, geometry, golden section, or what have you–have been made in the history of Japanese aesthetics. Beauty, in Japan, has never been perceived as an intrinsic attribute of a given object, but invariably as something that exists in the mind that perceives it. The first manifesto of the Japanese sense of beauty so understood appears in the opening statement of the preface to the Kokinshū, the first anthology of Japanese poetry compiled on imperial order, in the early tenth century; "Japanese poetry has its seeds in the human heart, and takes form in the countless leaves that are words." Similar sentiments were expressed in the centuries that followed. So, Fujiwara no Teika (1162-1241), the greatest tanka poet, said in his Maigetsu Shō (Excerts from the Monthly Lessons): "Make your heart the base, and be selective about diction. That is what my deceased father used to tell me." Zeami (1363-1443/45), the founder and the greatest writer of an on Noh drama, said in Fūshi Kaden (Flower Transmission): "What your heart finds novel is what is interesting." A summary of this line of perception was made when Motoori Norinaga (1730-1801), a scholar of Japanese literature and poet, came up with the famous phrase mono no aware, "sensitivity to things," to explain the essence of Japanese poetry. In the history of the Japanese sense of beauty, what may be called the "aesthetics of feelings" has played an important role.

When beauty is regarded not as a specific attribute of an object, but as what is touched off in the mind perceiving the object, the nature of the object ceases to be of primary importance. Just as parental love is born not because the child has a perfect look, so is an aesthetic sentiment provoked not because something incorporates a golden section or because a woman has a proportionately balanced body. Rather, for the mind that has learned to feel beauty, any phenomenon can be beautiful. The preface to the Kokinshū went on to say: "we must voice the thoughts that are in our hearts, conveying them through the things we see and the things we hear." The "things we see and the things we hear" may not necessarily be perfect or impeccable. As the essayist Yoshida Kenkō (1283-1350) rhetorically asked in the Tsurezuregusa (Essays in Idleness), "Why should we look at cherry flowers only at their prime, the moon only when it is cloudless" (section 137). Or as his poet friend Ton'a (1289-1372) is quoted as saying, "A thin silk cover looks attractive when it's worn at top and bottom, and a scroll roller when its mother-of-pearl has fallen off" (section 82). So here is born an awareness of beauty in things that are imperfect, missing, or ruined. In the classical aesthetics of the West, some painters, such as Nicholas Poussin (1593/4-1665) and Claude Lorraine (1600-1682), were even prompted to creat paintings of "idealized landscapes" on the theory that nature as it is is imperfect and therefore to be amended. In contrast, the Japanese tendency has been to find interesting any phase of constantly changing nature and to see a specific beauty in each.

2.

The Japanese sense of beauty, such as I have described, is naturally reflected in the world of Japanese art. For example, the preference for small, delicate things, or things that are "reduced in size," can be pointed out as one outstanding characteristic in the Japanese expression of beauty. The special appeal that things reduced in size have for Japanese sensitivity is evident in the art of garden-making, which is in essence an attempt to create an impression of "deep mountains and dark valleys" in a small plot, as well as in the internationally known art of bonsai. Especially, in such decorative arts as lacquerware, textile dyeing, porcelain and earthenware, metalwork, and woodwork, superb techniques were developed that managed to give expression to the smallest, the most elaborate details. Those people who coveted and acquired such precisely, subtly wrought objects no doubt adored the unparalleled craftsmanship congealed in them; at the same time, however, we must assume that they saw something beautiful in the details so meticulously worked out. This admiration for details is evident not only in the decorative arts, but also in the fine arts, such as painting.

From the earliest examples in Buddhist themes that used gold foil cutouts, to those in pre-modern periods done on screens and sliding doors, Japanese paintings tended to be strongly decorative. These often show a manifest preference for things reduced in size, not only technically, but also in spatial composition and in the way the subject is dealt with. Prime examples of such paintings are the screens of the sixteenth and seventeenth centuries showing fūzoku, people's "customs and manners," where a countless number of tiny people are depicted in colossal detail.

It is often pointed out that, generally, Japanese painting, when compared with Western painting, is flat, and lacks realistic elements. To be sure, in its disregard for the unified three-dimensional expression of space made possible by perspective and shading that were markedly fine tune since the Renaissance, Japanese painting is not "realistic." Indeed, it is precisely because of this that Shiba Kōkan (1747-1818) and the few other Japanese artists lucky enough to become acquainted with Western painting techniques were astonished by the realism that could be achieved through them. Nevertheless, this does not mean that Japanese painters lacked the desire to observe the real world and reproduce it "realistically." They were realistic—not in spatial composition, but in the depiction of details. And this had a good deal to do with the Japanese sensitivity that found an aesthetic pleasure in a world reduced in size.

Let us consider some of the screen paintings depicting people's customs and manners that were produced in abundance in the early Edo Period (1603-1868), such as the Rakuchū Rakugai (Inside and Outside Kyoto), the Shijō Kawara (Riverbank at Shijō), and the Sairei (Festivals and Rites). Most of these describe various parts of Kyoto, with temples, merchant houses, streets, rivers, and bridges often congested by a great number of milling people. What is interesting about such paintings is not so much the overall composition of each, as the manner in which countless details are presented. The details are given as if looked down upon from above the clouds, but no painting gives a bird's-eye view based on perspective, such as understood in the West. Each building, each street, is depicted not from a fixed viewpoint the painter assumes, but from, as it were, a continuously moving viewpoint. In addition, the people in these pictures are not really depicted as if seen from above, either. Instead, a street showman with a monkey, street vendors, and passers-by are, though small in size, all painted in minute detail as if observed by someone standing near each person depicted. Indeed, examined carefully enough, even the design of each woman's kimono should be distinguishable. The difference between this approach and a bird's-eye view in the proper Western tradition is that in the latter such details would go against the principle. The people depicted on these screens are small not because they are seen from a distance, but because they are reduced in size.

If such size reduction is effected in each part of a painting, as it is in these screens, it is natural that any of these screens should not produce the kind of unified space that is the mainstay of Western painting. As typified by the theory of perspective perfected during the Renaissance, the unified spatial composition of the West presents an image of the world formed from a fixed viewpoint—the painter's viewpoint. Essentially, the theory of perspective is based on the assumption that the size and the color intensity of a given object correspond to its relative distance from the viewer. In other words, the farther the object, the smaller and the ligher it becomes, and the closer the object, the larger and the darker it becomes. In this arrangement the relative smallness of a figure does not mean that he is a midget, but that he is farther away from the painter, and the relative obscurity of this costume does not mean that it is soiled, but that, again, it is relatively distant. By thus establishing a relative distance for each figure and each object in a painting, a three-dimensional, unified space is created. For such a unified spatial composition the premise must exist that the painter's viewpoint remains fixed. This is because the relativity of distance occurs only in relation to the position of the painter's viewpoint, it changes as the painter moves. To realize a spatial composition in Western tradition, all the parts to be recreated on a canvas must be viewed from a single point.

But a fixed viewpoint does not exist in such paintings as the Rakuchū Rakugai, each of which is in effect a collection of independent details. The whole town may be presented as if seen from above a cloud high in the sky, but each figure or spectacle is depicted as if the painter were standing nearby. The painter's position is not the same when he paints the showman with a monkey at the right and when he paints a festival procession at the left. He freely moves about the town of Kyoto and depicts whatever attracts his attention from a position so close to it that he can clearly see even the pattern on his subject's kimono. Or, we may say that he moves about in order to observe each scene minutely. As a result, his painting may not present a unified space, but it is filled with "realistic" details.

3.

Along with a preference for small things or things reduced in size, a preference for things that are clear or clean is reflected in a number of artistic works to show another aspect of the Japanese perception of beauty. Typical of this aesthetics is the attitude that has treated with respect the unadorned wooden structures of the Ise Grand Shrine or blank space in a painting.

Originally, the word kiyora, "cleanliness," described an unblemished, unclouded condition. It did not denote a positive state with something good, but a negative state without anything unnecessary or repugnant. Artistically, this attitude may be said to have formed the basis for an "aesthetics of denial." For the ancient people's inclination to see beauty in things clean was inherited in the attitude in later periods that found a rich, profound beauty in the monochrome world of ink drawings that rejected brilliant colors of any kind, or in Noh drama where restraint in movement and props was carried to the extreme. This aesthetics of denial may also be seen in the famous morning-glory episode involving the unifier of Japan Toyotomi Hideyoshi (1537-1598) and the tea master Sen no Rikyū (1520-1591). Hearing that Rikyū had cultivated a gardenful of morning-glories, Hideyoshi asked to see them. Rikyū complied. But when Hideyoshi arrived, the garden was empty, and only when he was led into Rikyu's small tea room, he saw a single morning-glory arranged in the alcove. The same aesthetics is, needless to say, related to the ideals of wabi and sabi, which exalt simplicity and restraint.

When the love of small things and the aesthetics of denial are merged, one result is the unique technique of taking out a specific aspect of nature and presenting it in close-up form. Typical of this technique are the pictures of "flowers and grasses," which are so common in Japanese art. Of course, in the West, too, there are a great number of paintings depicting a variety of flowering plants. But in the West, flowering plants are always presented as part of an appropriate surrounding, as in Botticelli's Primavera, which gives a section of a spring field and in many still-life's of seventeenth-century Dutch painters, where the flowers are neatly arranged in a vase on the table. In contrast, the Japanese pictures of flowers and grasses usually present nothing but flowers and grasses—often only portions of them, totally isolated from their surroundings. Take a representative masterpiece in this genre, the Natsukusa Akikusa Zu Byōbu (Screen with a Picture of Summer Grasses and Autumn Grasses), by Sakai Hōitsu (1761-1828). In it, flowers and grasses are meticulously painted in the foreground, but except for a suggestion of a stream there is nothing else: no ground, no field, no sky. Other than the flowers and grasses as the subject of the painting, all one sees is a spread of abstract silver. From the way the flowers and grasses are depicted, it can be easily imagined that they are out in the open, but the painting gives no specific object indicating that they are.

A uniform silver or golden background, incidentally, is favored by the Japanese not only in pictures of flowers and grasses, but also in pictures of customs and manners and in figure paintings. Such a background naturally carries with it a decorative effect, but it also has a simplifying effect of discarding everything unrelated to what is selected as the central subject. This should be evident in the Tagasode Zu Byōbu (Screen with a Picture of "Whose Sleeves"), apparently an indoor scene; in the Matsura Byōbu (Screen with Matsura Scenery), an outdoor scene; and in the Hikone Byōbu (Screen with Hikone Scenery), a combination of outdoor and indoor scenes. In any of these no specific object is given to indicate whether the scene is outdoor or indoor. In Western paintings of customs and manners, such as those produced in quantities in seventeenth-century Holland, elements of the actual world surrounding the central subject are usually made part of the painting. So, if the painting concerns an indoor scene, part of the wall, floor, or the ceiling will be shown, and if it concerns an outdoor scene, part of the town or the woods will be incorporated.

In this regard, the Taisei Ōkō Kiba Zu (Paintings of Western Kings on Horseback) at the Suntory Museum and the Kobe City Museum are interesting examples that show the difference between Western and Japanese views of artistic presentation in a stark sort of way. In these paintings the equestrian figures are evidently based on Western models; indeed, some of them are known to come directly from the print series, Portraits of Roman Emperors, which were in turn based on the paintings by Stradanus. But the Japanese borrowing ends with the figures. For, whereas in the original prints the background of each emperor is filled with scenes from Roman streets, in the Japanese paintings the background of each figure is uniformly gold.

The strong Japanese concern for a specific subject spawned the unique compositional technique of presenting only a small section of a given object. The genre of painting employing this technique is known as the Sesshi Ga (Breaking-off-of-a-Branch Painting). As the name suggests, a typical painting of this genre may present only a branch of a plum tree, say, and nothing else. Or, even where some other part of the tree is shown, such as the trunk, its presentation can end abruptly where the paper space runs out. Here is an example of 16th century and in the Kameido no umeyashiki (Kameido Plum Trees), by Andō Hiroshige (1797-1858), only a small section of the trunk of a large plum tree is shown in the foreground. That this bold composition struck Western painters as fresh and novel may be evident in the fact that van Gogh made a copy of this Hiroshige print in oil paint and used a similar composition in his Sower, and that Gauguin obviously had the same thing in mind when he did his Vision After a Sermon. It is well known that other Western painters of the nineteenth century were also greatly influenced by ukiyo-e prints. The important aspect of that influence lay in the bold, startling composition such as this river scene by Hiroshige, which shows only a part of a bridge and which inspired Whistler in his "Old Battersen Bridge."

4.

As may be apparent in the Rakuchū Rakugai and other paintings, the kind of composition where the painter's viewpoint freely moves from place to place and the details observed by the moving viewpoint are enumerated in continual fashion has no unified space but tends to endlessly expand sideways. In the perspective composition of the West, which was explicitly described for the first time by Alberti (1404-1472) in his treatise On Painting, the painter looks at the world in front of his eyes from a fixed position and expresses in a pre-determined framework the world seen as if through a window frame. For him, what corresponds to the window frame is the space of his canvas. In Western painting, therefore, the framework of the canvas, like the painter's viewpoint, is an essential premise for effecting a unified spatial composition. In Japanese painting, which has no fixed viewpoint, the canvas is infinitely expandable, at least in principle. In reality, of course, a screen or a sliding door does set some limits, but the world depicted in one tends not to be completed in the space given but to go beyond it. When it comes to the paintings in the Sesshi Ga genre, the existence of other parts of the depicted subject is assumed as a matter of fact, so that the world beyond the limited space almost becomes a part of the world captured in it. To put it somewhat differently, whereas in classical painting of the West the world depicted in the framework of a painting is expected to form a complete microcosm isolated from whatever is outside, in Japan's classical painting that is not the case. There, whatever restrictions a given space may have seem weak. Actual physical limitations there certainly are, but they do not put a lid on the world outside.

What illustrates this point best is the form of picture scroll that used to be widely favored in Japan. To be properly appreciated, a picture scroll is to be unrolled at one end as it is rolled up at the other end, so that the picture may develop continually as it moves along little by little before the viewer's eyes. This arrangement has no set framework, and presupposes the movement of the viewpoint. Naturally, the form favors as the protagonist someone on the move, as in the Shigizan Engi Emaki (Picture Scroll on the Origin of Mt. Shigi), which is thought to have been made in the second half of the twelfth century, and the Ippen Hijiri E (Picture of Ippen the Sage), which dates from 1299. Typically, the protagonist travels from mountain to village, from town to town, through space and through time. Because a picture scroll is the visualization of a story or a legend, it contains a variety of scenes illustrating a variety of narrative developments. But notably, there is no clear demarcation between any two scenes.

In the West, too, the picture scroll form existed, but disappeared quite early. And when a sequence of pictures was made to tell a story with temporal progression, pictures were made independent of one another, rather than put in a continuous format. For example, when Michelangelo (1475-1564) frescoed the ceiling of the Sistine Chapel, he first divided the available space into nine sections following the architectural pattern and in each section produced a single scene. These nine scenes from Genesis are each distinct, not continuous. Here, too, is the difference between Japan and the West in the perception of space, as well as the difference in the sense of beauty based on it.

The fact that Japanese people have especially favored the picture scroll form indicates that they have a particularly strong sense of space as a continuum. Picture scrolls were made not only in the Heian and Kamakura Periods (794-1392), but they continued to be made long afterwards. There are even modern masterpieces such as the Ōhara Gyōkō (Imperial Visit in Ōhara), by Shimomura Kanzan (1873-1930), and the Seisei Ruten (Eternal Change), by Yokoyama Taikan (1868-1958).

The Japanese sense of space as a continuum can also be seen in endeavors other than painting. For example, in traditional architecture, no clear distinction is made between indoors and outdoors. A typical house has such parts as the nokishita (below the eaves), the nure-en ("wet porch," porch not covered by the eaves), and the watari-rōka (crossing corridor) that cannot be defined as inside or outside parts, but which in their amorphous way play an important role in naturally linking the indoors and outdoors. A similar things can be observed inside the house, too. There, the room partitions are deliberately impermanent, and two or more rooms can be turned into a single large space by removing the sliding doors dividing them.

The lack of a sharp distinction between the space inside the building and the space outside also means the uninterrupted continuation of the human world into the natural world in Japanese perception. Japanese people do not regard nature as an entity separate from man; instead, they have developed the view that man is part of nature, one with nature. It is no accident that flowers, grasses, birds, water flows, and other manifestations of nature have been frequently taken up as subject matter in Japanese art. The importance of traveling in picture scrolls and classical drama derives from the fact that it provides occasions where man and nature merge into one.

Another outstanding aspect of the Japanese sense of beauty may be said to be the merger of art works with daily life. The sliding doors and screens on which paintings are lavished are at once art objects and furniture. Kakemono, or hanging scrolls, in the alcove are changed for seasonal and other specific reasons to create an aesthetic space in ordinary life. In Japan, where no true distinction is made between fine arts and decorative arts, as it is in the West, artists have often been craftsmen, and the same motifs have recurred in paintings as well as in craft works. In modern times, the Japanese mode of life has been extensively Westernized, and the traditional approach to art appears to be being lost. But as long as art works of the past remain, the Japanese sense of beauty will also remain. And these works of art will continue to speak to the lovers of beauty of the world in a universal language.

5

Now let me show you some slides which best illustrate the Japanese sensitivity to beauty which I have thus far discussed.

The first slide you see here is that of the Ise Jingū (Shrine). . The special characteristics of this building is that for the past 1200 years, the shrine has been rebuilt every twenty years in the exact same manner. This is part of sacred ritual of the shrine. That is to say, although the shrine is constantly being renewed, it maintains the oldest tradition. The structure of the building is extremely simple, consisting of a round center columns of plain wood which stand directly out of the earth. Ridgepoles are laid over the center columns and are covered with gabled roof. The beauty of this structure lies in the simplicity of the barest necessity of columns roof and the wall. There are no decorations, either on the columns or on wooden walls. They are not even painted. All excess has been eliminated. Vertical pillar(s), horizontal crosspieces and slanting roof is reminiscent of architecture of classic Greece, such as the Parthenon which stand on the hills of Acropolis in Athenes. Certainly, just as Winckelmann aptly described the temple of Parthenon holds within it "Simple unity and quiet grandeur". This can be said as an example of architecture in the western culture which has simplicity without any excessiveness. But even this structure, compared to the structure at the Ise, has much decorations. The columns are lined with vertical grooves which accentuate their vertical structure. The upper part of the columns are decorated with capitals. Relief was carved on the entablatures and although now, they are gone, beautiful sculptures decorated the gables. And it is thought that the entire structure was painted with flourishing colors.

The fact that the building is very closely linked with the surrounding nature is another major characteristic of Japanese architecture. For example, the temple of Parthenon is a complete and independent structure in itself. In case of the Ise Shrine, it is surrounded by a garden fenced in with a wooden fence, Tamagaki . And the building cannot be a separate entity from this garden. The importance of the relationship between the building and the surrounding space is also illustrated by the Ho-o-do of Byōdōin Temple in Uji. This temple is called the Ho-o-do, or "Phoenix

Pavillion", because the entire structure is reminiscent of a bird with wings spread wide apart. In front of the building is a pond. The entire beauty of the building is completed by its reflection in the pond.

Another important facet in the Japanese architecture is that just as it was seen in the Ise Shrine, the intermediary between the interior and the exterior of the building, in other words, the eaves or the banisters of the building, or in case of the Ho-o-do, the roofed passages connecting the buildings, play important roles, both structurally and functionarily. These parts can be defined as a "Gray Zone" which can neither be defined as outside nor inside. For example, the part under the eaves of the roof, seems from those inside to be an "exterior space", while those on the outside see it as an "interior space". The gardeners who work on the outside call this space not "under" the eaves but "inside" the eaves in Japanese. This means that interior and the exterior are not divided but is related in a continuous natural motion. At a glance, Ho-o-do appears to be one large building shaped like a bird, but in actuality, it consists of four separate buildings.

In fact it consists of "Amida-do" at the center, flanked by two buildings on each side which make up the wings and part which make up the body of the bird, behind the "Amida-do". However, because the eaves of these buildings overlap, they appear to be part of one large building. In other words, each independent building blends in with buildings surrounding it naturally, through the use of the gray zone.

Thus, the Japanese architecture, in general, is very "open" to nature which surround it. In other words, the interior of the house is at one with the nature outside. There are buildings such as Itsukushima Shrine at Miyajima which is completely fused with nature surrounding it.

Compared to this, the Western architecture divides the interior and exterior of the building very clearly. For example, in case of Parthenon in Rome, although the entrance way in front part of the building is decorated with Greecian style frontal proch, the main body of the building is shaped like a cylinder topped with a half a sphere. The walls are completely closed in. As you can see in the plan of the building, except for the entrance, there is no connection with the outside. There is not even a window. Of course, without any windows, there will be complete darkness. There is an opening at the summit of the spherical structured roof to let the light in. As you can see in the 18th Century work of Panini, people could see a little bit of sky from this window placed high up on the ceiling. They are completely shut in, inside the building.

This continuity of the exterior space and interior space can be said to be a characteristic of Japanese garden as well. As can be illustrated by the Ginkakuji or Katsura Rikyū in Kyoto, the garden is a natural extention of the interior of the building. At times, this continuity expands even further, and there is a technique called Shakkei or "borrowing landscape". This incorporates the natural surroundings beyond the private domains of the building. On the other hand, are gardens where mountains and deep valleys are built in within a small space of the garden. The Karesansui Garden in Daisenin in Kyoto is an outstanding example of such types.

It is well known that Japanese people have always lived in harmonious feeling for nature. To the Japanese, nature is not something which you fight with, but something with which you must co-exist harmoniously. It can be said that man is not a master of nature who rule, but simply a small entity in nature. One of the main characters of a play written by 17th Century French poet of the classical school declares:

"Je suis maitre de moi, comme de l'univers." In Japan, we can recall number of poets and writers who would declare that "they are masters of themselves." But we would not be able to think of anyone declaring themselves "the master of universe." In the western world, the thinking of Greek philosophers that "Man is the measure for all things." has persisted quite strongly until the present. But in the hearts of the Japanese people, is the feeling that man, just like any other animal or plant, is only a small entity in nature.

This is probably the reason for the important role played by nature in Japanese literature. For example, in the entire classical school of French literature, only line of poetry which sings of nature appears in "Le Cid" by Corneille.

"Cette obscure clarté qui tombe des étoiles." In comparison with this, for example in the play by Monzaemon Chikamatsu, nature is vividly depicted in the climax scenes such as Michiyuki scenes. Same can be said of art. In Europe, in a true sense, landscape painting was not established until 17th Century. Whereas, it is known through records that Sansui landscape paintings were widely painted from Heian Period or 9th and 10th Centuries. The oldest Sansui screen which still remains comes of 11th Century, even this is much older than European landscape painting. And here is also another example of the 13th Century, Kasuga Mandara .

The way nature is depicted differs considerably from Europe and Japan. In the western paintings, the point of view of the artist is fixed at one point, and unified natural space is constructed from this point of view. We can pinpoint the place the artist stood to draw a painting from western landscape paintings. However, in the Japanese paintings, such as biographical portraiture of the trip of Ippen Shonin or scenery of Kyoto seen in Rakuchū Rakugai Zu , the artist's point of view wander about and the picture expands endlessly to the right and to the left. The "continuous space" we observed in the Japanese architecture holds true in Japanese paintings.

Not only does the point of view of the artist wander in Japanese paintings, the artist picks up points, when drawing people or nature, which he wants to emphasize and drops those parts he feels are unnecessary.

Claude Lorrain, in his landscape and Rubens in his "Autumn Scenery" pick up natural landscape from one point of view and depicts that scenery in unified and detailed totality. Whereas in the "Summer Plant, Autumn Plant Screen" by Hoichi Sakai, only the flow of the stream and the plants are focused. The rest remain as a completely blank space. Same can be said for paintings of flowers. For example, in the "Flowers in Vase" by Jan Brueghel, not only the flowers are carefully depicted, but the vase which hold the flowers and the table on which it stands as well as petals which have fallen on the table are carefully drawn. Compared to this, in the "Iris Screen" by Korin, all background has been deleted and only the flowers are painted. Such emphasis of the "part" and "freedom of point of view" creates unexpected structure in such work of art and this has influenced the European artists in the latter half of the 19th Century.

Furthermore, the establishment of the perspective in art was possible in European art through the establishment of fixed point of view. Because the point of view is fixed, it is possible to differentiate the far and near. In other words, the artist has grasped a world in front of him in a total unity. Van' Eyke's "Portrait of Arnolufini's" is an outstanding example of this. The room, the furniture and people in the room, mirror and even the room reflected in the mirror are all depicted from one fixed point of view. Whereas, in the Japanese painting of people in a room, such as Genji Monogatari Emaki or Kasuga Gongen Emaki , while the pillars and building are seen from the above, the people in the building is depicted as though they were sketched from the side. Again, the artist has taken liberty of freely changing the point of view.

Another outstanding example of people within a building is Velazquez's "Ladies in Waiting". He has drawn depth into a flat canvas surface so that the people and the room appear as though real. The knight standing at the door way, in actuality, is drawn side by side to the ladies, but he appears to be standing much farther back. In order to express this effect, not does Velazquez only draw the knight small, but draws him with simple stroke of the brush. Valazquez expresses not how the actual knight is like but how the knight appears at a distance. The important person is the artist—master of the world—and not the object. The impressionist artists such as Monet, developed this visual sensitivity of the artist to its limit. The crows in Capcine Street of Paris has been reduced into simple touch of the paint by the artist.

However, when a Japanese artist depicts a crow, as can be seen in Rakuchū Rakugai Zu or Namban Screen , the artist moves his point of view so that he can go near every object he wants to draw and he thus draws every individual in detail. He does not allow the object to be subjugated by him but rather the artist allows the object to subjugate him.

Such characteristics of Japanese art such as strong interest in details, emphasizing the important feature and ignoring the unimportant, obeying the object rather than ruling the object and skillful use of the gray zone, are alive not only in the genre of paintings and architecture, but in everyday life. I assume that they exist in many forms in the present day technology as well.

THE JAPANESE DEBATE ON TECHNOLOGY AND CULTURE

Prof. Shuhei Aida
Professor, University of Electro-Communications

1. A Stone Bridge Speaks

Small as it is, there stands a historic temple in Sakyo-ku, Kyoto. It was rebuilt in 1662 and is called Rengeji (the Renge Temple). If you sit in the old inner temple facing the garden the atmosphere will almost certainly remind you that the legacy passed down by men of culture many years ago have been succeeded in their respective forms and shapes in the minds of the Japanese.

In one corner of this typical Japanese garden composed of stone and trees stands a stone bridge. It is not an overstatement to argue that this particular stone bridge is the original image of modern Japanese technology, production technology in particular. Both ends of the stone bridge are firmly fixed on the supporting rocks. Beneath the bridge at its mid-point a stone pier projects upward out of the water. Strangely, the top of the pier is not in contact with the bridge and the pier is not supporting the stone bridge. Instead, there is space between the stone bridge and the pier. The secluded part of the garden can be seen through the gap.

According to the temple priest, all stone gardens tend to transmit a feeling of rigidity. Therefore, this paticular bridge has been ingeniously designed to demonstrate that even a stone structure can exhibit flexibility as it touches the pier when people cross. It seems as if the splendour of this design concept were speaking about the essence of Japanese culture. This bridge is a masterpiece which communicates a feeling of softness which approaches that of a wooden bridge. When I thought of the sentiments of the gardener who had provided stone with this flexibility I felt as if I had been listening to the stone bridge speak.

The Japanese never fail to give the feeling of softness even to a hard stone bridge, reflecting how splendid the Japanese way of thinking and culture are! Taking a general view of the garden, the stone bridge presents itself as something soft, depending on the location of the viewer, the time and the changes of light playing upon it. The opening provided between the stone bridge and the pier is nothing less than a representation of the infinite capacity of human thought. This expression of Japanese thought has acted upon everything it has contacted, to build the modern mechanical automation system and production technology with its flexibility and freeness of form. The harmony that exists between man and machine as recognized in Japanese industry has a relationship with Japanese culture, as exhibited by men of culture who built the "flexible" stone bridge many years ago. As the well-known phrase "Japanese spirit with Western Learning" implies, the Japanese have learned of technical matters from the West and infused them with their own culture.

2. Thought and Social Structure Differ from Those of the West

Let us first discuss Japanese production technology which is enjoying the attention of the world. Even today with the phenomenal growth of technological innovation, we still do not have any production completely unmanned plants, and it seems it will be a long time before we can have such production facilities. Most of the machines used today are not completely automated, although a number of robots are being applied to undertake repetitive work. In other words, due consideration and cooperation among designers and operators as men are indispensable, if the full potential of automated machines is to be extracted.

The greater the number of production processes, the more difficult it is for machines to shift from one production process to another without the assistance of workers. The "boundary technique" to connect two successive production processes has not yet been fully automated, a fact which makes it necessary for workers to take responsibility for the overlapping work between one process and the next. Even if the work load of the workers increases, it will be necessary for them to undertake the work leading from one production process to another, as otherwise automation as a whole will not function as it should, making it easier for us to understand that the social and cultural facets of men should not be neglected, even in the age of automation. Individual technologies play important roles in their own ways in all the advanced countries. When they are combined into system technology, however, the participation of society and men is absolutely essential. The more huge and sophisticated system technology becomes, the greater the necessity for men to be involved in its various aspects. It can be stated with certainty therefore, that the result depends on the actions of a group of men, that is, social structure and culture rather than on machines themselves.

In European societies, there are sharply delineated contractural relationships between individuals and groups. In other words, the relationships between individuals and groups are systemized. Individuals have clearly divided scopes of work within a group of workers. In Japanese society, on the other hand, individuals belong to a group, both in reality and in their consciousness, although there are legal contracts between individuals and groups.

The terms "uchino kaisha" and "uchino kojo" (which literally mean "our home company" and "our home factory", respectively,) are often heard in Japan, offering an eloquently example of this relationship. This illustrates the vagueness in the direction of thought among individuals and groups. In Japan, there is not even a clear-cut distinction between individuals and groups.

This Japanese way of thinking, social structure and control system are considered to be the motive force which makes automation effective. The Japanese attitude toward machines is quite different from that of Westerners. The Japanese tend to perceive things as a whole rather than as a number of separate entities, and it seems to me fortunate that the scale and function of today's automation fits the Japanese and mechanics at their respective levels, due consideration and emphasis is given at all times to the effective automation of the factory as a whole. This is something which is not easy for Westerners engaged in production technology to understand.

Japan's electric appliances, automobiles, etc. are not just copies of those of the West. The Japanese have acquired knowledge from the West, but these products are manufactured by Japanese systematic production techniques and represent the dynamics of Japanese culture. I think that the source of this dynamism can be found in the stone bridge in Kyoto.

3. Technology and Design

As the stone bridge bears witness, technology develops where there is culture. In other words, technology is in itself culture. In addition, technology serves to mature culture. For one reason or another, however, the Japanese do not seem to recognize this properly. They tend to draw a clear line between technology and culture and think that these are two different things having nothing to do with each other. Next, we shall discuss "design" as a "bridge between technology and culture".

Design is also an important factor in technology. It must be note, however, that the design factor varies widely depending on the research and development stage and the degree of product diffusion. In other words, at the research and development stage, designs based on physical and empirical measurements have priority, while at a product's distribution stage, designs that appeal to consumers take preference. However excellent a product may be from a physical point of view, it will lose its value if its appearance is unacceptable and it does not appeal to the general public. In this sense, designs are made on the basis of logic and the taste of consumers.

At the International Design Convention held in the United States a few years ago, I expressed my views relating to the "form" of design. I think in this connection that there are two basic concepts, one being "time and totality" and the other "time and space". The former is a "form" having a fairly clear structure, while the latter is vague, sensory and expansive. In many cases, this vagueness is evident in human communication, which tends to lay emphasis on sensory considerations rather than on accurate data. By contrast, the value of computers is acknowledged only when they are operated using highly accurate data. The notion of design varies with the object involved and the person evaluating it.

Artists create their own works by opposing all existing "forms". It may be said, therefore, that their lives consist of days fighting against existing "forms". The comments made by Mr. Isamu Noguchi at the International Design Convention were informative with respect to the various problems involved in technology and culture.

During the period from the 1980s into the 21st century, much importance will be attached to design in the civilization of advanced countries.

Highly advanced technology will contribute through design to the building of a new culture. Feedback from technology to culture is the future question for design activities to resolve. In this sense, it seems certain that design will emerge from its existing concepts and tend to be tinged with soft technology.

With the advance of internationalization, technology will serve as a communication medium between different cultures. Under such circumstances, the questions implicit in design and its objectives make an organic coexistence between man and technology possible, and similarly the establishment of a live-and-let-live society in which man and machines can communicate with each other. For this purpose, it is necessary for us to scrutinize the origins of Japanese design and ascertain what should be the more essential design criteria in this modern society.

4. Relationship to Culture

Office automation in Japan has already passed the stage of research and development and its application is spreading. And as mechanical systems, first introduced because of their novelty, are made to function more thoroughly, friction between them and personnel become more heated with the result that personnel feel more alienated and gain less satisfaction from their work.

The era in which machines could be freely used on desk tops is now to be looked back upon with nostalgia, for in the current era with machines coordinated into systems the presence of man himself is diminishing. The current era of office mechanization is referred to by certain European intellectuals as the era in which laws and rules have become disorganized.

The recent remarkable developments in microelectronics, in particular, have led to the introduction of automative technology not only in the production plant but also in the office, bringing, as everyone knows, a number of negative effects together with various forms of convenience and profit.

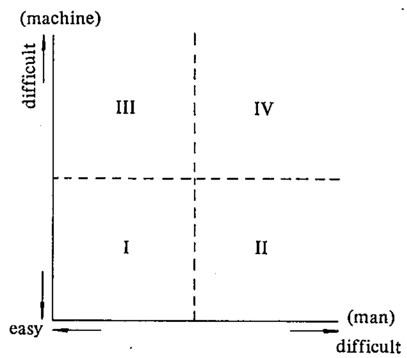
Viewing human activities in terms of the individual and the group, for instance, megatronic functions, exemplified by the robot, are not only physiologically and psychologically incompatible with human beings on an individual basis; but on a group basis as well, they prove to be at odds with social customs and the essence of culture; they invite intellectual discord over the dignity of human labor and how it should be executed; they extend the differences between skilled and unskilled workers and generate various other problems in society at both the individual and group levels.

As these negative factors emerge and become understood, we must consider as a topic of new scientific technology, a practical methodology for reducing or eliminating them so that we can guarantee with more assurance that society will be improved through office automation.

In any case, consideration of the quality and scale of office automation is a very important social issue. It is important that concerned managers and engineers, upon recognition of the social and cultural features of their individual environments, not only develop and introduce individual aspects of technology but also give important consideration to the relationship between these technologies and personnel and establish standards regarding the same.

5. The Office as a Network of Personnel and Machinery

The automated office is a social space in which a network of personnel and machinery has been realized, a space into which numerous concepts of interfacing can be introduced. The question is how man can create and operate an intermediate area where both man and machine can function. In approaching this question, the fundamental difference in concept between the West and the East is that the former departs from the machine side while the latter departs from the human side.



I: Easy for man and machine
II: Easy for machine bur difficult for man
III: Difficult for machine but easy for man
IV: Difficult for both man and machine

Chart I – Work Area for Man and Machine

The philosophical basis for the man/machine network lies in the dualism of Descartes, which Norbert Wiener comprehended as a system and presented as cybernetics. Much literature has been written concerning the details of cybernetics, and here we shall simply present a breakdown of work areas by man and machine based on degree of performance difficulty. As can be seen in Chart I, there are four such areas. The question is from which of these four areas is office automation to be realized and no doubt the appropriate area for beginning, as computer technology progresses, is that area where performance is easy for machinery but difficult for man. This is not actually the case, however. The primary focus of office automation is the area where performance is easy for both man and machine.

6. The 3C Environment Theory

In conjunction with the development of information processing technology centering on the computer, office automation has come to be gradually introduced into more sophisticated areas of human labor, and the more mechanical systems advance, the more operations conducted through human sensitivities such as imagination and volition will require specialists with outstanding human capabilities. We must not, of course, forget that improvements in human capabilities will be required in direct proportion to the extent of progress in mechanization.

As people in the modern world lose their sense of purpose of significance from their work, introduction of office automation provides even more substitutes for personnel in the performance of office duties, and it appears that eventually people will not have to work at all. Such a rosy picture is not very realistic, however, because office automation simply involves a change in the kind of work people will have to perform.

Human activities are limited, both in terms of sensitivity and in terms of response. For example, even though factors such as infrared light and atmospheric pollution may exist as physical phenomena, human beings are not apt to be aware of them through direct sensibility. Again, viewed in terms of response, there are physiological and anatomical limits to the activities of a human being no matter how skilled he or she may be.

In view of this fact, J. von Uexhull (1864–1944) thought of every type of living thing in terms of sense perception and response. Thus, although man cannot know the world as seen by each different insect or animal, he can imagine it based on the world which he can see. In other words, what must be remembered is that the environment of the world perceived by animals is probably different from that perceived by man. In thinking along these lines, the natural world can be more accurately perceived and more correctly understood by expansion of the world of sense perception and the world of response.

In consideration of man and machine in the sphere of office automation, it must be remembered that the worlds of sense perception and response are very different for mechanical systems, established and operated through physical laws, and for human beings, who function through natural laws. It is in the extent to which these different worlds can be coordinated that the key to the acceptance or rejection of office automation lies. In the sphere of office automation, the aspects of sense perception and response both for man and machine should be accurately perceived, and new standards should be established which serve as the basis for the creation of a theory of a humanized environment for the office.

Given this necessity, the 3C environment theory covering office automation ought to be carefully considered. This theory represents an attempt to establish office automation as a man/machine network based on the remarkable advances made in communication, control and command technologies following development of the computer while also considering the environmental theory of von Uexhull. These three forms of technology reflect a fundamental concept for showing in a more universal way the importance of information in human activities. A brief explanation of the theory follows.

7. Communication

With developments such as communications satellites, information can be transmitted by telecommunications on a global or universal scale, thus eliminating the physical restrictions on the relationship between the office and information and drastically expanding the scope of this relationship. The time has come for this fact to be recognized and given due importance throughout international society both in terms of sense perception and response, for it serves to foster so-called "information capacity" and to make for smoother execution of communication.

8. Control

The profitability of office functions is enhanced through communications technology together with the reduction of physical restrictions initially by techniques for the control of machinery in remote areas. It enables the office to demonstrate its functionality not only when operated during normal periods but also in the face of emergencies. Generally speaking, moreover, improvement of "control capacity" in an individual office is directly connected with its prosperity.

9. Command

No matter how superb machines may be as a medium, unless they can be made to function as a system, they will not be adequate for office purposes. The principal means for establishing and operating an office compound so that better information can be obtained the office can be coordinated to function as a whole is to clarify a leadership network and foster "leadership capacity."

Through coordination and strategic implementation of these three Cs, technology can be made to upgrade office functionality. Given this situation, hopefully the three capacities respecting information, control and leadership will be augmented and modern technological capacity such as communications technology will be fully utilized so that office automation can be effectively realized.

10. Information Capacity

There is no better translation into Japanese of the English word information than that reportedly given by Ougai Mori, the distinguish literary figure of the Meiji ear. Mori's translation accurately conveys the idea of the English word information as including both an element of human sensitivity and an element of physical measurement. The difference between data and information can be viewed as depending upon the presence or not of the human element. Originally, there was no word or conception in Japanese for the English word data, and thus it was directly incorporated into our language as it was unlike the English word information.

Generally speaking, data refers to physical numerical values such as those used to show sales results. Changes in accumulations of data must be interpreted by specialists and taken as the basis for predicting what transformations will result in the respective system(s). Information results from the application of human sensitivity to data, and it must always incorporate some form of human contribution to be regarded as such. And in our modern information–oriented society, the quality of information largely depends upon whether correct human sensitivity has been applied to it; the foundations of society are largely affected by this factor.

This fact must be recognized especially with regards to information covering office automation. Together with improvement in data quality, every effort must be made to rear specialists who can make judgements based on this data. In short, information capacity makes possible the qualitative improvement of measurement data, the maintenance of sophisticated specialist groups to handle data, the acquisition of correct information regarding office trends, and the speedy processing and organizing of this information. Improvement of information capacity results from repeated execution of the following three activities.

1. Clarification of all forms of presumed office work and establishment, as fully as possible, of scenarios to accommodate this work.
2. Systematic acquisition and compilation of data required for implementing the above scenarios; establishment of a data base and translation of data into information.
3. Sensitive capture of all types of signals and selection of one from the above scenarios to execute office management.

These activities, which are to be repeatedly executed during times of normal operation, point to the great significance of information capacity in serving as a basis for dealing with possible crises.

11. Control capacity

Control capacity can be divided into two forms: one is the existing capacity to deal with crises which might erupt into social panic, and the other is the capacity to resist ripple effects of disturbances originating at the point of crisis eruption, prevention of the expansion of these effects, and elimination of them. Thus the establishment of control capacity at both the individual and group levels is a very important issue. In each field, prior determination must be made of what ought to be preserved and every effort should be made to cultivate resistance and control capacity.

Man differs from other animals in that he is able to a certain extent to plan out his activities. Man, in determining his volition and carrying out his activities, takes himself into consideration together with current conditions and current information. Thus in a country such as Japan, which has not had to face a great crisis in over thirty years since the Second World War, it is very difficult to get the people to seriously consider the possibilities of a crisis and take time out from their daily affairs to undergo training so as to augment control capacity.

12. Command Capacity

Command capacity is the capacity to effectively implement office management through the coordination of information and control capacities. Thus it is very important to activate during normal operating times a command network to oversee various systems such as communications and transportation. In the broadest sense, this requires interaction between man and technology. In addition to leadership capacity with respect to decision-making, organizing, organization management and negotiation, what also is required is an accurate grasp of current conditions surrounding communication and information systems established through modern technology and full augmentation and operation of the same.

13. Presence of Proper Mental Framework

As can be clearly understood from what has been written so far, in order to realize more improved operation of office automation there must be more human-oriented, forceful leadership capacity. Introduction of highly sophisticated machinery such as the computer only brings added responsibility for personnel in top management. It is best to assume that the size of group supervisory networks will grow smaller with fewer personnel.

Generally speaking, efforts are usually made to solve a particular problem only after it has actually been confronted. They originate from a temporary resistance on the part of supervisors to resist forces superimposed from the outside. In using the computer to create office automation, we take any number of various factors into consideration, but in the final analysis, these factors boil down to one issue. And that is that outstanding administration is needed if corporate systems are to turn out profitable, and this administration must be established prior to the making of any plans for office automation.

Among people connected with administration and management the gap between theorists and those with practical experience has been widened drastically. It is true that systems methodologies such as operations research (OR) will prove to be profitable to a certain extent, but the various expenses involved in developing these systems are by no means slight. And as has been pointed out from time to time, specialists in systems methodologies such as OR have their own particular methods for solving problems and they merely seek out those problems which their methods can be used to solve. Whether we realize it or not, Japanese society must reconsider especially its tendency to reach out for various foreign techniques, and the time has come when we ought to make every effort to rear personnel with the capacity for human-oriented leadership.

Once, when a specialist in the United States was asked why system failures occur, he reportedly answered that it was because systems are made so as to fail. Systems extract from chaos those elements conducive to a particular purpose, and compile them according to a certain type of method. Thus a system is characterized by constant change; it cannot exist in a fixed unchanging mode. In other words, a system failure results either from intrinsic factors built into it or from the fact that it interacts with a chaotic group from which the failure is initiated.

In designing office automation, attention must always be paid to the health of personnel groups, and leadership with a philosophy must be demonstrated. It is in the form which this design takes that these factors reveal themselves. Indiscriminate introduction of systems from outside sources will never prove to be really profitable.

With respect to the computer machine, it is in the very interaction between the system and outstanding human-oriented leadership capacity that the key to profitablity and greater welfare for the human group lies. Everything begins with man and everything ends with man.

THE IMPACT OF THE MICROELECTRONIC REVOLUTION IN JAPANESE INDUSTRY

Prof. Hideichiro Nakamura
Professor, Senshu University.

With the coming of the 1980's, much discussion has been created here and there about industrial robots. It doesn't seem, however, that the three different subjects – what is happening in the factories right now, intermediate range of innovation to be achieved and future technical possibility – are dealt with clearly separately in discussion. Actual conditions in manufacturing factories and practical possibility should be more seriously reviewed.

From the viewpoint of both robot manufacturers and their users, this report studies the current condition of the robot industry in Japan and the process of change in the mechatronic industry caused by the introduction of robots and shows the actual change brought about in employment and quality of field labor.

Progress in production technology is becoming accelerated by microelectronics. The opportunity appeared, firstly, when the compatibility of quality improvement with cost reduction was required of enterprises under situation of limited quantitative expansion, or when they were forced to switch over from manufacturing a few kinds of goods in large quantity to manufacturing a variety of goods in small quantity of adequately meet the needs of the market. Secondly, despite stagnant growth in employment, the shortage of skilled workers was not solved and the supply of workers became seriously critical for workshops with bad working environments. Thirdly, while there were rises in wages after the first oil shock, the relative price of mechatronic equipment and machinery declined.

Since around the latter half of 1979, the production of industrial robots has shown a sharp rise. One of the major reasons for this is the fact that the price of industrial robots remains level in spite of their much improved functions resulting from cost effectiveness due to increased production on the side of manufacturers (e.g., the Unimate Robot System 2000 series of Kawasaki Heavy Industries, Ltd. was put on sale in 1975 for ¥12 million, but the price remains as it is even today while its capacity is much improved.) On the other hand, the wage level rose to 3-3.5 times that of what it was in 1970 on the part of users companies. In other words, the introduction of robots has become more favorable to the users.

2ndly. In mass-production type industries, existing special machines became increasingly fixed, except for the production system whose equipment are separated (manufacturing systems using many automatic machines arranged in a row), because of the increased needs of production of various goods in small quantity (it is not impossible to use special automatic machines in a 'mixed line' – different types of product flow on the same production line – but their use becomes rather inefficient because of their complicated structure.)

As a solution, a combination of universal machine and robot was put to use. In other words, a universal machine plus a mechatronic control system was used to advance automation to deal effectively with the production of various goods in small quantity.

3rdly, the infrastructure or the mechatronic industry as a whole where robots may display their efficiency has been much improved, that is, manufactured goods themselves and their parts have become improved in quality and social maturity at this point.

The Impact of The Introduction of Robots on Labor/Employment

The reporter feels a resistance to the use of the word "Robotization" to mean the flexible manufacturing system (FMS) at the production site. This is because the concept of a robot tends to be followed by an image of a machine controling a man. Rather, robotization may more properly be regarded as soft automation.

The idea is generally accepted that once robots are introduced into the production site, a good many workers become unnecessary there, meaning an increase in unemployment.

The introduction of robots in Japan, however, has so far taken place chiefly in factories to perform such tasks as painting, welding, etc. where experienced skills are required but where it is difficult to supply workers because of bad working conditions, or, in factories of simple work where there are problems of safety, such as feeding materials to press machines.

Let us now study the painting robot system on the automobile production line in order to review the production and employment problems followed by the introduction of robots. In the case of automobile manufacturers, automatic spray guns which are capable of two-dimensional operation have been introduced for some time now. However, the irregular surface of the body cannot be painted evenly by this system. So this part of the vehicle body requires the workers' hand. The playback robot made it possible to save labor in this type of operation.

Since the work environment of the painting shop or booth is especially bad by nature, there will be nobody in two years or so who will want to be a painter, especially in the case of medium & small enterprises. They say even in a large company that it is difficult to assign new graduate employees to this type of operation.

Besides, it is also said that a career of nearly 10 years is necessary to become an experienced painter with sufficient rust prevention and decorating skills. The paint labor-saving system including robots consists of decks for preparatory work, painting booths, ventilators, drying furnaces, conveyors, painting robots, and other ancillary equipment.

A production of 10,000 units a month in two shifts requires 40 - 50 workers in the conventional painting process. But, when the labor-saving system is used, only about 10 workers are needed to engage in operation & maintenance, thus achieving a saving of 3/4 - 4/5 of the workforce. An investment of about ¥400 - 500 million is said to be needed for this system.

Since the painting work is performed by a playback robot, an experienced worker must coach the robot for the painting operation, and therefore his role becomes very important.

Taikisha, Ltd. supplies Nissan Motor and other automobile manufacturers with painting robot systems. (The robot body is made by Kobe Steel Ltd.) At its Zama Engineering Center, experienced workers give their robots a training in operation in the booth of the experiment plant. The observation of this teaching creates the impression that these workers act like floor directors in a TV studio rather than a factory worker. With a time switch hanging from their neck, they instruct the robots in the best methods of operation as if they were directing the action of an actor in movies.

It is in the welding factory of the body production line that a full-fledged introduction of robots was made in the automobile industry, along with the painting process.

At the Zama Plant of Nissan Motor Co., full automatic multi-welding machines were first introduced into the No. 3 Body Assembly Factory in 1970 through 1971 for chassis floor welding. Later in 1977, 50 Unimate robots made by Kawasaki Heavy Industries were introduced in the same factory for automated welding of body sides, which usually requires more minute and flexible work. As a result of the introduction, unmanned operation was realized in 97% of 3,500 - 4,000 welding spots. Taking acount of an increase in special maintenance workers, this introduction saved 0.7 worker per machine, or 1.4 workers in 2 shifts. 70 workers have been reduced at the body factory for a total of 140 in 2 shifts. In some working areas, spot welding was a harsh job for workers as they had to be physically exposed to sparks during the operation. Before the introduction of robots, annual production showed a high increase – 15% in 1975 and 11% in 1976, tending to cause a labor shortage. So the introduction was carried out quite smoothly.

It appears now that the introduction of robots into the automobile production line has completed the first stage. As to the next step, however, the full-fledged introduction into the assembly line may give rise to a new employment problem under the current condition that the production capacity is reaching its ceiling.

In March this year, labor and management of Nissan signed "A Memorandum on the Introduction of New Technology", including ME. In the Memorandum the management assures that,

(1) A plan to introduce new technology will be presented to Labor in advance.
(2) Dismissal or lay-off will not be effected by the introduction.

(3) No demotion, no wage reduction, no deterioration of working conditions
(4) In the case of reassignment and/or change in job classification, adequate training will be given to the employees concerned according to their aptitude.

This agreement reached at Nissan may indicate that, in order that the introduction of innovative technology may not conflict with the employment situation, objective consciousness and constant efforts are indispensable on both sides of labor and management.

Relationship of the Introduction of Robots and Particular Technology

Industrial robots are not introduced into the production site capriciously. Their introduction is achieved according to the software used for quality improvement and cost reduction both of which have been accumulated in the field. This process is vividly shown in the case of the Kawasaki Heavy Industries attempting to introduce conveyor robots into the parts machining line for hydraulic motors. ("Emergent Investigation of the Influence Given by Development of Technological Innovation on the Employment of Advanced Aged Persons", Japan Economic Investigation Association, March 1982, pp. 106 -)

In 1970 this factory adopted the slogan "Improvements Devised From the Viewpoint of Users" as a part of the corporate campaign for low cost automation, and since then improvements of production equipment, jigs & tools, machine layout and work method have been embodied through its small group activity.

In the course of development, these improvements gave rise to the problem of streamlining manual operations of setting on or taking off workpieces from the machine-tools or carrying them to and fro. The workpieces of this operation line are 6 kinds of hydraulic motor casing which wiegh from 14 kg to 23 kg. The weight of these loads made it unsuitable for them to be handled by hoist or auto-loader in their setting on or taking off with the machines. Thus, robots were introduced to solve the problem.

Noteworthy in this connection is the fact that a good environment for the introduction of robots is created as a result of complete rationalization of the work site. If there is no software accumulation there, robots introduced into a workshop lose their effectiveness utilization even if an attempt is made to remove some of the workers.

In introducing robots in the factory, users are faced with a series of problems to be solved in advance. That is, we have to solve the problems of the interlocking of two machines with a different precision (machine-tool – ±0.1 mm and robot – ±1.0 mm). Or, the improvement of feeding and positioning methods of materials, dimensional examination of workpieces, disposition of tool chips, and other technical problems should be solved before robots can effectively function. The skill to master the robot must be brought forth basically as development of a particular technology on the part of users.

Before the introduction of robots, there were 3 persons working in 2 shifts in the factory. After their introduction, 2 persons were able to do the same work in 2 shifts and one surplus worker was given the work of honing and the other the monitoring work of robots. Half a year after introduction, no full-time monitor was necessary. One worker was assigned to the work of honing and monitoring of robot operation (chiefly, regular quality inspection and change of cutting tools). That is, the work is done now by one worker in two shifts, saving 4 workers in total in comparison with the work force before the introduction. The 4 eliminated workers were reassigned to the material machining line of related parts, forming a work group with the worker of the robot line. And every one of this group has mastered the skill of operating the robot.

This machining line is operated in two shifts now absorbing 4 more workers from the other line. Thus, by adoption of robot technology, the amount of production has been increased without an expansion of facilities. As a result, the activity of this group is said to have improved even more. The fact that a robot removed the need for humans to handle something heavy thus decreasing worker fatigue and removing causes for occupational diseases such as lumbago has given the worksite an opportunity to think about their improved working conditions.

Starting with Low-cost Automation

A good number of arc welding robots as well as painting robots were widely used in small enterprises rather than in large enterprises, and the use is at the ratio of 9 of the former to 1 of the latter. A small enterprise named Hirai Ironworks (capitalization – ¥12 million, annual sales – ¥460 million with 26 employees), for example, bought a universal multi-joint arc welding robot in 1979, and has gained possession of 3 of them now.

Like the aforementioned Kawasaki Heavy Industries, Hirai Ironworks which manufactures chiefly bodies for children's vehicle and part/metal pressing metal dies, has also tackled low-cost automation since 1965.

Under the leadership of the non-engineer management, its employees, most with a junior high school level or with an equivalent background worked together and relied upon ingenuity in their leisure time in cooperation with outside electrical engineers to create workable devices of their own, such as long bar cut & supply machines, special arc welders, automatic pipe perforators, chassis carts, etc.

This actual performance of low-cost automation led to the introduction of arc welding robots and a display of their efficiency. In detail, a children's vehicle of as many as 23 models has 20-30 welding points on the body. When this welding operation is done by a robot, special dies and jigs will destroy the practicality of robots on the contrary because of their frequent change of jigs.

By developing more universal peripheral equipment and the system which enables the change of jigs in a minute on the basis of the experience of low-cost automation, this enterprise is successfully achieving large productivity improvement per worker per robot (a production of 200 vehicles per robot a day). Thus, according to Mr. Seiji Hirai, President, the more variable the demand may be, the more the mechatronics can display its effectiveness.

Before the introduction of robots, 3-4 groups were working in the chassis production department, each consisting of one experienced welder and one assistant, and forced to work overtime every day, but after the introduction, 3 workers who attend to a robot each perform the same amount of work (200 units a day), thus achieving double the productivity.

The direct reason for the introduction of robots into this enterprise was a shortage of welders (reduced to as few as two employees at a time) and a measure for increasing the number of aged employees. These middle or advanced aged assistants were forced to perform physically hard labor by the journeyman welders. In introducing the robot into the factory, these assistants had to first be trained as robot operators. So the factory manager first had to complete a course of training held by the robot manufacturers himself and then give the others direct instructions regarding welding conditions and robot operation on the job. It took nearly one year for them to master operation of the robot through perspiring "mentally" rather than "physically". As a result, these three workers became more interested in their work and the management became more confident in dealing successfully with its aged workers.

This case may indicate that the introduction of arc welding robots stimulates the development of low-cost automation (This may be regarded as progress of intermediate technology.), and that old type welders are no longer needed on the one hand while simple assistant workers are relieved from too much heavy work and their position is raised higher. That is, workers are being brought to life as a new type of worker in these days of mechatronics.

The example of Hirai Ironworks is a case of a small enterprise on the top level of technology. Even if robots are introduced in the factory, the ability to develop their periphery equipment and jigs differ from enterprise to enterprise, and their universality is not made the most of in many cases.

Similarly to the case of NC machine-tools, it is not unusual that only the president, or his direct successor of the enterprise which has introduced the industrial robots, squarely tackles the machines while their employees are quite indifferent to them. That is, general workers do not work outside normal work hours while top management work overtime studying the new machines introduced.

Thus, industrial robots will be able to display their efficiency only where there is a strong desire on the part of management to attain a unique development of the enterprise's proper technology, stimulate a healthy interest in their employees and where there is an innovative atmosphere in the workshop in which both labor humanization and labor efficienty are pursued. It is of interest to know that Mr. Hirai recommends "Starting with the low-cost automation" when you want to introduce industrial robots in the factory.

Characteristics of Robot Industrial Organization

The robot industry has been developed as a new field by manufactures in the machine industry in a wide sense, such as shipbuilding, iron & steel, electric appliances, machine-tools, etc. Pioneer enterprises have secured large market shares in the respective fields. That is, Kawasaki Heavy Industries which has introduced advanced technology from Unimation Inc. (U.S.) holds 90% of the market as pioneer in the field of spotwelding robots. The second largest is the market of painting robots and Kobe Steel has introduced technology from Trallfa Co. of Norway holding a 50% share. Yasukawa Electric holds 70% of the arc welding market.

However, new manufacturers are succeeding the pioneers one after the other in those fast growing sectors where a sizable demand may be expected, and there is a little possibility for organization of an oligopolistic market. ("The Robots", Toyo Keizai Special Edition, No.6, 1982, pp. 92 -)

If the robot industry has grown fast, its market is not large at all for the participating enterprises. Even in the case of Kawasaki Heavy Industries, which realized sales of 450 units or ¥5.5 billion in 1980, 650 units of ¥7.5 billion in 1981, and 1,000 units or ¥10 billion in 1982 – these amounts of sales accounted for only 1% of the total corporate sales involving less than 1% of their total number of employees.

Organizing the robot industry are several medium core special manufacturers as well as diversified departments of large enterprises. That is, in the sector of feeding robots, Aida Engineering, the top special manufacturer of presses, has a large share of the market for large & medium machines, and specialized manufacturer Orii (Capitalization – ¥50 million, Annual Sales – ¥4.2 billion, No. of Employees – 80) has a share as high as 80% of the market for medium & small machines.

Orii's press robot is a complete development of its own and may be called a simple automatic hand. Its mechanical driving system uses unique large cams controlled by a microcomputer with high speed high precision – its cost performance is well recognized.

Recently, Orii also succeeded in developing an ultra-high speed feeder controlled by microcomputer which is able to feed the press with coiled steel plate at an accurate speed.

Having more than 200 patents based on its own original development, Motoda Electronic Industries (Capitalization – ¥30 million, Annual Sales – ¥1.0 billion, No. of Employees – 101) a special robot manufacturer, has developed a unique user – oriented model of loading robot.

Dainichi Kiko (Capitalization – ¥200 million, Annual Sales – ¥4.5 billion, No. of Employees – 238), a special manufacturer of robots, does not confine itself to a specific kind of robot but manufactures all sorts of robots, forwards the goal of a workerless factory. Its export ratio is high. It is a highly international-oriented organization, being engaged in robot production (OEM) for leading machine-tool manufacturers overseas and the establishment of joint ventures with large foreign enterprises.

Taiyo Tekko (Capitalization – ¥120 million, Annual Sales – ¥12.3 billion, No. of Employees – 680), which originally started as a specialized manufacturer of hydraulic & pneumatic machine parts, has been manufacturing automatic line systems for the precision machine industry since the end of 1950's. Based on its performance capacity, Taiyo entered into production for the mixed lines of small & medium batches. It is now supplying production systems equipped with robots rather than the individual robots themselves.

It is noteworthy that the medium core enterprises such as these have entered the robot industry and occupy a unique position in the competition for business among enterprises because of the unique models they have developed and their general capacity or systematization which surpasses that of the large enterprises.

In short, this industry is intellect-intensive rather than capital-intensive, and the optimum business size of its enterprise is not large. The industrial organization is characterized by the enterprise competition system with different natures and enterprise strategies composed of diversified divisions of large enterprises and special medium core enterprises.

Marketing Innovations of Robot Manufacturers

Let's take a look at management strategy, or marketing strategy in particular, of robot manufacturers in industrial organization where severe business competition is expected in the near future.

In developing a new market for robots, their handiness is the key to the sales approach. As for the teaching a playback robot, Osaka Transformer Co. makes it an important sales point that "those who know the welding operation and who can use a table calculator or operate a hoist crane would surely be able to use the robot".

The control panel is so structured that the microcomputer tells what the next steps are to relieve the operator from anxiety about misoperation. Motoda Electronic Industries also says in selling their robots, about their control system, "The structure is so easily made that anybody who knows how to play 'shogi' (a popular Japanese game like chess) can devise their program."

In order to develop future new market for robots, so-called technology transfer will be an essential point. That is, it will be important to note the technical difference between industries and to apply the robots developed for the users in the mechatronics industry to those in other industries.

For instance, Taiyo Tekko has attempted to apply its robots, originally developed for automobile parts manufacturers as dispenser of sealing materials (highly viscous material), to other purposes such as cake decorating machines (to make names, letters, designs, etc. with chocolate) for the confectionery industry.

The mechanism which controls the flow of sealing material and dispenses a fixed amount evenly may be applied to the use of manufacturing mark designs with cream and chocolate. However, in order to use it as a finishing system for cake decorating, we have to be able to conform it to the industrial proper technologies, such as control of chocolate temperature, cream whipping and quality control of cakes.

This robot may be diverted to other purposes in the industries, such as shoe-making, vinyl product manufacturing, etc. To accomplish such technology transfer we inevitably have to have an insight into the quality control levels and new technological needs in many manufacturing industries.

Direction of Development of Robots

– Manufacturers & Users –

As mentioned earlier, the technology of peripheral equipment must indispensably be secured on the part of users, except in the case where a robot is introduced as an independent system. The introduction of a robot does not lead to operational efficiency when there is no accumulation of engineering technology to build the robot in the operation line. Contrarily, an enterprise with high unique manufacturing technology of its own conceives a strong desire to develop and manufacture original robots of its own on the groundwork of the hardware developed from its software, and in some case these robots may be put on the market. The fact that nearly 150 enterprises have already participated in the robot industry may be an indication that there are many cases like these mentioned now.

Robot manufacturers try to deal with this situation in two different ways. One way is to tackle the development of peripheral technology themselves that is necessary for their users. There are, however, too many restrictions on business activities for manufacturers to satisfy the diversified needs on the part of users. In order to meet demand, tie-ups with tool and jig manufacturers or with robot system consulting firms yet to enter the new field will be required.

According to Dainichi Kiko, however, the so-called "standard products" that specialized robot manufacturers and other leading robot makers put on the market are not industrial robot at all.

Based on the product concept that a robot should be made to order for individual users, Dainichi Kiko is a thorough user-oriented manufacturer who makes every thing from attachment to peripheral equipment within the house. Characterized by a "Research and Development Group" composed of a young entrepreneur (43 years old) with venture spirit and young employees (average of 26 years old) who have made it possible to carry out the management strategy it has realized rapid growth. This is quite difficult in the case of large enterprises.

The second is the direction of product development in which robot manufacturers standardize (modularize) robot components and supply various robot systems according to installation conditions.

It is Motoda Electronic Industry that develops and sells multi-purpose loading robots based on a product concept like this. That is, this kind of robot has the special feature that all basic components of loading robots from X, Y, & Z axes to pedestals are modularized so that various robot systems may be constructed to meet installation conditions and their functional expansion and scale enlargement may easily be made.

They say that 20–100 combinations are possible even in the case of typical systems. And they cost as little as ¥3 million–¥5 million because of their parts are modularized. The idea is that they do not offer a robot product for sale but that they sell robot kits.

In other words, a standard or an order-made large system does not produce a big profit relative to its high order price, because a lot of time is spent for its installation & service. It is generally acknowledged that the determining factor in the popularization of labor-saving equipment is the cost reduction through their standardization like in the case of hydraulic cylinders.

The product concept mentioned above make it possible to become closely connected with the improvement movement of the users through their field TQC, having the advantage that the introduction of robots becomes possible at low cost. At any rate, robots will be widely used in these two directions.

Much discussion has been created now about an intelligent robot which has senses, comprehension, judgment and thinking power. Robot manufacturers, however, state in common that playback robots will be the mainstream for some time, say, for the next 5 years or so.

The relative value of the intelligent robot amounting to several tens of million yen is too high in comparison with the replacement effect of labor. Therefore, if unemployment should rise several percent as the result of robot introduction, as some journalists suggest, this type of robot would be further delayed in development.

The introduction of robots has progressed smoothly in Japan thus far. This is because field workers put themselves in the place of a robot user in dealing with it, and because employees who may be removed by its introduction are easily transferred to other workshops with relatively better working environments. But for these surrounding conditions, the peripheral equipment of robots which largely depends on field technology would be prevented from being developed and the effective utilization and qualitative improvement of robots would be hindered.

Other than growing enterprises which are able to insure sufficient jobs for workers who are made surplus through production expansion or development of new technology, the workerless factory will not be able to gain the assent of workers. In a sense, it may be said that the microelectronic revolution will expand the difference between enterprises (not difference between sizes).

What the Homemade Automation Movement Suggests

It is a well-known fact that one of the determinants supporting the high quality of 'Made in Japan' today is the QC circle activity in the field of production. However, we feel anxiety at the same time about shifting over to a workerless factory as the result of the large-scale introduction of robots into the production process. That is, some may fear that it will not only deactivate the circle activity, but also wipe it out entirely.

As mentioned earlier, the introduction of robots does not directly lead an increase in unemployment, simplification of labor or negation of field know-how, but instead it may open an opportunity of promoting formation of new skills, better development of field know-how or humanization of labor. However, when we allow robot introduction to take its own course, there will be no assurance that it will result in the positive adaptation of field workers to technological innovation nor a display of humanity. There must be a clear outlook for the new production structure and man-machine system. Noteworthy in this respect is the statement of Mr. Shigeru Shinomiya, Vice President, Honda Motor Co. about their production technology development strategy.

In the production factories of Honda Motor where large spot welding robots and painting robots are used, the "Homemade Automation Movement" is also being pushed in parallel and various kinds of automatic machines are operated as a result. These automatic machines seem simple but eliminate excessive quality from achieving too significant a productivity improvement (workerless factory). It may be an indication of new step of development of their field QC circle activity (called New Honda–NH in Honda Motor).

From its beginning, Honda Motor has had an affiliate called Honda Engineering (EG) which manufactures equipment and machines for Honda Motor, and it naturally has a robot development and production capacity.

According to Mr. Shinomiya, however, the mission of EG is not to force the field operations to use the completed robots they design, but rather to show them how to use the robot units they develop and manufacture. Where and how to use these units should be left to the operation. In other words, the introduction of robots should be realized on the line extended along the "Homemade Automation" movement.

There is a saying, "As to the use of robots, engineers tend to start with where they are easy to install, not necessarily where the field operations need them." The right to decide priority of robot introduction should originally rest with the field operation.

Mr. Shinomiya is consistent in his assertion that the predominant position of Japanese mass production assembling technology should be grasped as the matrix of engineers' technology that develops new production equipment and new production processes, skills to use existing equipment most efficiently, and technology that is born only from the reform and device of those who are engaged in the work. (This will be the technology that improves and develops jigs and tools and further alters existing equipment and machines.) Development and introduction of robots are also positioned somewhere in the development of this matrix.

EG endeavors to more highly improve the robot units, the field operations utilize these units more positively, and thus it is anticipated that robotization is realized smoothly where it is needed and that a new field technology suitable to the age of robots is born. What is subsequently produced is the image of the robot which makes the best use of the field proper technology, or, the idea of 'my machine' instead of 'that machine and me.'

The production of robots should not be entrusted solely to the side of manufacturers, but should be a joint effort of manufacturers and field users.

Mr. Soichiro Honda, the founder of Honda Motor, once mentioned to me to the effect that workers will lose their will to work and come to feel that they are mere part of a machine or will cease to develop, if "graduate-employees design or purchase a machine by themselves and ask them to work with it." Give the field workers a chance to think and produce better ideas based on the experiences. When the workers are permitted to alter their machines given them to use on the job, then they use the machines more effectively. (See "Lineage of Commercial Spirit", by Hideichiro Nakamura, 1973, p.13). As will be noted, the founder's idea on machines has been given life in the course of mechatronic revolution.

With the spread of robots, the position of field workers changes from that of being groups of workers to becoming groups of engineers. Without the know-how of these people, innovation on the production line would not be possible in the first place, and maintenance and further quality improvement of robots would be difficult.

Images of Mechatronic Specialized Manufacturing Companies

"The White Paper on Medium & Small Enterprises, 1982" reports that 64% of the NC machine-tools shipment in 1980 for domestic use were directed to the medium & small enterprises (See p. 138). A new production system with NC machines has been spread rapidly among many subcontractors in the machine industry, thus producing in certain fields new small enterprises which are not classified as subcontractors under the conventional concept of the term.

As one of the leading small enterprises of this type, I would like to discuss the case of Senbokuya Seisakusho (capitalization– ¥60 million, annual sales–¥2.5 billion and no. of employees–75, plus 60 part-timers). Although robots have not been introduced in this company yet, the computer-controlled machine groups used there have a considerable impact on human labor in a manner quite similar to the use of robots in that they release the workers from much of the manual work.

Senbokuya was founded in 1958 as a press manufacturing subcontractor. Taking an intense interest in the automation of press operations, this company has now 50 high-flex automatic presses of 30-150 tons in operation.

In parallel with the advanced operations of parts pressing, the company further expanded its business in the assembling of functional parts with a built-in thermostat. It is engaged at present in highly advanced assembling operations by using automatic welding machines of its own make and an automatic testing & adjusting machine made to special order by Nippon Electric Co., capable of examining bimetal functions. On the other hand, stamp dies have been produced within the company (as well as put on sale), and as early as 1976, a NC wire-cut electrical discharge machine (the 170th ~ 180th machine introduced into Japan) was bought (possessing 14 units now), and machining center was introduced in 1980 (5 units now).

With highly capital intensive heavy equipment such as this, Senbokuya is today considered to have such a high capacity as to be comparable to other leading companies or even surpassing them.

One of the characteristics of Senbokuya is its skillful usage of these highly efficient machines. Since most of the metal dies are order-made, NC tapes have to be prepared with high degree of efficiency in order to utilize these NC machines to their best advantage.

As personal computers were early introduced into the company in response to the employees' request, two-dimensional automatic programs have already been developed within the company, and NC tapes are prepared very easily by means of dialogue programs. (As to the three dimensional system, the one developed by Tam Co. has been introduced.) Each of the NC machine operators, including a female part-timer and a deaf person, are programmers.

In order to keep the NC machines in unmanned operation overnight, they must be free from tape changing. It is even common for them to use consecutively five long three-dimensional manufacturing tapes, each measuring 250 meters. This company, however, has designed and produced a unique tape winder, which links three separate NC tapes into a long one, thus eliminating the manual type change, and is further developing a tapeless system by means of a Winchester drive. As is the case with Hirai Ironworks mentioned eariler, this company is imbued with the spirit of challenge to the development of intermediate technology, a traditional virtue of Japanese small enterprises.

The outfit of machining centers and wire-cut electric discharge machines (plus 3 regular electric discharge machines)—a host of equipment—represents a strong productive power unparalleled in other enterprises of the same industry. For example, in the case of manufacturing successive feeding stamp dies, the production period of two weeks can be reduced nearly by half, by concurrent operation of the 5 wire-cut machines for each die.

In the case of a general order for metal dies, standard unit dies are quenched in advance, holes are made for wires and punched blocks are provided ahead of time. Upon receiving orders from customers (through facsimile) in the evening, the company immediately sets to work on programming. Thus the ordered molds can be ready for the customer by the morning the next day through continuous unmanned operation of the machines overnight.

Based on the idea that "machines are useless for other purposes when they are dealing with a certain work," this company equipped with numerous NC machines is active in receiving orders for parts for trial production as well. For example, in the experimental production of binocular frames, it normally costs ¥2 million and requires 1-1.5 months before delivery if the frame is to be produced from a simple mold & press operation. However, if the wire-cut electric discharge machine plus machining center are used to cut this irregular thin frame (3mm thick) out of the aluminium material, a delivery of only about 1 week and at a cost of ¥280,000 are needed for the work.

By keeping his hand in this kind of work with which large enterprises have given up, Mr. Hidetsugu Senbokuya, President, shows an eagerness to expand the frontier of NC machines, rather than to seek immediate profit from it. The cost for trial production is, in fact, estimated on the basis of actual figures despite the customer's statement of limitless budget. The results of cost accounting are made public to those concerned.

Then can you tell what constitutes the basis for this high level of technology which exceeds that of large enterprises, having some one hundred companies as customer? First of all, it is due to the fact that modern machine tools are located concentratedly in a narrow space, so that each field operator may be able to acquire a full knowledge of the advantages and limitations of the machine he uses.

Secondly, because the pressing machines are located in an adjacent workshop, operators can spontaneously absorb the know-hows of mold users. They say "In 2-3 years, operators will be able to make molds out of experience without the use of drawings". Thirdly, as many of the works are the orders for trial productions which are varied and difficult for those with ordinary machines, they have abundant opportunity for challenging them with modern technology. This may be an advantage of advanced subcontractors.

Fourthly, machines to be used are specified, such as presses of Aida, machine centers (MC) of Mitsui Precision or electrical discharge machines of Mitsubishi Electric Corp., so the company also has the role of showroom for machine manufacturers. Those manufacturers, in turn are forced, in a sense, to supply the company more actively with the most up-to-date technological information.

In the factory of this company, many employees of different careers such as carpenter or cook are being trained to be skilled operators of the new machines. Based on the corporate personnel policy, the employees are assigned to a job they desire to tackle. Field operators try to programming, then designing of molds and trial productions, then CAD. Thus, training needs are grasped spontaneously.

On the other hand, its top management attaches great importance to the old-type skills attained by trained workers over many years, the skill to wrap up works of assembling, finishing and others. The management has a clear understanding that skilled NC machine operators can be brought up in 2 or 3 years, but that old-type skilled workers are not trained in such a short period.

Like Hirai Ironworks mentioned earlier, Senbokuya is always open to visitors—a sort of showroom of robots and NC machines for their manufactures. According to Mr. Hirai, the visit of outsiders helps improve the morale of the employees as much as TQC does. Both Hirai and Senbokuya are enthusiastic about the training of their employees, and based on the concept that workers should hold a broader view in the age of robotics, they carry on a unique and positive policy—in the case of Senbokuya the employees are encouraged to choose a job as they wish, and Hirai's employees are asked to report in writing once a week their impressions of an NHK TV program, "Management Strategy" (video tape).

These two companies hold fast to the idea that the introduction of new machines will not necessarily bring immediate profit to them but that at least 1-3 years will be needed for the study on their efficient use of these machines. What makes it possible are the programs for introducing pioneer-type new technology and their financial structures which enable to support of the programs.

Conclusion

The ME revolution is often regarded as if it were the age when experienced workers become out-dated or various technical know-how that workers have mastered over the years become useless. If so, then is it desirable to preserve work which has already become less interesting for workers because of its more or less unhuman nature?

It is interesting, however, to note that as mentioned earlier, entrepreneur of medium-sized core robot manufacturers with strong individuality or those of companies positive in introducing NC machines and robots regard the ME revolution as an age whan all employees have to face the challenges of the innovation in the progress of liberalization of labor from routine work, a time when they must try hard to eliminate bureaucratic management which large enterprises are liable to fall into and which do not hesitate to prevent from this challenge, and to strive for active communication between management and labor.

Appendix A "An Investigation as to the Introduction of Highly Automated Machines"

The reporter's intention is to maintain that the introduction of NC machines and robots will little contribute to productivity improvement, unless there is an innovative atmosphere for pursuing both humanity and efficiency of labor in the working environment.

It has often been emphasized by some erudite persons and critics that, in Japan too, the introduction of these highly automated machines will bring about less employment or more unemployment, and cause middle and advanced aged workers to undergo much suffering.

I would like in this connection to introduce to you the results of "An Investigation as to the Introduction of Highly Automated Machines" (1983 edition) conducted by Kanagawa Prefecture, a representative modern industrial district in Japan.

According to the Investigation, highly automatic machines have been introduced into 27% of all business establishments, robots in 11% and NC machines in 21% as of 1982 (Table 1). It is estimated that robots will be introduced into 27% of the enterprises and NC into 26% by 1987.

In order to find the impact of highly automatic machines on the employment situation, the Investigation also covered a comparative study of 1978 and 1982 in regard to changes in workforce strength between establishments which introduced the machines and those which did not (Table 2).

Contrary to the general expectation, the results of the Investigation indicates that employment increase is higher in establishments where automatic machines are introduced, than in others (non-users). The enterprises engaged in manufacturing or assembling micro-electronic products and parts particularly show higher increase in employment.

However, it is true that the increase in terms of the number of regular employees during the corresponding years is higher in enterprises which did not introduce automatic machines. In other words, the ratio of employment increase remains smaller in users than in non-users, though the former is higher in so far as the worker strength is concerned. ME-related establishments show, in particular, remarkable increases in this trend.

In examing changes in the number of employees by functional division of establishments, it was found in the case of user enterprises that employees increased in number by 10% in the manufacturing division, and by as much as 49% in the R&D division. In both divisions, the number of enterprises with increased employees exceeds that of those with decreased employees. This fact explains that, while machining operators are tending to decrease in the manufacturing division as the result of the introduction of high automatic machines, new job opportunities are presented in the areas, such as teaching of playback robots, preparation of NC tapes, selection/determination of cutter angles of jigs and tools called tool presetting, maintenance, etc.

It is also reflected in the fact that upward changes in job classification are being made, i.g. skilled operators of traditional machines are permitted to tackle the development of new software programs for NC machines, or development/improvement of self-developed automatic machines, NC & robot peripheral equipment, etc. These facts were also pointed out in the above mentioned Investigation.

Under the current situation in Japan, high automatic machines are introduced on the condition that no workers are dismissed from employment as a direct result of their introduction. That is, the introduction does not lead to substantial decrease in employment or increase in unemployment. I would like to point out that their introduction is compatible with the increase in employment in the manufacturing industry, even if the increase in employment of new job classifications related to the ME revolution (e.g. the increase in computer software employees) is not taken into account.

Table 1

The introduction rate of high automatic machines by industrial classification and no. of employees

		The introduction rate of high automatic machines (%)	Industrial robots	Breakdown NC machines	Transfer machines	FMS
Total	n=2900	26.9	11.3	20.5	4.6	6.6
Foods	n= 295	1.5	1.5			
Fiber & clothings	n= 87					
Lumber & furniture	n= 75	22.6	10.7	16.9	3.2	
Paper & pulp	n= 140	3.9		3.9		
Petrochemi.	n= 219	7.6	4.6	3.7	1.5	
Iron, steel & non-metal	n= 130	17.8	6.2	15.2		11.2
Metal Prod.	n= 312	31.3	16.7	19.3	7.1	9.7
Machines	n= 367	51.5	9.2	48.6	5.5	4.0
Electric appliances	n= 641	32.9	13.6	24.3	3.8	4.4
Transport. equipment	n= 290	42.0	22.2	34.4	17.4	9.1
Precision	n= 83	31.6	11.3	24.6	7.0	17.5
Plastics	n= 104	29.4	26.0	10.7		12.4
Others	n= 193	19.7	12.4	11.3	3.0	7.9
– 29	n= 186	6.2		6.2	1.2	
– 49	n= 934	20.0	5.7	14.6	1.9	4.3
– 99	n= 814	20.0	7.4	15.0	2.3	4.8
–299	n= 629	32.7	16.6	21.5	5.6	2.9
–499	n=141	46.0	17.7	40.2	8.0	12.3
–999	n= 107	64.4	30.0	57.7	19.5	7.1
1000–	n= 91	88.6	58.6	77.6	30.9	20.7

(n=No. of establishments in Kanagawa Prefecture. having more than 30 regular employees)

Table 2

Changes in no. of employees (1978 – 1982) by establishment

Please see notes below.

		−30	−20	−10	0	+10	+20	+40	+40−	N.A.	(−) (%)	(+) (%)	(%) (%)
Total	n=2.900	7.6	12.2	17.2	4.0	15.9	11.6	12.3	11.7	7.5	37.0	51.5	115
High automatic machine user establishments	n= 781	6.0	9.1	20.8	3.4	18.0	13.5	11.8	10.7	6.7	35.9	54.0	111
High automatic machine non-user establishments	n=2.119	8.2	13.4	15.9	4.2	15.1	10.9	12.5	12.1	7.7	37.5	50.6	116

Total	n= 448	6.2	6.3	6.3	4.4	14.4	13.7	13.0	24.8	11.0	18.8	65.9	142
ME users	n= 206	5.5		9.5	1.1	17.3	18.6	11.7	22.4	7.0	18.6	70.0	123
ME non-users	n= 242	6.8	8.5			12.1	9.5	14.1	26.9	14.4	18.9	62.6	159

(−) % of establishments whose employees decreased in number during the period.

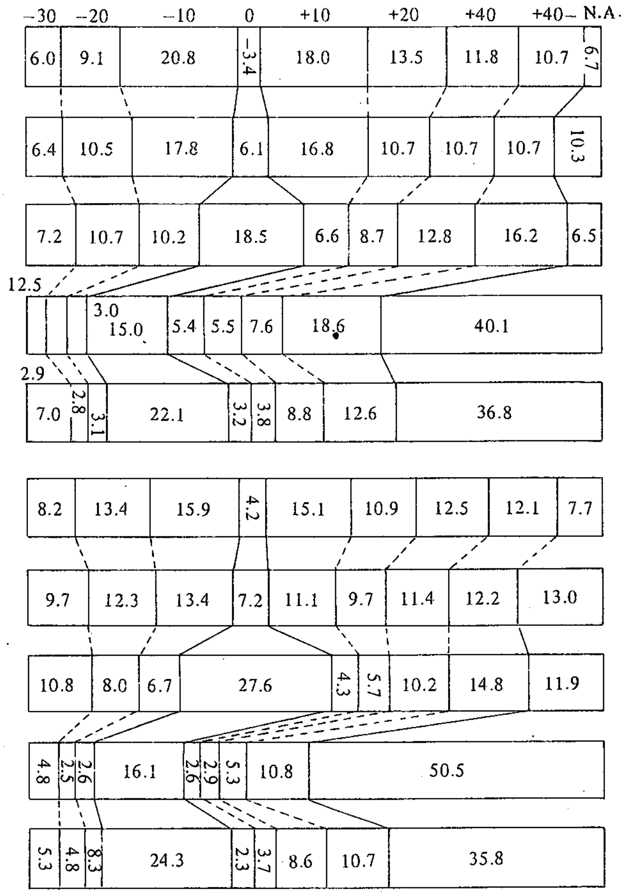
(+) % of establishments whose employees increased in number during the period.

(*) % shows the increase in number of employees during the period.

Table 3

Changes in no. of employees by functional division (1978 – 1982)

Please see notes below.



	(–) (%)	(+) (%)	(*) (%)
High automatic machine user establishments Total	35.9	54.0	111
Manufac.	34.7	48.9	110
Admin. & Clerical	28.1	44.3	115
R & D	8.2	37.1	149
Marketing & others	12.9	28.2	116
Non-users Totai	37.5	50.6	116
Nanufac.	35.4	44.4	116
Admin. & Clerical	25.5	35.0	111
R & D	9.9	21.6	126
Marketing & others	12.4	25.3	118

(–) % of establishments whose imployees decreased in number during the period.

(+) % of establishments whose employees increased in number during the period.

(*) % shows the increase in number of employees during the period.

Appendix B

Office Automation – The Points at Issue

Discussions are focused in this Report, chiefly on the current situation of the ME revolution on the industrial level, and there was little or no space to cover the subject matter on the office level. So I would like to refer very briefly in the following few pages to the current OA situation together with the points at issue.

From the outset of the 1980's, a lively discussion was started about Office Automation (OA) in Japan as in other parts of the world. Small, highly efficient and inexpensive personal computers are gaining a general popularity at a tremendous speed. (Annual output – 110,000 units in 1980, 330,000 in 1981, 660,000 in 1982, and 1,110,000 in 1983)

Together with the development of Japanese word processors, the spread of personal computers may clear away all paperwork and secretaries in the office. As the use of computers becomes more expanded, office employees will decrease in number accordingly. It isn't felt by the Reporter, however, that these observations do tell the current OA situation adequately.

OA is originally an efficient system for dealing with business information available for management decision making. In that, it seems to pursue the same objectives as that of the Management Information System (MIS), which aroused much discussion about 10 or more years ago. However, it differs radically from MIS. That is, by means of a large-scale computer system, the latter aims specifically at providing top management with information useful for their decision making, serving as a centralized information system which is under the control of limited number of professionals and experts.

Contrarily, OA should function as a decentralized information system, under which each worker uses computers for the processing or the utilization of data according to his managerial level. That such office system has recently come into reality is because most have become capable of using computers, along with the appearance of personal computers.

So far, data processing by means of large computers (and a lot of terminals) has been limited to corporate data covering the whole operation of a company. And it seems to perform only 30% of the total clerical work. The remaining 70% is work having no involvement with computers at all. (Information is processed within each of the operating divisions, sections and branches only.) The introduction of personal computers has enabled them to handle this data through computers.

So far as personal computers are concerned, it is not the time for advanced business offices to introduce any for the sole purpose of their own, but instead the days are coming when their local network (LAN), or that including a large host computer, should be formed. The formation of these networks is essential for the rational utilization of personal computer peripheral equipment (printers/plotters), for the utilization of data stored in host computers though micro-host-computers, or for the joint ulilization of data prepared by individual personal computers.

Komatsu Seisakusho (a manufacturer of civil engineering and construction machines) is forming strenuously a local network (LAN) for efficient operation of its office work (indirect operation). According to the experience of its Kawasaki Plant (no. of employees–1,200, including 300 indirect workers), in order for their computer staff to make the most of their LAN, it is primarily essential to establish an easy network system so that every employee may maintain a positive attitude in using these automatic office machines.

Therefore, the computer/personnel staff of the plant are giving all of their employees training in the use of PIPS, a simple language developed by Sord Co. of Japan, and KOA, an application software developed within Komatsu as a supplement to PIPS, while avoiding BASIC which is difficult to learn. In addition, with the intention of alleviating the barrier of empty data input, they set to work on a new network system involving super minicomputers which simplifies the use of data from the host computer.

As far as its objectives lie in the efficient operation of office work and the release of computers from the exclusive possession by experts for that of general employees, OA will not lead to an immediate decrease in the workforce. If it aims at direct personnel reduction, its spread would certainly become difficult, because the employees' spontaneity in participation is indispensable.

AUTOMATION AND CORPORATE POLICY IN JAPAN

Dr. Shigeru Shinomiya
Executive Vice President Honda Motor, Co, Ltd.

Dr. Taizo Ueda
Managing Director, Honda Foundation

It is a great honor for me to have been given this opportunity to talk on Automation and Corporate Policy, principally on our experiences in Honda Motor Company.

Before going to the problem of adapting automation to production of cars and motorcycles, I would like to speak on the cultural background of Japanese technology.

Italy has her own cultural system so does Japan. Each of these cultures has a unique cultural system based on the two respective histories. As accurate perception of the common and different characteristics of various cultural systems may be the starting point of intercultural communication.

Therefore, I would like to, first of all, tell you how the Japanese perceive technology.

Any one nation has its traditional way of perceiving technology. Very strong rejection may be seen when certain forms of technology are introduced, while no rejection may be observed for other types. For example, those of you who have visited Japan may have observed that automatic vending machines are installed almost everywhere in the urban and rural areas of Japan, under the eaves of small stores, in hotels, and in railway stations. At the present, there are approximately 5 million vending machines selling juice, cigarettes, railway tickets and so on in Japan. The Japanese do not hesitate to make use of vending machines in their every day life.

Technologies are accepted by society only when they meet with the needs of the society. In the introduction of a new technology, the following situations may be observed: in one situation, the technology is accepted even though it requires a partial change in the social structure and is not considered a nuisance; while in another situation, a technology is rejected because it intrudes into the social structure. Such situations arise from the culture of the nation, on which the perception of technology is based.

The first sciences and technologies that Japan imported from Europe included guns, medical science, and astronomy. In 1543, the Portuguese brought guns into Japan. In 1549, Francis Xavier arrived in Japan, Japan's first encounter with Christianity. Then medical science and astronomy were brought to Japan. These be referred to as very practical sciences and technologies. Approximately three-hundred years elapsed from this period until metaphysics was imported into Japan from Europe.

I would like to touch upon Japanese religious awareness here. The Japanese are not normally conscious of their religious behaviors, nor do they try to cast light on the meaning of their behavioral patterns. Many Japanese, for example, perform Shinto rites on congratulatory occasions such as wedding ceremonies, the day of celebration for children of three, five and seven years of age, ground-breaking ceremonies, and completion ceremonies of constructions. The same individuals, however, would perform Buddhist rites for death-related occasions such as funerals and memorial services. And in everyday life, it can be said that relationships between parents and children or with neighbors are maintained in accordance with Confucian ideology. Moreover, all of these patterns of behavior have become folk customs, thus a Japanese person does not stop to consider whether his or her behavior is based of Shintoism, Buddhism, or Confucianism. The three religions in the minds of the Japanese spontaneously appear and disappear.

Shintoism was originally polytheistic and of a vague and unsystematic nature. Buddhism and Confucianism, which were imported to Japan in the 6th century from China were also Japanized. Therefore, they have become something quite different from the prototype Buddhism and Confucianism that exist today in India, China, and Korea. Because the roots of Japanese religious awareness are found in Shintoism, it is possible for Buddhism and Confucianism to coexist without leading to any form of absolute confrontation. Accordingly, a decisive difference is observed in Christianity where the relationships between God and man are strict and tense.

Visitors to Tokyo will probably be surprised to see our style of food, clothing and housing, in which Western culture and Japanese culture coexist. We have our traditional "Kimono" and the same styles of clothing as that of the Europeans – it just so happens that Japan is a huge market for European fashion goods, too – ; high-rise buildings and Japanese-style housing, and all sorts of cuisine.

Japanese theatricals also show extreme diversity: "BUGAKU" with a 1,000-year history, "Noh" or "Kyogen" with a 600-year history, traditional Japanese plays such as "Kabuki" and the plays of modern Japanese writers such as Abe Kobo appear on stage. And, at the same time, a large number of European and American plays by such European and American playwrites as Shakespeare, Schiller, Moliere, Tschechow, Ibsen and also such modern playwrites as Ionesco, Harold Pinter, Peter Shaffer and others are presented. It was back in 1758 when a Japanese (Shozo Namiki) invented the revolving stage. Later in 1905, the renouned director Max Reinhardt, applied this revolving "Kabuki" stage. Following this, almost all theaters in Europe have installed revolving stages.

In the world of pictorial art as well, something Japanese and something Western distinctively exist, exerting influence upon each other without eliminating the other. This might seem strange to Western people. One of the characteristics of Japanese culture can be said to be the capacity for coexistence. The Japanese can be said to have absorbed everything, transformed it to a Japanese type, and incorporated it into the Japanese cultural system. If the Japanese cultural system is one that is able to accept various types of value systems, we might as well say that such a system is an important concept in the modern world where everything has become diversified.

Let me now return to the subject of technology. Historically, the Japanese have never showed any opposition to technology belonging to the category of machine mechanisms. The Japanese believe that robots were invented as a mechanism and that a machine which works in a manner similar to human beings is useful for mankind. If something seems useful for their life, the Japanese would evaluate and adopt it. Japanese people give priority to functions. If one technology has the characteristic of assisting and improving the functions of human activity, then the Japanese would be willing to adopt and utilize it.

However, a big problem is presented here. The most important issue we must face in the introduction of robots, a typical example of automation, is "What is the real purpose of robots?" It is necessary to consider the relationship between human beings and automation.

Before discussing the subject of management policy, let me now show you a film. This film was produced for today's lecture by professor Masahiro Mori of the Tokyo Institute of Technology, an expert on robots, with the cooperation of the Honda Motor Co., Ltd.

When European science and technology were imported in the 16th century, as I mentioned earlier, the Japanese people were able to immediately understand and applied them because the foundation of such science and technology was in existence at that time in Japan. Tools, agricultural implements, and so on have undergone remarkable development and industrial art objects, with high craftsmanship, and practical instruments have carried on a long tradition. Furthermore, the astoronomy that perceives the universe as one mechanism had been developed as well.

Following the Meiji Restoration of 1868, science, technology, and industry in Japan underwent modernization. And following World War II, especially during the 1960s and 1970s, Japanese companies were able to achieve production improvement and distribution efficiency. For example, the average annual growth rate in labor productivity in the manufacturing sector of Japan recorded 9.5% for the years between 1960 and 1967, 11% between 1967 and 1973, and 5.8% between 1973 to 1980. The figures recorded in the U.S. during the same periods were 2.5%, 3.6% and 1.1%, respectively.

In the Honda Motor Company, the number of employees during the decade of the 1960s increased annually at an average rate of 15.7%, while sales increased by an annual average of 20.4%. However, in the decade of the 70s, the number of employees increased by an annual average of 2.7% and sales by 15.5%.

One of the reasons why the management efficiency of companies was improved was the immediate response companies made to the diversified needs of consumers. Honda Motor Company, for example, has 47 factories in 29 countries of the world at present. In our 35-year long history, Honda has constantly sought the needs of consumers in each country of the world, has considered how to satisfy the needs and produce the goods at low cost and high quality, and has carried out such ideas.

What I would like to emphasize here, above all, is the fostering of human resources in the company. We have made our utmost efforts to bring out the abilities of our human resources in the company, fulfill their purpose of working, and develop their abilities. Based on such efforts, we have adopted a system of the participating society in our company.

"Companies are no more than the concurrence of people," is a time-honored phrase. It has become all the more necessary to consider the basic relationships between automation and human beings as the process of rationalization by means of automation is increasing.

Automation is merely one method of rationalization, and should not be put a simple schema that equates automation with labor saving.

Automation definitely has a purpose. In recent years, automation through the introduction of robots has become popular. It is after the case, however, that the adoption of robots is, in itself, the purpose.

In an attempt to define what work is in the relationship between human beings and automation, it is necessary to classify work into two categories: the kind of work human beings should carry out; and the kind of work human beings should not engage in. Automation should be introduced, first of all, to those areas of work human beings should not be engaged in such as carrying heavy goods, difficult work, work in unhealthy environments, work in which quality maintenance is difficult, and so on. Automation in such areas is a need of field workers.

However, the needs of technological experts tend to precede that of field workers. Thus, it is often the case where automation is realized in such areas where automation is easy or where technological interest exists. Many areas that actually require automation are left untouched due to such reasons that automation is not profitable or difficult in terms of technology. Nevertheless, the responsibility and obligation of technicians should be to make effective investments.

It is an incomprehensible fact that those who are not in the position to be affected by the labor saving have the inclination to encourage labor saving. Automation should be basically considered from the standpoint of those who should be affected by the labor saving.

The economics of automation such as investment effects and so on are important factors. However, if they are to be the only yardstick for judgment, it is quite likely that automation would fail.

Automation, if it is first introduced in the fields that meet the needs of the site workers, would result in improved productivity and sufficient investment effects. It is necessary to clearly define, with the cooperation of field workers, the needs of the site.

During the 1960s, large investments were made for rationalization. However, on the other hand, the simplification of repetitions work let to a loss in terms of human nature, which posed a question concerning productivity improvement. Reconsideration has been given to the "human" aspects of rationalization.

In the 1970s, we positively adopted such self-management activities as an improved suggestion mechanism, circle activities, and so forth. Such a participation system together with the management system was incorporated into a matrix system, through which we have made rapid progress in production efficiency. In Japan, where the social custom calls for long-term employment, it is an important factor in increasing productivity that employees feel their purpose of working is fulfilled.

Based on this historical fact, it will become increasingly necessary and important that rationalization through automation and increasing productivity through participation activities are not separated but integrated when implemented.

Production technologies can be divided into two categories: 1) technology to develop a production process different from the conventional one and technology to develop hardware to materialize the process; 2) technology to fully utilize the existing production facilities. The latter is a technology fostered only at the production site and is one fostered based on the principle of placing priority on the field workers and products. This is simply called know-how. Those who create the know-how are the craftsmen of today. Automation should be realized through the cooperation of today's craftsmen and production technology.

The adoption of robots as a means of introducing a flexible production system for the porpose of multi-product production and as a means to rationalize the production system in order to keep exclusive investments required by shorter life cycles of products to a minimum, is observed in every industry and exhibiting successful results.

Robots, however, are not for the purpose of replacing the entire human work force, nor are they almighty. Robots can only perform work based on the procedures and methods they have been programmed to follow. Such procedures and methods of programming robots represent know-how, which are created by the efforts of the craftsmen at the site.

Robots themselves can be purchased by anyone with the capital, however, know-how is something to be created by one's own hands. Know-how is an asset for companies. By giving birth to know-how different from that of other companies in the same industry, a company can become more competitive. This is exactly where field craftsmen can really display their talents. Robots will never create know-how nor suggest any improvements. It is important to establish a robot system over which human beings reign.

It is also important that field workers create automated facilities at the site by their own hands according to their own needs. There are many examples where workers make better use of the simple facilities they themselves have developed in comparison to the magnificent facilities they were given. When using machines, workers would naturally have a different degree of attachment to the facilities in whose development they participated, in comparison with facilities merely given to them and allowing no room for involvement on the part of the workers.

Regarding robot systems, attempts at rationalization are often made by replacing human beings with robots in the same work process and in similar work positions. However, the present work process and work positions are the most suitable for human beings in terms of work. There must be other functions better suited for robots. Human beings only have two arms, whereas many robot units could be used in one process to realize a much shorter work process. In the installment of items, it would be possible to change conventional positioning from horizontal to vertical, from top positioning to bottom positioning, and so on. If field employees develop a system that is most suitable for robots with their own hands by combining various kinds of robot units, then a unique system incorporating their own know-how, a system that human beings can reign over, could be created. What is important here it to form a clear-cut concept of automation and develop, with one's hands, the means to attain the goal. This is the basis for maintaining competitiveness to keep the edge over others.

As more automation, including robot systems, is introduced, the management side should remember to clearly define the expected image of field workers. Field workers, who have made considerable contributions to productivity increase through the participation system including circle activities, should not be made to feel betrayed or discouraged by automation.

Mere pursuit of inflexible technology would not bring about technological innovation, but would only destroy the independence of mankind. It would not contribute to the formation of culture, either.

The creation of a new technological culture centering around the present relationship between technology and craftsmanship is the task committed to all of us, managers and technicians.

I would like to conclude my speech with the following words.

A European poet said, "To know thyself, behold the behavior of others. To understand others, behold into thy heart."

These words hold true not only in the age when the poet lived, but in the current international relations and internal conditions of company management.

TECHNOLOGICAL INNOVATION, AUTOMATION, SOCIAL DEVELOPMENT: THE JAPANESE POINT OF VIEW

Dr. Akinobu Kojima
President, Nihon Short Wave Broadcasting Co.

The world is in the midst of an era of change. The economic social structure is undergoing a big change and international politics and world economy are being looked upon in an entirely new framework. Ours is an era of historical transition marked by two significant turning points: The Nixon Shock (1971) and two successive oil crises (1973 and 1979); and it is a period of disruption brought about by the formation of a new order. Technological innovation, moreover, has accelerated the pace of change, has expanded its scope and amplified the undulations characterizing it. With advances in such areas as robot application, the current of innovation in microelectronics has started to generate dramatic progress in the realms of factory automation, office automation and home automation. This innovation is forecasted to have a huge impact not only on the transformation of the industrial structure, but also on the pattern of employment, the social structure, family life style, and even the culture in general. It is indeed a great transition worthy of being called a new industrial revolution, but just what form it will take and to what extent it will produce change is still not very precisely predictable. Ours is an era of uncertainty holding out great hope for the future but also apprehension as well.

Until a few years ago, whenever the terms "technological innovation" were used in general, they were understood to mean great historical inventions. Beginning with Watt's steam engine, which ushered in the first industrial revolution, inventions such as the railroad, automobile, nuclear power, rocket, and transistor all led to new mass-scale production, and proved to be the impetus for great economic diatrophisms. But viewed in terms of a long-term undulation referred to as the Kondoratief cycles, technological innovation in this sense will not be forthcoming. Never before has there been such great debate even among economists concerning the possibilities for technological innovation. Nevertheless, economic and industrial society in the decade of the 1980s will definitely undergo a great revolution centering on automation. It goes without saying that the core of this revolution will be electronics primarily brought about by progress in areas such as the super LSI, microcomputers, and optical communications. At the foundation of all these developments is the semiconductor, which cannot be considered as a technological innovation in the traditional sense because it is merely an extended application of the transistor, which in theory was already invented back in 1948. But semiconductor technology brought about rapid reduction in the size of computers within a short time span of a little over ten years and a remarkably wide-scale reduction in computer prices. With regard to IC prices, in Japan the price of a 16K Ram LSI as of June, 1979 was ¥5600, but in March, 1983 its price dropped to ¥330. At the end of 1980, one 64K Ram Super LSI was ¥27000 but by 1983 its price dropped to ¥1300.

As a result, the super LSI and the microcomputer have come to be attached to a diverse range of machine types; the era of the robot has been realized, and innovative change has come to permeate not only every field of industry but also general office operations and even family life. The NIHON KEIZAI SHIMBUN (JAPAN ECONOMIC JOURNAL), the company with which I am affiliated, is now conducting a campaign project called the "New Industrial Revolution." The wave of change which we are currently facing is generating a great revolution on a scale exceeding that of the old industtrial revolution begun in Great Britain during the later half of the eighteenth century and even that of the second revolution brought about by electricity, chemical industries, and the introduction of flow production through automation. This fact explains why the current change is referred to as the "New Industrial Revolution." The robot has come to play a leading role at the work site and is replacing both blue-collar and white-collar workers. In the past, during the old industrial revolution, there was a campaign called the "Luddites Movement" aimed at destroying machinery, and this raises the possibility that workers who have lost their jobs to robots might condemn technology and embark upon destructive campaigns again. At the same time the robot will free workers from monotonous tasks and enable them to pursue more creative, future-oriented types of work; it may thereby enhance the quality of culture and the arts throughout the world and lead to the firm establishment of a more enriched mode of life.

It must be admitted that at the present stage it is very difficult to accurately forecast the economic and social effects which the realization of factory, office and home automation will bring. It might perhaps be better to simply say we do not know what these effects will be. In order to investigate these effects at the work site and in the home, Japan's Ministry of International Trade and Industry (MITI) has recently established a committee of specialists which is expected to release its report in the next two years. The latest book of the American journalist, Alvin Toffler, entitled "The Third Wave," became a bestseller a few years ago, and another book entitled "Megatrends," written by John Naisbitt, president of the Naisbitt Group of America, has been selling extensively throughout Japan. The reason for the success of such books is the fact that we really do not know how the economic and social structure will change in the future. No doubt in the future more advanced levels of technological innovation will be made in fields such as factory automation, office automation and flexible manufacturing within the industrial sector, but advances will also be made in the realm of private home life with progress in home automation paralleled with developments in communications technology; on a medium-term basis, the leading role will be taken up in the information field by advances such as INS (Information Network System) and realization of a highly sophisticated communications society can be expected. Before such a society appears, however, it is of course essential that diligent measures be taken to accomodate for the changes which it will bring.

Social Changes Resulting from Old and New Industrial Revolutions

	Era of Old Industrial Revolution	Era of New Industrial Revolution
Basic needs	Enrichment of materials	Quality of life
Consumer orientation	Popularization; standardization	Individualization; diversification
Principal objects of needs	Physical materials	Information, culture, service, health
Basic production	Mass production of diverse consumer goods	Low volume production of diverse range of products
Production system	Flow operation; automation	Flexible manufacturing, robots, computer aided design, MC
Core technology	Steam engine	Electronics, new materials, biotechnology
Trend towards mechanization	Increased substitution for manual labor	Increased substitution of intellectual labor
Leading industries	Heavy petrochemical industries	Individualized production
	Era of Old Industrial Revolution	Era of New Industrial Revolution
Plant location	Concentrated coastal industrial zone	Regional distribution; airport vicinity industrial zone
Corporate structure	Expansion with concentration at home office	Diversification; distribution of functions
Lobor force	From farms and villages to large cities	From large cities to regional districts
Economic structure	Divisions in production and consumption	Fusion of production and consumption
Market structure	Mass production; popularization; expansion	Non-mass production, specialization, fractionalization
Major distributors	Department stores; supermarkets	Specialty stores
Major household expense	Durable consumer materials	Miscellaneous expenses
Social structure	Crowding and depopularization	Development of regional cities and communities
Energy	Concentrated use of fossil fuel	Diversified use of soft energy
Political strucutre	Centralization of power and representative democracy	Division of power among regions, direct democracy

(Source: Nikkei Industrial Daily)

One of the first effects which change will bring is further progress in the electronification of the industrial structure. Already after the second oil crisis, the electronics-related industry in Japan achieved a rapid increase in its share of real production sums. Electronics-related industries include those producing electronic equipment such as computers and semiconductors but also those producing other equipment with built-in microcomputers such as light electrical appliances, electric appliances for household use, office equipment, industrial equipment and precision equipment. In 1975 the electronics-related industries accounted for 5.9% of total production; in 1980 it took up 8.5%, and by 1985 it is expected to take up 10.6% of total production according to forecasts by Sumitomo Bank. This trend is in direct contrast to that of materials industries such as steel and synthetic fibers, industries which played a major role in the development of Japan's economy after the Second World War. Percentages for these industries are forecasted to drop from 29.6% in 1975 to 27.6% in 1985. Electronification of industry has progressed so steadily that electronics can now be called the new staple of industry in place of steel. In the mechatronics sector, industrial robots and NC (numerical control) machine equipment are expected to appear along with CAD/CAM (computer aided design/ computer aided manufacture) for the purpose of rationalizing design operations. From this will emerge FMS (flexible manufacturing systems) and eventually development of fully automated production systems in the future. These rapid technological innovations will bring about a significant increase in the size of the market for the electronics industry of Japan, expanding it from 4 trillion yen in 1980 to around 20 trillion yen by 1990. In consequence, the economy has shifted from an era of expansion in volume terms to an era of improvement in terms of life style quality. Even in Japan, where good performance is given special attention, industries are entering an era of medium to low level growth. In the future, only the electronics industry can be expected to maintain very high growth levels of 10% or more.

Progress in electronics technology is not only expected to expand the market shares of electronics-related industries but is also expected to bring about qualitative changes in the entire industrial structure in the form of greater service and greater software application. In considering the case of the manufacturing industries, it must be pointed out that with the first industrial revolution in which the steam engine, electricity generator, motors and other equipment fully replaced manual labor power, came large volume production, large volume transport, and large volume sales (consumption). However, in the new industrial revolution, in which automation is achieved with computers to result in industrial robots and flexible manufacturing systems are realized through systemization of NC (numerical control) machine equipment, an intellectual revolution will result since the machine will work in place of human intellectual labor; this revolution is progressing to the point where even skilled workers will no longer be necessary. A very pronounced shift is being made in emphasis within the manufacturing industries towards software engineering. Furthermore, as systems for production of a diverse range of products becomes established through electronification of the produciton line, it should become possible to reduce costs for the production of individual products so that they can compete with mass-produced articles. If this senario emerges, consumers will be able to select individual products specifically suited to their own tastes. Competition in the market will focus on how accurately the needs of consumers can be met. Knowledge and money will have to be centered on product planning. The importance of affiliated departments such as sales and management will increase and much greater emphasis will go for product manufacturing service operations.

This expansion in the importance of the service department in the manufacturing industries, together with the recent developments in communication and transportation modes, has been a factor behind the trend towards separation from the processing department. This applies both inside and outside the nation. Progress in the evolution of an information society obviates data differentials with in a single nation, and the necessity for concentrating main offices and plants within large cities will disappear. In the jet age, the world has been quickly reduced in dimensions, and social intercourse has been made quite easy. In such a new era, it will not be unusual to see international division of labor within R & D departments or product planning departments, and it will be possible to entrust more to corporations unique to regional small and medium-size cities. Also conceivable is the commencement of industrial cooperation surpassing individual national boundaries and other international barriers and even leading to the intermingling of different industrial types.

Over the last ten years electronics technology has undergone rapid development and in the future this technology will form the basis of a huge change in industrial soceity as a whole. It is not a question of the scope of corporations. The key to victory lies in the establishment of a network whereby data transmission capacity, technological capacity and the capacity for international comprehensiveness can demonstrate themselves in the most efficient manner. We have entered an era in which emphsis is placed on youth and vitality, on management systems in which policy can be determined quickly, and on organizations which make prompt response to change possible. As venture business firms, which concentrate all their R & D efforts on pioneer technology and thereby gain a high level of technological capacity, gain in overall strength, it becomes much more likely for large corporations to steer a course of fragmented proliferation rather than expansion of the overall corporate body. Child companies which evolve from the various operational departments of large corporations may in any number of cases prove to be more prosperous than the parent firms. And in this sense the era can be referred to as one characterized by new venture business of unique small to medium size corporations.

Expansion of service departments, of course, will not be limited to only the manufacturing industries. Within existing service industries, distribution and financing will be enhanced through development of optical communications systems and super-computer systems; and new business operations will appear such as new medical treatment information systems, home banking and point of sales systems in the medical supplies sector. Various types of service operations will emerge from new developments in the information industries.

Given that the importance of the service industries is increasing within the overall industrial structure and that the economy is shifting in emphasis to services, the medium-range forecast committee of the Economic Planning Agency released a report last year entitled "Japan in the Year 2000" in which, as can be seen in the attached charts, Japan's service industry is expected to reach 140.9 trillion yen by 2000 or over twice its size in 1980, and thus make up nearly 50% of the entire industrial structure.

As shift is made towards services in the industrial structure, a vacuum is generated in industry; workers who loose their jobs to robots take up a superficial interest in cultural phenomenon as recompense and criticism that society is losing its vitality begins to emerge. Yet the shift towards services and robot application is basically desirable for Japan's economy and it can be expected to strengthen the economy in qualitative terms as a whole. In the first place, as automation significantly enhances the productivity of the manufacturing industries, the introduction of electronics to machinery can be expected to enhance the productivity of the service industries, which up till now has been low. Secondly, as progress is made in data transmission in society, new knowledge intensive services will function to increase the level of value addition in the economy. Thirdly, a form of industrial structure will emerge which fosters conservation of energy and natural resources and is thus most suitable for an era of limited natural resources. Fourth, shift towards services has little effect on materials costs and as wage costs are stabilized through improved productivity, commodity prices are also more stabilized. It is considerations such as the four just mentioned which justify the view that robot introduction is good for the economy as a whole.

The problem is that the electronification, Japan will be functioning at the foremost position in the world and in the future its industries will maintain their relative international superiority for some time. This is especially true when factors such as the following are considered: 1) Japan has no rival when it comes to capacity for development of technological components; 2) healthy labor/management relations are maintained in Japan because of its company union system; 3) the Japanese people continue to be diligent as severe competition persists in society; and 4) the rate of financial savings in Japan is overwhelmingly high. For these reasons, we must be prepared to face continuous trade and economic friction vis-a-vis overseas nations.

In addition to the theory of a strong Japanese economy, a more cautious theory has also emerged in view of the following point. That is that with the introduction of the robot, creaks may begin to emerge in the pliable industrial structure of Japan which incorporates small and medium size corporations under subcontract. As large corporations introduce robots even to small-town plants functioning under subcontract, the level of sophistication throughout the industrial sector will be enhanced, but it must also be remembered that unless a robot is made to operate throughout 24 hours each day, its merits are lost. In a time of economic recession, adjustments cannot be made with robots as can be made with hours for workers. Furthermore, subcontracted companies with robots would be even more pressed to cut off further subcontracted companies in times of recession to make compensation, thus leading to greater social friction.

The next question which must be considered is the effect that progress in electronification, together with automation, might have on corporate operations, especially on workers and employment. It is only natural that fear of the effects of employment reduction would arise in an era in which robots are lined up in rows in the production processes of factories, and equipment such as word processors and personal computers are activated in offices. For example, at the Fuji plant of the FANUC LTD., a well-known large scale manufacturer of NC equipment and industrial robots, operations have become so highly automated that it takes only one worker to cover an entire night of performance. Cautionary arguments that microelectronics would lead to further unemployment took hold especially in the nations of Europe which are faced with unemployment problems, but in recent years serious debate has begun to emerge even between labor and management in Japan. Nissan Motors reached an agreement with its labor union (about 70,000 members) in March of this year concerning introduction of industrial robots and other equipment utilizing the latest technology such as FA technology. The agreement calls for prior consultation between labor and management before introduction of new technology. The agreement clearly stipulates that employment and work conditions will be maintained and its essential points can be summarized as follows: 1) Loss of employment or temporary lay-off will not result from technology introduction; 2) Worker demotion, wage reductions, and poorer work conditions will not result; and 3) In transferring union members or changing their types of work, due to consideration will be given to the worker's capabilities and aptitude and proper education and training will be provided. (NIHON KEIZAI SHIMBUN: March 1, 1983). Japan is not the only nation in which written clarification has been made of the proper relationship between labor and management for responding to microelectronic developments, but the case of Nissan Motors can be presented as an example for future reference.

The joint electrical workers union (570,000 members) issued a report based on its regularly scheduled convention held in July 1983 concerning the effects of microelectronics on employment; it revealed that middle-aged and older workers in the electrical industry, the foremost in application of microelectronics, were exposed to more severe work environments than had ever been forecasted. The same report revealed that the workers wanted most when assignment changes are made are men in their twenties and thirties; female workers and middle and old age workers are excluded. Among the 277 corporations investigated for the report, 13% or about 50,000 workers out of a total of 370,000 lost their jobs through introduction of microelectronics. This trend was reportedly especially pronounced for fully matured corporations in heavy electric apparatus, household electric appliances and audio-related equipment. Even though these corporations are most advanced in terms of labor conservation, as many as nine out of ten workers claim that overtime is increasing (about 40%) and that they do not receive enough paid vacation time. In addition, as many as two out of three young male workers in fully automated plants complain of mental stress and fatigue and apprehension is increasing over the effect of automation on worker health.

The same union has thus taken a very strong stand against microelectronic application; it carries out thorough checks for prior consultations between labor and management and for health and safety; it establishes concrete guidelines concerning guaranteed employment and other matter, and it directly opposes the application of microelectronics when it is forecasted to have a direct effect on employment in realignment of personnel. When research was conducted five years ago in 1978 by the OECD on the effect of the spread of the microcomputer, Japan produced the most optimistic report, claiming that it would have almost no effect on employment in the nation. But the rapid advancement of microelectronics once into the 1980s has made it unwise to simply stress optimistic points. The fact that corporations are reluctant to hire new graduates and others have stopped hiring entirely this year only indicates all the more that conditions do not warrant optimism. An increasing number of corporations have drastically reduced the number of male and female high-school graduates in particular that they will hire. This trend is explained by the necessity for sharp cuts in employment of new workers resulting from rationalization of immediate and affiliated departments through introduction of factory and office automation.

In general opinion is divided between optimism and pessimism over the question of the effect of microelectronics introduction on employment. It is clear that if microelectronics is introduced at plant sites in the manufacturing industry, productivity will increase and labor conservation will result, and thus if there is no expansion in productivity, there will be no demand for new workers and employment will either be reduced or stop altogether. If expanded application of microelectronics leads to the successful development of new products, however, employment should also expand in accordance with increasing demand for the new product. In the automobile and electrical equipment industries of Japan, which account for about 60% of all industrial robot application, the trend up till now has not been towards reduced utilization of human labor but, on the contrary, towards increased utilization.

Another argument in favor of an optimistic outlook is that although introduction of microelectronics leads to replacement of human labor and the elimination of old job categories, it also generates new job categories and thus in total, it does not lead to a reduction in demand for human labor. Introduction of revolutionary data processing technology has led to the development of new needs in society. By overlapping industrial types with new forms of technology never before dreamed of, new markets are generated and the necessity emerges for new forms of human capacity. The need for fully developed manual workers with accumulated experience will diminish, but demand will grow in the current era for more workers with intellectual competence to accommodate new fields. Examples of such new fields include design of robots and other equipment, research and development, and servicing and management once new equipment has been introduced. Still others are design of systems after microelectronic technology has been introduced, software development, and new marketing to accommodate technological innovations. Even in such areas as administration and finance, the pivotal operations of corporations, there will be a necessity for human labor as never before seen. These considerations lend strong support to the view that the overall volume of employment in the manufacturing industries will by no means drop.

Among administrative and business affairs centering on the service industries, office automation has led to increased office efficiency and a reduction in required human labor but at the same time data has become more sophisticated and its evaluation has required greater diversification and specialization among personnel and with the development of more refined consumer services and other features, office automation is not expected to have any harmful effect on the overall volume of employment.

In general up till the present, most surveys in Japan have resulted in an optimistic outlook. Even if this optimism is not as great as that of the report on Japan submitted to the OECD, most survey results indicate that as of now no serious effect has been made by microelectronics on employment. Example of such survey include the following: the medium term report issued in August of last year by the Employment and Occupation General Research Center's Survey Committee on the Effects of Microelectronics on Employment; the survey report of the Japan Economic Research Association issued during the same term, and recent monthly reports of Sumitomo Bank Survey (May and June, 1983 issues).

The manufacturing and service industries have brought about a great change in the structure of demand for human labor. Yet if economic growth can be smoothly maintained and if the speed with which technology innovation advances is not too swift, the oversupply of middle and old-aged workers ousted from current work sites can be properly dealt with in the new age if education and retraining for assignment transfer progresses smoothly; then adequate adjustments can be made for the changes in structure resulting from microelectronics. There will be no need to worry about the effects of microelectronics on employment if the spread of microelectronics on employment if the spread of microelectronics occurs in conjunction with an expanding capacity to absorb human labor centering on the service sectors. Until now, Japan has been blessed with such favorable circumstances. An example which I myself occurred at THE NIHON KEIZAI SHIMBUN Inc. when, through the introduction of computers into the process of newspaper manufacture, about 100 workers involved mainly with printing typesetting were no longer needed. These personnel were transferred either to regional cities where printing had commenced or to security or office duties within the main office in Tokyo without any friction arising.

The question is whether such transfers can be made as smoothly in the future. Advances in microelectronic technology have been exceedingly swift and it will no longer be confined to simply manual tasks such as painting and welding but will extend in the future to other areas including the services. At the same time stimulatory effects have emerged on demand for new products in anticipation of developments in sectors such as new materials, biotechnology, and fine ceramics. Thus the effects of gaps in the progress of technological innovation must be carefully observed. Cases will emerge in which assignment transfer or job training within one corporate body alone will not be adequate to meet the situation. According to a report by the Economic Planning Agency entitled "Japan in the Year 2000," in cases in which job transfer within one company is limited, progress must be made towards transferring workers to related companies or even reassigning them to different companies. Thus the necessity may arise for vigorous spread of information on jobs and workers being demanded and for corresponding education and training programs which surpass the scope of a single corporate body. The report points out that it will become necessary to establish information systems and external job training and education facilities to foster the engineers and technicians that will be needed to met the diverse needs of industrial society in the future.

According to new estimates on future population released by the Welfare Ministry's Research Center on Population (November, 1981), Japan's population is expected to expand from 117 million in 1980 to reach a peak of 130 million around 2008, then slowly decline afterwards and eventually stabilize. During this period the post-war baby boom generation will reach the middle and old age categories, thereby bringing rapid acceleration of overall high age level throughout the population. At the beginning of the 21st century, the percentage of people 65 years of age or above in the entire population of Japan will be higher than the percentages in the nations of Europe and America. The speed with which the age level in Japan is advancing is remarkably swift. It took from 45 to 135 years for the percentage of persons 65 years of age or older in the nations of Europe to go from 7% to 10%; in Japan this percentage increase will be realized in merely 26 years.

Percentages of Persons 65 or Older in Japan

1975 = 7.9%	1980 = 8.9%
1990 = 11%	2000 = 14.3%

The overall age level of the population in Japan will thus steadily become higher in the future but the composition of the population will also change drastically. When broken down into the three categories of young age group (0 ∿ 14 yrs), productive age group (15 ∿ 64 yrs), and old age group (65 yrs or above), the composition of the populatin will shift as shown in the attached chart. The percentage of the productive age group will increase up to the first half of the 1990s, but as the trend is towards more middle-aged and older workers and as the supply of labor increases, it is forecasted that advances will be made in microelectronic application that perpetuate the same level of unemployment for some time (current unemployment at 2% or so). Estimates of the Japan Economic Research Center, for instance, point to an unemployment rate in Japan in 1990 of as high as 9%. The rate is expected to improve afterwards due to a drop in labor supply reaching 4% in the year 2000. This forecast is probably based on the assumption of significant employment reduction due not only to future population shifts but also to developments in factory and office automation through microelectronics. Yet when you consider Japan's capacity to cope with change, its relatively high growth rate, its strong competitive capacity, and the fact that the percentage of productive population will increase more rapidly in Europe and America than in Japan, unemployment resulting from microelectronics can be expected to be much higher in the nations of Europe and America than in Japan. And this senario only strengthens the view that international economic friction will remain for a long time.

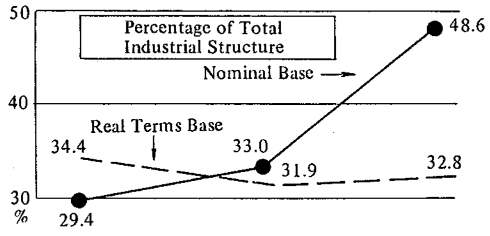
In sociological terms, the spread of microelectronics will have a definite sweeping effect upon the life style of the individual. Communications technology combined with computer technology has generated a sophisticated, information-intensive society in which even the individual in his home can make use of the latest technology. People are experiencing improvements in the quality of their lives; microelectronics has enabled them to have more free time; and they have been able to easily obtain information services covering education and culture. Man, who has been freed from manual labor through plant automation, is now burdened with less office work because of office automation; and with home automation, his very life style will undergo a revolutionary change.

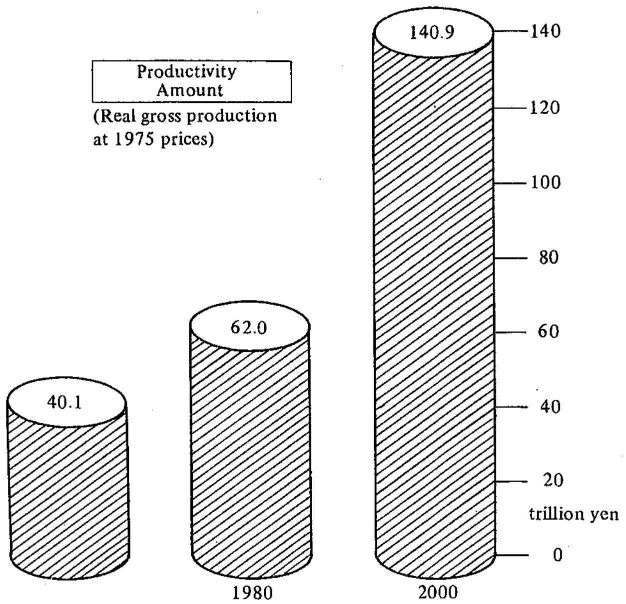
Much emphasis has come to be place on the forecast of an era in which work is done in the home. Microelectronics will directly connect the house with the work site so that workers will not have to leave to go to companies but will be able to perform their tasks at home. Alvin Toffler, for instance, in his book, "The Third Wave," was early in pointing out this form of change. Production and consumption will both take place simultaneously in the home, ushering in the era of the "prosumer," a newly coined compound word. By pressing on the keys of a computer, the employee can do his work at home; he can do his shopping at home, and he can even do his banking there so that even trips to the bank will be unnecessary. Life outside the home is forecasted to center on enjoyments such as theater-going, dinning in restaurants and visiting other centers of social intercourse. Permeation of social life by the computer will bring about what might appear as a science fiction type dream world but we must stop to consider just exactly to what extent such a senario is possible and what it will mean for society as a whole and for the happiness of the individual.

Concerning this point, Naisbitt writes in his book "Megatrends" that in his opinion not so many people will want to work in their homes. He believes that most people want to be together with others and want to get out to go to the company. I must agree wholeheartedly with his estimate that by 1990 there will be no more than about 10 million people who will actually be engaged in remote communication even from among the most enthusiastic advocates of work in the small electronic room. Naisbitt is making forecasts about American society, but this outlook is even more applicable to Japanese post-war society which developed from a foundation of vitality grounded in the economy. We must not forget that a sense of psychic stability and of value in human life, while interrelated with housing conditions, comes precisely from the interactive relationships with other people which work occasions. We welcome the convenience which partial work performance at home can bring, for example, to pregnant woman, those receiving medical treatment, or older workers but it is not feasible to expect everything to be done in the home through computer. It is certain, however, that an era of new media will appear in which means of data transmission and data processing functions will be developed to the highest levels of sophistication and the newspaper will take on an entirely new appearance. While diverse forms of data are accumulated in diverse forms, the topics of concern will no doubt be how a more culturally enriched social life can be established and how a new services-oriented society should be organized.

Finally, I would like to touch upon the question of international relations. Progress in microelectronics will not only generate problems among advanced nations, especially with regard to the perpetuation of economic friction centering on Japan as mentioned earlier, but also sizeable problems between North and South. It does not appear that in the future differences between North and South will diminish and even technological transfer from advanced nations to developing nations in the form of child industries will not bring an easy solution. Over the medium and long terms microelectronics will steadily advance to the nations of the South and this could disrupt the organization of world trade at its very foundations. The People's Republic of China, for instance, has established four programs for modernization so that the nation will reach the levels of the current advanced nations by the turn of the century. It is impossible to gauge the effects which full application of microelectronics in China by the 21st century would have on the economic and political world order. The same applies for India, another nation with a huge population. What would result is a change so great as to be labeled a new wave in history. We must proceed cautiously towards the establishment of a new economic world order in which nations both North and South can exists and prosper together. It is strongly hoped that world political leadership will emerge based on dialogue between North and South.

Outlook for Service Industries

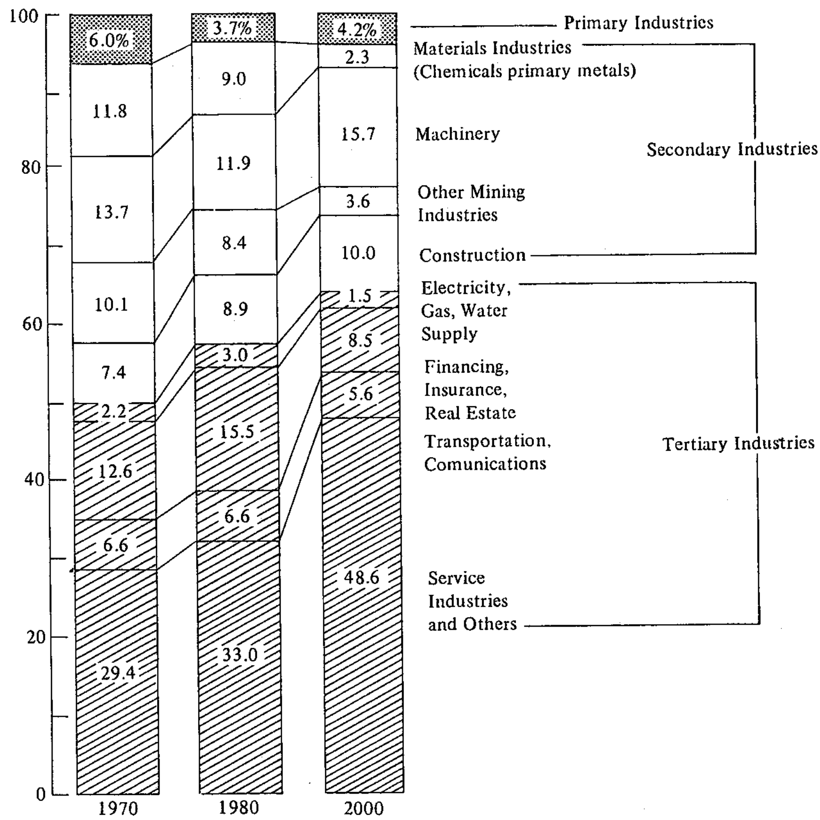




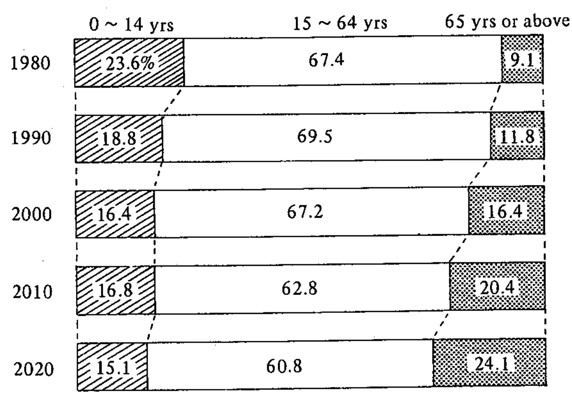
(Remarks) 1. Data from "Annual Report of National Economic Accounts" by the Economic Planning Agency and from estimates by the General Planning Department of the same Agency.

2. Service industries covers all tertiary industries except the following: transportation, communications, finance, insurance, real estate, electricity, gas, and water supply.

Outlook for Industrial Structure
(Nominal base composition percentage)



(Remarks) Data from "Annual Report of National Economic Accounts" by the Economic Planning Agency and from estimates by the General Planning Department of the same Agency.



International Comparison of Productive Age Population Percentage

(Unit: %)

Nation \ Year	1950	1960	1970	1980	1990	1995	2000	2010	2020
Japan	(49.4) 59.6	(54.3) 64.1	(60.3) 68.9	(60.4) 67.4	(61.9) 70.0	(62.5) 69.3	(61.3) 66.8	(57.2) 62.9	(55.1) 61.5
France	65.9	62.0	62.3	64.0	67.0	66.5	66.3	67.3	64.4
West Germany	67.3	67.8	63.7	66.3	70.3	68.9	67.8	65.4	64.1
Sweden	66.3	66.0	65.5	64.3	66.1	66.7	67.0	65.4	62.9
Great Britain	66.9	65.1	62.8	64.3	66.9	66.5	66.5	67.1	65.2
U.S.A.	64.9	59.7	61.9	66.3	65.0	65.2	66.5	67.5	64.8

(Note) 1. Productive age population percentage is the percentage of people from 15 to 64 years of age against the entire population.
2. Figures in parenthesis regarding Japan indicate percentages of people from 20 to 64 years of age against the entire population.

SUMMARY OF THE SEMINAR AND PROPOSALS

Prof. Shuhei Aida
Professor, University of Electro-Communications

1. Automation impacts on human workers

The social and cultural effects of automation on human workers have occurred at least since 150 years. The recent explosion of microelectronics and robotic applications has cleared our understanding of both the gains and the risks: mismatch to human physiological, psychological and cultural characteristics; alienation from fulfillment and dignity in work; widening of the gap between skilled and unskilled workers, and between technologically developed and underdeveloped communities; decrement in individual and national security. Attention to these problems can insure that automation results in a better society. The industrialist, who is responsible for enlarging the scale of automation, should also play a role in adapting it to people. For the time being, technology should be individually designed to each culture.

When we have considered the history of the research and development for the automation technology, we have divided into three-stage, that is the "equalization", "efficiency" and "humanization", as shown in Figure 1. The essential concept of automation technology has been developed to realize the social equalization by the distribution of the technological merits. However, this kind of concept has gradually changed to the one of the efficiency, because the automation technology has been infused the economical oriented activities. Therefore, the conventional automation technology has only persuaded the industry to make the efficiency. In this situation, the modern technology or civilization has been re-considered, how do we introduce the humanization, to the mechanical automation systems. That is the essential concept of "Adapting or flexible Automation", and it should be adopted to man, culture and society.

The worker organizations in all countries have welcomed automation because both productivity and worker safety can be increased. As a percentage of total effort, though the actual production phase requires less effort, the preparation–planning, design and engineering–and after the product–inspection, transportation, marketing, installation, maintenance, etc.–require more as shown in the Figure 2.

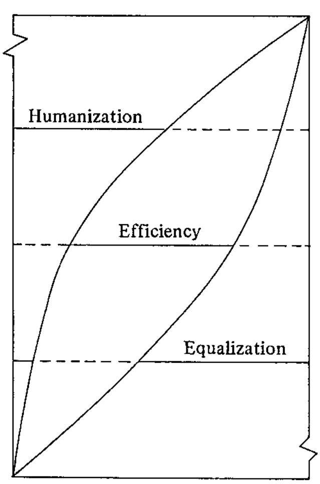


Fig. 1 The economical progress and a characteristic weight for technology

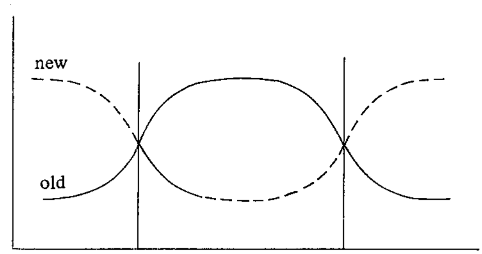


Fig. 2 Old (Preautomation) and New (Postautomation) Allocations of Human Worker Effort

Even though preparation and support have been found to require skill levels that are higher, insistent workers have demanded that they be retrained for the new jobs, and partake in decisions about how automation is introduced. It is very important strategic study, how do we make the policy that transfer the workers from production area to the both sides.

2. A Guideline for our joint research

The joint research is focussed on the strategic studies of technology and culture, comparative studies on the basic of Automation impacts on human workers, and its mode of introduction and operation in both countries, taking into consideration the social and cultural impacts, and structures, etc.

The tentative scenario is as follows;

1) Identify conventional automation system as a mechanical structure without human workers.

2) How the conventional automation system in which stages and weighted have been introduced to factories?

3) Under what kind of policy is the conventional automation system operated, i.e. in workers level, engineers level, manager level . . .

4) How do we identify the differences in policy, in operation manual, in training workers, engineers and managers.

   - These differences are crucial elements to activate automation system, accordingly they are very important.

   - These differences are mainly derived from the interculture factors.

Methodology

Comments about methodologies in persuing the research mentioned above;

a) Delfi method
What fields, rank, scope of people concerned should be subject to this research, also specialists from trade unions who are interested in automation? Interview or question and answer by mail?

b) ISM (Interpretive structure Model)

CONTEXT ISSUES represent the subjects of our study.
The differences consist of those derived from different factors in ELEMENTS and their RELATIONS. Those differences are expressed by a structure.
Iterative method by feed back loop (. . . . in figure) is introduced as shown in the above figure.

These 1) - 4) are the first stage of the research and we will attack the problem of the structure on the basis of the above four researches, going to the extent of the problem of innovation and culture.

Automation should be adopted where it produces life enhancing products and services to be distributed on a just basis, provides creative and fulfilling employment of people, conforms to their physiological, social and cultural norms, and is not exploitative of other peoples or natural resources. Optimization under such constraints is a serious responsibility of all of the attendances here in Torino!

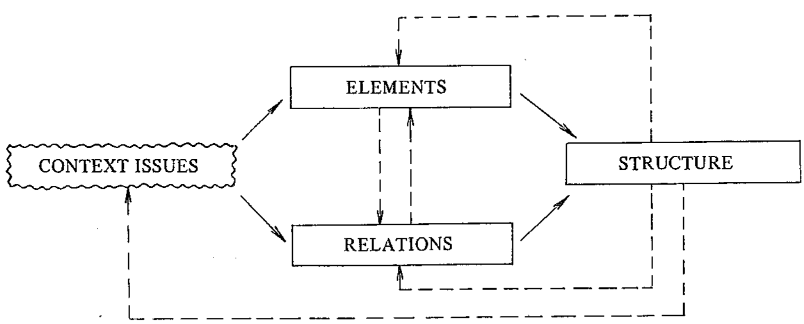


Fig. 3 The Flow diagram of ISM method