本田財団・インド工業連盟（CII）共催シンポジウム
技術・イノベーションと企業家精神の連携

（日本語版は巻末CD-ROMに収録）

Honda-CII Symposium
on Linking Technology, Innovation & Entrepreneurship

A Report of
The Honda Foundation - Confederation of Indian Industry (CII)
International Symposium 2007

HONDA FOUNDATION
財団法人 本田財団

Cover Photo :

For Publication

The present report is an account of all the speeches that were made during the symposium entitled "Linking Technology, Innovation and Entrepreneurship" held in New Delhi in February 2007, on the occasion of the Japan Year in India.

Indian entrepreneurs, policymakers and researchers, as well as Japanese and Thai representatives were invited to this meeting, animated by lively presentations and exchanges of opinion. The venue then changed and concrete examples of Japanese advanced technology development - such as the fuel cell powered vehicle, the humanoid robot, the highly efficient business jet, the manufacturing of bio fuel, and the solar power generation panels - were introduced, transmitting the dream of a near future when "Ecotechnology" will be created.

This meeting was made possible by the partnership with the Confederation of Indian Industry (CII), which is fulfilling its leading role in the remarkable development of modern India. We would like to thank the participants for their cooperation which made it possible to rent the venue for this event; among the participants, we would like to mention Mr. Kisaburo Tokai, member of the House of Representatives of Japan, the Embassy of Japan in New Delhi, JETRO New Delhi Centre, various firms from the Honda Group in India, and Honda R&D Co., Ltd.

It would be an immense satisfaction if the discussions and friendships cultivated through this international meeting were effective in the mutual edification of both Japan and India, and in the acceleration of international understanding, as well as the development of a human society in harmony with our natural environment.

Toshio Ban Managing Director Honda Foundation

Honda-CII Symposium

on Linking Technology, Innovation & Entrepreneurship

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Tetsuhiko Ikegami
Commissioner, Space Activities Commission, Ministry of Education, Culture, Sports, Science and Technology (MEXT)
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Session Chair/President, Kanazawa Gakuin University
Executive Supervisor, National Museum of Emerging Science and Innovation (Miraikan)
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Honda Foundation URL : http://www.hondafoundation.jp
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Profile of Participants

Arun Jaura

Senior Vice President - Engineering & R&D
Mahindra & Mahindra Ltd.
Chairman - CII Task Force on Technology

Dr. Arun Jaura is the Senior Vice President of Product Development and R&D for Automotive Sector in Mahindra & Mahindra, Mumbai, India.
Prior to joining M & M, he had a 10 year stint at Ford in Detroit. In his last assignment at Ford, Dr. Jaura was responsible for Vehicle Engineering of Escape Hybrid Platform in Detroit. He is the recipient of the prestigious Henry Ford Technology Award in 2004 for the world's first Hydrogen Engine Propelled Hybrid vehicle. Prior to that, he was in DRDO at Chennai for about 10 years working on battle tank and combat aircraft systems.
He has a distinguished career of over 24 years in the area of Research and Advanced Engineering, and Product Development. Has 4 patents issued in US/Europe and several in the pipeline, 37 publications in International and National journals and numerous conferences. He is an internationally known subject matter expert on hybrid and hydrogen technologies. He is regularly invited for consultations and mentoring by ASME, IEEE, SAE, industry, governments and the academia.
He is a member of NATRIP's Technical Advisory Committee, Chairman of CII's, Taskforce on Technology, Chairman of SIAM's Frontier Technology Committee on Advanced Propulsion, Co-chair of CAR committee on Adcanced Propulsion.
Dr. Jaura completed his BE from NIT, Srinagar, M. Tech from IIT, Chennai and Ph.D from Concordia University, Montreal.
In addition, Dr. Jaura is the technical consultant to USAID/KEVA alliance on advanced propulsion and sustainable mobility in South East Asia.

Kisaburo Tokai

Member of the House of Representatives
(Hyogo Pref. 10th Electoral District)
Chairman, Research Commission to Promote Research and Establish a Nation of Innovative Science and Technology, LDP

[Education]
1970 Graduated from WASEDA Univ. (Department of Science and Engineering (Architecture))
Started working for the NIKKEN SEKKEI
[Career]
1986 First elected to the House of Representatives
1991 Director, Youth Division, LDP
1992 Vice-Minister, Ministry of science and technology
2000 Senior Vice-Minister, Ministry of science and technology
2002 Chairman, Budget; Audit and Oversight of Administration Committee (HR)
2002 Senior Vice-Minister, Education, Science and Technology
2003 Chairman, Budget; Audit and Oversight of Administration Committee (HR)
2003 Deputy Chairman, Policy Research Council LDP
2004 Chairman, Federation of Hyogo Pref. LDP Branches
2005 Director-General, International Bureau LDP
2006 Chairman, Finance Committee

Tomohiko Kawanabe

Senior Managing Director & COO
Fundamental Technology Research Center
Honda R&D Co., Ltd.

1977 After graduate Yokohama National University, Joined Honda Motor Co., Ltd.
1978 After one year internal training at Sayama automotive factory, transferred to Engine Research Department of Wako R&D Center, Honda R&D Co., Ltd.; engaged in research activities such as Low NOx Engine, Low Emission Engine, High Altitude Emission Control
1979 Transferred to Denver (Co) Lab of Honda R&D of America, Inc.; starting up a new lab and operation, engaged in many high altitude engine tests
1983 Returned to Engine Research Department of Wako R&D Center of Honda R&D Co., Ltd.; engaged in '84 model year US Civic Development programs
1984 Transferred to Engine Research Department of Tochigi R&D Center of Honda R&D Co., Ltd.; engaged in CRX 50MPG, '88 model year Civic, '89 model year City (Electronic Controlled Fuel Injection, Electronic Controlled carburetor)
1989 Engine (compact vehicle class) Research Department Manager
1992 Engine (full size vehicle class) Research Department Manager; engaged in Ultra Low Emission Vehicle "ULEV" development
1996 Deputy General Manager for advanced power plant development at Wako R&D Center of Honda R&D Co., Ltd.
1997 Director of Honda R&D Co., Ltd.; lead engineering officer for '98 model year Accord ULEV
1998 Transferred to Tochigi R&D Center of Honda R&D Co., Ltd.
2001 Executive Chief Engineer of Honda R&D Co., Ltd.
2002 Managing Director of Honda R&D Co., Ltd.
2004 Managing Director and Chief Officer for Fundamental Technology Research Center and President of Honda Research Institute, Co., Ltd.
2005 Senior Managing Director and Chief Officer for Fundamental Technology Research Center and President of Honda Research Institute, Co., Ltd.
2006 Authorized Fellow membership of Society of Automotive Engineers (SAE)

Pawan Munjal

Managing Director & CEO
Hero Honda Motors Ltd.
Past Chairman, CII-National Committee on Technology & Innovation

Pawan Munjal was born on 29th October 1954. A graduate in Mechanical Engineering, he has been a Director of Hero Honda Motors Limited, a joint venture between Hero Cycles Ltd., and Honda Motors Co. of Japan, since inception. Over the years he has played a significant role in its development and growth. The Company, under his leadership, has emerged as the world's No. 1 two-wheeler company now for 5 years in a row. He has been instrumental in bringing about technological and managerial excellence in the Company's operations. As the Chief Executive of one of the principal Hero Group Companies, he is a constituent of the Core Team, which looks at growth and strategic planning for the entire Group and associate Companies.

A well-known personality in industry forums, he has been the Chairman of several Committees of CII viz. Technology & Innovation (2004-05), Environment (2003-04) and Sports Committee (2000-01 & 2001-02). He is the past Chairman of the Northern Region of the CII (1996-97). He is currently a member of the Society of Indian Automobile Mfrs (SIAM) Committee on Two & Three-wheelers. Mr. Munjal is a member of the prestigious World Economic Forum and International Enterprise Singapore's Second India Advisory Panel. Mr. Munjal is an active Rotarian and Past President of Rotary Club of Delhi Southend. He is a member of the Board of Governors of IIM, Lucknow and Punjab Public School, Nabha (Punjab). A keen golfer, he takes keen interest in the development of sports in the country. He is the Past Chairman of the Asian PGA Tour Board of Directors and the Past President of Professional Golfers Association of India (PGAI). Under his guidance, Hero Group launched the Hero Indian Sports Academy (HISA) in collaboration with Laureus Foundation, to offer equal opportunity in sports and reward genuine sporting talent in the country.

Atsushi Sunami

Associate Professor and Director of Science and
Technology Program
National Graduate Institute for Policy Studies

Atsushi Sunami is an Associate Professor and Director of Science and Technology Program at National Graduate Institute for Policy Studies, Japan. He is also Affiliated Fellow of National Institute of Science and Technology Policy (Ministry of Education, Culture, Sports, Science and Technology). Also, he is a co-director of the Japan Research Center at Beijing University since 2006. From 2004, he is a consultant for Japan Science and Technology Agency on Asia policy and a council member of the Honda Foundation and the Okayama Institute for Quantum Physics among others. He is also serving in the advisory committee on international affairs for Ministry of Education, Science and Technology.

His research has concentrated on a comparative analysis of national innovation systems with particular focus on China and India, and an evolutionary approach in science and technology policy-making process. He is currently working on a book called "Era of Open Innovation and China" (in Japanese, NTT Publishing) forthcoming in the summer, 2007.

Professor Sunami holds BSFS from Georgetown University. He obtained MIA and PhD in Political Science from Columbia University. From 2001 to 2003, he was a Fellow at Research Institute of Economy, Trade and Industry established by the Ministry of Economy, Trade and Industry, Japan. He also worked as a researcher in the Department of Policy Research at Nomura Research Institute, Ltd. from 1989 to 1991. He was a visiting researcher at Research Center for Advanced Economic Engineering, University of Tokyo, Science Policy Research Unit, University of Sussex, and Tsinghua University, China.

Saburo Kobayashi

Visiting Professor, Graduate School
Hitotsubashi University
Ex-Executive Chief Engineer
Honda R&D Co., Ltd.

Join Honda R&D in1971, dreaming of designing sports car, but assigned to Airbag research for 16 years, and put into market as first Japanese auto-manufacturer. Most of Honda associates, except Mr. Honda & a few executives, were against the Airbag so that the research was severely tough. There are a few engineers did such long term research in Honda.

Why creative challenging technologies are produced from little resource Honda?

Describing Honda cultures & its origin through direct experience of 16 years research, and try to make clear what is Honda DNA.

Academic :

1968 Bachelor / Mechanical Engineering at Waseda Univ.
1970 Master of Science / Mechanical Engineering at Univ. of California, Berkeley (Bio-mechanics)

Occupational :

1971 Honda R&D Co., Ltd.
1982 3rd LPL (Large Project Leader) of Airbag
1985 Chief Engineer
1987 Put Airbag into mass-production
1993 Vice President / Honda R&D Americas.
1996 Senior Vice President / Honda R&D Americas.
2000 General MG, Corp. Planning Div. Honda Motor Co.
2000 Lecturer Science & Engineering, Waseda Univ.
2005 Executive Chief Engineer / Honda R&D Co.
2005 Retired from Honda
2006 Visiting Professor, Hitotsubashi Univ. Graduate School of International Corp. Strategy
2006 Lecturer Engineering, Tokyo Univ. Lecturer -Chuo Univ. -Hosei Univ. -Tokyo Univ. of Science - Yokohama National Univ. -Shibaura Institute of Tech.

Anjan Das

Senior Director & Head
Technology, IPR, and Technology Development Centres
Confederation of Indian Industry (CII)

Post Graduate in Mechanical Engineering from Indian Institute of Technology (IIT), Kharagpur, India
Twenty one years of post qualification experience in Project Planning, Project Coordination & Monitoring, Project Engineering, Project Management, Technology Development, Project Evaluation, Technology Transfer, International Technology collaborations, Intellectual Property Rights and Consulting Engineering Services.
Currently heading CII's Technology & IPR Division and also CII's Technology Development & Promotion Centres in the states. Working in the areas of Public-Private Partnership in pre-competitive technologies; Technology transfer / services and IPR areas.
Worked in Automobile and IT industry and also in Ministry of Science & Technology, Govt. India
Consultant to many industries in Waste management projects. Consultant to World Intellectual Property Organisation (WIPO), Geneva for conducting a study on the Growth and Potential of the Biotechnology Industry in India. National Expert of UNIDO.
Expertise in Technology Management, Technology Audit, Intellectual Property Rights, Waste Management Projects

Rishikesha T. Krishnan

Professor
Indian Institute of Management, Bangalore

Rishikesha T. Krishnan is a Professor in the Corporate Strategy & Policy Area at the Indian Institute of Management, Bangalore (IIMB), India. His research interests are in the areas of strategy, innovation and competitiveness. At IIMB, he is currently the Chairperson of Research & Publications. He was earlier the Chairperson of the Postgraduate Programme in Management (PGP) at IIMB.
Prof. Krishnan has been a consultant to, or conducted management development programmes for, British Telecom, Daimler Chrysler, Wipro, Siemens, Sasken Communication Technologies, the Murugappa Group, the Aditya Birla Group, Kochi Refineries and the Governments of India and Karnataka.
Prof. Krishnan worked for four years as the General Manager of a small high technology company in the telecom sector from 1987-91. During this period, he also co-founded a software company working on specialised engineering application software. From March 2001 to October 2001, he worked with a software product start-up in the knowledge management space founded by an IIMB alumnus.
Prof. Krishnan obtained the M.Sc. degree in Physics (5-year integrated programme) from the Indian Institute of Technology at Kanpur and the M.S. degree in Engineering-Economic Systems (now Management Science & Engineering) from Stanford University. His doctoral qualification was obtained from the Indian Institute of Management Ahmedabad, where his thesis proposal won the outstanding thesis proposal award instituted by the Industrial Finance Corporation of India.
Prof. Krishnan has been a member of the Confederation of Indian Industry (CII) National Panel on Intellectual Property, R&D, Technology and Innovation, and a member of the executive committee of the Strategic Management Forum of India.
He is currently on the board of the Indian Institute of Health Management Research, Jaipur. He is an independent director on the board of D-Link (India) Ltd.
Prof. Krishnan is an active member of Globelics and Asialics, international fora that focus on the understanding of innovation systems and competitiveness. He is on the editorial advisory boards of the International Journal of Management & Entrepreneurship, Asian Journal of Technology Innovation, Science, Technology & Society, Real CIO World, and ManagementNext.
Apart from papers published in academic journals, Prof. Krishnan's articles have appeared in the Economic Times, Business Line and the Financial Express. He has presented his research at seminars at a number of reputed institutions such as Stanford University, London Business School, the Hebrew University of Jerusalem, and Hong Kong University of Science & Technology.

Somenath Ghosh

Chairman & Managing Director
National Research Development Corporation

Education: B. Tech. Chemical Engineering, IIT Kanpur, 1975 M. Tech. Chemical Engineering, IIT Delhi, 1977
Mr. Ghosh is the Chairman & Managing Director of National Research Development Corporation (NRDC). NRDC is a Government of India enterprise under the Department of Scientific and Industrial Research engaged in transfer of technology to entrepreneurs and industry in India and overseas.
Before joining NRDC, he was the Director General of Consultancy Development Centre, popularly known by its acronym "CDC". CDC is a national nodal organization representing the interests of the consultancy profession. CDC has over 1000 members countrywide and it is supported by Dept. of Scientific & Industrial Research, Ministry of Science & Technology.
He was also the Secretary General of Technical Consultancy Development Program for Asia and the Pacific (TCDPAP). TCDPAP was set-up under the aegis of UN-ESCAP and APCTT.
Mr. Ghosh has almost 30 years of technical and management experience in engineering, research, technology implementation, education & training, and marketing.
In 1988, he started Access Engineering Systems Pvt. Ltd. That has developed and marketed static equipment and piping solutions for the Chemical Process industry. The software products for the process and mechanical design of static equipment include heat exchangers, pressure vessels, columns and tanks, that are in use at over 250 companies in India and overseas. He has executed over 200 consulting assignments in design and analysis for refineries, petrochemicals, oil & gas, engineering consultants and equipment fabricators in areas, such as, piping flexibility analysis, fatigue and failure analysis, flow-induced vibration analysis, equipment design, industrial automation, and system integration linking order processing to design, manufacturing and ERP systems.
He started his career with Larsen & Toubro Ltd. Mumbai where he was responsible for the development and design of critical equipment in the thermal cycle of Nuclear and Thermal Power Plants. He was also involved in the design, construction and execution of projects in fertilizers, petrochemicals and refineries. He is familiar with design codes, such as, ASME, TEMA, IBR, etc, and has worked with a wide range of software packages for plant design, simulation, analysis and project management.

Tateo Arimoto

Director General, Research Institute of Science and Technology for Society (RISTEX)
Japan Science and Technology Agency (JST)

Education Background:
Mar. 1974 Master degree (Physical chemistry): Graduate School of Science, Kyoto University
Official Positions:
Apr. 1974 Science and Technology Agency (STA)
Jul. 1986 Director for Planning and Management of International S&T Exhibition, Planning Division, Science and Technology Policy Bureau, STA
Apr. 1987 Director for Planning, Policy Division, Science and Technology Policy Bureau, STA
Aug. 1987 Director for Planning, Planning Division, Science and Technology Policy Bureau, STA
Apr. 1989 Senior Specialist, External Relations Department, National Space Development Agency of Japan (NASDA)
Aug. 1989 Director, NASDA Los Angeles Office
Jun. 1992 Senior Specialist, External Relations Department, NASDA
Feb. 1992 Director, Science and Technology Information Division, Science and Technology Promotion Bureau, STA
Jul. 1994 Director, Planning Department, Japan Marine Science and Technology Center
May. 1996 Director, Radioactive Waste Policy Division, Atomic Energy Bureau, STA
Jul. 1998 Director, Department of Public Communications, Japan Atomic Energy Research Institute
Jul. 1999 Director, Policy Division, Science and Technology Policy Bureau, STA
Jul. 2000 Director, Research Promotion Division, RIKEN Yokohama Institute
Jan. 2001 Deputy Director General for Science and Technology Policy, Cabinet Office
Aug. 2002 Deputy Director-General, Lifelong Learning Policy Bureau, Ministry of Education, Culture, Sports, Science and Technology (MEXT)
Jan. 2004 Director-General, Science and Technology Policy Bureau, MEXT
Jul. 2005 Executive Research Fellow, Economic and Social Research Institute, Cabinet Office
Sep. 2006 Director General, Research Institute of Science and Technology for Society (RISTEX) Japan Science and Technology Agency (JST)

Tetsuhiko Ikegami

Commissioner, Space Activities Commission,
Ministry of Education, Culture, Sports, Science and Technology (MEXT)
Special Advisor, National Institute of Advanced Industrial Science and Technology (AIST)
Guest Professor of Tokyo University of Science, Emeritus of University of Aizu

Tetsuhiko Ikegami was born in Tokyo, Japan in 1940. He received the B.E. degree (1963), M.E. degree (1965) and Dr. Engrg. degree (1968) from the Tokyo Institute of Technology, Tokyo, Japan.
In 1971, he joined Nippon Telegraph & Telephone Public Co., which is Nippon Telegraph and Telephone Co. (NTT), now. He was appointed Executive Manager of Opto-electronics Labs (1989), and Senior Executive Manager of NTT Science and Core Technology Laboratory Group and NTT Basic Research Laboratories (1994). He became Senior Vice President, a board member of NTT, in 1993.
In June 1996, he became CEO and President of NTT Advanced Technology Co., dealing with technology transfer and total solution business with 1200 employees. In July 1998, he moved to university as Vice President and in April 2001 became President of the University of Aizu (UoA) which is featured by Computer Science and Engineering and terminated March, 2006.
In AIST, he is serving VP for special mission of President from the establishment, 2001.
He is serving members of committees in Japanese Government in particular for implementation of Japanese Science & Technology policy from 1996. Now, he has served a member of Academia, Science and Technology Council in MEXT as Chair of Referee Committee for Special Coordination Fund for Promoting Science & Technology and also a key member of Information Technology Study Group in the Council of Science & Technology Policy.
In his R & D activities, he has performed pioneering and significant works on the optical-fiber communication technology, in particular, on laser diodes including finding of resonance-like phenomena in the direct modulation and reliability study of the devices, which led success in undersea optical-fiber system applications. In 1982, he succeeded in transmission of optical signal at 400 Mbit/sec through 100 Km normal optical fiber in 1500nm wavelength region by using the DFB laser, which brought a break-through for development of present fiber transmission systems.
He served President of IEEE/Laser and Electro-Optics Society (LEOS) in 1994 as well as managing members in professional societies in academia and in international standardization committees.
Dr. Ikegami is a Fellow of IEEE, Optical Society of America and Institute of Electronics, Information and Communication in Japan, and recipient of JSAP Excellent Paper Award, IEICE Distinguished Achievement Award, OITDA SAKURAI Memorial Award, IEEE/LEOS Distinguished Service Award and the IEEE Third Millennium Medal, Minister of General Affair's Award, etc.
Tetsu and Sachiko have three daughters.

T. P. Govindan

General Manager- Corporate technology
Crompton Greaves Limited

- Masters in High Voltage Engg , Indian Institute of Science Bangalore
- 30 years experience in Industrial R&D
- Currently Head, Global R&D Centre, Crompton Greaves Ltd, Mumbai involved in the integration and improvisation of existing technologies & generation of new platform technologies.
- Areas of interest : Technology Management , IP strategies , High Voltage Engg , R&D Organization building
- Holder of 6 patents
- Represent India at CIGRE, Paris, in the subject of "Emerging Materials and Technologies for Electrical Systems".

Kunio Nakajima

Professor
National Graduate Institute of Policy Study

Received the B.E & M.E from Tokyo Institute of Technology. Officer of Ministry of International Trade & Industry from 1968 to 1999. Executive Director of Japan Chemical Innovation Institute [1999-2000]. Professor of Tokyo Institute of Technology Department of Chemical Engineering [2000-2004]. Professor of National Graduate Institute for Policy Studies [2004-]

V. J. Prakash

Managing Director
Ultra Motor India Pvt., Ltd.

Mr. V. J. Prakash is the Director on the board of Ultra Motor Co., Ltd., UK and Managing Director of its wholly-owned subsidiary in India. Ultra Motor is introducing Electric Vehicle in India in partnership with the Hero Group.
Mr. Prakash is a mechanical engineer from Regional Engineering College, Trichy, and pursued his management degree from Indian Institute of Management, Calcutta.
Before joining Ultra Motor India Pvt., Ltd., he was the Managing Director (European Operations) of Moser Baer. Moser Baer is a world leader in Recordable optical storage media.
He was also on the Board of Bharti Teletech Ltd., as Executive Director and CEO, responsible for its Telephone terminal business between 1998 and 2002.
Mr. Prakash was also the Vice President and member of Corporate Managing Committee of Samtel, India's largest picture tube company and was associated with the company for more than 10 years.
His other earlier assignment include a stint as Plant Manager at Poysha Industrial Company, Ghaziabad.

Chetan Maini

Deputy Chairman & CTO
Reva Electric Car Company Pvt., Ltd.

Chetan Maini is the Deputy Chairman of Reva Electric Car Company Private Ltd. (RECC), a joint venture between Maini Group of Bangalore and AEV LCC, USA. Chetan has over 14 years experience with electric, solar and hybrid-electric vehicles in India and US. Chetan holds a graduate degree in Mechanical Engineering (BSME) from the University of Michigan where he focused on solar electric vehicles, and a postgraduate degree in Mechanical Engineering from University of Stanford where his focus was on hybrid electric vehicles. At Stanford, he was the project leader for the hybrid electric vehicles. At Stanford, he was the project leader for the hybrid electric car project and earlier at the University of Michigan, he was the key team leader of the Solar Car team that won the GM Sun Race and stood 3rd in the World Solar Challenges in Australia.
He has a patent in energy management system for Electric Vehicles and has presented several technical papers on EV's globally. Chetan has received the Dr. M.S. Swaminathan Award for Environment Protection for the year 2001, The YEO Thomas Alva Edison Award for Entrepreneurship and Innovation in February 2002 and the 'Monte Carlo Sustainable Mobility Award 2005' for RECC's leadership in developing the world's best selling electric car at the 21sst Electric Vehicle Symposium in Monaco in 2005.

Hiroto Ishida

President, Kanazawa Gakuin University
Executive Supervisor, National Museum of Emerging Science and Innovation (Miraikan)
Specially Appointed Professor, Institute of Industrial Science, the University of Tokyo

Date of Birth: September 16, 1941
Place of Birth: Tokyo, Japan
Home Town: Komatsu and Kanazawa, Ishikawa Prefecture
Education: Graduated from the University of Tokyo, Faculty of Engineering, Department of Nuclear Engineering, in 1964
Master of Arts, Political Science, University of Illinois

Career in Outline:
1964 Joined Science and Technology Agency(STA)
1982 Counselor (Science), Embassy of Japan to the United States of America
1991 Director General, Atomic Energy Bureau, STA
1995 Vice Minister, STA
1999 Ambassador of Japan to Czech Republic (also to Slovakia)

Hobby: Watching Kabuki and listening to Bunraku.
Writing stories and scenarios for Kabuki and Bunraku.

Patarapong Intarakumnerd

Project Leader
National Science & Technology Development Agency (NSTDA), Thailand

Dr. Patarapong received B.A. degree in Economics (English Programme) from Thammasat University, Thailand in 1993 with first class honour, the M.Phil. degree in Economics and Politics of Development from Cambridge University, UK in 1994, and D.Phil. degree in Science and Technology Policy Studies from Science Policy Research Unit (SPRU), University of Sussex, UK in 2000. He is currently a Project Manager of Thailand's National Innovation System Study at National Science and Technology Development Agency (NSTDA). Dr. Patarapong is a regional editor of International Journal of Technology and Globalisation and a member of international editorial boards of Science, Technology and Society Journal, and Asian Journal of Technology Innovation. His research interests include national innovation systems in Thailand and newly-industrialising countries in Asia, industrial and knowledge-based clusters, Technological capabilities and evolution of latecomer firms, financial incentives for enhancing innovation capabilities and competitiveness, and roles of Research Technology Organisations (RTOs) in industrial clusters and national innovation systems. He is a founding member of Asian Network for the Economics of Learning, Innovation, and Competence Building Systems (ASIALICS) which is an Asian chapter of Global Network for the Economics of Learning, Innovation, and Competence Building Systems (GLOBELICS). He has been a member of scientific and organising committees of several international conferences. He has been invited as an advisor of research projects conducted by German Development Institute (GDI) and Japan International Cooperation Agency (JICA) and a consultant of United Nations Committee on Trade and Development (UNCTAD). Recently, he co-authored a book on 'Asian Innovation Systems in Transition' (with Bengt-Åke Lundvall and Jan Vang) published by Edward Elgar. He used to teach as a special lecturer on Innovation and Management for Change at the College of Management, Mahidol University, Thailand, and Global and Institutional Change at King Mongkut's University of Technology Thonburi, Thailand.
He was one of the key persons in drafting National Science and Technology Strategic Plan (2004-2013) and Thailand's Strategies for Entering Knowledge-based Economy and Society submitted to the Prime Minister. He is now working in the secretariat team for conducting research and preparing agendas for National Science and Technology Policy Committee chaired by a deputy prime minister and its Sub-committee on Cluster Development and Sub-committee on Science and Technology Infrastructure and Institutions. He is also a member of National Office of Education Council's Sub-Committee on Future of Thai Education in the Next 10-20 Years.

Sri Krishn Chopra

Principal Adviser & Special Secretary
Ministry of New & Renewable Energy
Government of India

Dr. Sri Krishn Chopra, Indian, citizenship has a Ph.D. in Energy Engineering and Master of Science in Industrial Engineering both from Stanford University, California, USA, and Bachelor's degrees in Mechanical and Electrical Engineering from India. He is currently Principal Adviser & Special Secretary, Government of India, Ministry of Non-Conventional Energy Sources, New Delhi and is the senior most scientific officer in this Ministry. Earlier he was Senior Advisor in the Ministry of Non-Conventional Energy Sources in the level of Additional Secretary. He was Adviser in the National Planning Commission, Government of India. He had worked as Professional Staff Member in the World Bank, where he was selected through the Young Professionals Programme. He was Principal Consultant to F.A.O. for Energy Planning for Agriculture & Rural Development. Dr. Chopra has been a Visiting Professor in the Centre of Energy Studies at the Indian Institute of Technology, Delhi and at Indian Institute of Technology, Kharagpur. He was Visiting Professor at the Centre for Studies on Science Policy, School of Social Sciences, Jawaharlal Nehru University. He is Visiting Scientist in the Department of Physics in the Banaras Hindu University. Dr. Chopra was awarded the prestigious Jawaharlal Nehru Fellowship in 1999 for Research Study on the subject ENERGY POLICY IN INDIA. Based on this Research Study a book entitled "Energy Policy for India: Towards Sustainable Energy Security for all in India by 2020", published by M/s Oxford & IBH, New Delhi. He has been conferred various awards for his distinguished contributions including the Doctor of Science (Honoris Causa), and the Institution of Engineers' Environmental Engineering Excellence Award, among others.

Hiromori Kawashima

President, Honda Foundation

Birth Date and Place : February 27, 1922 in Fukushima, Japan
1942 Enter the Home Ministry
1955 Counselor of the Regional Headquarters of the National Rural Police
1957 Temporality Transferred to the Ministry of Foreign Affairs to serve as the First Secretary at the Japan Embassy to Yugoslavia
1963 Director of Security Division of Metropolitan Police Board
1970 Director of Administration Bureau of National Police Agency
1971 Director General of Cabinet Research Office
1973 Deputy Chief Cabinet Secretary
1976 Vice-President of Japan Railway Construction Public Corporation
1977 Vice-President of Honda Foundation
1979 President of Japan Railway Construction Public Corporation
1981 Commissioner, Environmental Dispute Coordination Commission in Prime Minister's Office
1984 President of Central League (Prof. Baseball)
1992 President of Honda Foundation
1998 Japan Professional Baseball Commissioner
-2004

2007 Honda-CII Symposium on
Linking Technology, Innovation
& Entrepreneurship

Inaugural Session

WELCOME ADDRESS:

Arun Jaura

Senior Vice President - Engineering & R&D
Mahindra & Mahindra Ltd. and Chairman - CII Task Force on Technology

Archimedes once said, "Give me a lever long enough and a fulcrum on which to place it, and I shall move the earth." This is not me. This is King Hieron II who was absolutely astonished by the statement. Archimedes built a machine that was able to single handedly move the ship from a distance away. I thought that this is one of the best examples of linking technology, innovation and entrepreneurship. Centuries back, when we did not have even the power of computing using certain devices and now this is an important link which brings us all here this morning in our pursuit of using technology for innovation and innovation to being a great enterprise. It is my privilege again to welcome you all.

In the scenario of energy crisis being faced world over, few of the best examples of these linkages come from large and successful companies like Honda. The technologies involved in fuel-cell cars, the solar cells, and bio fuel shall play a key role in solving these crises in the time to come. That will be displayed by Honda. At the same time, the experiences of Honda in technology management and also maintaining the technology innovation, and enterprise-chain shall be an asset to Indian companies in the era of globalization. It is a privilege welcoming the Honda team here to India to this symposium.

Technology and innovations have grabbed more headlines in the first six years in the century than they did in the entire last century. The reasons for this are pretty clear: the business environment defined by cut-throat global competition and the technology enabling competition that copy good idea overnight (some of us call it reverse engineering to be more creative). The complexities of the business environment, coupled with an ever more demanding consumers, are further enhancing the importance of tuning innovation. Value addition is all about the thing that technology will change, about innovation, and about doing new things in new ways for commercial advantage.

Technology plays a leading role in innovation and entrepreneurship. Innovation is the better way to deliver value. We need more emphasis on exploring and testing new business models. Technology and innovation are the engines for integrating environment which exert a great impact on society and are themselves product of social relation.

It might appear that I am preaching to the choir, but no! I think reiterating these aspects this morning will be a good preamble to get started with. In our time, technology, innovation and entrepreneurship play a very fundamental role in creation of wealth, economic development and in improvement of the quality of life. CII has been driving this agenda for over a decade now. Together in partnership with the industry, we want to create a technology movement in the country. Today, CII Technology & IPR Division through its team of technology professors at Delhi, Hyderabad and Chennai provide the range of services to the industry for identification, upgrading, adoption and assimilation of new technologies. This Symposium is aimed at with respect to successful integration of technology, innovation and entrepreneurship for the benefit of Indian companies.

KEYNOTE ADDRESS:

Kisaburo Tokai

MP of Japan/Chairman, Research Commission to Promote Research and Establish a Nation of Innovative Science and Technology, LDP

As suggested by the title "Linking Technology, Innovation and Entrepreneurship," this conference is about how we could link these, and realize values from them, for the progress of our society and economy. Many innovation experts are here from industries, universities, governments of India and Japan. These people are going to share their knowledge and experience with science and technology, and make in-depth discussions about challenges and issues facing them today. In my understanding, all such exchanges will not only lead to deeper ties between the two countries, but also help a sounder development of Asia and the rest of the world.

In recent years, national policies bearing the word 'innovation' are prevailing in OECD countries as well as BRICs countries which include India and China. It seems such policies attempt to address the emergence of, and the shift to, knowledge-driven economies in the increasingly global context of world economy.

Japan's no exception. Last March the Cabinet meeting approved the science and technology policies and strategies articulated in the third-term Basic Plan for Science and Technology. This plan has two fundamental goals: one, to achieve sustainable development through environmentally-compatible growth of economy; two, to stand as 'Innovator Japan' to leverage the power of innovation for more robust economy and industry. Both substantial investments are admitted, and necessary reforms are planned for these purposes.

Abe administration which came about last autumn is now working on an up-to-year-2025, long-term economic strategy called 'Innovation 25' program to fix it by next summer under the leadership of Prime Minister Shinzo Abe.

Let me briefly talk about the Basic Plan for Science and Technology program which has been functioning as an important benchmark for Japan's science, technology and innovation policies. It derives from Basic Law on Science and Technology unanimously approved about a decade ago in 1995 of which I was one of the promoters. Based on this law, the Basic Plan has been reviewed every five year since 1995, with each term having specific government investment goals for R&D activities: so far we've invested 17 trillion yen for the first plan, 24 trillion yen for the second; and 25 trillion yen was admitted to implement the third term from 2006 to 2011.

These investments have not just boosted R&D activities in universities and public institutions which were stagnant in a flux created by rapid globalization after the end of Cold War, but also stimulated similar activities in the private sector and their engineering management strategies. I think such government support has much to do with the recent recovery of Japanese economy.

And now, speaking of my role in the government, I'm a member of LDP of Japan, which is the majority of the current ruling parties, and have chaired for two years the Research Commission to Promote Research and Establish a

Nation of Innovative Science and Technology which LDP established as a kind of steering board for science, technology and innovation policies.

One year ago, the 25-trillion-yen budget proposal for the Third Basic Plan met with host of controversy and policy debates under the government's tight fiscal circumstances. Fortunately, my research commission was able to assert political leadership and reach an agreement with opponents within the ruling parties by persuading them this hefty investment will most benefit the future of the country.

Besides budgeting, my research commission is actively working on important policy issues as well, which include how the government continues institutional reforms in universities and public institutions, how it retains and trains quality human capital, and how and when it enhances large facilities with the next-generation supercomputer and other cutting-edge equipment. For these purposes, we often carry out hearings and interviews with relevant companies, universities, and government agencies, and go for research site inspections as needed.

It's getting harder and harder to bring about innovation, or secure quality manpower, within the framework of one's own country, as globalization prevails. This situation has encouraged Japan's shift of policy focus to Asia as the center of hot spot growth by enhancing mobility in terms of both manpower and technology. Japanese officials realize the particular importance of strengthening ties with India for which there are especially enormous future possibilities.

I came to India for the first time last year. While visiting universities and companies in Delhi, Mumbai, and Bangalore, I had an opportunity to talk with a few people from CII. These visits impressed me with India's quality human capital and their serious orientation everywhere in research sites and business offices toward sustainable future.

Yet, unfortunately, Japan and India have long been historically and geopolitically distant, and our exchanges still remains insufficient. It is our strong hope the two countries would work together for deeper, wider connections at various levels in government, industry, and school. In this regard, we are very much looking forward to this symposium as an important place for such relationship building.

Sustainable development may not be possible without environmentally-compatible, economic expansion of Asia. This signifies there are growing needs of cross-border collaborations in particular in the fields of industry technology toward ecotechnological solutions for environment, energy, and resource issues.

In this context, India and Japan are required to enhance and make our relationship a positive sum for the prosperity of the entire Asia, which is better off from mutual competition and coordination in the whole spectra of what we do, including politics, economy, environment policies, and pro-innovation science and technology policies.

To put it another way, we are responsible to work together for sustainable development of human civilization as the time-honored, politico-economic powers sharing democratic, liberal, and other values in various social systems. I sincerely wish this symposium would be successfully launched and become a powerful driver to consolidate friendly relationship between India and Japan.

SPECIAL ADDRESS:

Tomohiko Kawanabe

Senior Managing Director & COO
Fundamental Technology Research Center, Honda R&D Co., Ltd.

Honda R&D is working on research and development for product and technology. I want to emphasize that the unique feature of our research center, which is that it is an independent company separated from its affiliate company Honda Motors. Our founder Soichiro Honda was an engineer whose great skill was creating products from his own unique ideas but at the same time he was an exceptionally innovative Executive Officer. On behalf of Soichiro Honda, and to think about the next generation society and also to provide jobs to many people through our product, Honda R&D was borne. Honda R&D consisted of 5 centers i.e. motorcycle, automobile, power equipments, aircraft engines, and fundamental technology.

In the view of Mr. Soichiro Honda, technology means giving people joy and happiness. Therefore, technology requires to be harmonized with human beings. The concept of ecotechnology aiming at the harmonizing of the environment and the human spirit is the common value in the 5 research centers. Honda philosophy is the basis for all Honda's activities. The basic philosophy is to create the "Three Joys" and to have "Respect for the Individual." The "Three Joys" are the joy of buying, of selling and of creating Honda products. Through these convictions and facts, we want to create a trusting relationship to share those joys with all people who relate to Honda's activities. The respect for the individual means the concept that we would like to share the joys while respecting each other, standing on fair relationship, having trust, and doing our best of ability. Honda is a group of individuals who have a strong will and big role directing toward a common dream and target.

In the long history of Honda's development, I believe the creation of the CVCC engine gave us the world's first low emission engine. It was a great point in our innovation history. It was 1972 that the CVCC engine was developed. In Japan and United States, pollution was a serious social problem caused by economical development and increasing automobile use. For instance, children collapsed at schools during physical education training as a result of air pollution by photochemical smoke oxidants. At that time Honda was one of the smallest automobile manufacturers in Japan. The pollution created by high emissions was actually the chance to take a big step forward in technology and business. He decided to start the development of the CVCC engine but he achieved a stage that many other big automakers had said that it might be impossible. At that time, I was a university student. I clearly remember that I was so impressed that such a small car maker, Honda, managed to create the first low emission vehicle in the world. After that came the first oil crisis. However, thanks to CVCC engine's fuel economy and low emission, it became a big seller and contributed to the future business development of Honda.

Over time, emissions less vehicles have been further improved and at present, near zero emission have been achieved. I have involved in the development of the low emission engine for approximately 25 years since I joined Honda. Now, emission levels are achieved that we could not expect when I joined the

company. I believe that it was the result of the accumulation of the technology and our engineers including myself. We all have sympathy with Honda's concept of Honda's technology. Now, sustainability in humans, in economy and in society is issues of the 21st century; namely, the problem of global warming and exhaustion of natural resources. As I have presented in our case with the CVCC low emission engine, even also society has these new big problems. I believe that contribution by technological innovation provides new business opportunities.

INAUGURAL ADDRESS:

Pawan Munjal
Managing Director & CEO, Hero Honda Motors Ltd.
Past Chairman, CII - National Committee on Technology & Innovation

The speed of change is much faster in the current scenario. The clock speed of business is perhaps 10 times more than what it was 5 years ago. It is also more deceptive than ever seen before. They miss this change to find values in the market place to see the problem differently and to find new value quicker than anyone else. This is what the 21st Century is all about. Today, markets and technology are changing fast. Internet connectivity is breaking down physical borders and creating connection between people, economies, organizations and governments in ways that were never thought possible. This makes it very easy to replicate good ideas very quickly and very fast. The current business environment is about being unique. This is where competition for talent and brand share is critical.

Businesses need to cultivate their uniqueness to stay ahead in the areas. There is thus continuous pressure to innovate the wise view and better product processes and services faster than competition. It is the race and only the fittest will survive. We have been seeing this in our industry over the past couple of months. Each one of us is trying to introduce newer models, newer renovations, newer ideas, and newer parameters in our products every other day. In the words of Bill Gates, "Innovators are those who are able to offer the promise of so much to do so many in so short a time." In order to survive in the future, India has to turn into an innovation led economy. Increasingly, companies are becoming conscious of this fact and focusing on the externals to teach the business environments, which is only one step towards focusing on innovation.

According to Professor S. Dutta, integration of the critical factors such as good ideas, talented people, capital or any division is successful and possible in a country only because of innovation. I was originally supposed to end this program with the concluding remarks but my role has been changed.

We have the Member of Parliament from Japan here with us trying to show us the support from Japan. We have a huge team from Honda Foundation from Honda R & D over here showing their support to us. We have seen over the last two decades how Honda has brought in their technologies and newer innovations into the market place and how that has helped not only Honda but us as their joint venture take a place in not just Indian market but also in the world market. As we just said that we have not for five years but for six years, we have retained our world leadership. With newer technologies coming in from Honda, I am sure it is going to have not only us but a lot of other companies who are associated with Hero Honda to go much further beyond where we are today.

This, I suppose, is also powering a lot of other companies and institutions in India to take on innovation and to take innovation to new heights and to take not just companies but institutions to much greater heights.

CONCLUDING REMARK:

Anjan Das
Senior Director & Head, Technology, IPR and Technology Development Centres
Confederation of Indian Industry (CII)

I would like to mention a few of the initiatives what CII is having in technology innovation and entrepreneurship including intellectual property rights and industrial designs.

One of the major missions CII has launched last year is the mission for manufacturing innovation. We are already in the process of creating innovation index for particularly manufacturing industries. We are also having a major initiative to create an innovation culture in the manufacturing industry at large. CII is also coming up a study and the report on National Innovation Mission. I can see persons here from IIM Bangalore, contributing a lot. By March 9th, CII will be launching this report which will actually highlight what are the enabling environments for India to innovate more in all aspects of life.

In another initiative, I am very proud to announce that we are also a partner of one institution in Japan, which is Japan Institute for Innovation and Invention (JIII). This is a secretariat for the International Forum for Innovation Promotion (IFIP) which has 35 countries as the members. India is one of the member countries in that Forum. This IFIP which they do every year is an international exhibition for young innovators below the age of 20 years from 35 countries' top 10 innovators. They take part in international exhibition. I am very happy to announce that this year India is hosting this international exhibition for young innovators and 12 countries are participating in this exhibition.

CII also has major initiatives in technology, nano-technology and in particular waste management technology. I can see Prof. Grover with us. I am very happy, sir. We have Bamboo Application Technology. We have lot of activities in industrial design and intellectual property rights.

Now, about this particular symposium, CII is very happy having a partnership with Honda Foundation to do this symposium and we look forward for many more things in the future.

2007 Honda-CII Symposium on
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& Entrepreneurship

Technical Session 1

Technology Management in Private Enterprise

Session Co-Chair:

Atsushi Sunami

Associate Professor and Director of Science and Technology Program
National Graduate Institute for Policy Studies

Today, our session is about management of technology at firm level, but what we are not going to talk a lot is the concept of MOT, but instead we will hear a lot about the cases and real experiences from Mr. Kobayashi and also to introduce the concept of MOT. In fact, in Japan, the MOT concept has not received a citizenship until few years back when we started such things like MOT courses. Our graduate programmes did not start teaching MOT until 2005. This is the concept actually we imported too much from the United States, from graduate programmes at places like MIT. However, as you know, Japanese companies like Honda are very innovative. They did not have to teach about management. They did not have to go to the courses of MOT or MBA, but for all those years, they were very active in R&D and innovation activities.

So, today what we would like to convey is a message from our experience in how companies like Honda were able to come from the local firm in a small city in Shizuoka to become one of the world's largest multinational corporations and are now heading for the frontier of the various areas of technology. What is more important is there are so many Japanese firms who have different styles of doing innovation. Honda is a very unique organization which is very different from other Japanese companies that you always hear about. This is in part our responsibility, the responsibility of academics like Dr. Krishnan and I; for academics have not done a lot of studies on companies like Honda. So what you always hear is the Kanban system, or Just-in-time system, and other management activities of companies like Toyota; but not so much about stories about companies like Honda. Today, I believe that it is a great opportunity not just for you but for academics like us to hear real experiences and activities of the company that is so unique and different from the other Japanese firms and doing a lot of innovation.

Session Co-Chair:

Arun Jaura

Senior Vice President, Engineering and R&D
Mahindra & Mahindra

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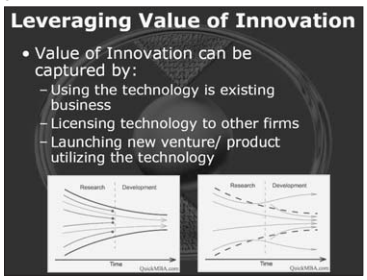

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What I am going to do is that I am going to introduce to you why innovation, what innovation, where the world is, what are the innovation that is there in the industry and not specific to automotive. Then, I will take you through how innovation environment in Mahindra & Mahindra is. I have been at Ford for several years. I have a perspective of how the North American industry is and how the Indian industry at Mahindra has been for the last 18 months. Then, I have things that we can see that there is a difference and how we can make a difference as a community and as engineers.

So, firstly we discuss the innovation in the private sector (*See #2*). What is innovation? Why do we want an innovation after all? Everybody works very hard but when everybody is working hard, innovation is a differentiator. Today, when I look at the market or when we look at what we make e.g. SUVs, Scorpio, why would somebody buys a Scorpio vs. another SUV? That is the question that we have to ask ourselves. Somebody buys a Scorpio because it is different in certain respects. I am just taking Scorpio as an example; it could be any other vehicle. Let us take a Honda vehicle as well. So, innovation is the differentiator. How you rediscover innovation could be an innovating a process, it could be innovating a product, and it could be innovating a customer's delight. With the competition getting so stiff, I think the customer's delight feature is one of the features that you can give to the consumers because the product or process is more or less being stabilized and saturated to an extent. Again, I am not trying to make a sweeping statement here because there is always room for improvement. There are always things to do better.

So, if you look at the leveraging value of innovation, you think of using new technology for your existing business or are going to next step, i.e. partnering with people or looking at what is there in the world and what you would not have (*See #3*). You can enter into life-building technology with others. If you see the papers these days in India, every newspaper that is there has some sort of a news item saying, "This Company has got this." Or, "This Company has started a joint venture with this company," and this and this and this. So, every day, it is more or less mergers and acquisitions. The reason for that is not just to get dearer markets but also to get technological and innovative strength that the global players have. With the opening up of the economy, this has done wonders to our environment here in our system.

Now, we at Mahindra also have got several joint ventures. Also, we are partner in many. We have partners in the U.S... We also have other partnerships and joint ventures. So, this is another way to leverage the value of innovation. Now, our engineers find what we say.

If you look at the left picture there, it is research. We have all these fantastic ideas. So, that is another way of looking at the value of innovation. This picture here is a very classic example of how innovation works in a company. If you look at the blue box in the middle where the bulb is dropping the ideas, this is an idea generator in

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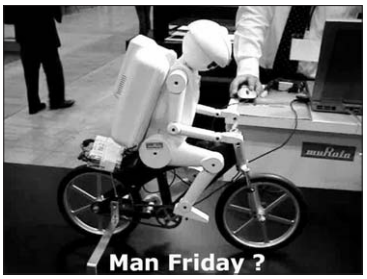

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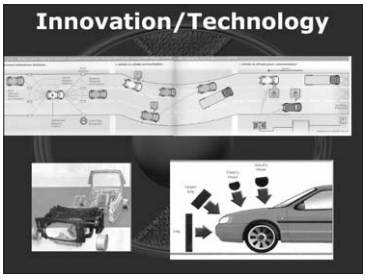

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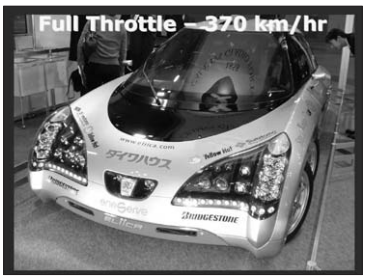

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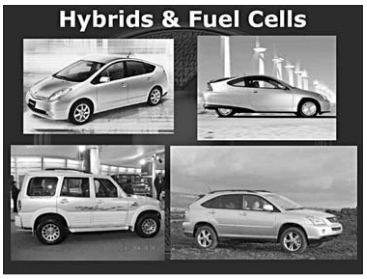

which our engineers, our technologists, our employees come out with imagination, brain storming sessions, and idea management experimentation. All these ideas are falling as bulbs on the conveyer. Then, there is a committee, there is a group of people who are evaluating them and once that fits in line with the business which is idea quality control on the right side, you do an evaluation, you do an analysis and you do an implementation. So, those come out as products. As it comes as a product at the bottom right of the picture, it fuels the profits and the profits fuel the management's perspective and thinking. And then, you go back right on top where you have seen this engine powered by the management. So, the management also encourages these kinds of things. This is a pictorial presentation of how innovation and the environment in the industry would or could work.

Innovation is also about bridging the energy gap (*See #4*). I will just provide you a perspective through a few examples here. For example, we talk about Bio Fuels. In this one, we talk about Honda doing Bio Fuels and the hybrids. Similarly, there are other OEMs in the market to do all these vehicles. When we talk about all this, this is again innovation. Also there is energy gap. Energy is a big deal today. You are talking about national security and energy independence. Can we get into this sector? Can we actually enhance and catalyze this?

To give you a personal assistant, you have the robot (*See #5*). He will do everything for you except giving you a shower. It costs $280 thousand today, but at some point in time at some day, this cost will be affordable to us. You want something from the corner; you ask Mr. Robot, he will get it for you. He can get you the newspaper or go and get you a pack of gum or whatever and he will come back. So, this is going to be a reality very soon and this is the real stuff.

You talk about innovation and technology (*See #7*). You talk about high speed driving. We have the Golden Quadrangle coming up in the country. We have high-speed lanes in the U.S. and in Europe. Now, there are automatic warning systems in the vehicles that actually control the speed of your car. It will actually control the fuel that is going to your engine and slow down your vehicles.

You talks about lightweight materials. You talk about the body-in-white aluminum. You talk about it in Aston Martin and Jaguars. Then you also talks about safety i.e. active and passive safety. The right picture at the bottom is talking about that as well. When you are driving and there are the pedestrians, how do you take care and then be sure that the pedestrian does not get injured very badly? So again, this is innovation and technology. We never thought about this, 20 years ago or may be 15 years ago but now we are starting to look at these things very closely and very cautiously because we want to make a difference through innovation and technology for everybody.

Now, let us talk about this. Could you imagine a car like this on the top left corner? We are talking about this big truck here. This is innovation

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and technology. It has full throttle i.e. 370 kms an hour (*See #8*). This is a vehicle. This is a picture taken in Yokohama about 2 months ago. This is a vehicle that actually goes on road at 370 kms an hour. Could we have imagined this kind of a car or an automobile even 20 years ago? We talk about bullet trains in Japan. We talk about bullet trains in Europe. Now, this is a bullet on the road.

Let us put it that way. We talk about hydrogen fuel cells. The world has got so much into this. These are not concept models anymore and are real vehicles (*See #9*). You can actually buy them overseas. The one on the left bottom is the Scorpio Hybrid. This was the vehicle that Mahindra's had unveiled at the Auto Expo New Delhi last year. This is the innovation in India. Indigenous engineers' Scorpio Hybrid. On the right on the top, you can see the Toyota Prius, Lexus and other vehicles.

Then, is this innovation? Yes! This is innovation. You go to the inner countryside. This is a picture taken in Africa. There are no cars. People have done some innovation. They have taken it at the back of a vehicle and the bulls are pulling it. This is innovation but this also tells you that there is a need for transportation. This is just an example in the Transportation Segment. There are similar examples in other areas as well. It is all about hybrids in solar panel. If you have this vehicle, you try to conserve energy and try to get best-powered density that you can. This is another one i.e. the Segway, the transportation way (*See #11*). In the U.S. now, in Washington DC itself, the Postal Department has got all these vehicles for delivering mail in neighborhoods. This could be the way of transportation. Let us say that if you want to drive from the hotel to the CIA office, you experience no emission or zero emission. This is self-balancing. You do not even know how to drive or ride a bike. You just stand on this.

But, also look at customization. This is somebody who has customized this vehicle to run a three-wheeler. It runs on CNG, it runs on hydrogen and it runs on LPG. This is a picture taken in UK (*See #12*). Now, this is something that people are looking at. So, what I am telling is that even customers are looking at ways to innovate and come out with better and better techniques to take innovation forward. A number of e-mails I get say things like, "We have invented this. Can we sit down and talk about this?" "If we want to put the invention in the automobile industry, can we do this? Can we do that?" So, that also tells how fast the customer is trying to look at changing the ways that the industry is delivering them the products as well.

The change is all around (*See #13*). Last year the world produced the most efficient transistors at a very lower cost. This is unbelievable. 20 years ago you just talked about this, but we could not have handled it. But today, this is what the fact is. People are talking about hybrids. People are talking about safe driving.

So, what is innovation? (*See #14*) It is not just ideas. It is about aspirations. What do I want you to aspire into? What do I want to look

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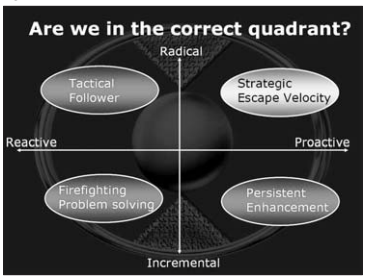

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at? When I say 'I', it is not just this room full of people who are just here but it is we as engineers, we as technologists, we as financers of innovation. So, what do I want to aspire? It is about people. It is how you create that environment. It is about how you foster innovation in the industry. It is about how you foster innovation in your company. That makes a difference. It is actually and finally is the ideas. Like I said earlier, an idea's value worth 10 cents until it is implemented, and to implement the idea is what that makes a big difference. The leaps are made because of the implementation of ideas.

So, here we are (*See #15*). On the x-axis, you have the reactive mode on the left and the proactive mode on the right. On the y-axis, you have the radical on top and incremental at the bottom. So if you are in the second quadrant, radical and reactive, you always be a tactical player and remains a follower. You say "I also want to do something like this," and you are reactive all the time. Do we want to be in that quadrant? I don't think so. We were in that quadrant three years ago because that is the nature of business at that time, but not today. Then, we come to the third quadrant that is reactive and incremental. We are now into the fire fighting and problem solving area. You know, we introduced this technology. We put it in this market and this happened and that happened. We are just trying to chase the issues of what you have done and you are trying to catch up all the time. Then, you are proactive and incremental. You are persistent. You want to enhance. You want to make the difference for people. You want to make the difference for the customers and for yourself. And finally, if you want to be strategic and have the velocity to take off, then you have got radical thinking, radical innovation and you have been very proactive. That is where you can make the difference.

So, first thing is innovative thinking. What you see at the industry? Let's say, as Mahindra, as Ford, as Honda or as Toyota, whoever, what do you look at? No one is satisfied. Look at the number of patents GE files per year. That tells you how good a private enterprise is. That will decide the annual profits and the bottom-line and all that. Now, I am talking about money but we are talking about ideas, innovation and technology. How many patents have been issued? How do we create this mechanism? Do you have an Idea Bank? Yes, we do. Can we create one if we do not have one? Look at the number of papers that have been publicized. The publication of papers is a mechanism to encourage innovation, and to think. What sort of technical and networking forum that we actually participate in and where our employees participate in? This is a big difference and a big deal. International shows, conferences, auto shows, markets and other forums are the different ways to introduce a product. If I have to do this state-of-the-art thing, I will probably go to some Southeast Asian market or I might go to Germany, Europe, or some other country, and then see what I have. So, I have to go to the real world usage or the real world technology and then membership of a society, task forces and things like that. It is actually bringing in juices from outside into your environment and into your company.

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Of course, the bottom-line is selling according to demand. If we do not do it well, we do not go anywhere. At the end of the day, it is all about the people and the environment. So, for fostering innovative thinking, companies have the center of excellence and some companies that do this very well (*See #16*). There are vertical pillars, and there is the center of excellence. When they do a project or a program, they use certain matrix to evaluate people in those projects or programs, and after the term of the projects, people come back to the home base to constitute the backbone.

Can we have satellite offices? Today, in this age, there are so many satellite offices. If Mahindra wants to do business and introduce a global project, we have satellite offices somewhere in Europe and somewhere in the US, somewhere in Japan, or Korea or wherever. It is just the automotive industry I'm talking about; it's across the industry, they have satellite offices because you want to capture the thought process and the ideas in the local market. Did we talk about the joint cooperation? The joint cooperation or the projects are increasingly done by the coordination of academia, industry and government. This trident of success is very, very important to make it happen. The industry alone would not be able to press it forward. You have to push forward partnership with academia and government. There are classic examples in the world where that have actually done it and succeeded so well.

Now, we move on to Early Vendor Involvement. Get the vendors on board upfront so they have early participation and interest in what you do. Everybody is looking at its stake in the joint venture that we talked about. So, in any Auto, IT, or Aero Meet-ups, what you do. Let us take an example of automobile sector (*See #17*). You talk about lightweight aluminum natural fiber, you talk about recyclables, and you talk about infotainment and other big, big things in the customers' mind today when you come to an automobile. You talk about biometrics, hydrogen engines, fuel cells, hybrids, ethanol, bio-fuels, safety, airbags, pedestrians' safety, engine technology and nano-materials. This is not just a big automobile environment i.e. nano-materials in building constructions or nano-materials in the area of ferrous and non-ferrous application. You talk about ethanol and it is just not in the automobile business. It is in the other industries as well. You talk about green building and it is not just about the automobile, it's about cross sector.

Now, let us talk more about innovation at Mahindra. We have something as the K. C. Mahindra Award (*See #18*). This is an award that is given in India for the design. This is a design contest where several universities and colleges participate. There is a theme every year and the first prizewinner gets 100 thousand rupees, which is equal to about $2000 for my foreign guests here. So, we do this every year. This is a big competition for us and for the students. This is symbolic actually and it is not that $2000 makes a difference. It is symbolic for yes we are doing something. On the right side, I can see the president of the automobile sector and this is one of the students getting an award. This is a second prize that he got last year.

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We also do encouraging innovations in terms of leveraging fundamental research facilities (*See #19*). We fund a lot of students' projects across the country and also overseas. If you see in the middle at the bottom, that is Delhi College of Engineering's Hybrid Car that they built. They participated in the event in the U.S. and you know they won in that class. So, you get all these bright young minds actually contributing and participating and bring lots of ideas to the table. It is not the end. You actually get those young talents in your workforce and can take it forward to kind of leapfrog in that business. You have to develop an empowering environment. If you look at today's assessment system, if you succeed and you do well, you are paid a big bonus, stock options, or whatever. But in R&D, in technology or innovation, you have to have a room for failure; unless you fail, you cannot learn. You have to ignore that failure in the interest of learning and going forward. So, empowerment transparency holistically connects the customers; and at Mahindra, we do a lot in this context actually. Exposure in emerging technologies helps measure the goal setting and objective appraisal (*See #20*).

We also have something called innovation awards for in-house products and processes where we have three awards in the process, and here you can see Mr. Anand Mahindra giving away the innovation awards (*See #21*). This was last October. Now, the first prize is Rs.100,000. The second prize is Rs.50,000 and the third prize is Rs.30,000. There are companies across the M&M Group that participates in this. There is a committee and then there is a jury from external industry as well as one of our internal members. I am a member of the jury as well from the automotive sector. This year we have got 37 entries. Everybody gets the chance to present. We shortlist and then the top three are picked on the product and the top three are picked on the process.

So, this is again something that we foster and we encourage inside the company. So, I am trying to go back to what I said (*See #22*). Innovation is broadly ideas. It is about aspirations. It is about people. And finally, it is ideas that actually count. To summarize, today's environment is very dynamic (*See #23*). The customer is changing. Look at the customer five years ago in India and look at the customer today; and it is not only India it is all over the world. Innovative products out of box will help us. So, what could we do with the million persons in our development labs? Again, this is a slide from one of the books from IBM. Just imagine what we can do with one million workforces. We have a million plus nation, right? Every person in the country is your workforce. Every person comes up with an idea. We can create wonders from the black & white giant wheel. We can make a very colorful life for everybody i.e. for ourselves, for our children, our grandchildren and ourselves.

Panelist:

Saburo Kobayashi

Visiting Professor, Graduate School, Hitotsubashi University
Ex-Executive Chief Engineer, Honda R&D Co., Ltd.

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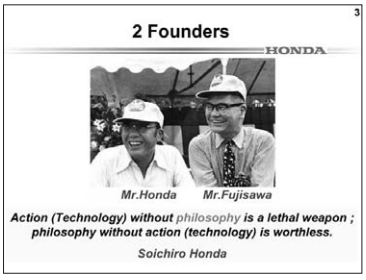

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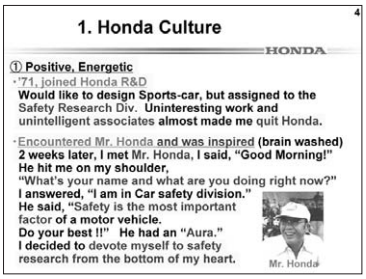

Today I will talk about what I experienced in Honda. I joined Honda R&D in 1971. The very first day, I almost quit Honda. Why? Because I found full of stupid associates there. My English conversation teacher recommended me, "Don't use the word 'stupid'! Say 'unintelligent'!" But frankly speaking, they were just stupid. Class A people get in Toyota, Nissan, Mitsubishi, Mazda, or Isuzu, and remaining persons join Honda. That's true. No Class A people, no money, no facility. Now Honda has become a 900 billion dollar total-sales company. They say Honda's been lucky. I too felt they have been lucky. But only being lucky wouldn't create a 900 billion dollar company, so today I would like to talk about what is the secret behind from what I experienced in Honda.

There are two founders to Honda, Soichiro Honda and Takeo Fujisawa (*See #3*). Mr. Honda says, "Technology without philosophy is a lethal weapon. Philosophy without technology is just a story. It's worthless." So, we consider philosophy as very important before technology. Now, I would like to talk about Honda's culture-positive and energetic.

You know I wanted to resign when I was assigned the Safety Research Division. I hate that. You know I wanted to make the car but the Safety Research Division crashed the car everyday. So, it was uninteresting work and those unintelligent, stupid associates almost made me quit the Honda. But one day I encountered Mr. Honda (*See #4*). One day when I was passing through the gate, I found Mr. Honda is coming this way. He was the CEO of Honda Motor Company. I bowed and said "Good Morning." He pats my shoulder and asked, "What is your name? What are you doing in Honda?" I answered, "My name is Kobayashi. Recently, I have joined Honda R&D. Right now, I am doing motor vehicle safety." And he said, "Oh! Simply it is the most important factor in motor vehicle. Do your best!" And he left. He's got a special aura with him. So I changed my mind and decided to devote myself to safety research from the bottom of my heart. I still do not know why it was so. That is a true story. He's real energetic.

Number two is Honda's main custom: "A00", "What is your opinion?", "Say it in a word." (*See #5*) Those are big annoyance to freshmen, but it's an invitation to "own" thought. I would like to explain one by one. What's "A00"? It's the basic requirement or objective. The third CEO introduced this kind of system from the U.S. Military mission command. The U.S. Military mission command on its very first page writes down what the basic requirement or objective is. This is where "A00" comes from. So the "A00" is a kind of custom in Honda R&D. People there always asked me to explain the "A00." The first time I encountered the "A00" was when my boss asked me to make the design change to a certain safety seat. I made a drawing and brought it to the guy in charge Mr. Moriya. He asked me, "What's A00?" So, I explained the basic objective as performance improvement, lighter weight, and cost reduction. Mr. Moriya said, "No, no, no, that's not the A00". I was so surprised. He said, "Better performance for what? Lighter weight for what? Less cost for what? That's what A00 is about." Unbelievable. The

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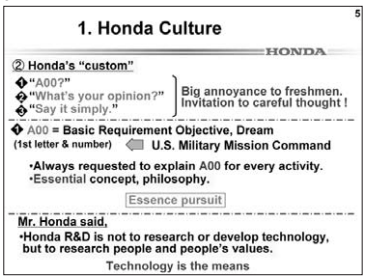

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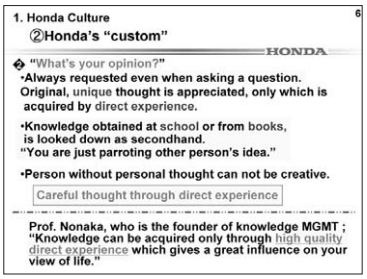

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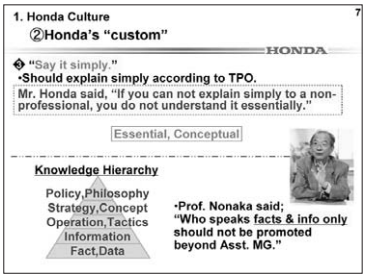

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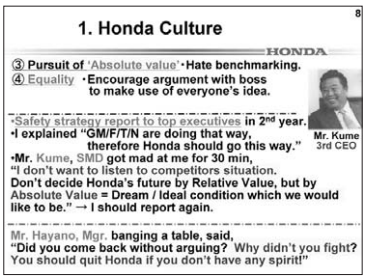

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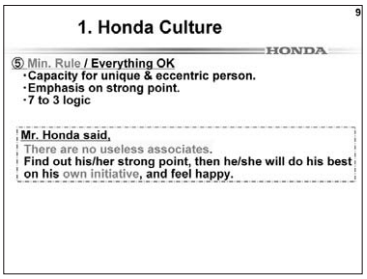

concept here is distinction between objective and means. Some stupid CEOs say, "Profit is the objective." No! No! No! That is only the means. Profit for what? So, that is the basic philosophy that every Honda associate understands.

So what is the essence? The pursuit of philosophy. Mr. Honda said, "Honda R&D is not to research or develop technology." I was so surprised because I joined Honda to research technology. He said, "No! It is a place to research people and people's value." So, first you should find out what is the value for customers in 20 years or in 10 years, then use technology to achieve that kind of value. Technology is the means. So, what is the objective? This is more important. Most of the system we know is about using means and not objective. Fuels for vehicles, is that objective? I do not think so. Intelligent transportation system, is that objective? These are the means. There are full of means in our daily lives. Someone may misjudge what is the real objective.

Number two is "What is your opinion?" (*See #6*) When I was going to make a new safety seat, my boss said, "Why don't you go to an Interior Division engineer to ask what is the next safety seat?" So I came to the Interior Division guy and I asked, "What is the next safety seat for the Civic?" Instantly, he asked me, "What do you think?" I said, "No! No! I have come here to make a question and you are supposed to answer." He said, "Oh! Stupid guy;" and asked, "Do you have a car?" I said, "Yes! I have a car." He said, "You come from the Safety Division. So what do you think?" Since then, even if I had small knowledge, I should say, "I consider the safety seat should be such and such. But is that right?" Or should I say, "I consider the safety seat should be such and such, but this portion I cannot understand." Then, we started discussions. That's Honda's custom.

They welcome unique opinions. You receive an awful evaluation when you say something everybody knows or have heard of before. We try to be unique and we try to have a unique opinion. Sometimes boss says, "Oh! You've got a very unique opinion. Where did you get this?" If you say you learned it at school or read it in a book, then he will look you down because you are just following others' ideas. We hate it. So, a person without personal thought cannot be creative. That's the origin of creation. Professor Nonaka, one of the founders of knowledge management research, said, "Knowledge can be acquired only through high-quality direct experience, and may be not from books." That's what I agree.

Number three is "Say it simple." (*See #7*) We should explain something simply according to time, place and occasion. Mr. Honda said, "If you cannot expand simply something to non-professionals, you do not understand it essentially." For example, suppose if you are asked, "What is the motor vehicle safety?" You think, "Motor vehicle safety? OK, in real world, there are so many crashes. Front crash, side crash, rear collision, and you need to watch pedestrians, motorbikes, and there are intersections, such and such. And they are such and such in U.S. and

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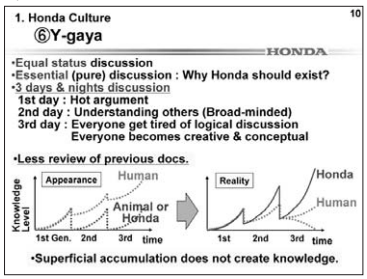

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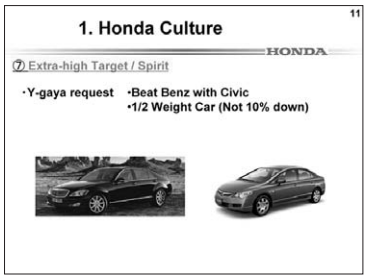

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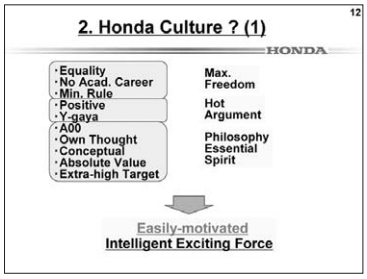

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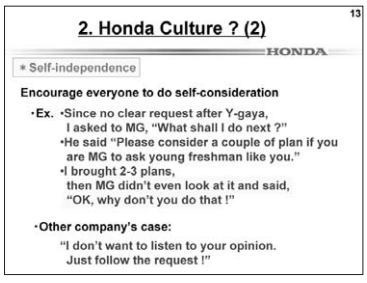

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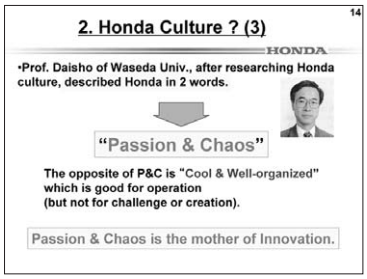

such and such in Japan." We hate this kind of person, and send him away. "What is the motor vehicle safety?" The simple answer is "minimized customers' injury in a clash". "OK! Then how do you minimize the injury?" From here next things start. This is what "Say it simple" means. This makes people conceptual, make them think in essence. This is very important. OK?

I'm not an expert here because I have become a visiting professor all of sudden. But as I understand there's a hierarchy in knowledge from facts, information, then operation, strategy, and finally philosophy. If you discuss with your colleagues, make a big argument, you are talking things in the same level, and go up, go up to what's essential, then questions like "Why should Honda exist?" or "What is happiness of people?" No philosophy, no big argument. Again, a good friend of mine Professor Nonaka said, "Those who speak facts and information only should not be promoted beyond Assistant Manager." I totally agree to it. "Then what? Then what? What is the essence?"-that's very important.

OK, I have a question to you all. Please answer simply in five seconds. What is the goal of your life? Tell me in five seconds why your organization should exist? So far I have made speech 100 times, and every time I asked the audience this question, nobody could answer it in five seconds. This is the basis of philosophy because the goal of your life is asked her. I don't want you to consider this kind of thing every day. No, no, no. But this is a very important question, so why don't you consider it once a year? Why you don't consider it? Because most of your job, say, 90% or 95% of your job is operation. In Honda, when you should sell five cars by tomorrow, and if your associate asks you, "Why Honda should exist?" Then you say, "OK, OK, but we consider it later, later, and later," and you never consider it for whole one year. That's not good. For Honda, this is the question the boss always asks you, "What is the basic philosophy?" This is self-independence. I understand Ph.D. stands for Doctor of Philosophy. Recently Ph.D. never talks about philosophy.

Next thing is the pursuit of absolute value (*See #8*). We hate benchmarking. We don't like that. Also important is equality. Equality is very important for innovation, challenge and creation. Operation wise, like in factory operation, a kind of hierarchy is necessary; but equality in challenge is important.

I would like to take one example. I made a safety strategy report to Senior Managing Director Mr. Tadashi Kume, after two years I joined Honda R&D. I explained to him that General Motors, Ford, Toyota, and Nissan are doing that way, and therefore Honda should go this way. Mr. Kume got mad at me for 30 minutes. Because I was a freshman or sophomore, I was so afraid; but he got mad at me for 30 minutes, so I listened to him. He said, "I don't want to listen to the competitive situation. Right now, you are deciding the direction that call on Honda's future safety directions. So, you should not decide looking at

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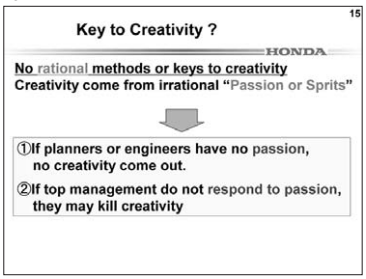

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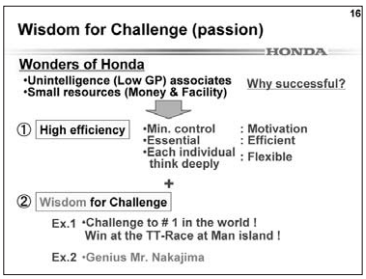

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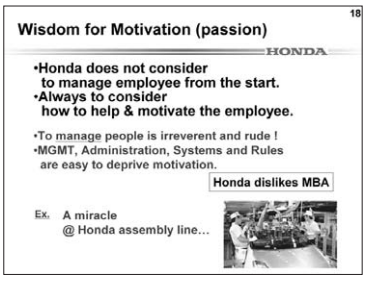

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competitors, but you should decide from your dream or ideal condition which we would like to be." So what Mr. Kume is talking about her is a kind of absolute value. We hate a relative value.

Anyway, I should report to him again. Then I returned to my office, and Mr. Hayano, my manager who just returned from another business meeting, asked me, "What was today's report like?" I replied, "I should report again." Then Mr. Hayano asked me, "What were the discussions?" So I said, "No! No! There were no discussions. I explained about the directions of Gen Motors, Ford, Toyota, and other competitors, and therefore Honda should go this way, blah, blah, blah..." Then, my boss took me to the small room at the backside of Honda R&D and he said, "Did you come back without arguments? Why didn't you fight? You better quit Honda if you don't have any spirit." That is a true story. Those are very crazy bosses. Don't you think so? Crazy bosses, but they taught me a very important thing. Good bosses are not so important, but crazy bosses are. I love them.

Another point is "Minimum rule: everything is OK." (*See #9*) So capacity for unique, eccentric person: emphasis on strong points. Our 7-to-3 logic is that 70% of the associates should be polite, normal persons while 30% of the associates should be kind of strange, crazy guys. We welcome such crazy guys. Mr. Honda said, "There are no useless associates." These are very kind, warm words. I love that. Mr. Jack Welch said, "Class B and C persons, get out!" They go very different directions. I prefer Mr. Honda's way.

Here is one more thing to mention: "Waigaya." (*See #10*) Waigaya is brainstorming and equal-status, flat discussions about "pure" questions like "Why Honda should exist?" or "What is love?" One day we discuss about love and that kind of the basic philosophy. The Waigaya meeting normally takes place Tuesday night, and then on Thursday we have hot arguments because we are all flat. "OK, Why don't you drink sake?" and we take a hot bath together and argue. Then comes the second day, we say things like "I don't like you, but I understand what you said," and it creates a kind of nice circumstances. Sunday, everybody gets tired of logical discussions. Logic is not so good for challenge or creation. On Sunday with a kind of gut feeling discussions, we can often get to newer ideas. This is not something like a tradeoff between cost and performance. Waigaya serves both things totally and finds out new concepts. That's what Waigaya is.

The next thing is "Less look at previous docs." You know human beings grow up because of the accumulation of knowledge. Our Safety Division has the Safety Strategy Waigaya every year which normally brings no last year's documents. I was so surprised. Animals cannot use last year's knowledge. So Honda is like a dog animal, is that right? I don't think so. Human cannot grow up so quickly, sometimes goes down. Why? Because of previous documents-trap of improvements. Improvements are OK, but you cannot make innovative ideas if you are trapped by the previous documents. That is very dangerous. A Honda

associate who experienced his first Waigaya grows up very quickly during his second-time or third-time Waigaya. First I said I met stupid associates because their looks, their faces do not change in one generation. But inside they might be smart persons.

OK, then "Extra-high spirit or goals." One day Mr. Kume, then president of Honda R&D, gave us a Waigaya request that "Beat Benz with Civic!" (*See #11*) For first two days, everybody complained, "He is crazy and old enough to be crazy!" Two days were filled with complaints, and the third day everybody got tired of complaints, and began to say, "OK, Mr. Kume may not want us to beat Benz totally. Why don't you beat this portion or what?" And a constructive atmosphere started to build. Then we got something new. So this kind of crazy request sometimes works very well; of course, not on an everyday basis. If so, your company goes down. "Sometimes" is the key here.

So Honda's culture as I recall is the culture where there is "maximum freedom for hot arguments, equality, philosophy and essential spirit." That's the foundation for our easily-motivated, intelligent and exciting force (*See #12*). That is the Honda's culture. Also, self-independence encourages everyone to do self-consideration (*See #13*). One day after a Waigaya, there was no clear request was made to me, and I asked the manager what I should do next. He said, "Please consider a couple of plans if your manager is to ask young freshman like you." So, the following day I brought 2 or 3 plans, and the manager did not even look at it. He said, "Okay! What don't you do that?" That's Honda's way. In other companies' case, "I do not want to listen to your opinion. Just follow the request." That is not a good training for the associates.

Let us take another example. Once Honda R&D and another company, I cannot recall their exact name, had a trainee exchange program. They quit it after one week since both parties had big complaints. Honda people went to the other company and complained, "I cannot do the job since too noisy, detailed requests to this and that. I cannot do the job." And the associate of the other company came over to Honda and said, "I cannot do the job because of only vague and unclear request I got." This is a true story. Very different cultures.

A professor at Waseda University Mr. Daisho, who is a very good friend of mine, made his research on Honda, and said he can describe Honda in two words - Passion and Chaos (*See #14*). I love that. Passion and chaos are good for innovation. The opposite pair would be "cool and well-organized." These are good for operation, but not for creation. So you got Silicon Valley passion and chaos, you got Shanghai passion and chaos, you got New Delhi passion and chaos. So you can create something new in this area.

In the context of passion, I would like to show you one example at Honda's Sayama Factory assembly line. Before I joined Honda R&D, I did a part-time job about 20 days at the Sayama assembly line to learn what the motor vehicle is. We here had 10 minutes' break in the morning and 10 minutes' break in the afternoon. There were line workers who were may be junior high graduates and they said, "Honda is counting on me." Most of the line workers said so. I felt it was a kind of wrong remarks. So, after the part-time job our assistant manager gave me my salary and asked, "Mr. Kobayashi, do you have any question?' He said, "Yes, I have one question. Most of the line workers say that Honda is counting on them. So, I believe they misunderstand the situation." The Assistant Manager said, "No, no, no! Mr. Kobayashi. Mr. Honda often visit assembly lines, pats shoulders of the associates, shake their hands, saying 'You are

assembling this car right now. This car goes to one customer. For that customer, this car is the Honda Motor vehicle, represents Honda Motor Company. If you don't assemble it nicely, Honda Motor Company is gone.'" That is why every single line worker considers Honda is counting on him. I think this is a very nice management style. Here I found a very thin red thread which ties line workers, managers, and all other associates to Mr. Honda's right hand. Very nice management style. These days stupid MBAs cut this thread. It's not a right management style.

And concluding my speech, Mr. Kume said the fundamental of creativity is mutual goal, at the A00 level, not something like profits or cost reduction (*See #19*). A variety of people with equality creates the team member feeling. Contributions for other associates, for customers, and for society-this sense of anti-selfishness leads to creativity. So that's my conclusion.

Panelist:

Rishikesha T. Krishnan

Professor, Indian Institute of Management, Bangalore

Honda Foundation has been doing an excellent job of trying to communicate the philosophy of the founder of the Honda Company and the Honda Foundation to the world. I think we have got an excellent glimpse of that from the presentation we just saw. We saw some of the unique ideas that have gone into the founding of the company as well as the foundation itself. I think we owe some gratitude to the Honda Foundation for allowing us to have access to these ideas.

In my presentation, what I will try to do is to give you a little insight into what is happening in the field of Technology Management in India in recent years. This is somewhat an impression, and I am not going to give you data and graphs and so on. What I am going to try and do is keeping with at least one of the ideas that Mr. Kobayashi was talking about, my opinion of what is happening in Technology Management in India. Hopefully, this will be informative to all of you and will help you get a picture of some of the challenges before the Indian private enterprise in the field of Technology Management and Innovation.

If you look at the trajectory or the kind of progression which companies typically follow, and I am talking about companies from developing companies, you will find that they typically go through a sequence something like this: they first start by learning how to produce or creating a production capability. They then move on to investment capability where they are able to actually create fresh facilities with improved performance based on their own investments; and finally they are able to move to an innovation capability to be able to create something new, unique, different and so on.

So, if you look at the way Indian companies have been evolving over the last more than a decade or so, you can see a very clear evidence of this progression which I have tried to elaborate a little more based on some work done by Naushad Forbes who was earlier supposed to be in this session. What it says is that you basically start by learning how to produce, i.e. by actually learning how to operate a particular plant or a production facility. You then move on to produce more efficiently. You bring in some improvement to the process, balancing equipment and so on. Then, you learn how to improve the production itself. You actually bring about modification, and do reengineering and other kinds of process improvements. Then you actually do improvement of products, i.e. you do value engineering, you try to create other ways in which customers can get additional value from the product or services you are providing, and finally you move to learning how you design new products. If you look at the progression of the Indian companies across sectors, whether it is automobiles, pharmaceuticals, or any of the other sectors where we have been making rapid progress, you will see that companies are rapidly moving through this progression and many of them are now at the stage of designing new products and introducing them in the market.

If we look at technology management in India, it has changed quite a bit over the last 20 years. Traditionally, Technology management in India focused on things like absorbing imported technologies, how to transfer technologies typically from a laboratory to a firm, how to develop local alternatives like import substitution, how to create intermediates that were not available, how to adopt processes for local materials, for example, some are raw materials like coal and crude that have different characteristics than what would be ideal for production; so, how you actually adopt your process to use these inputs and development of new processes particularly to exploit some of the differences in the Indian Intellectual Property Laws. So,

Technology Management in India till about, say, ten years ago, largely focused on how to perfect some of these activities.

But if you look at what is being happening in the last decade or so, we see that there has been quite a change in the nature of technology management activities. One important change we see is the adoption of best practices in product development, particularly the use of structured product development processes to create innovation pipelines, generate a lot of new ideas, and to use of advanced tools, for example, product life cycle management and other computer-based tools to manage the product development process. We also see evidence of acquisition of foreign companies, which was mentioned by Dr. Jaura also in his presentation, for multiple reasons, to access to intellectual property, to be able to participate in standard battles, and also to get access to advanced technologies.

Also, interestingly, we find that innovation is no longer restricted to the technology sphere alone. We find that many companies are actually combining innovation in technology with legal innovation, and I will clarify what exactly I mean by that in a moment. There is also a big movement to address the so-called "Bottom of the Pyramid" to do innovation for affordability and enhance growth of markets; and to address another important aspect of innovation, energy efficiency improvement, not only which is particularly dear to the heart of the Honda Foundation, but which we see even in traditional sectors like sugar where companies are using co-generation to improve the efficiency of the process. We also see collaborative development. Companies, laboratories like Tata Consultancy Services and a whole host of academic institutions and laboratories have combined together to develop "bio-suite" which is a new biotechnology or bio-informatics software product.

So, what I will do in the next few minutes is that I will just elaborate a little on these new developments, tell you and give you some examples of companies that are following some of these practices, and I will then identify some of the challenges that Indian industry faces in improving its technology management capabilities.

I think many of these products would not be strangers to all of us here. It includes the products from Dr. Jaura's company. It also includes REVA, an electric car about which Mr. Chetan Maini is going to be speaking to us later in this day, and a number of two-wheelers that have been developed in India in the last few years. Tata's Indica and Indigo that have been very successful automobile products, and also the product innovation that has taken place in the aerospace business, particularly the advanced light helicopter now renamed Dhruv and the light transport aircraft Saras which has been developed by the National Aerospace Lab. These are some of the new products that have been created by Indian industry and Indian research laboratories in the last decade or so. They have a strong impact on the Indian economy. But what is more important about some of these developments is that from a managerial perspective, many of these companies have actually incorporated some of the contemporary technology management practices in coming out with these products. This gives us a sense of confidence that these will be not be just a flash in the pan or single products, but we will actually see a stream of products actually emerging in the future.

Just to give you a glimpse of what are some of these practices, I thought I would share with you one successful story in the last couple of years, which is the development of Ace, a light transport vehicle developed by Tata Motors. Let us just see what some of

the practices or what some of the processes are which Tata Motors has followed in developing this very successful vehicle. First was the identification of a unique opportunity. They realized that there is a need for a safe and comfortable vehicle which could transport goods particularly in the crowded streets of India, which I am sure that even now Japanese guests have had a lot of experience in the short time they have been here. But at the same time, the product needs to compete with three-wheelers on cost. The reason is that clearly there are alternate forms of transport that already do this at a very low cost.

At the same time, it is very clear that for many of the vehicle operators, there is a need to feel proud about their vehicle, and also a need to feel that they are actually operating a vehicle which is good for their status. They are actually creating a four-wheeled vehicle, something that Tata saw as important and finally, of course, in today's world everything has to look good. There has to be a high degree of such things. You cannot afford to have the kind of looks that many of the older products on the road actually have. To identify user needs, marketing was involved early in the product development process. About 600 different stakeholders, including drivers, owners, end users, mechanics and opinion makers were interviewed over six months and then the performance measures were translated from these customer expectations rather than from product specifications. So, this very early involvement of customers was one of the key features of the development of this product. Typically, if you are looking at most companies that are trying to develop very market-oriented products are having a very close ear to the customer, and this is probably one of the best ways of ensuring that your product does not fail in the market place.

The way you actually go about this is going and listening to customers very carefully. For example, one operator of the vehicle whom the Tata Team went and spoke to said, "If I have a four-wheeler, then better marriage proposals will come." This is an owner of a small vehicle who really was looking at a kind of status benefits he will get by operating a vehicle which looks better. Another user came and said, "Reduce the 407 (which is a very popular and successful Tata LCV) to half of its size and price, and give it to me!" So, basically the concept he wanted to convey in terms of overall ways is he likes the whole product made together, but he wants it smaller and clearly at a lower price. These kinds of statements were translated into the objectives of the product, and also the team used techniques like 'design to cost'. They realized very early that the cost per ton and per Kilometer was critical, and in fact the management told the team that the project would be abandoned if it did not meet the cost requirements. But doing innovation in the product alone is not enough: you need to also innovate in other parts of the value chain. Actually, you will find some of the other innovation that actually came into this in the whole variety of areas, whether it be interacting with suppliers, whether it be partnering with vendors, or even in engine development where they actually took the Indica's engine and tried to bring it down into a smaller size and created a completely new sales and service network as close to customers as possible.

In terms of team composition, you see that they thought of new concept, so they needed to have fresh thinking. Therefore, they brought in a completely new team of young people with good leadership abilities who could network well within the organization. This is one way they actually fuel the passion of the young team; somewhat similar to the idea of Honda which was just shared with us a short while ago.

The results were quite amazing. In just first eight months of launch, they had more than 30 thousand units sold. I do not know what the current situation is, but a few months ago there was still a huge order backlogged. More importantly, they have created a lot of organizational dynamism which is now spreading to other products. Now they apparently have a new product based on this which is actually going to be a small passenger vehicle and which is going to be a competitor to the Maruti Omni on the anvil. We keep hearing about a lesion of small car projects which are actually flowing from this particular product.

What is equally interesting about this is that Tata Motors actually figures in a list of top innovators in the world compiled by Booz Allen Hamilton. What is unique about these innovators is that they are highly-leveraged innovators and the company is with best overall performance. They distinguish themselves not by the money they spent. So, it is not actually spending more money, which actually results in better innovation, but by the capability they demonstrate in ideation, in project selection, in development and commercialization. We can see that in many of these unique capabilities in these areas were demonstrated by Tata Motors in developing this product.

We have a number of other examples including pharmaceuticals in new drug delivery systems and chemical entities. We have companies like Ranbaxy and DRL Life Sciences. We also have companies like Strand and Biocon. In telecom, we have the Midas Communications which is doing wireless local loop optical multiplexing. They have just won the award for indigenous technology development. We have companies like ETM which are doing digital signal processing for video. So, we have a whole range of innovative companies across sectors that are actually involved in innovative new product development.

Another very exciting development in recent years in the technology management arena has been the fact that companies are actually looking to acquire other companies for their capabilities. As you know, if you have a strong strategic importance of a particular technology but your familiarity is low, one of the best options is actually to go for acquisition. Why is acquisition of a company a better idea than acquisition of a technology? This is because when you acquire a company you get all the elements that go into it. You get the physical systems, you get the managerial systems, you get the skills, and you get the values. I think we understood the importance of values in an organization from the previous presentation. When you actually go and acquire a company as a whole, hopefully you get that along with the skills and knowledge and the people. How is it relevant to India? It is actually happening just in front our eyes. Right here in Delhi, we have Moser Baer which is a leading company in recordable optical media market. Just last week, they acquired OM&T, a Phillips optical technology and R&D subsidiary, which is a significant part of the blue ray technology development and commercialization effort. Interestingly, OM&T is currently the only company outside Japan which ships blue ray disks. So, by acquiring this company, Moser Baer actually got access to the blue ray technology and may be able to actually build a leadership position in this next generation optical format. We have so far seen a very few companies in India that have actually tried to get involved in this kind of format or standard wars, and it is suddenly a very exciting development to see companies getting into this kind of arena.

Another important acquisition for intellectual property is that by Biocon. Biocon is one of India's leading biotechnology companies. Last year, they acquired Norbax, a

U.S. company which has done some of the pioneering work in human oral insulin. Why did they acquire this company? They did so because it gave Biocon the ownership of over 300 patents or patent applications related to oral insulin. Biocon is now working on a second-generation oral insulin drug that is expected to have a higher specific activity. This acquisition of Norbax will actually help them fight patent disputes that might come in the future. So, it is much more than the technology itself; rather it is the ability to defend Biocon against patent challenges in the future and that is the main reason of this acquisition.

Another very exciting company is the second largest forging manufacturer in the world, Bharat Forge, which created tremendous manufacturing capacity but was trying to expand its psychological capabilities. In January 2004, they acquired the assets of CDP which is a company based in Germany with a very long history of more than almost 180 years, renowned for its technology, product design and development capabilities. What does the acquisition of CDP bring to Bharat Forge? It means that Bharat Forge will now be actually able to work with BMW on creating suspension components for the next generation of vehicles. This would not have been possible without this acquisition. In December of the same year BFL acquired another company in the aluminum forging business, which gave it access to some of the other leading automobile companies.

In the area of combining legal and technological innovation, we find that companies like Ranbaxy are actually having or making important strides in combining legal innovation with their chemistry, which include understanding the intricacies of the patent law, understanding gaps, being able to actually combine technical innovation in their legal procedures to come up with molecules in the generics markets.

I will go over to the next perspective that is basically looking at how innovation is transcending technology and law. Here, we are actually looking at innovation across the value chain. As I mentioned earlier, innovation need not to be always in products and processes. It could also be in the value proposition, in the supply chain, in terms of its target customers, and in terms of the enabling technologies that go into a product.

Here, we have some very important innovations happening in the telecom services sector. For example, Bharti Airtel has architected a new business model where the value proposition is low cost, reliable, lifelong telecommunication services. But the supply chain has been changed where they have outsourced the network and the IT backbone. Their target customers are the people who never have dreamed of owning a mobile. We can see that tremendous explosion of mobile capabilities is there in the country.

In the software industry, we see a number of important developments happening; to name a few, the quick absorption of new technologies, state-of-the-art software factories, the largest number of CMM Level 5 organizations in the world, innovation in manpower recruitment, selection and training, new domains such as R&D services, and customer centric innovation. So, clearly the kind of innovations happening here are not necessarily in the technology domain but in a number of other areas that are actually going to benefit customers. In terms of the Indian technology companies, the highly innovative companies seem to have some common characteristics. Typically, I find that they are led by technically qualified entrepreneurs. And therefore, there is strong top management support and interest. They have a much focused business

strategy. They are largely financed by internal accruals. They have a strong investment and capability building. They pay particular attention to learning mechanisms and they have a strong people orientation. These are what seem to go into building the kind of organizational capabilities that are required for knowledge-based innovation and which are really the foundation of many of these companies whom we spoke about.

While this scenario seems very impressive, there are also a few problems that remain. I will just spend a couple of minutes to talk about some of the challenges that remain in the area of technology management. While some of the efficient companies in the country are world class, in aggregate terms, India is not a dynamic technology adopter. Unfortunately, for example, the labor productivity is only 15% of global levels in the modern sectors. In fact, if you look at the difference between the Indian modern average and India's potential, you will see that part of it is due to the lack of investment in new technologies, and also issues like poor design for manufacturing, which are actually technology management issues. So, while we have a robust and vibrant technological sector, unfortunately this is only in part and there are still are a number of enterprises, which really have a big gap to cover in terms of achieving global levels of productivity.

Second issue is in terms of technology transfer. The numbers of technology transfer agreements have actually declined after liberalization started. While this might seem to be a good sign, it may also be a danger because it means perhaps that not enough new technologies are being absorbed into the economy, as was suggested many years ago that about 90 % of Indian companies, in one study of 2002-03, did not report any R&D expenditure. This again is a cause of concern because it means that a large number of companies are actually not active in the R&D area. There is also lack of a critical mass of dynamic high-technology manufacturing firms and even the government support programs do not find the kind of demand you would expect in a vibrant high-tech economy. Startups are finding it difficult to reach critical mass due to funding and growth related issues. There are barriers to academics moving into industry. The record of commercialization and technology transfer from research labs, unfortunately in spite of many years of efforts, still has a lot of scope for improvement. The domestic market for technology continues to be relatively underdeveloped. Even in IT which is a strong area for our software sector, there is unfortunately insufficient emphasis on investment in IT in the manufacturing sector and an inadequate leverage of IT towards driving business value. So, these were some of the challenges for technology managers in Indian industry as we go forward.

2007 Honda-CII Symposium on
Linking Technology, Innovation
& Entrepreneurship

Technical Session 2

Management of Technology in Public Research Institutions and Role of S&T Policy in Linking Technology, Innovation & Entrepreneurship

Session Co-Chair

Somenath Ghosh

Chairman & Managing Director
National Research Development Corporation

This session is to do with the management of technology in public research institutions and the role of S&T policy in linking technology, innovation and entrepreneurship. Today, since we have Honda and other speakers from Japan, we have much to learn from these friends about this linkage that links technology from the source, i.e. research labs and institutions to innovation process through which to develop new products.

Though the research institutions in India have been very active for a very long time and much of the research in India is publicly funded since the 70s, 80s or 90s, the driving force in this process of innovation has been what is called self-reliance. So, the driving force behind innovation in the past decades in India was different than today; as we have become a part of the globalized society since last five to ten years, we see a closer linkage of universities and research institutions with the corporate sector, which is linked through licensing the model of managing innovation in tune with the model that we find in the developed countries.

Panelist:

T. P. Govindan

General Manager - Corporate technology
Crompton Greaves Ltd.

Just to mention to you a few words about Crompton Greaves. Crompton Greaves is the largest private sector electrical company in India. Its position number is 7 at this point in time on transmission & distribution business in the world. We have operations in about seven countries in the world. Our sales is now over $1 billion, roughly Rs.5,000 crores plus. We have 7,000 employees' strength. I belong to the Global R&D Center and we have 250 engineers in that particular R&D center.

So, what I share will be experience of what we had over the last 30 years in that particular R&D center, and what exactly is happening in a private sector on large scale R&D and what their future and role are like in relation to technology.

We have a business mission to be Number 3 in the world by 2010, and we also have a technology mission to be the best in R&D by 2010. These are the business missions and technology missions. And in that backdrop, I invite you to this particular presentation.

These are the logos of models we have coined in the last few weeks, and a few ones are the representatives of our technology horizons. The logo is transiting of the technology journey of the company from 0 & 1 to 2 & 3. I will just go to my next topic which explains what exactly that means. Most of the Indian companies have been really strong in technology improvisation, technology absorption, and adaptation. They are yet to gain stream in the technology generation.

We have represented technology in four quadrants here. You see here Horizons 0, 1, 2, and 3. "Horizon 0" means incremental technology that means optimization, material saving, performance improvement, and technology activities to make the product better. "Horizon 1" means derivative type of technologies that you do not have the product, you make the product but the technologies, by and large, are the same. If you make a 500 kW motor from a 250 kW motor, that is what we call derivative technology; the same is true when it comes to the induction machine as the basic platform technology remains the same. So that is called "Horizon 1". In "Horizon 2", we have got technology platforms, technology missions and the center of excellence, the type of expert area. And "Horizon 3" represents the disruptive or breakthrough technology. These are Horizons 0, 1, 2 and 3 as we have coined. Actually, many of major Indian corporate organizations are either transiting from "Horizon 0" to "Horizon 1," or from "Horizon 2" to "Horizon 3". If we look at "Horizon 0" and "Horizon 1" together, they represent technology improvisation or technology adjustments; and if you look at "Horizon 2" and "Horizon 3" together, they mean technology generation. So, this is the journey what we have gone through.

I have just tried to get here some technology value chain. In a technology, it can be broken into three big boxes, i.e. technology assessments, technology generation, and technology protection. We are very strong in technology assessments. Crompton has been carrying its Indian operations in the market-related knowledge products for 70 years. And that is not through many technology platform generation, we have a lot of platform technologies with us but imported them from all over the world sometime in 80s. We improvised them. Technology assessment training means technology absorption, and in no way its development, cross fertilization, and technology improvement. This is Horizon 0 and 1 type of technology work. Many of our Indian companies are extremely strong in this area.

We are trying to migrate from technology assessment to technology generation. Technology generation really means platform technologies and high value and very high value improvement. There are also disruptive and breakthrough technologies. Breakthrough technology is in the form of solid-state lighting, or superconductor-based operator, i.e. transformers, motors, and switch gears are considered disruptive technology which is likely to come in about 15 years' time. This is a transition which we need to take and we are consciously taking now.

Technology protection is the third link in which Indian corporations are not really strong. As far as IP is concerned, I am speaking with respect to electrical engineering on which I have an inside information. Perhaps, pharmaceutical and biotech are at a little bit advanced stage, but electrical engineering industry is reasonably lagging behind in technology protection. That means IP wealth creation, technology management capability, and data and information security management system. We also need constant benchmarking. It was mentioned that Honda does not want to benchmark, but perhaps they can say so because they are at the stage of leading revolution. By and large, benchmarking is an extremely relevant tool for technology management to know where it stands. We believe managing these three big boxes is exactly technology management. And that is the capability which may be built into this country as an issue. So, that is an issue for the country as a whole.

We have clearly laid down a seven-step technology direction. How do we make a transition from a technology improvisation organization to a technology generation organization? First we benchmark our products; second, we identify the respective platform for each product; third, we map our competency as to what is necessary and what do we have; fourth, we achieve the identified competency through a very high-level technology network; fifth, we create a robust structure based on that competency; sixth, we continuously monitor and shrink the product development cycle time as soon as possible; and finally, we create and enhance intellectual property wealth. These are the seven technology direction steps we have identified. This is the company's technology policy built off by our technology director last year during the National Technology Day.

We have a clearly laid IP roadmap starting with creating an IPR cell, creating awareness across the company. During last two years, we have created this awareness among a thousand of our Crompton Greaves engineers, 1,000 out of 1,300 engineers work for our company. Completely trained on IP knowledge, these engineers now generate the product invention free. When you develop a product, you develop it in such a way that access to innovation, right at the beginning, creates some tools such as innovation management tools. So, at the time when you develop a product, the novelty is built in and then you go for an IP portfolio management.

These are the seven steps which have led to the IP management in Crompton Greaves for last two years. Perhaps, I should mention this with a little bit of pride because this moment is the first in electrical engineering in this country. I do not know it is in parallel with other engineering industry. This may be put in a different format, but means the same thing.

And this is the IP portfolio of Crompton Greaves. Number does not speak high, but what I want to show is that during the last two years, it certainly operates on the plateau of patterned curve. We are seeing that for the last few years, it is growing

exponentially. This is because of IP awareness and IP movement within the company for the last two years.

We have a clearly laid down technology mission. The technology mission can be seen this way: 30% of revenue through new products is here to come. If we sell Rs.100 worth product, Rs.30 has to be through sale of new products; and this forms the need for doing R&D. This is the reason why R&D needs to be there, or technology needs to be there. We need five of big breakthrough platform technologies. We are transiting consciously from the technology improvisation area to technology generation area; and our mission statement is that we need five breakthrough technologies in another area.

Product development cycle time is one of the issues within the industry. This product development cycle time should be considered in comparison with the best in class, such as 100 patents per year and 4% budget allocation for R&D. Currently, we are operating at about 1% budget allocation for R&D against Rs.100 sale. Most of the Indian companies operate at 0.5% to 0.7%, whereas a technology generation company, typically an electrical engineering company, requires about 4%. 1% has been good enough for us so far because we were a technology improvisation company. So, there was no need for spending greater than 0.5% to 0.6%. Now, the 1% figure must be multiplied because we are going to shift from Horizons 0 and 1 to Horizons 2 and 3. There is a need for this type of budget allocation and this is our company's R&D mission for 2010.

One of the biggest issues for an R&D organization will be the competency in a technology. The R&D organization considers competency of its people as its assets. We are consciously enhancing competency of all our technical people from Level 0 to Level 5. Level 0 means that he is a fresher to that particular technology, and Level 5 is an international expert. With Levels 2 and 3, come there that he is reasonably independent on that particular technology. This has been done for all the engineers at Crompton Greaves India and overseas operations. It essentially helps us to be top-heavy as far as R&D is concerned. In R&D, we want people to be top-heavy, i.e. Level 3 and above should form more than 60% of its total strength.

This is different from manufacturing. Manufacturing will prefer to be bottom-heavy with less of managerial people and more of workman type of operations. R&D needs to be top-heavy. If you have 100 people, 60 of them should be Ph.D. And how do we do that? We do that by competency mapping of R&D engineers, and specifically train Level 3 engineers to promote them to Level 4, and Level 4 engineers to Level 5. This is our planning strength. Technology networks are essentially used so that our deficiency in Level 4 and Level 5 engineers can be taken care by the effect of the networking. That is how the movement is.

Just to show you, these are electrical engineering expertise areas. We have about ten expert areas in Crompton Greaves being a global company. If you look at electronics, it is put into elemental technologies, which include embedded systems in communications and consumer electronics. Even competencies for the major areas like electronics are broken down to elemental areas, and each of them is targeting that we require somewhere about Level 4 and an average of Level 2.5. We constantly monitor if the aforementioned training and technology network projects are done, and if these competencies are attained in a reasonable time.

I have three technology issues that I need to mention. Perhaps the commonality between a private R&D and a public R&D could be in these areas. They are common. First, enhanced academia-industry interaction was mentioned in the morning. In academic fields, competency builds off of delivery whereas industry wants technology development along with the competency building up. There seems to be a better meeting ground between the academic field and the industry. This is a significant issue. We have been trying to discuss it with many high institutes such as IIT all over the world. But this seems to be an area, which really entered into a dialogue so that technology development along with competency building is the need of the day.

Secondly, there is inadequate IP awareness. We have been doing considerable work on promoting IP. It needs to be a little more pushed as curriculum in academics needs more IP professionals, i.e. engineers turning into IP professionals. Industries need to take this up on their own, such as what we are trying to do is that we are promoting the awareness across the company.

Lastly, I believe that there is an inadequate technology management band with the industry. When I say technology management apart from technology generation, protection enforcements, I mean the basic job of a technology manager is to identify the risk involved in technology and form a model to mitigate those technology risks. We do not seem to have enough people in the country to promote technology management as a subject because that is going to be a necessity if somebody needs to be in technology generation. From Crompton, we have another technology leadership program which is about one year program to enhance bandwidth to, say, fifty technology managers with competence of Level 4 by 2010. But this continues to be an issue in the country.

Session Co-Chair:

Tateo Arimoto

Director General, Research Institute of Science and Technology for Society
Japan Science and Technology Agency

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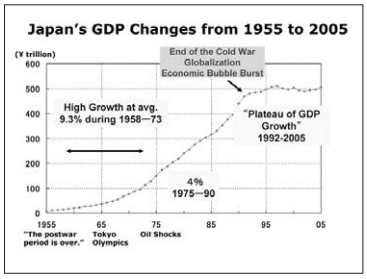

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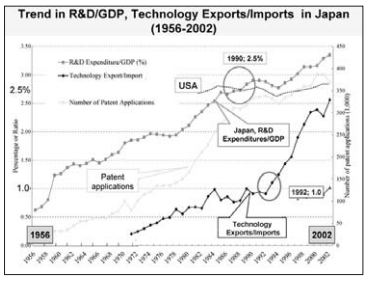

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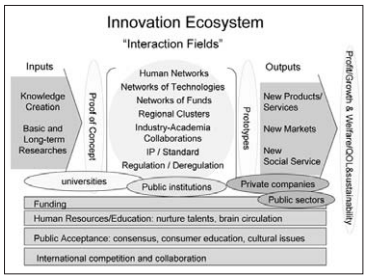

I have involved in the Japanese science policy for almost 30 years. So, this time my goal is to give you some discussion points based on the Japanese experiences from the policy aspects on the national innovation systems.

As you may know that the term innovation, its definition and scope, is very ambiguous and diverse. There are innovation for growth, innovation for making money, profits and welfare, whereas there are innovation for employment, innovation for life quality, social cohesion and sustainability. My personal observation is that the American people including their government are focusing upon innovation for making money, but the European side now looks at not as much making money as social cohesion. So, from the public policy viewpoint, we have to make comparison between these goals of innovation.

With that said, I would like to get started with showing you the long-term GDP growth of Japan after the end of World War II (*See #2*). You can see that until the early 70s, we got sequential high growths of around 9.0% during that time. It is similar to the current Indian economic situation. After that high growth age from the middle of the 70s through the 90s, we have the 4% economic growth. After the end of the cold war and the globalization started up, we are facing the GDP fluctuating growth until the year before last. So, as you may know that now Japan's economy is recovering and rising again, this year is projected to mark an about 2.3% growth. Japan is now at the threshold of the turning point due to rapidly changing economic environment after the end of the cold war and the ICT revolutions. In terms of economical and technological development, our country is transiting from the catch-up phase to the front-runner phase in which we have to thrive on innovation based on our own knowledge and technologies. So, we now need innovation policies in terms of public policy as well as management of private enterprises.

So, this chart shows you the long-term R&D investments and technological exports of Japan after the World War II (*See #3*). R&D investments include both public and private money, and they are still growing at almost 3.5% in terms of ration of R&D spending to GDP. We are now exporting many high technologies to the world. So, this is a very important chart toward making what we call "innovation eco-system" in Japan.

Innovation is the need of long-term duration and innovation is a stochastic process (*See #4*). On this slide, the left hand side shows the upstream of innovation, i.e. knowledge creation and basic long-term researches. On the right hand side are output and outcomes in order to get goals such as profit, welfare, social cohesion, and sustainability. Also private companies' output is there, such as new product, service, market and social value. But the middle point, "interaction field", is very important here: it has many elements needed for innovation process, which include people, technologies, private and public funds, foreign direct investments, and government regulations. So, public

policies should be compiled in this interaction field to get as much outcomes as possible.

The public institutions until the end of 80s were at the stage of high growth. Organizations like Japan National Railways (now, JR group), Nippon Telephone & Telecommunications (NTT) and other big public firms put in a great deal of effort to transfer their knowledge and technicalities to industry through the commercialization of that knowledge. But after the globalization started, the role of public institutions and universities to help produce innovative outcomes has been changing both rapidly and substantially. So, during the stagnation period in the last decade, we had to change institutional systems and reform public policies so that public institutions can set up a new innovation system through industry-government-university cooperation. Also they may be playing a big role to construct advanced large facilities for innovation. They also have other roles such as intervention and synthesis of disciplines.

As you all know, new high technologies need to be integrated from traditional disciplines, knowledge and engineering. To establish new academic fields like nanotechnology, biotechnology and ICT technology, you need to first combine these elements. The same applies to the creation of new social and economic values. For Japan, robotics is an area of major technological advantage. So, we have got nanotech, biotech, ICT, and robotics: these are prioritized areas to receive more R&D money from public policies as innovation frontiers.

To sum up my arguments, yesterday when we had a chance to visit the Honda factories in the suburb of New Delhi, I recalled Mr. Soichiro Honda loved dreams. My understanding is that he focused upon innovation. Of course, he used it not only for making money and employment, but for social cohesion and sustainability. But I believe his main point was innovation for dreams.

Panelist:

Tetsuhiko Ikegami

Commissioner, Space Activities Commission,
Ministry of Education, Culture, Sports, Science and Technology (MEXT)
Special Advisor, National Institute of Advanced Industrial Science and Technology (AIST)
Guest Professor of Tokyo University of Science, Emeritus of University of Aizu

My background is engineering in the area of optical communication and networking as well as computer science and engineering. So, mine is different from the Honda area. But in many cases and also here, I have to introduce what really is going on in Japan and in particular, what public sector can do for linking technology, innovation and entrepreneurship. Here, public sector includes public universities and also national research institutes. I am partly linked to National Institute of Advanced Industrial Science and Technology (AIST). This is in public sector, even though it has become an independent corporation recently.

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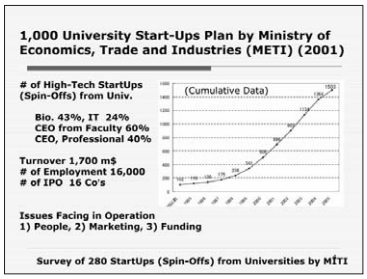

Japanese strategic science and technology policies started about ten years ago in 1995, and the Basic Law on Science and Technology was settled (*See #2*). Thereafter, we have completed two big plans, the First and Second five-year Science and Technology Basic Plans, and we spent a little money. I will talk about that later on. But in any case, strategic science & technology policy started in 1995 or 1996. Why it started in 1996? There were two reasons for that. One was that the Japanese industry was very strong as you know and was very autonomous. They became very successful without support of public sectors, national universities and institutes. That means national institutes or public sector was ignored by the industries. We are not sure if it is right or not. From the viewpoint of universities, universities at that time looked down on companies. So, there was no interaction between them. Universities sent smart students to companies, and that's all.

Before beginning of this century, a number of the faculty members was about 0.2 million in Japan. They were elites selected by very tough entrance exam as you already know; so they were isolated from the industry or the society at large. At the national level, they have been government people, and still they are. The number of researchers is about 10 thousand and they are very basic research oriented.

And then, very strong reforms started in the beginning of this century in 2001. The reason was that at that time the Japanese industry was facing big difficulties. Also Japanese economic conditions had been very bad since the economic bubble popped. The government had to enhance collaboration between universities and industry, hoping technologies that the public institutes generated would help the industry if they were successfully transferred. So, there were many major items here: deregulation, the principle of competition, evaluation of performance; and the government released mission statements to the national universities and research institutes in which it stressed the public institutes should contribute much more to society. Also, the government raised substantial subsidiary for the public institutes, but researchers need now to get their money from competitive funds, which are a quite new model for Japan but very common in the U.S. and the U.K. Presidents of national universities are now authorized a strong, independent power to manage their institutes.

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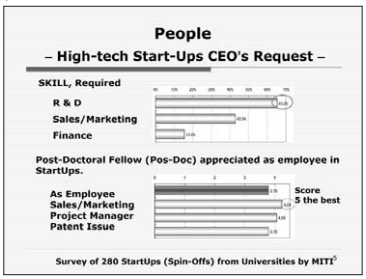

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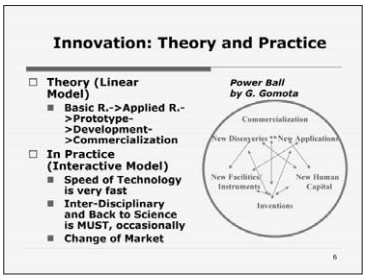

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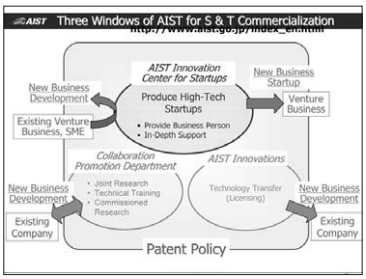

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This means they are now responsible for personnel affairs and budgeting. Although it's not easy to get all these reforms work as planned in the real world, these big changes certainly took place at the beginning of this century. That is my rough sketch of the strategic direction in our science and technology policy.

Next, I would like to talk about R&D spending in Japan (*See #3*). R&D spending in Japan is very high. In total, it is 3.2% of our GDP. 20% of that total comes from the government. This means our government's support for R&D activities amounts to roughly 0.7% of GDP. I think that it is big money. After the strategic science and technology policy started in 1995, the government put a total of JPY 33 trillion (approx. $0.3 trillion) for ten fiscal years for the First and Second Science and Technology Basic Plans. It is again quite a lot of money.

As was said earlier, the government has enhanced collaboration amongst industry, universities and the governments. For instance, national institutes and universities now create so-called "Technology Liaison Offices" for propelling technology transfer from them to private companies. Associated deregulation has empowered them with larger power of autonomous management. In this freer environment, the number of high-tech startups and spinoffs from the public institutes has increased. And the new cabinet is supporting open policies and innovation, and preparing a strategic initiative called "Innovation 2025".

What is the result? We have put a lot of money in the public sector, but we have to take care of the result. So, let me show you an example of the outcomes from those strategies (*See #4*). In 2001 METI released this 1000 University Startups Plan and here is the result. As you can see from this figure, there is a very smooth increase in the number of high-tech startups from universities. If you look at what kind of startups they are, you find 43% of them are biotech companies, and 24% are IT-related companies. This distribution may be similar to here in India. About 60% chief executive officers of these companies come from university professors and faculty members, and 40% of them from the private companies. This means a lot of these CEOs have previous experience in management of organization. The total turnover is about JPY 1,700 million. The number of employment is about 16 thousand, but if you look for initial public offering companies, over 16 are now publicly traded.

METI asked CEOs of these companies what issues are facing them (*See #5*). CEOs find the prime issue is people, the second is marketing, and the third is funding. As you all understand, what people you have is the single most important factor to make startups succeed. METI also asked the CEOs what kind of skill they want from their employees. The top requirement is R&D capabilities, followed by skills for sales and marketing and then skills for finance. As most of these startups are high-tech based, it is quite natural they need R&D skills most. In

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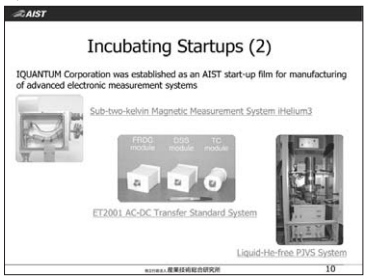

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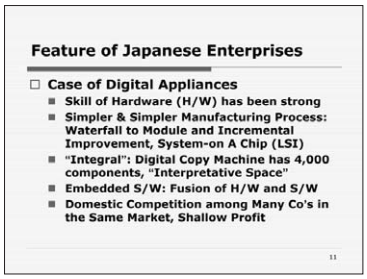

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Japan, it is very tough for R&D people to find a good job in the private sector, but that which these CEOs value their talent as highly as skills of managers, patent pros, and sales and marketing pros is a very good news for them. R&D capabilities are indispensable for innovation which is a very hot issue both in Japan as well as here in India.

We had a lot of discussion about innovation as what is innovation, but you know the theory and practice are very different (*See #6*). According to theory innovation will be generated through the path from basic research, applied research, such and such, and finally to commercialization. But in practice, they are not so linear and much more interactive. So, each element is bouncing as you can see above, and my friend Dr. Gomota says that it is powerful. So, each element is bouncing each other. That is in the practice. So, today technology is very fast and also it is getting more disciplinary. In many cases the back of science is very important in managing high-tech startups as you can guess, and also change of market intervenes here.

If we think about the practice, the basic ingredients for innovation are people and environment (*See #7*). Already some speakers have addressed this kind of things, but people we need for innovation can think outside the box, and they are willing to take risks and optimistic with dreams. And such people should work in an environment where they are accessible to human capital, startup funding, technology, facility, and office. All this makes road to market shorter. Of course, a little bit of luck is necessary as a basic ingredient for innovation. I always advise young researchers and engineers that doing innovation is having entrepreneur mind and strong will. What I mean by this is, as we very much rely on young people for doing innovation, the idea of innovation should be presented to us in simple ways, and no simplification is impossible without entrepreneur mind and strong will.

Now let me introduce to you some of activities of AIST associated startups (*See #8*). One of the ways to push forward innovations is startups, and AIST also helps get new startups started. You see here the AIST Center for Startups. Its role is to create venture business as a new startup or from existing small and medium firms as a second startup. Also the collaboration with industry is very important to exchange information and help them in the areas like technical training, and such and such. Many people point out addressing IPR and licensing issues is a key function expected for this center. We are promoting startups in this manner, but it is no easy job.

In terms of incubating startups, there are many things written here, but one thing I want to emphasize is the importance of hands-on experience or training. One result from this incubation effort is the company making the robot on the picture. This is not a human like robot, very different from ASIMO. This one is a healing robot for the aged. It looks like a seal and aged persons are very happy with this strange look of the robot. He can speak some words, and make response to actions of his master. So, this one is very nicely welcomed

in senior care homes.

Next, I would like to talk a bit about the strengths of Japanese enterprises by taking digital appliance makers for example (*See #11*). Digital appliance is presently one of Japan's strongest industrial fields. Their hardware skills are very strong, and they are very good at improving process lines, and one genius of Japanese makers is exemplified in the sophisticated, so-called "incremental improvement" process. In the case of digital appliances, the System-on-A-Chip is widely used which substantially reduces the number of components used for a given product. This approach is very good for making highly complicated, yet less expensive, digital appliances.

Also, the strength of Japanese makers comes from the so-called "integral" architecture. The Industrial Performance Center of MIT points out Japanese makers are strong partly because "interpretative spaces" are allowed in their workspace as evidenced by the "integral" approach. Let me give you an example. If you make digital copy machines, you need about 4,000 different components. How do you assemble them? It is a very complicated process, but the integral assembling makes it possible to produce very complex machines at low cost.

Another recently common technique is "embedded software". Actually it is common worldwide, not only in Japan. This is a new paradigm of making things, basically the fusion of hardware and software techniques.

In Japan, domestic competition among many companies in the same market is very tough. So, this competitiveness may be a trick or secret to explain why Japanese companies are so strong. According to Economist magazine, India's GDP will surpass Japan's in 2032. I am not sure about this, but I am surely happy I can count reasons why Japanese industry is so strong.

The next thing I would like to discuss about is the role of the public sector, national universities and research institutes, for innovation (*See #12*). As Mr. Arimoto pointed out, for many years public companies exploited R&D results and social infrastructure for nation's growth very well. In fact, Nippon National Railroad Company built the renowned bullet train Shinkansen, and NTT the optical fiber network across the Japanese land. Perhaps the public sector is very strong in making infrastructure. In India also, you may someday find it appropriate to let the public sector take care of certain areas. The public sector may be also strong in low-tech combined with high-tech. For example, the combination of agriculture and automobile yields new energy like bio-ethanol and fuel-cell battery. This is an area of building foundation for sustainable future, so it could be nicely conducted by the public sector. Possible areas include healthcare, renewable energy, and sustainable environment. And finally, the public sector has been good at education and training people. But there is one thing I want to suggest: Japanese schools usually do the "know first, do next" education. This is upside down, I guess. Skill first, then knowledge.

Finally, I would like to introduce some new activities conducted by the Japanese government; that is, the next-generation supercomputer. Only the public sector can manage this kind of giant facility. The government is planning a very high-speed supercomputer running at ten Petaflops. As you can see, even though hardware is very fast, software is much more important to manage and make best use of such kind of facility. So, R&D or grand-challenge application software for nanotech, life sciences

and other areas is a must. If we can make a very user-friendly supercomputer, we can do many things not possible before. Recently simulation science has been growing very nicely, especially in the area of sustainability science, and the next-generation supercomputer could be a very powerful tool to predict the future. So, R&D of this type of advanced application software is the key, and we welcome Indian smart people to join us with this kind of projects.

Two years ago I visited Bangalore and I appreciated your activity in bio area and also in computer area. I met a person from Strand Genomics, which I guess changed their company name. Their business is associated with bio, and they were making very user-friendly software. I felt bio and software technologies would be a very promising combination of business for startups. Also at that time, I went to the Infosys Tech Park. Many Japanese companies go and ask Infosys to educate their employees. In this sense, Infosys is becoming a big competitor to Japanese universities. The chairman Mr. Narayana Murthy is a very wonderful personality with warm mind. He is also the advisor to the University of Tokyo. So, through him, we have made a very good connection between the two countries. Also, I have been to IIT Delhi and found a very fascinating group in bioinformatics.

Lastly, let us discuss India's challenge in relation to Japan (*See #13*). Some argue that the "now" business model of India may be facing a challenge of "skip hardware to software". This is not entirely true. I know you are also going into much more hardware area. But, in relative terms, we would say that you are going to skip hardware to software. It will be very successful for the future. For instance, in the area of biotech, India gathers so called "wet" data from abroad, and processes it into "dry" data to produce new drugs and other products. This is quite a new mode of production in an industrial sense.

Also, you have a global citizen mind. Once I asked my friend in India, "We can see Chinatowns all over the world, but there are no 'Indiatowns', why?" His answer was, "Oh! We have very global citizens." It's true, I agree with you. So, you have a lot of advantage. The Internet revolution is going on, and here come ubiquitous computing and networking. There are new business opportunities on the web. India has a large pool of high skilled people, and they will meet big opportunities in the future. As to the creation of a new partnership with Japan, we will be here to help you. Your Prime Minister Dr. Singh visited Japan last December, and said in his address, "We must exploit synergies in the development of Indian software and Japanese hardware industries." I agree such, if realized, will surely bring us a bright future.

2007 Honda-CII Symposium on
Linking Technology, Innovation
& Entrepreneurship

Technical Session 3

Case Studies on Linking Technology to Successful Enterprise - Challenges and Advantages

Session Co-Chair:

V. J. Prakash

Managing Director
Ultra Motor India Pvt., Ltd.

As you can see, the session is on linking innovation, technology and entrepreneurship. You would be wondering why these need to be linked. This is so because I believe having new ideas or having new business starts with some sort of innovation, which obviously has a technology entrepreneur, and nothing works without entrepreneurship. So, we are stating the obvious when we say linking innovation, technology and entrepreneurship. Having said that, there is much water that has to flow under the bridge before it can become a successful renowned business and contribute to the society.

I will take a few minutes to say a few things about what is my connection with technology and why do I stand here in front of you amongst these very eminent speakers who are about to address you. The technology that we are talking about is bringing electric vehicles to the Indian market. That is the company, Ultra Motor Company of UK, who has set a wholly owned subsidiary in India to do that.

If you look at the world of the surface transportation, it is dominated by IC engine based automobile industry which is a huge install base of investments, ecosystems, employment, and what brings together with that is the whole lot of vested interest and the crowd that brings with it. However, I do not think we should grudge it to the industry because it is fully deserved. CII itself would probably be lessened to a half of its size if the auto industry was not there. That is true of our economy and that of many other nations. Even if auto industry were to shrink by a small percentage, I think the economy will be shrunk to a great extent. It is to the credit of this industry that it has an unbeatable solution for every mode of surface transportation, be that personal or goods. However, the banyan tree effect that it is spread across the industry has made it very difficult for alternative technologies to come to the fore. For anyone to enter this area, it needs a very brave company or a person, and just staying there would be a great feat.

However, the industry has not let grass grow under its seat. It is continuously evolved. It has become better. It has become faster and it has become cheaper to own an automobile. Now, if I see the industry is already in the sweet spot of surface transportation, then why we should look for any alternative. As Bob Dylan said the answer is blowing in the wind and if it is not blowing in the wind, it should be pretty obvious to everyone especially those who are sitting in this forum. These are depleting non-renewable energy resources, global warming, and spiraling fuel prices as you know it all.

The Ultra Motor Vehicles believes that the solution lies in electric vehicles both pure and hybrid. Now, why should be look at electric vehicles? The technology is very mature. There is no rocket science and it is pretty simple. There is a motor and hybrid turns the wheel. That is it. Nothing more! Can anything be simpler than that? There is no fuel injection. There is no transmission. There is no different shell. That is all that has. And there are, of course, no exhaust pipes. That should be great news to a lot of people living in Delhi and other congested places in India. It makes use of the existing ecosystem. You do not have to build billion dollar fabs to start producing this new technology. Motor has already been made all over the world. So, billion of dollars worth of investment already exists. You just need to crank this investment to get more out of it. All you need is the 220 Watt wall socket in your house, in your garage, in your office or wherever and nothing more. Operating costs are 20% lower than fossil fuels. I am not really comparing it here with the gas-based systems i.e. CNG, LPG,

and whatever other gas because it is not a very good solution for smaller vehicles because the cylinder takes up a lot of space at the back.

The limitation of electric vehicles is obviously the distance to charge but if you take daily commuting, 80% of the people travel less than 70 Kilometers, which presently is the limitation or the optimal kind of limitation. You can always build a vehicle, which will go farther. But in terms of commercial application, 70 Kilometers is, as far as it would it go right now, economically. It is virtually maintenance free. There is no oil in it. You can dissemble your electric vehicle completely on this carpet out here with a tool kit literally from your hip pocket. That is all it needs to maintain it.

We bring easy solutions to the world. And about the UM technology application, I will give you an idea. Here are some of them. This is how you can move people and personal on a three-wheeler. The motor is out there. You can see how simple it looks. It looks a little bit like a bearing and nothing more than that.

How do we bring in the technology creativeness and the business model, and how do we plan to replicate it elsewhere in the world. Duplication is not the right terminology but I just used it for simplicity sake. Now, we started off by identifying an invention, which was originally used in Luna Rova way back in the 70s. The scientist who was working on that was located and he was funded to develop the prototype, which was then patented in U.S. and thereafter elsewhere in the world. This is what is known as the impulse energy motor. I shall not go into the technology. Thereafter, this technology was brought to India because India was identified as a potential market for this. In terms of identifying markets with highest potential countries with high population and low cost transportation challenges and the characteristics of this market is price to performance and in other words, affordability. The other set of markets are typically the Kyoto Protocol type of countries with high level of environmental consciousness. Of course, here to enter this market you need stringent department of transportation requirements and also much higher cost of stocking, distributing and marketing.

Ultra Motor's business model is in selecting a center of excellence for technology development, which has started in India, and the challenges are much higher than what we thought we could solve in India. So, in terms of being able to meet the price performance, we have decided to move further development out of India into Taiwan. For finding the best location for the commercial production of the Ultra Power Pack, which comprises the motor, the driver, the batteries, the charger and the related things to assemble our electric vehicle, I shall offer no prices for guessing which is the best location, it is China. And then we needed to decide whether we should do it ourselves or whether we should partner. This decision India has already been taken. We have signed a technical marketing collaboration agreement with the Hero Group i.e. the Hero Cycles Ltd. in Ludhiana.

Ultra Motor brings the total EV solution. The product, incidentally, was launched and the dealership is about to be launched by the end of this month. We bring in the total electric vehicle solutions, product selection and design, power packs, strategy and execution, marketing and brand building. The partner, the Hero Group, brings in vehicle assembly service warranty. Their brand i.e. the Hero brand will be called the Hero Electric and they will be responsible for localization of various parts. In the other markets, we plan to replicate this and prove the potential in one large market.

And that large market we have chosen is India. We will raise money. Nothing works without money. We will develop appropriate business models for other markets and also develop technology from centers of excellence. We will create mini electric vehicles labs in markets to adopt local requirements. We already have one in India. We are starting the next one in California. We will leverage production and supply chain for manufacturing base and then decide whether we should do it ourselves there or to partner with someone there. We will choose whom to partner with and what to partner for.

Session Co-Chair:

Kunio Nakajima

Professor
National Graduate Institute of Policy Study

At the Ministry of International Trade and Industry for which I worked for 31 years, I mainly got involved in industrial and science and technology policymaking. Since my retirement seven years ago, I have continued my policy studies at the National Graduate Institute of Policy Study. I would like to show you the outline of Japan's industrial policies.

Roughly speaking, over the two decades after the end of the World War II, our industrial policy focused on fostering the Japanese industry and enterprises. We protected companies from the U.S. and European competitors. Then in the next two decades, we let several companies go into the same market and compete with each other. At the same time, we encouraged their cooperative development of technologies and products. I believe this constructive competition basically within the domestic market became the key driving force behind Japan's economic miracle. And there is one more thing to note, that is, the remarkable technologic advance and development also came from the public sector, from the public companies such as NTT, Japan Railway, electric power companies. In short, support from these public enterprises underpinned the fast growth of competitive private enterprises.

The current two decades, 16 or 17 years to be precise, is the age of globalization. Everybody is trying to identify the direction to take, and how the industry at large could implement it. In this sense, Japan is learning by trial and error right now.

Next, today we have many people from auto industry. So, speaking with regard to it, automobile makers have been no doubt the central force of the Japanese economy at least for the past twenty years. They have made a great deal of contribution to economic expansion of the nation, and their related businesses, especially in terms of employment. As this chart shows, auto and auto-related industry creates 5.5 million jobs. This is nearly 10% of the entire Japan's workforce, which is around 65 million in total. Such weight of the auto industry is common among industrialized nations in the world. The auto industry is not only important for economic development and employment, but indispensable for the amenity of modern consumers. A total of 70-million vehicles are used by 120-million people living in Japan. This is amazing, isn't it?

Now the auto industry is this big. But if you look at this picture, this light blue line shows the trend of auto production. Look at 1955. Honda started making four-wheel vehicles around this year, but Japan produced only 1 million units in total at that time. Now we produce 11 million units a year. Other colored lines represent auto-making countries; the dark blue one is the U.S. for example. But it is kind of meaningless to figure out auto production on a country-to-country basis because this industry is multinational in nature. In countries like Germany and Japan, domestic cars hold a large market share. In countries like U.S. and U.K., their cars are built more by German and Japanese producers than by their own producers. So you might want to look at the auto industry from a different perspective.

While automobiles are indispensable not only for people's living but for industrial development, they face tough challenges. Needless to say, there are earth environment issues, such as CO_2 emission and depletion of fossil energy, which are inseparable from them. Also automobiles have safety issues. As you may already know, the basic concept of car-making has been unchanged in essence since its advent in the last 19th century. The history of car-making is the history of improvements to address customer

expectations for faster, safer vehicles with more amenity and comfort. I suppose the challenges facing the auto makers are very likely to shift the focus of their product design to more environment-sensitive, energy-oriented features.

In this context, I guess we probably head for discussions about how the auto makers could deal with those issues, and make advances in technology and innovation. I hope such discussions will be enlightening and provoke intelligent minds of the esteemed speakers and the clever audience here.

Panelist:

Tomohiko Kawanabe

Senior Managing Director & COO
Fundamental Technology Research Center
Honda R&D Co., Ltd.

Today, I would like to talk about Honda's challenges in the area of innovation and innovative technologies.

Honda has always placed the highest respect and importance on research. The founder of Honda, Mr. Soichiro Honda, believed that the goal of R&D was to research in order to develop technology. Rather, he wanted to research to understand people and their values. He believed that technology is a means to meet the needs of people.

Honda R&D Company was established as an independent company in 1960, twelve years after the founding of Honda Motor Company (*See #1*). The idea to make R&D a separate company came from Honda's cofounder Mr. Takeo Fujisawa who was a sales executive, not an engineer. He believed that the foundation stone of Honda as a company was innovation. He also believed that the decision to invest in research should not be based on economic or commercial performance, either. Research does not always have a direct impact on financial results, but cumulative results of research become a driving force of the business sustaining future growths. Later Mr. Fujisawa recalled separating R&D into an independent organization was the turning point of the company (*See #2*).

In research, it is important that engineers must not be intimidated by the fear of failure (*See #3*). They must be released from their mistakes and provided an opportunity to reflect on these failures within themselves. If engineers have no freedom to make mistakes, "No Play, No Error" behavior would be widespread. This kind of behavior inhibits the development of innovative technology. The goal of research is to make clear the unknown things into the known things. These activities depend largely on the ideas and inspirations of individual engineers.

In Honda R&D, we understand that success in research is a result supported by 99% failure. Of course, we are not making 99% failures as our success shows. However, product development must follow a schedule based on the business plan. And there is no way that failure here is acceptable. Based on these fundamental differences, the function of research and development are separated in Honda R&D (*See #4*).

Honda R&D has five centers which are motorcycles, automobiles, power products, aircraft engines, and fundamental technology research (*See #5*). My Fundamental Technology Research Center sets a long term vision. We are researching innovative technologies that might create new businesses or renovate existing products. Our typical research projects include aircraft, humanoid robot, energy and environmental research, and intelligent systems. Last year we achieved one of our goals in starting the aircraft enterprise which has much to do with the creation of our Jet Engine business. In 2003, we came to the conclusion that we will try to step into the areas of science and to research more advanced innovative technologies. We established the HRI, the Honda Research Institute, to meet this purpose (*See #6*).

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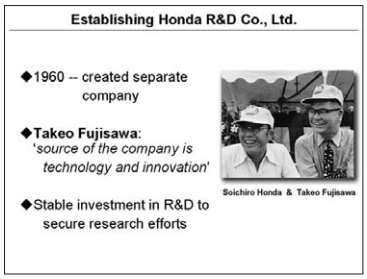

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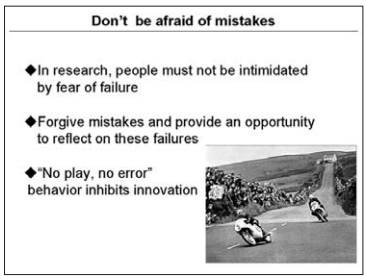

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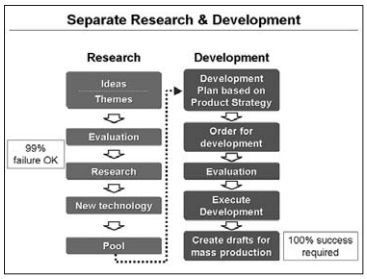

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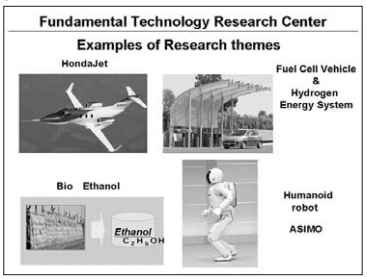

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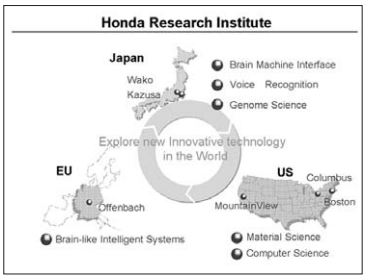

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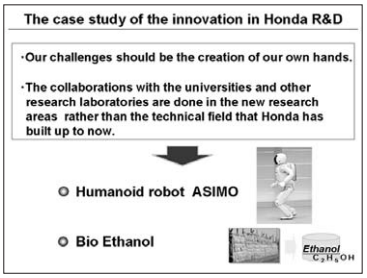

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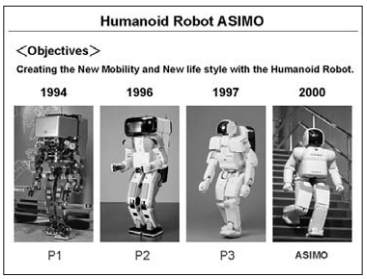

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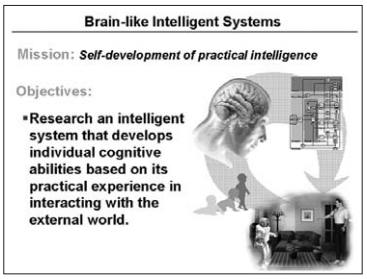

HRI has four science fields, material science, computer science, brain science applications and rice genome research. At HRI, we do joint research with outside institutions such as universities and national laboratories which have expertise in the specific scientific fields.

I would like to introduce some of the themes for the case study of the innovation at the Fundamental Technology Research Center (*See #7*). For research, we keep in our mind the following principles: our challenges should be the creation from our own hands while the collaboration with universities and other research laboratories are done in new research areas rather than the technical fields that Honda has built up to now. Our humanoid robot ASIMO and the research connected with it is an example of the former case. As an example of the latter, I would like to share with you later some details on the research of the biorefinery for ethanol generation from rice straw.

The objective of the research of the humanoid robot is to create new mobility and new lifestyle (*See #8*). These are the pictures of our own robots that we have created and developed over years. Now, I am pleased to show you our progress in robotic research with a short video. This is our first robot built in 1986 just after the Fundamental Technology Research Center started. It was really difficult to have the robot walk as you see, it walks at a very slow speed but anyway we managed to have it walk. So, engineers always think how human walks, and the result was that in 1990 the robot's walking extremely improved. But, if there are some unstable conditions on the floor, it got difficult to have the robot continue to walk as you see here. So we put some new ideas and the robot became able to walk on stairs and steeper slopes. This is the P1 robot built in 1994. Here you see the P1 robot's upper body, but power was still supplied from the outside through a port. And this is the first robot, P2, with an integrated power unit. It looks more humanlike. And this is the P3 robot built in 1998. This is about 160 centimeter tall. He could open the door. And in 2000 we introduced this as ASIMO. This is the newest one we built in 2005. It can run. Its running speed is about 6 kilometers per hour. He can learn cornering and slaloming. Anyway, we have spent more than 20 years for step-by-step innovation with engineers' efforts.

As you can see, the humanoid robot ASIMO could have attained quite a high level of athletic ability and thereby ASIMO has provided people in the world with positive emotion. In order for ASIMO to enter into lives of people and to be helpful to people from on, innovative intelligence needed to be involved. The present ASIMO is operated by the manmade computer program. Therefore, it can only move in pre-programmed way. It still lacks an ability to interact with the external world as well as intelligence adaptable to its living environment. Learning intelligence from living things has been one of the themes of our Fundamental Technology Research Center. HRI is currently conducting brain science research aiming to create a brain-like intelligence system (*See #9*). I wish to use such system to develop a machine with recognition and self-learning functions for the future.

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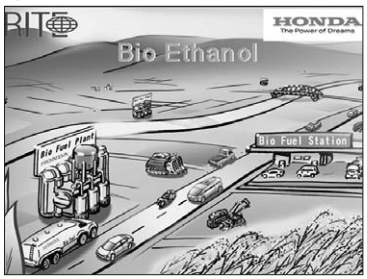

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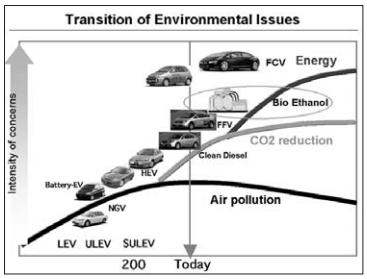

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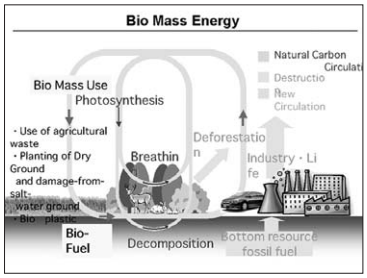

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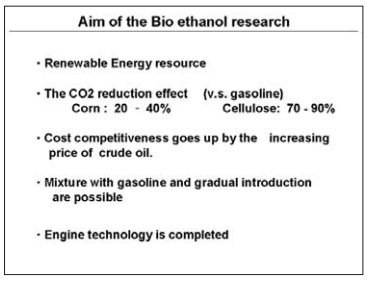

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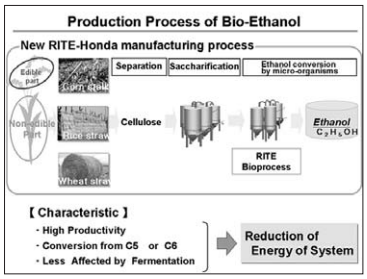

Now, I would like to introduce our bio-ethanol research (*See #10*). This research is a joint research collaboration of Honda and a Japanese public research organization called RITE, Research Institute of Innovative Technology for the Earth. In the research, RITE mainly takes charge of the research of the RITE bacterium, which effectively coverts sugar to alcohol, while Honda is responsible for the performance evaluation of the process and the efficient bio-ethanol manufacturing technology. For many years, Honda has created innovative technologies and products, and also developed solutions to address environmental issues and concerns (*See #11*). For example, as the solution for air-pollution, we developed world's leading exhaust emission technologies such as CVCC and ULEV or Ultra Low Emission Vehicles. Furthermore, we have developed new combustion technologies and the hybrid systems as a solution for higher fuel efficiency. The cleanest diesel engine and also the recent hydrogen driven fuel-cell vehicles are certainly fitted as primary candidate for the future. In respect of environmental issues, we at Honda believe that fuel research and reduction of CO_2 is important as a power train research.

Let me explain to you an example of our fuel research projects. This figure shows the general concept of bio-energy cycle (*See #12*). The largest cause in the increase in CO_2 density in the atmosphere is the combustion of the fossil fuel. On the other hand, CO_2 is fixed by plant photosynthesis. Therefore, in order to reduce the amount of CO_2 exhaust and to hold off global warming is to decrease consumption of the fossil fuel and use biomass as an alternative energy resource. For this aim, we are promoting bio-ethanol research (*See #13*). Bio-ethanol is a renewable energy resource. The CO_2 reduction effect is estimated 20 to 40% if corn is used in place of gasoline, and 70 to 80% if cellulose is used. The cost competitiveness has improved by increasing price of the crude oil. Mixture with gasoline and gradual introduction is possible. Flexible fuel engine technology is almost competed. From these observations, I think that bio-ethanol is a very realistic and effective technology for CO_2 reduction.

The current bio-fuel production method depends on edible resources like corn and sugarcane (*See #14*). In addition to those edible resources, producing ethanol from non-edible grain and agricultural waste such as rice straw or cornstalk has been longed. However, the process to purify ethanol from the non-edible based cellulose is so complex that no institution has yet succeeded in its mass production technology. Last year, Honda verified that the RITE bacterium developed by rice gene manipulation has tolerance to the fermentation inhibitor and could be effectively utilized in ethanol refining. For the first time in the world, we opened a course for breakthrough on the cellulose-to-ethanol production technology. In addition, we are aiming at our system implementation that can minimize our gross energy needed when ethanol is generated. I believe making bio-fuel from a huge volume of cellulose waste, which is currently disposed by burning anywhere, will be a very well and positive way to tackle this matter in the near future.

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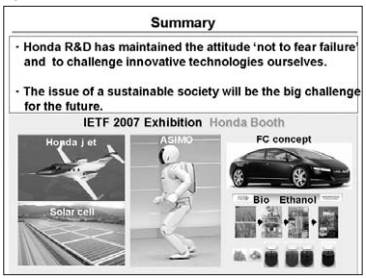

Now, I would like to summarize my presentation (*See #15*). Honda R&D has continued to challenge for innovative technologies. The result of these challenges has enabled us to create Honda products like motorcycles, automobiles and power products, HondaJet and ASIMO. It has also provided the society with joy and pleasure. The issue of sustainable society will be a big challenge for the future.

Panelist:

Chetan Maini

Deputy Chairman & CTO
Reva Electric Car Company Pvt., Ltd.

I am just going to take you through, since the topic for the day has been innovation challenges, some of the innovations we have done at Reva and some of the challenges we have faced for the last few years and also some of the new technologies and directions we have been working on.

One of the major things in innovation from my perspective is the fact that what is that need when one innovates. Is that need very different? I think I want to spend a few minutes looking at India and looking at the differences that we have here and new opportunities on the electric vehicle industry in particular.

If you look at the snapshots in 20:20, India is going to have over 1,200 cities with over 100 thousand of population. The transportation is probably going to be five times more today and pollution is probably 7 times more considering that not only you are going to have increased cars but you also going to have slower driving conditions. So, all this is actually going to make the conditions worst. So, it is a very fundamental problem today i.e. high growth rate in cities, high population and high vehicle growth rate also. Our resources are very different in India. We have very low oil reserves. We have even no availability of eco-friendly technologies. We have large reserves of alternate fuel for coals. We have great human resources and a low cost manufacturing base. Our circumstances are different too. We need low cost mobility. Our distances traveled are much less. We have low average speed, low intercity driving and limited financial resources.

So, can we innovate and have solutions that are different? Can we have solutions with zero pollution? Can we reduce dependence on petroleum imports? Can we look at reducing congestion of urban areas? Can we lower intensity mobility cost? Can we do all of this in economic resources in a sustainable manner in this country? And I think this is where the electric vehicles have a role to play. They are definitely not going to replace everything else, but, from the Indian perspective, they are going to have a much larger role to play. I think it's important to understand this because studies have shown that India and China are going to be very good in terms of manufacturing and market potential. A good example is the fact that in China, you see the EV Industry especially for motorcycles, small scooters and bikes that has gone from 40 thousand in 1999 to 15 million this year. So, there is a big growth potential in this new industry.

So, now there is a little bit about the product and then we will talk about the technology. The REVA is easily seating two adults and two children and fully automatic. It has extremely low energy cost and it is Rs.45 per Kilometer. It is twice cheaper than driving a petrol-driven car. It can travel around 65km/hour with a maximum run range of 80km. It is pretty high on diagnostics and good deal of safety in terms of steel space frame and dent-proof body panels. What we did was that, from 1994 to 1999, we really developed core technologies because electric vehicles were out there. I think the difference between ours and those which already existed was that they were too expensive. So, if you want to make electric vehicles cost effective, what would you do differently? We spent a significant amount of time developing core technologies, and then tested around 40 vehicles for over a million kilometers with the help of the Ministry of Non-Conventional Energy Sources, and then finally launched the product in 2001. From then, we were looking at more developing markets besides India. Today, we have around 1,800 vehicles on the road and out of which around 700 are in London. It is the largest fleet of electric vehicles in any city globally today. It has been ranked as the most green and energy efficient vehicle in Europe.

As we went to develop the car, the first challenge we found amongst others was human resources. Electric vehicles are actually a combination of aerospace engineering, materials, electrical energy storage, electronics, IT and software. We set up the organization with a very young team and had guides that would look at specific areas. But the young team managed it. That is very important because they had come from different disciplines in order to make this happen. We give a lot of freedom to people with no limitation and this really helped us create a lot of innovations in the entire process. They were good to take some technology challenges, but, being a smaller company, we envisioned the initial volume to be low. So, how will you design products to enable you to break it and actually become profitable? We had to reduce entire capital investment: we used different technologies to allow us to reduce the capital investment by almost 90%. The car has dent-proof ABS body panel technology. It has a steel space frame. It comes on the assembly line in the first step on its own wheels. It does not need conveyer systems. We used a very unconventional methodology, but the advantages were that we got lighter weight areas as well as we reduced the cost of investment in the process.

The other thing is that in electric cars, as you see the mobile phones, how quickly they change, and technology changes very quickly. So, it is important from day one that everything was designed in the product to have an open architecture base. The entire product was based on the energy management system that controls all the other electronics in the car, i.e. the motor controller, the instrument panel, the vehicle controls etc. Actually, this is very advantageous because during the development cycle we can change the entire drive train. We could really shorten the time-to-market because we designed everything on an open architectural basis.

As is said, being a smaller company, we needed to focus on key technologies. A couple of examples are that the main energy management system that I showed you on the earlier slide. It is the patented, main onboard computer system that has really resulted in using this in increased range by 20%. It monitors the batteries in real time and allows you to maintain them correctly.

There are several other areas or things which you can look at here. The conditions in India are extremely different from the West. A good example is the power conditions. It is very rarely that we are going to have places where we do not have blackouts. So, designing a charging system that takes Indian power grid conditions is actually a very critical area. We spent a good three years developing core technologies in these areas just to combat local conditions. Again, this is not a thing that you can just go and buy from somewhere because those systems just would not work in India. If you are content within your limited challenges, how do you give customer comforts? So there are two core technologies that worked in it. One is that most of our European products go with climate control seats. This is thermoelectric devices that are built into the seat structures and by passing electricity, one side gets hot and one side gets cold. Through channels in the seat, you can heat or cool the passenger. It uses 50 watts of energy compared to a few kilowatts to an air-conditioning system. So, this is a very efficient use of energy. Heating is quite common. Heating and cooling is not as common at all with only car in Europe today has this feature. The other aspect is the entire air-conditioning system in the car and a lot of innovation went into this also because this had to be rather unique requirements. Along with that, there come a lot of nice features where you have a remote control feature which is especially nice in Europe. There is a button through which your air-condition and heating comes on

and cools or heats your car for 20 minutes and shuts down and uses the power from the main grid and so does not deplete your battery.

So, we have tried to combine technologies in these areas to meet customer requirements. We have also looked at constantly innovating our technology, especially the drive technology and this is the area where you can see how electric vehicles are going to change you a lot. New innovation of the drive technology means same weight, same size but 40% more torque, 10% increase in efficiency, and huge other improvements in life. So, there are huge jumps in these technologies right now as it is in the initial innovation stage.

From suppliers' perspective, I think there were a lot of concerns in terms of convincing suppliers, the process, especially for the new technology. We developed key partners for key technologies, and in certain cases we established a particular company within the group that we could not get from suppliers in certain areas of plastics, electronics and charging systems. Testing was another key area. It was not that easy just to go and say how do electric vehicles perform and get data like you have for IC engine products. We tested over 40 cars for over a million kilometers; and each car has a built in storage that can acquire three years of data so that we can tell you two years ago, how many kilometers you did and how it performed. We also developed several test equipments. For examples, we have a test track that you can run the car unmanned for 24 hours a day to allow you to basically test different systems which is another very key issue in electric car you use. It is difficult to test 24 hours a day because of the limited range.

I move on the next challenge in this area. There were no standards in India for electric vehicles when we initially started off. Today there are some standards. So, there was another challenge. The same thing the European side may look at when we go to Europe. Standards there were at a very initial stage on the new technology and faced a fair amount of issues related to certification because things would not have taken place as yet. When you look at various features, this is a high-end product for a country like India and one of key issues is how you end up servicing such products. So, we actually have a complete Palm-based diagnostic system. This is a new system that is wireless enabled. So, even on the car working in the U.K., we get the data within an hour into the service centers in India. So, we have used a lot of technology for transferring information. As is mentioned earlier, since we store three years of data, we use this information very effectively to improve new products and processes in the place.

As part of any other, we have been through a lot of uphill on the finance side and on the government side. I think that these slowly have been overcome. The whole issue here is that an often-asked question is, "where has it been running?" and "who in the West has done it?" I think that these are areas where India can think differently. Sometimes, technologies can go from this side also. We showcased a lot of new technologies in the auto show. We have done larger vehicles such as buses and pickups, and all possibilities for electric vehicles today are attempted.

We showcased the next generation vehicle in Monaco in 2005. This has a top running speed at 120 km/hour and the range of run is 200 kilometers. As several new features are shown, there are nickel chloride batteries i.e. high temperature batteries, an electric control driving system, and an onboard charging system. One of the key features it has is an integrated dashboard system that allows you to get your speed,

drop it, and do any way you like. In addition to that, over the click of the button, you can go to e-mail; you can go to the MP3 player, or to your GPS for navigation or to the internet. It is completely key less entry. Just enter a password and go and through. This is a new technology and how we can look at it. We have also forced back and looked at developing two generations of fuel cell vehicles. The first one was launched by the President of India on Technology Day a couple of years ago. This is a Palm based fuel cell in hybrid mode. This is the second generation device that we developed from the DRDO, the Indian Defense Labs. This is based on methanol, and aero reformer in there and more of alkaline based system. Both were running in a hybrid mode. Fuel cell was not the primary driver on these areas.

So, where do these technologies go in our idea? I think that over the next 15 years, electric vehicles are going to play a major role on zero emission transportation. Battery technologies like new lithium batteries are going to give you a 3x to 4x range. Fuel cells and solar fuel cells will be the things of the future. These will add to this, and enable all electric vehicles with the energy source in next 10 to 15 years. It is going to change as newer things develop. What we would be focusing on is basically these areas of technology that we feel is becoming the next energy source as times are changing.

Some concluding thoughts are as follows. I think for technology and product development in India, one needs to think differently and look for innovative ways of doing things. Constraints can often be viewed as opportunities. Often, when we had issues, we translated that into an opportunity be it a financial issue, a government regulation or something else. I think that always helped us a lot. I think no prior bondage gives us freedom to explore different possibilities. We started from a clean slate of paper. We could start and design things differently and I think this really helped us a lot.

2007 Honda-CII Symposium on
Linking Technology, Innovation
& Entrepreneurship

Valedictory Session

Session-Chair:

Hiroto Ishida

President, Kanazawa Gakuin University
Executive Supervisor, National Museum of Emerging Science and Innovation

Today, we have had plenty of unique and thought-provoking presentations and energetic discussions. The Japanese experience was reported by some of our technologists, the policy makers, experts and Honda people. They have illustrated how innovation and entrepreneurship were originally transformed into practical technologies and products in Japan. The presentations of Indian panelists have shown their efforts to learn knowledge and proved their spirited entrepreneur approach to be the key driving force for the rise of India. With the great economic fronts in both countries i.e. India and Japan, the relationship between the auto and IT industries hold the key to propel progress in entire Asia. It is possible. We have to strengthen our cooperation. For example, technological advance in auto industry can be replicated in other Indian industries or companies. We will take off many IT and software issues.

I took little time to say my comment. My impression of this symposium is that Japan and India have been closed countries with each other. Again, Japan is required to be a friend for India and similarly India is required to be a friend for Japan. I believe that it is very important to cooperate with each other. Of course, it is very important for us to expand a perspective for Asian friends including other countries. Cooperation and coordination is most important for promoting technology and innovation.

Address:

Patarapong Intarakumnerd

Project Leader
National Science & Technology Development Agency, Thailand

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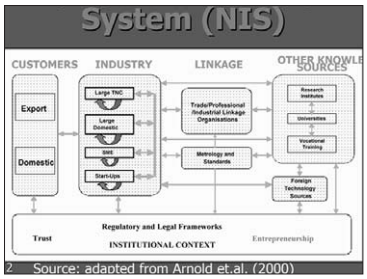

2 Source: adapted from Arnold et.al. (2000)

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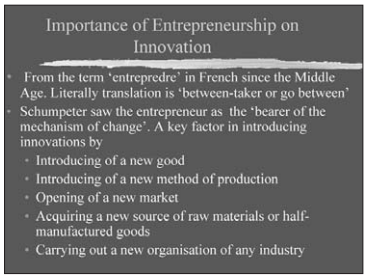

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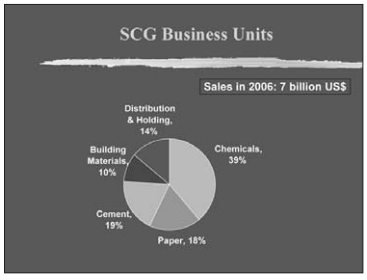

Here, we are talking about the relationship between entrepreneurship and innovation. In every country we have a system, National Innovation System (*See #1*). In the system, there are interactions between companies and research institutes, companies and universities; and also interactions between producers and customers, but this entire scheme is operating under institutional contexts. One of the very important institutional contexts here is an entrepreneurship (*See #2*). Entrepreneurship is a very old word. It is related to middle age. A famous economist saw the entrepreneur as the bearer of the mechanism of change and the key factor in introducing innovation. When people say that innovation is only for high-tech industry or only products, which is not really true. Innovation can be found in introducing a new product, in introducing a new method of production, in opening a new market, in acquiring a new source of raw material or half-manufactured good, and also in carrying out a new organization of any industry, all of which are very important in terms of bringing innovation to the fortune.

What I am trying to talk here is not a successful case study but a study of a firm and also an industry that tries to come up with innovation and show the entrepreneurship. So, it is not a successful case like India, the case of Honda, or the case of other Indian companies that we have listened. I think we can learn a lot from the ongoing case or the failure case as much as successful cases. One of the case studies here is the case study of the largest Thai manufacturing company called the Siam Group (*See #3*). This is a very old group in the Thai business history. Established in 1913 by Rama VI, the company is listed in the Thai Stock Markets since the year 1967. The Crown Property Bureau, which is the manager of the royal family's assets, is the leading shareholder of this company. Siam has historical roots in producing cement. Its core business has been expanded into chemical, paper, building materials and distribution. Their total assets may be small compared to large Indian companies or Honda; it is only six billion US dollars. Its total sales are about seven billion US dollars per year. Its number of employees is around 24,000. We can see that this company, though small, is more diversified than Honda, but as not much diversified as an Indian business house like Tata Company. The biggest sales are coming from chemicals product (*See #4*).

What I am going to talk here is how they want to change their strategy on R&D management to a broader perspective, i.e. to technology and innovation management (*See #5 and #6*). This company used to have a centralized R&D Center but it is closed now; and has moved to business unit facility. Why? Because they have a limited alignment with the business needs. If you have a call center for highly diversified business units within one company, and if there is no link with production, with design activities in business unit, then it is not going to work. So, they have to change their strategy and then, when using the R&D strategy, you should have a technology road map like we have listened to many cases here; but in this company, they did not have the technology road map.

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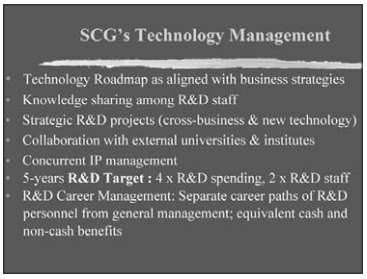

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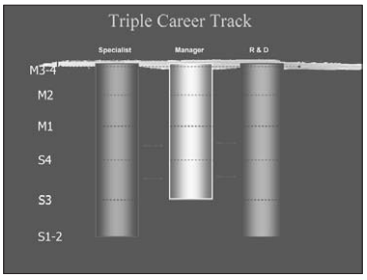

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A very important thing for R&D and innovation is to retain R&D experts. This company in the past could not do that: they made no career advancement for R&D experts. This is because they perceive them as inferior to managers or engineers, so this is one of the mistakes that they tried to correct. What they changed later is that they started to decentralize the R&D Center. Here there is an opportunity for you to work in the area of production and transfer to the line manager. There is an assignment linked to business requirement of this strategic business unit. They have started to have a technology roadmap in the year 2006, and try to have synergy among businesses. But as I said, this is the company that is moving and struggling to have a synergy among businesses; they are trying to retain R&D experts that are still perceived in the company as minority. I think the case of Honda is a very good case that they can retain these R&D experts. Let them work in a free environment and they can have a good career path. I think this is very important. So, this company is trying to move from R&D management that is very narrow to be much broader one. Now, we are talking about technology management or innovation management. What they are doing is that they are setting up a technology management committee and Intellectual Property Right Center in the year 2006-07, and then try to create a category to develop their own technology and intellectual property right, and to promote a stable path for R&D careers and synergy among business units.

What they are trying to do is to define their core technology road mapping and to ally with business strategies so that they can set up what they want to achieve (*See* #7). And what they want to achieve is in line with their marketing strategies, with their production strategy, and with their business strategy. They are trying to create knowledge sharing among R&D staff. They have tried to create strategic R&D projects across businesses and new technologies. They are trying to reach out to the outsiders, and try to have collaboration with external universities and institutes. The reason is that in many companies, they are not supposed to be forth, they are trying to link that strategy only within the company. At present, I think people know that no one can innovate alone. We need to learn from each other. So, the successful companies now are trying to opening up to universities, to research institutes, to other companies as well, and also they are trying to start to manage the IP. So, they have set up the target that within four years, they want their R&D expenditure. Within these years, they want to increase R&D expenditure and increase their R&D staff also. And then, they have tackled the human resource issue; that is, they are trying to separate the career path of R&D personnel from general management and provide them with equivalent cash and non-cash benefits (*See #8*). Here, what they are trying to do is they are trying to separate the career path of specialists and R&D experts from that of managers and engineers. Now, they are trying to move to this direction.

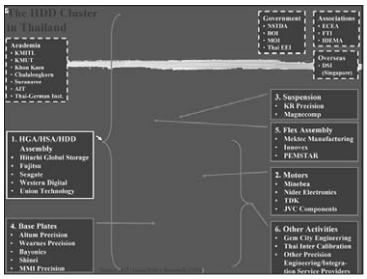
So, in summary, by stating this case, we can learn that the technology management should have an alignment with business strategy (*See #9*).

10

Importance of HDD to Thailand

- 1st in the world rank of HDD exporter after Singapore (or around 10 billions US$ in 2005)
- Employs more than 100,000 people
- Dominated by giant TNCs like Seagate, IBM/Hitachi, Western Digital and Fujitsu
- Local content is around 30-40
- The cluster concentrates around central and northeastern regions, near Bangkok.

11



12

International Disk Drive Equipment and Materials Associations (IDEMA)

- Founded in 1986, as an international not-for-profit trade association representing $22 billion HDD industry worldwide.
- IDEMA, Thailand established in 1999.
- Its committee includes all giants, main suppliers, representatives from concerned government/education institutes like Board of Investment, Asian Institute of Technology and National Electronics and Computer Technology Centre.

13

The Bridging Roles of IDEMA

- A platform for business networking & information sharing (through training courses, market updates and advance technology seminars)
- Focuses on what Thailand needs: development of HR and automation infrastructure (e.g. with AIT providing Certificate of Competence in Storage Technology)
- Worked with BOI to make HDD cluster a "prioritised" cluster receiving special tax privileges for investment to enhance *skills, technology development* and *Innovation.*
- Established "a HDD cluster managing organisation" led by experienced cluster manager

14

Conclusion

- Entrepreneurship is an indispensable institutional context of national innovation system
- Rather than perceiving entrepreneurs as born and pre-given only, entrepreneurship can be stimulated and enhanced both at the firm level and industry/cluster level.
- For developing countries relying on FDI, government should leverage knowledge and entrepreneurship of TNCs and link them to local firms and other actors in the NIS.
- Industrial associations like CII can stimulate the 'collective' entrepreneurship leading to shared visions, joint actions and knowledge flows among their members.

In R&D management, it is very important to attract R&D experts and maintain them by providing an attractive compensation and recognition. The work has to be challenging enough and must encourage them to have a different perspective and freedom. At the same time, we need some kind of organization to handle with our people. Also, if we want to move something, we need a critical mass of people. So, this is what they are trying to do.

Secondly, we have talked a lot about entrepreneurship at the firm level. But actually, entrepreneurship can happen not only at the firm level but also at the industry level and cluster level as well. Here I am going to talk about transnational cooperation-led innovation and collective entrepreneurship. This is the case of the hard disk drive (HDD) cluster in Thailand, which is our first exporter of hard disk drive in the world. We exported around $10 billion in the year 2005. We employed more than 100 thousand people. This industry is different. It is dominated by transnational corporations. Thailand is a country that welcomes foreign investment since the decade of 1960. So, there are a lot of foreign investments in Thailand. The HDD industry is dominated by Seagate, IBM, Hitachi, Western Digital and Fujitsu. The local content is around 30% or 40%. This is a cluster because there is geographic proximity. These companies are located in more or less the same geographical area in the central or northeastern region and not so far from Bangkok.

Here, we can see that this is the map of the HDD cluster in Thailand (*See #10 and #11*). The cluster is composed in units of assemblies. The big transnational corporations that I have mentioned are also the suppliers and most of them are foreigner or joint ventures. But also, what is unique of this cluster is that there is a relationship with various groups like relationship with academies, universities, and also with government agencies and research institutes.

What kind of entrepreneurship can we see in this cluster at the industrial level? It is the entrepreneurship that is used and performed by industrial association. Here, we have what we call International Disk Drive Equipment and Materials Association, or IDEMA (*See #12*). Actually this association is a worldwide association that deals with the Thai chapter called the IDEMA Thailand established in the year 1999. It has a committee that includes all regimes, i.e. representatives from HDD main suppliers and the concerned government agencies who provide the tax privilege to transnational companies through FDI like National Electronic & Computer Technology Center of National Science and Technology Development Agency (NECTEC), and educational institutes like the Asian Institute of Technology.

What they are doing with the entrepreneurship is that they demonstrate it as a platform for business, networking, and information sharing, training course, market updates, advanced technology seminars (*See #13*). They focus on what Thailand needs in this industry. If we want to pull the entrepreneurship together, we should focus on critical issues and we should be able to identify and sort them. What Thailand

needs in this industry is the human resource and automation infrastructure, so they work with the Thai universities to develop specific courses to tackle these problems and they work with the broad investment to make the cluster as the prioritized cluster. It is receiving special privilege for investment to enhance technology development and innovation. When we talk about entrepreneurship, we need somehow an organization who works to take all activities together, i.e. the group activity. So, here they have a managing organization led by an experienced manager. This manager is to work for multinational cooperation before but he also knows university. So, he knows both industry and academy. These managers are working to bring all parties together.

My conclusion is that entrepreneurship is indispensable in context of national innovation system; and rather than we proceed in born entrepreneurs only, an entrepreneurship can be stimulated and enhanced both at the firm level and at the industrial or cluster level (*See #14*). For developing countries when we talk about entrepreneurship and innovation, we should not only encase in the national forum as well but we should encase in transnational corporations. The role of FDI is very important. The government should leverage the knowledge and entrepreneurship of transnational corporations and try to link them to local firms and to universities and other actors in the national innovation system. I think this is one of the points that I want to stress because when we talk much about entrepreneurship, we just only look at the forum and we forget that outside the forum, there is a relationship that the forum have been carrying even with universities and foreign companies as well.

If we talk about the India's leading industrial association, CII, we can do many things to stimulate collective entrepreneurship leading to joint action and knowledge flow among the members. So, the role of industrial associations is very important to encourage collective entrepreneurship.

Valedictory Address:

S. K. Chopra

Principal Advisor and Special Secretary
Ministry of New and Renewable Energy
Government of India

I find that I am the only one in this gathering who belong to and works for the government. I think in popular perception, government is a body not really always identified with innovation because they think that government is trying to block creativity and regulate and constrain, but that is not entirely true. Mr. Chetan Maini did not mention in his excellent presentation that way back in 1996-97, our ministry which is then called the Ministry for Non-Conventional Energy Sources gave him support to develop their products and we are even now giving support for the promotion of their technology. So the government's perception is not entirely correct. If in deed it is there, I know many people think of government is a whole lot of files, red tapes and so on. But I do not claim I represent the Government of India. The Government of India is a very big system and I am only from one ministry. My presentation brings out some of our experience in promoting innovation but they need not be entirely official views of the government of India, they represent my views as a professional also.

We have, of course, the example of Japan where the government and the industry worked very closely together. Just now, we heard the speaker from Thailand how the government is working together with industry. So, this is the trend of the times. In our country also, the rapid growth that we are seeing in the economy today i.e. 9.2% and which has poised to grow because of not just investor-friendly policies but of innovation-friendly policies that are being taken up in different sectors of the economy.

Now, I would like to tell you a little about the renewable energy sector with which I have been associated for some years. Earlier also I had been working in the energy sector for the World Bank and later in the Planning Commission. So, I think the earlier speakers have discussed the meaning of innovation in great detail. Somebody just mentioned that if we have to do an innovation, we have to do things differently, but of course it should bring down cost and multiply the utility. I think this is Peter Drucker who said, "It is the change that creates a new dimension of performance." That is how he defines innovation. I think how it all translates to business.

Now, you have heard case studies of businesses so far. Many very excellent examples have been provided. I learnt from the organizers about the excellent presentation that took place in the morning. You know I was working with the World Bank in the late 70s and early 80s. Mr. Jimmy Carter was the President of United States of America at that time. I remember that it was a very serious concern in the United States in the late 70s that Japan was overtaking the U.S. in many areas because of the leadership in innovation. Therefore, there were national debates on technological innovation in the U.S. in those days. I still remember it was 1977 and I attended some of these discussions. Now, innovation has taken a new dimension after the globalization of the economy. As some speakers pointed out, we should not just think of the country but we should think of the whole world.

What about our own country India? Now, it has been projected by many that the rapid growth is taking place in the economy with the large pool of professionals and so on. India can be the hub of innovation in Asia; and, of course, it is true with our friends in Japan who have taken the lead in innovation in the world and who are also our partners in Asia. Yesterday, the earlier speaker told that we could join hands with them. We have this large pool of scientific and other professional talent beside the cost factor. You know, we have lower cost as compared to several other countries in East

Asia and of course, in the Pacific and Atlantic. We have the sizable quality of multidisciplinary talent. Of course, we have a huge market. You know more than half of the Fortune 500 companies are present in India and many of these are R&D and design centers. But despite this, I am looking at it from the overall perspective. I think it was pointed out about the problems which are well known such as the lack of infrastructure, power and electricity in particular. Despite the large number of management professionals, we still need experienced management professionals. We need not just export processing zones but innovation hubs. In many areas, we need to have more enlightened policies.

The point I am trying to make is that, however much you would like to wish away the government in new liberalized economy, it has to play a key role in overcoming many of these constraints in order to provoke technological innovation and link it to entrepreneurship. Now, I think these are also issues on which we must have had a lot discussion in the earlier sessions. Anyways, this brings out that the government must make it attractive to do business in the country. The government must articulate through our Five Year Plans. The Eleventh Five Year Plan is on the anvil and is being prepared by the Planning Commission in coordination with all the agencies of the government and also outside. Government has to support basic and applied R&D. We have to benchmark with international best practices. We have to articulate the vision for the future and create an environment for education and awareness.

Now, in this context I would like to tell you a little bit about sustainable development. Everybody mentioned about sustainable development. We read in the newspapers about the recent IPCC Report on what is going to happen in the world in next 90 years. In particular, it has highlighted concern for India where according to the IPCC, the greenhouse gas emissions have remained largely unattended and India apparently has the distinction of having the highest growth in greenhouse gas emission (not a very attractive distinction!). Even though in per capita terms, we are very low and we are not covered by Kyoto Protocol to curtail these emissions. So, when it comes to the subject on which I have been working for some years now, I must say we need sustainable development and energy is a very key element doing about sustainable development. Renewable energy has come of late because vitally important is to provide the carbon free and renewable substitutes for fossil fuels. We have seen all these vehicles for fuel cell car and the electric vehicles and so on. Besides that it also contributes to energy security, a really sustainable energy security. My book was on the sustainable energy security.

So, I would like to briefly tell you what has been the track record of technological development in commercialization in India by innovation in this sector and what policy prescriptions flow from our experience so far that should be relevant to us in our quest for higher growth of the economy in other sectors as well. Let me give you a few examples. Somebody mentioned that we are only talking about automobiles, but here we are going beyond that and I will tell you about wind energy. You all must be reading in the newspapers about the wind energy and about the wind energy giants in our country who are acquiring companies.

Now, this program was started way back in the late 80s and early 90s. At that time, I was advisor in the Planning Commission. We gave some support to Tamil Nadu and some other states that had done nothing, but had the potential to set up demonstration projects for which they had acquired the technology from Denmark

and some other countries. After that, it was demonstrated that wind electricity can be produced and fed into the grid, and then we took up demonstration projects. After that, with the collaboration of the State Electricity Boards, we set up in some selected states attractive policies to buy back this electricity and feed it into the grid. This is called 'wheeling and banking': you feed electricity into the grid where there is wind potential, and then you can draw it from some other place, and you just have to pay, say, 1% of charge or something. We give support to the development of the wind industry. So, it was the result of the government policies that wind sector today has grown enough to nearly 7000 MW of power and India is now the fourth largest wind power in the world just over the last 15 years. This has been because the government and the industry having worked together, and now we have got some of the major players of wind energy. We are No.4 after Germany, Spain and USA. So, this is a successful story for technological innovation that is brought about because of government, industry and research having worked together.

Then, we have the case of solar photovoltaic. You all know about the solar electricity and many countries including USA and Japan, in particular, have invested huge sums in development of solar photovoltaic technologies. In India also, we started a program for solar energy for indigenous development at the Central Electronics Ltd. of solar photovoltaic power using silicon photovoltaic cell. They were developed indigenously. Then, we have CEL, or Central Electronics Ltd., and Bharat Heavy Electrical to develop this. But we have realized that we will not go anywhere if we only limit ourselves to our country. After having developed this indigenous industry, we opened up our economy in 1991 and just at the time of opening up of the economy, we were the first sector to open up. We reduced import duties and we allowed foreign companies to come in solar photovoltaic. We have a number of companies. Mr. Maini was saying that they had gained competition. The indigenous industry also improved and the foreign companies set up base in India, created jobs and had joint ventures. Now, we have a large number of manufacturing firms in the small, medium and large sectors which update solar PV. Now, solar PV is still very expensive as compared to conventional elite, but it is now being commercially marketed all over the world. And Indian firms are exporting large quantities to the Western countries, even to Europe and USA. Indian solar PV industry used to be fourteenth or fifteenth, but now it is seventh largest because the large scale development is taking place in solar photovoltaic.

When it comes to the solar water heating system, you see it all over the countryside now, especially in cities like Bangalore and Pune. We developed indigenously the first low-grade solar water heating systems besides solar cooker and air heating systems. We provided subsidy that anybody who buys a solar heater, taking care of 50% of the cost. Sales of solar heaters picked up in areas where hot water use was throughout, for example, Pune and Bangalore; and in domestic water heating system, a number of manufactures came up. They tied up with foreign companies and hot water systems have become very popular. Now, the subsidy had been completely withdrawn. It is only by interim subsidy and indirect incentives.

Then, we come to these new technologies like electric vehicles and fuel cell vehicles. We mounted a program more than ten years ago. Mr. Maini mentioned about electric cars. Regarding electric vehicles, you have heard about the REVA story but Bharat Heavy Electrical supported them to develop a bus and this electric bus became very popular. In fact, in Taj Mahal as to Supreme Court's directions, only electric vehicles

are running. We have supported for developing electric three-wheelers by Mahindra and Scooter India. We gave them a demonstration project. They tried it and tested it. Then, now we are providing support to promote it in the country. But electric vehicles have got a limited range; therefore, we have to go in for hybrids and we are supporting that project in a few companies including Mahindra.

But we are looking ahead to hydrogen economy. India is one of the first countries to have developed our own vehicles. We had this two-wheeler, hydrogen motorcycle which uses metal hydride for storage because we could not have hydrogen gas cylinders. They would be very heavy and liquid hydrogen is very expensive. So, this hydrogen motorcycle is developed as part of our project. Now, we have fifty such motorcycles which are running in Varanasi and we are bringing them to Delhi.

In the area of fuel also, as Mr. Maini mentioned about the fuel cells, now we have got an active program for fuel cell development. Polymer Membrane Fuel Cells of 5×5 kW capacities was developed in 2000, but technology is not yet commercialized because of high cost and low demand; and now we are supporting this and a number of agencies are coming forward along with research and industry to have low-cost fuel cells in the country. For a fuel cell base, 3 kW systems are used for backup and a fuel cell vehicle is developed. But here also, our technology has been demonstrated at the last stage and beyond but commercialization is yet to take place. Certainly, Honda and other Japanese players in the area of fuel cells would be very important and very educative for us.

What are the lessons that we learnt in this renewable energy sector for promoting innovation and being intimate with entrepreneurship at the macro level? You have heard micro experiences of small industries and businesses; but at the government level, we found that before we opened ourselves to competition, before we opened ourselves to the world, we had to have our own technological know-how through R&D and also through demonstration using the indigenous industry. And then, we had to provide them direct and indirect incentives with continuing backup and R&D support. We have got a whole range of institutions like IITs, Indian Institutes of Science, and CSR labs which are working in new technologies areas. We make them mandatory, for example, solar water heating systems; many states have made it mandatory in new buildings and government buildings and so on but only when the supply is stable. Otherwise, this causes a breakdown as happened in the case of ethanol. 5% blending was made mandatory in nine states, but it could not be sustained because the supply was not assured. Then, we have incentivized the states and the local governments by giving them support from the Central Governments to provide an entrepreneur-friendly environment.

As far as new technologies are concerned, I just mentioned about bio-ethanol and bio-diesel. We are working in these areas also, but we find more aggressive government support and leadership are required. Industry is typically unwilling to come forward in these areas because they think of it more in long term. National Hydrogen Road Map was prepared by Mr. Ratan Tata himself under a committee set up by our Ministry with industry leaders, but industry is not very keen to invest in it. We have been discussing with CII for a long time. This is so because they feel that this is not something of immediate value to them; so, we must look to joint ventures with foreign companies that are looking for markets in India and are willing to transfer their technology.

What are, then, the conclusions that we found for promoting technological innovation? I think it is mentioned by the earlier people also. There has to be a team effort by academic institutions, applied research institutions, industry and government. We have found this experience to work in renewable energy, and I am sure we have worked for other new technologies also. Government must play a leadership role especially in new technology areas. I think the industry is much more enlightened now. They are looking ahead and they are looking to new areas in the global markets. They must also commit resources if they want to leap forward and get an early share in the new markets.

Indian science and technological know-how, industrial infrastructure, skilled manpower and overall policy climate must be combined together because we have bits and pieces here. We have a very high level of Asian know-how, but we are not combining it with infrastructure and manpower in a way. There is always a brain drain all the time taking place for one sector to another and one country to another. So, in summary, technological innovation, employment creation and entrepreneurship on a large scale would come about as a result of this team effort.

In this context, Japan provides a very important role model for us, and we in India would look forward to working with them in furthering the cause of technological innovation. Certainly, CII has been the leading industry organization and has provided enlightening leadership to the industry, to the government in general, and to our Ministry in particular. They are looking forward to working with us in building a climate of technological innovation. I hope that this symposium will set the tone for a national innovation movement in our country.

Greeting Message:

Hiromori Kawashima

President, Honda Foundation

My name is Kawashima and I am the President of the Honda Foundation.

Thank you for your active participation from beginning to end today, despite the long hours. I am still excited just thinking about the vivid presentations, opinions and interesting questions we have heard today.

I strongly believe that this symposium will become the cornerstone for the development of friendship and interaction between our countries.
This year we celebrate the 30th anniversary of the establishment of Honda Foundation. On this occasion, please allow me to share with you three of the many things I had the honour to be taught by my mentor - Mr. Soichiro Honda, the founder of the Honda Foundation.

Firstly: "Don't follow suit!" It is probably easy to follow suit for a while, but life is about trying to create new things all the time.

He was always saying: Success represents the 1% of your work which results from the 99% that is called failure. You must not be afraid of failing.

Secondly, "Discover your talents!" We all have an unknown self within ourselves. We have flaws, but we also have unique strong points, which we must praise and extend. One cannot discover one's talents unless one does the hard work himself. There is a classic written by Mr. Honda, entitled "My Hand Speaks", still widely read even today, where we find the words: "The hand is a second brain." In fact, the right hand of Mr. Honda was well known for its gift of being capable to discern unevennesses of a micron. He taught me that one shouldn't become weary; one should make efforts and put up with sufferings and hardship.

Thirdly, it is said that "People become what they are, due to people".

We must appreciate the fact that people are animated by a huge invisible energy. We are part of a society that also comprises those who are completely different from us. We cannot live in isolation. We therefore must help each other.

It is thus essential "to understand the grief of others", to show "consideration" (care) and "understanding" toward the others. It is the spirit of "selflessness and altruism" - be strict with yourself, and kind to the others. Respect the others, and be earnest in your desire to be taught that which you do not know and that the other possesses. Mr. Honda called this "being dearly loved by the other". He also said that the two things he most feared in this world were arrogance and excessive familiarity. One cannot admonish oneself too much.

Mr. Honda always took into consideration other people's feelings. He had a cheerful philosophy of life - "Life is to be enjoyed".

In the end, I would like to thank you all of you for attending today's event. Please accept my best wishes for your success in future. Thank you.

■ Report from the 17th International Engineering & Technology Fair : IETF

Honda displays latest technological innovations in India
Exhibition at the International Engineering & Technology Fair

Japanese firms displayed their products and developing technologies during the 17th International Engineering & Technology Fair: IETF, held February 13-16, 2007 in New Delhi, India. Various trading firms and electrical appliance manufacturers, including Japanese automakers, were present. Honda also had a booth, attracting throngs of spectators.

The technologies Honda takes pride in were brought together for a special demonstration in the Honda booth on February 14th, as Mr. Tomohiko Kawanabe, Director of Honda R&D Co., Ltd. and Mr. Masahiro Takedagawa, President and CEO of HONDA SIEL CARS INDIA LTD. introduced technologies like ASIMO - the biped robot, and HondaJet - a compact business jet, the first aircraft developed by the Honda Motor Company.

ASIMO was actually present at the demonstration. As it was climbing and descending stairways and slopes, and moving just like a human, spectators could not take their eyes off it, and kept asking one question after the other.

Having continued their efforts for the preservation of the environment, Honda also announced on this occasion the results of their research on the production of ethanol from biomass - a renewable resource of plant-derived material. Bio-ethanol does not influence the amount of CO_2 in the atmosphere, as the CO_2 released by the combustion of bio-ethanol is primarily captured through photosynthesis. It has therefore attracted attention as an environmentally-friendly fuel, an energy source effective as countermeasure to global-warming.

This CD-ROM contains transcript of speeches and presentation at the Symposium on Linking Technology, Innovation & Entrepreneurship, held in India on Feb. 14, 2007

＜**English**＞
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Honda-CII Symposium

on Linking Technology,
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