Proceedings

The 3rd Asia-Pacific R&D Management Seminar

Technology Management for an Extension of Economic Partnership in the Asia-Pacific Region

16-17 February 1998
Manila,Philippines

Sponsored by
Japan Science and Technology Corporation (JST)

Co-sponsored by
Department of Science and Technology of Philippines (DOST)

Organized by
Japan International Science and Technology Exchange Center (JISTEC)

Co-organized by
National Academy of Science and Technology of Philippines (NAST)

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Contents of Proceedings

Session II Information and Society

Session III Transportation and Economic Development

Closing Session

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Foreword

The world has entered an age of mega competition. In parallel with this trend, the economies of Asia have achieved extraordinary levels of development. One element fuelling this development was a huge influx of private sector capital, but with this inflow reversing suddenly and becoming an outflow within a very short period, since July 1997 some countries in Asia, such as Thailand, Korea, and Indonesia, have been facing a serious currency crisis. This matter was discussed at the meeting of G7 finance ministers held in London in February 1998, as an example of a new type of grave problem the world economy is facing.

Countries all over Asia have been affected by the financial crisis, either directly or indirectly, and each country is making steady efforts to protect itself from the fallout or to recover from it.

Technology was a major concern for countries in the Asia-Pacific region in the period when economic development was progressing apace, and remains so now, even in this time of recession, because of its nature as the foundation of growth of any country.

Since 1996, under the auspices of the Japan Science and Technology Corporation (JST), the Japan International Science and Technology Exchange Center (JISTEC) has organized annually the "Seminar on R&D Management for Sustainable Industry Development in the Asia-Pacific Region." The first seminar was held in Bangkok, Thailand, in 1996, and the second was held in Singapore in 1997. The third seminar was held in the Hotel Hyatt Regency Manila in Manila, the Philippines, from 16–18 February 1998, with the cooperation of the Department of Science and Technology (DOST) and the National Academy of Science and Technology (NAST) of the Philippines as the local hosts.

Following the lead of the two previous seminars, the third seminar took up the notion of "technology" and what it implies, perceiving technology as not limited to being merely a tool for advancing economic development on a worldwide scale, and devoting attention to the milieu that surrounds technology—that is, the people who advance technology and live with it. This expansion of our notions of what technology is stems from the understanding that technology involves human beings who perform R&D, promote a project, and produce value for other people. It is humans who create and develop technology, but the converse is that technology has a reciprocal impact on humans.

With this notion in mind, the current seminar began with case studies of various kinds. Critical analyses of past projects, from the planning stages to implementation, and including process management, were made by examining selected specific aspects of many projects. This was intended to provide useful information for forthcoming new projects to be set up in many Asia-Pacific countries. Such themes as energy, telecommunications, and transportation were taken up as topics for study, because these are key technologies in today's world.

At the beginning of these proceedings we summarized the meaning of the seminar, its results, and ways of connecting what we have discussed at the seminar to our future work. A summary of all the presentations at each session was compiled with questions and answers.

The seminar was attended by about 60 people. During the seminar participants made many pertinent comments and raised numerous questions, and discussion was vigorous and serious. It was the general impression that the focus of attention was moving from mere technology itself to the relationship between human beings and technology. This

was felt particularly in the discussion sections of the seminar.

Our special thanks are directed to the speakers, chairpersons, rapporteurs, and all those who participated in the seminar, and last, but not least , to the Department of Science and Technology (DOST) and the National Academy of Science and Technology (NAST) of the Republic of the Philippines.

Summary

Executive Summary

(Reported by Mr. Masahiro Kawasaki)

1. Background and Concept of the Seminar

The third "R&D Management Seminar" was held in Manila on 16-18 February, 1998. The purpose of this seminar series is to bring together the science and technology policy related people, project managers and R&D managers in the Asia- Pacific region (1) to learn about their experiences in their respective countries and to deepen mutual understanding, (2) to discuss ways to cooperate between each country and related organizations in future and (3) to establish networks between those in political bodies and R&D managers. In the first seminar, held in January, 1996 in Bangkok with sixty participants from fourteen countries and focusing on R&D policies, technology transfers and so forth, presentations and discussions were given on the present situation of each country and on their approaches. The theme of the seminar was "Seeking General and Mutual Understanding." The second seminar was held in January, 1997 in Singapore with sixty participants from thirteen countries with the theme "Accelerating Technological Innovation in the Asia-Pacific Region through Effective R&D Management." The themes of these two seminars concerned (1) R&D management for industrial advancement in developing countries, (2) R&D's support in advancing hi-tech industry, (3) education and training of personnel and plans to promote cooperation among industry, universities and government. After presentations on these policy and technology themes from various viewpoints, participants enthusiastically discussed and exchanged opinions. The seminars met fully the expectations of participants from different countries which were groping with the development of promotion plans for further economic growth through new industrial technology.

Today, the Asian countries are facing economic crises due to the exchange rates and finance problems. At the same time, Asian economic and social structures must be reformed to meet future globalization. Preparation and construction of infrastructure will improve the social and economic situation in those countries which lag far behind other advanced countries and will become crucial for any strategies aiming at the further advancement and globalization of all Asian countries. Moreover, for this preparation and construction of the infrastructure the development of the hard- and software for the energy technology system, the information and communication systems are indispensable. Through the promotion of technology in those areas the creation and advancement of new industries and services can be anticipated, and this is an extremely strategic point in

science and technology policy. In Singapore, Malaysia and some other countries national projects have already been promoted to establish an information communication network under such recognition. Taking into account this present situation, the main subject for the 3rd seminar was set as "Technology Management for an Extension of Economic Partnership in the Asia-Pacific Region." For strategies and ways of dealing with infrastructure construction the seminar was (1) based on example reports given by representatives of each country, and aimed at (2) deepening mutual understanding of technology management, (3) securing and training talented people who can promote such construction and (4) sufficient opinion exchange on how to cooperate in the future.

On this account, the seminar was divided into distinctive sessions as follows;
Session I: Stable Energy Resources and the Environment
Session II: Information and Society
Session III: Transportation and Economic Development

From the Japanese side, example cases in these areas were taken and used as reference for discussions in the seminar. Session I concerned the significance of nuclear power, stable energy supply, and related environmental problems including the present handling of radioactive waste. The development of digitalization of communication system at NTT was taken up in Session II. The history of the electrification of the National Railways Corporation up to the development of the Shinkansen was also reported.

2. Summary of the Seminar

Such themes were timely and the seminar was evaluated as extremely significant by the participants from each country. The purposes of this seminar which were to increase mutual understanding among participants and to pursue ways of cooperating in the future seem to have been fully achieved. Moreover, some participants showed enthusiastic interest to continue such seminars in future and even offered to contribute some expenses. Through each session of the seminar, the following points have been clarified as valuable for cooperation among participants in the future.

(1) The future vision of each country is to construct a sustainable economic society. To do this it is necessary to become connected to the global social network. It was recognized that it is necessary for countries or regions to acccomplish this on their own, and that it is crucial to prepare and construct broad infrastructure from an international standpoint.

(2) It was shown that economic advance and the development of new industries and

services depends on promoting a plan emphasizing thorough development of infrastructure which in turn entails hardware and software development.

(3) To successfully carry out such policies it was recognized that all countries share certain common needs as cooperation on funding and technology through partnership with various other countries and securing and training talented people who can promote the total project in their own countries and in cooperation with other countries. From Malaysia there was a report on how they are trying to secure competent personnel by appealing to the talented who are working successfully abroad to return to the country.

Session - I Stable Energy Supply and Environment

(Chaired by Dr. Tomomi Murata and reported by Dr. Wilfredo I. Jose).

1. Introduction:

The countries in Asia-Pacific Rim consist of wide variety of ethnic groups and cultures sharing the similar issues in their economic development. Approximately, three billions people occupy almost 60 % of the world population, and their density for the cultivated land of one square km is above 1,000 for most of the countries. It is one of the reasons why they need to be industrialized although, at present, they still strongly depend on agriculture in both production and the opportunity for employment.

The recent industrialization of Asian Countries, however, has made them tightly linked with the global economy not only as the sites for the assembly of industrial products of developed countries, but as the rapidly growing markets for themselves.

Although the present attitude of developing countries towards the issues of global environments as well as natural resources is somewhat different from those of developed countries, they recognize and concern about those issues as well. Actually, they face with contradictory aspects among the sustainable development, the economical growth and the speed of technological advancements.

The first priority of Asian Countries is to make the strategic investments to both social and industrial infrastructures, such as highways, bridges, harbor facilities, railways, hospitals, schools etc. aiming at the implementation of the scenario for the 21st century. In addition, the associated social systems such as higher education systems, insurance systems, financial circles, safety systems etc. are to be carefully established so that a country could digest the technological advancements, and adjust itself to the change in global economy.

It is our understanding that the financial supports and technological helps from developed countries, particularly from Japan has mainly been loans by which developing countries could improve and strengthen the various infrastructures as previously described. Japanese government has intended to provide assets, and assists for the self standing strength of developing countries as much as possible.

The objectives of this seminar are firstly to make clear the issues that we are mutually sharing in pursuing the productive R and D, secondly, to learn the lessons from the major projects or technological developments where not only the technical but the human and cultural aspects are involved, and finally, to implement the strategic R and D under given conditions. For this reason, in this seminar, (1)the strategic planning, (2) roles and collaboration among governments, universities and industries, (3) competitive

marketing, (4) international collaborations and (5)professional education have been the main interests of presentations and discussion.

2. The Summary of the Presentations and Discussions:

In this session, six papers were presented. According to the contents, they could be classified in the following three categories, namely, 1) Stable Energy Supply and the Associated Environmental Issues, 2) Energy Saving and Environmentally Friendly Design of Industrial Processes and Products, and 3) Wisdom for the Technology Transfer Across the Cultural Barrier.

1) Stable Energy Supply and the Associated Environmental Issues:

Three papers presented in this category are; (1) " Supply of Electric Energy in Japan ", by Osamu Kobayashi, Tokyo Electric Power Company, (2) " Geothermal Steam Field Development in Philippine ", by Mr. Serafin E Garcia, Philippine National Oil Company-Energy Development Corporation, Philippine, (3) "Photovoltaic Application in the 8th National, Social,and Economic Development Plan of Thailand(1997-2001) ", by W. Rakwichian, Naresuan University, Thailand.

The level of energy supply and its consumption has been the measure of the economic development of a country, but since the middle of 1970's, when the oil crisis happened, the energy consumption has not increased in developed countries as expected from their economical growth largely because of the development of energy saving processes and products.

Throughout this session, it was well recognized that there exists a good combination of energy resources suited for each country due to the economical and cultural backgrounds. The examples are the strategic development of geothermal power supply in Philippine as clearly presented by Mr. Garcia, the exploitation of photovoltaic applications in Thailand as Dr. Rakwichian positively introduced, and the promotion of the best mixed system with hydraulic, fossil fuels and nuclear power supplies in Japan as extensively described by Mr. Kobayashi.

It was advised by Mr. Kobayashi for developing countries to establish the stability of power supply as the basis for industrialization in two ways: (1) the minimization of interrupted power supply, and (2) load leveling of the power supply between day and night. In the former case, Japan has attained the order of six minutes per year by the everlasting investments for the required facilities. In the latter case, there are several ways, but the hydraulic power supply system by making use of the extra power at night is

the typical example in Japan.

From the middle of 1970's the power companies in Japan has continuously imported low sulfur fossil fuels as well as liquid natural gas so that they could control NOx and SOx down to 1/3, and 1/20 respectively within 20 years. These figures are world lowest ones. Regarding CO2, nuclear power generation has called the attention of the engineering world since CO2 emission is known to be quite small. It could be assessed positively in the future provided that (1) the long period safety of nuclear reactors, (2) radioactive wastes treatment, and (3) the control of the reactor byproducts such as plutonium are accepted by our societies.

For this reason, the technological and/or economic collaboration of Asia-Pacific Rim, in the development of energy resources, and lessening of environmental burdens would help each other to a great extent.

2) Energy Saving and Environmentally Friendly Design for Industrial Processes and Products:

Two papers are presented in this category; " Research Collaboration Among POSCO, POTECH and RIST in the Area of Environmental Catalytic Technology", By Dr. In-sik Nam, Korea, and " Energy, Environment and Recent Trend Auto-obile R & D in Japan" by Dr. Yasuo Nakajima, Japan.

Realizing the issues brought by the economic growth by way of mass production, mass consumption and thereby mass wastes, our societies, global markets and, therefore, technology are changing gradually but steadily towards the sustainable development. The recent global trend is the assessment to the quantitative understanding of the industrial processes and products throughout their entire life cycles, so called " Cradle to Grave " analysis from the viewpoint of input-output of e.g. materials and energy. This approach is represented by Inventory Analysis in ISO 14000s. The obtained information could well be utilized to find the crucial problems as to the productivity in energy and/or labor as well as resources indicating the chance of new markets.

The above mentioned trend suggests that our conventional approach, and present technology may not provide enough coverage and agility in the competitive global markets. Again, it strongly indicates that the strategic and intimate collaboration among industries, governments, and universities will be more enhanced in the future.

The example presented is the development of catalytic technology badly needed by steel makers in the reduction of NOx and SOx particularly at the sintering process of iron ores. It has been very difficult for industries alone to accomplish the technology required to catch up with the new version of the environmental regulations by their Governments. In 1987,POCO, POSTEC, and RIST has started a project aiming at reduction of NOx

utilizing copper modified Zeolite together with a new catalytic carrier which facilitates much reduction in operational pressure. The developed technology has reduced the NOx content to the order of 200 ppm at present.

The same collaboration has made the total reduction of SOx at coke oven from 1500 ppm to essentially zero emission. Dr. In-sik Nam has led this success from the academy side saying none of them could attain the objective alone.

It is the responsibility of industries now to establish the environmental control in a given time scale both in production processes and products through their life cycles.

In case of automobiles, the fuel efficiency and exhaust gas treatment technology have been the subject of the market competition in Japan. The example are the development of new engines to which the direct injection of fuel, and lean burn are possible leading to the drastic improvement in the fuel efficiency as high as 20 %, and 25 to 30 % respectively.

More recent advancement in the electronic control by CVT has dedicated to the addition-al efficiency by 20 %. Therefore, totally 50 % improvement in fuel efficiency has become substantiated. At this point, Dr. Nakajima strongly insisted that we have to remind ourselves as to the importance of the fundamental research which has made this remarkable technology practicable.

In Japan, the newest trend in R & D in the area of automobiles is the development of next generation vehicles. In case of electric cars, the key technologies are the design and material selection in reducing the total body weight, and the development of high cost performance batteries, especially with Lithium Ion battery and Nickel Hydride battery. The research on the fuel battery is also underway.

Most recent market topic in Japan is so called " Hybrid Car " developed by Toyota, which makes use of the benefits of the conventional gasoline system and electric system improving the fuel efficiency by twice and exhaust gases down to 1/10. These new technologies have been developed beyond the existing frame work of R & D within automobile industries. The environmental issues will certainly facilitate more collaboration even with the competitors.

3) Wisdom for the Technology Transfer Across Cultural Barriers:

Our paper was presented in this category: "R & D Management for Improving Existing Radwaste Treatment Systems and Problems in Technology Transfer" by Mr. Kosei Watanabe, Japan.

In general, the issues associated with technology transfer depends extensively on the kind of technology. Namely those in automatically controlled processes such as DRAM have little space for human factors or on-site modification coming in contrast to those of chemical plants where the manuals have the limitation in solving unexpected problems.

There exists the space for proposals and modifications to adjust the original planning to the local conditions and requirements from the customers. In a given time, the understanding of the situation, and the judgment for adjustments are to be made on site. This is the area where the human factors with different cultural background would exhibit the different approaches or answers as non-agreeable items for each other as Mr. Watanabe presented through his experiences.

The introduced case study was the technology transfer to Japan by Nikki Co. from US company regarding the radwaste treatment. The typical example was the word Quality Control " found in the manuals which brought about the different view or understanding on Japanese side as "Quality" could not be well implemented as stated just by the manual unless "Spirit" in accomplishing their objectives is present. This is due to the fact that the unexpected things always happen.

Traditionally, Japanese are good at the collaborative works, and tend to think for the others works if anything is wrong with them. The concurrent attitude in engineering towards the best solution applied to Radwaste Treatment, later on, led to the reduction of solid wastes, and the secondary wastes down to 1/5 and 1/7 respectively.These are the products of the concurrent engineering beyond the manually written one. They transferred the technology back to US company with these refined concurrent engineering tools.

The other aspects of Japanese engineering are Total Quality Control (TQC), and On Job Training (OJT) both of which require the participation by all so that they are able to cover any boundary and discontinuity by overlapping each other. In technology transfer, we strongly need such project engineers, in addition to specialists, who have birds eye view and concurrent attitude in solving problems and facing issues. The education through the experiences is certainly the key for success in technology transfer.

As we see that everybody holds his or her own DNA transmitted from the parents, we find the social DNA within our society or an organization usually in a hidden manner. It is crucial to notice them in technology transfer across the cultural barriers.

3. Summary and Conclusion:

As stated in the beginning, the role and responsibility of Asia-Pacific Rim in the global economy will be more prominent in 21st century because of their population, natural resources, and impact on our environments as we develop. In session-1, we recognized and confirmed that the following items are essential in " Stable Power Supply and Conservation of our Environments " perhaps in the other sessions too:

1) Think of Infrastructures being the basis of a country,

2) Continue the collaborative works beyond generations,

3) Establish the human networks across the borders, and maintain them,

4) Open the information and improve the reliability through cultural understanding.

We learned from our colleagues at the session that our task is not just to dispose but lay one box on another for the coming generations with "Spirit". We know from our history that the present chaos due to the change in "Sense of Value " is the indication of the birth of a new civilization which would give us "Brave and Wisdom".

Session - II Information and Society

(Chaired by Mr. Masahiro Kawasaki and reported Dr. Mercedes B. Concepcion)

1) Summary of the Lectures by a rapporteur and the chairperson

The major theme of this session is Information and Society, characterizing the society in the 21st century. Presentations were given by Dr. Yap Chee Sing from Malaysia, Dr. Sadahiko Kano from Japan, and Mr. Steven Wu from Singapore on their projects underway in their respective countries, and by Prof. Vishwanathan from India on characteristics of the network society. After their presentations discussions enthusiastically broke out among all participants.

The reports reflect the situations in their respective countries and were revealing in the light of technology management. Details can be found in each paper and the following is the summary of the session.

MALAYSIA

Multimedia Super Corridor 1996

Project Advocator: Government (Prime Minister)

Purpose: Achievement of Vision 2020 (high value-added, transformation to information economy)

Promoting Organization: Multi-media Development Public Corporation (joint venture between the government and the private sector), International Advisory Committee (NTT, Fujitsu, NEC, Sony, Soft Bank)

Project Range: development of hardware and software (legislation, personnel, fund raising), Construction of Cyberjaya city, New Administrative City, Business Center, International Airport, Communication infrastructure, highways, and railways.

Emphasis of Promotion Measurements: To educate and keep personnel (training at universities and companies)

JAPAN

(Telecom Network Digitalization 1975-1997)

Project Advocator: NTT only

Purpose: Development of Multimedia Communication

Promoting Organization: NTT

Project Range: Communication infrastructure, International Corporation with Asia forums

Emphasis of Promotion Measurements: Education in the company

SINGAPORE

IT2000 (Advanced Research & Education Network, 1995)

Project Advocator: Governmental Computer Committee
Purpose: Establishment of network infrastructure throughout the country
Promoting Organization: HSTB, a partnership between the government (Computer Committee, National Science Technology Committee, System Science Research) and the private sector
S-ONE is the Singapore Communication Public Corporation, National Computer Committee, and National Science Technology Committee.
SingaREN is the KRDL (Joint Laboratory of System Research and Information Technology Research)
Project Range: Establishment of ATMs, products, services, and development of personnel, S-ONE (ATMNW throughout the country), SingaREN (high-technology, education), NW indicates the establishment of the SingaRen Technology Center
Emphasis of Promotion Measurements: technology development through international cooperation, the private sector having line supply and the government doing fund raising and education for technology development.

This session focused on the strategies aiming at establishing networks for the economy and society. In this sense, networked society is positively regarded for the development of economy and society in the 21st century. Prof. Vishwanathan from India defines characteristics of networked society in the 21st century as "for anyone, at anytime, in any format, any information can be communicated." He pointed out that prominent change may occur in the fields of education, labor, culture, environment and health as a result of the networked society, and that there is concern about the misuse of virtual reality and therefore, a new system of education and training is necessary regardless of whether it is legislated or not and that India is consequently making progress on this at the moment.

The representative of China mentioned that they have a science and technology network with the EC countries and would like to participate in the Asia Multimedia Forum promoted by NTT. There was also an argument against Prof. Vishwanathan's presentation, regarding working hours and numbers of face-to-face contacts in networked society, as well as the increase in travel. It was also revealed that although S$3,200,000 as seed money for the HSTB project to R&D funds was expected in the beginning for a relatively small-scale project, eventually S$3,500,000 was required.

Throughout this session it was clearly recognized that two major movements, (1) the establishment of a global network for the economic society in the 21st century and (2) to establish the infrastructure for networks, the development in many countries of science and technology, including the humanities and social sciences in a broad sense, will lead consequently to the development of industry and society as well as stimulation of the economy. Moreover, the following are some points to be paid attention for promoting these projects.

1) Human resources are indispensable in order to develop hard and soft technologies, and to develop network and managment projects. Consideration shoould be given to training and educating personnel in companies in the country as well as hiring personnel inside the country who are moving abroad.
2) In each country, apart from Japan, the government is leading national projects, entering partnerships with the private sector. As implied in the term "joint project" they basically share, as partners, fund raising, risk, and so on.
3) Each project assumes the participation of foreign enterprises in terms of capital, technologies, and personnel, not in a conventional way, ie., one way assistance, but by supporting each other as partners.
4) In the process of implementing these information projects, human relationships and co-existence with nature should not be neglected, nor should education and professional training for the people of each nation who will become users eventually.

Session - III Transportation and Economic Development

(Chaired by Dr. Raul V. Fabella and reported by Dr. Ricardo G. Sigua and Mr. Koichi Goto)

The first lecture given by Dr. Hooper focused on the role of aviation transportation as a case study in economic development in Australia. The country depends greatly on the aviation transportation service for links with other areas in the world. In order to enter the world economy where competition is becoming intense, Australia enforced restrictions and rules in the transportation section. It showed the achievements of the private sector in preparing the capital for the transportation base and smooth administration. Moreover, economic regulation was recognized as a disadvantage to markets in dynamic change. The lecture outlined the role of aviation/transportation in the age of globalization and this can be a concrete example for other countries which are in a situation similar to Australia's where the role of aviation/transportation is significant. It also pointed out how important the development of human resources is for the measures coping with various kinds of infrastructure and maintenance of air service consumption in the Asia-Pacific area. The following were the major questions and answers.

Q. I consider that the role of government is shifting due to promotion of privatization. What do you think from the viewpoint of global competition?

A. For the purpose of effective administration of an airport, privatization was done and resulted in great success. It is a good influence for global competitiveness.

Q. The lecture was about international airlines. How about the situation of Australian domestic airlines?

A. We have two main domestic airlines. Transportation between big cities is the main business inside Australia and new entries are difficult. Mr. Ozeki introduced the history of the Japanese railroad, which lasted for a period of more than 100 years. He emphasized that a young generation contributed a great deal for the development of the Japanese railroad. Although it was behind compared with other Asian countries in the early stages, Japan advanced railroad construction with strong activity in the private sector. He divided the development of the Japanese railroad into four phases; the privatization of railways that had depended on imports, advancement of electrification, construction of the Shinkansen or bullet-trains, and privatization of the National Railways Corporation. Through each stage, he praised the role of young engineers in making many decisions. In any country, a big traffic system is changed by the innovative spirit of those who are involved. This shows that it can happen when there is passion and knowledge to change the surroundings (a typical characteristic of young

people with ability or talent.)
The major questions in this lecture are as follows.

Q. It was very interesting as a concrete example of industrial advance. In the beginning it was a privately-managed corporation and it was purchased by government. Why was that?

A. The Meiji government had experienced war twice, in the wars of Japan with China, then Russia, and recognized the railroad as a military affairs industry, and they wanted to put it under their control.

Q. The Japanese government announced they would actively promote information on ground traffic, as one measurement to promote the information-oriented society. I would like to have some information regarding the Japanese railroad situation.

A. When the National Railways Corporation was privatized, one company, the "Railroad Information System," was established and is active, specializing in information systems. Mr. Djamal from Indonesia introduced the changing situation from 1976 up to today in PT IPTN (Indonesia aviation space industry).

He explained the difference in each advanced stage from the previous one. Using a map he showed that Indonesia is a lot of islands and represents one big continent. From this unique characteristic, confidence and competitive power were created with a unified aviation transportation industry supported by its own aircraft, and because of this fact Indonesia exists in unity. Moreover, the problem of poverty was discussed (15 % of all of the population is below the standard poverty line). It is believed that the most effective and efficient countermeasures to this problem are to develop and promote the sightseeing industry because one of Indonesia's biggest strengths is its varied races and cultures. He described some strategies for this plan and emphasized the importance of aviation transportation which supports the sightseeing industry, while warning about the over-popularization of any single sightseeing spot. Major questions and answers were as follows.

Q. What kind of process raised the aircraft industry?

A. In Indonesia, airlines are significant, as well as shipping transportation, because the country consists of more than 7,000 islands. We have sent young engineers and students abroad to study since the independence of our country. It is Mr. Habibi who became a major leader for this movement. We also established aviation high schools to educate future employees.

Q. How many planes do you build domestically?

A. At first we only assembled imported parts, but now we are gradually improving our designs and assembling parts produced domestically. At the moment most parts are domestic except special electronic parts or propellers.

Mr. Wang, Chinese, first described the traffic problem caused by the recent, rapid Chinese economic growth. The traffic infrastructure must be developed to support such a growing economy. Although some projects are moving toward realization, traffic infrastructure is not balanced yet with the economic. He pays more attention to other innovative countermeasures to ease traffic jams in cities such as the ITS information communications technology. Examples shown of the future of ITS, are the electronic road toll collection system, traffic control system of urban regions, the community traffic system, road safety accident prevention system, advanced distribution system, traffic volume investigation and traffic information services. China is currently about to commence a project relating to ITS seriously. Activities of ITS in China from 1995 to the present time include international information exchange or the establishment of an organization developing ITS.

Major questions in this lecture were as follows.

Q. What sort of cars are the popular in China? Is ITS a necessary development?

A. Traffic jams become very intense in big cities such as Beijing, and it is recognized as indispensable to utilize the latest technology to control it.

Q. What range does ITS cover? Do you handle road, railroad, and aviation in a total way?

A. We are still examining it as a whole and we have just started. Currently, we are advancing individual projects. Finally, discussions of the whole session were done.

Major discussion themes were as follows.

- Privatization of transportation organizations and deregulation controls, and handling of subsidiaries
- Possibilities of mutual cooperation among aircraft industries inside Asia. The concrete process of the nationalization of the private Japanese railroad and the measures necessary to make the younger generation become more active.

Opening Session

The Role of Energy, Transportation and Information Technology in Sustainable Development*

Jose A. Magpantay
Technology Management Center
University of the Philippines

The financial crisis facing Asia today casts doubt on the region's ability to continue its phenomenal growth of the past twenty-five years. Suddenly, the so-called East Asian "miracle" has become an East Asian "(economic) massacre," with no end seemingly in sight (yet). Of all the countries embroiled in the crisis, the Philippines, unfortunately, has tasted only a few years of relative economic boom. One would therefore think that the country's leaders would be the most worried. But quite the contrary. President Ramos insists that the Philippines will be the first to recover from the crisis because our economic fundamentals are sound. Whether this is merely whistling in the dark or a conviction based on hard analysis is something we will soon find out.

In a sense the official optimism is not unlike the reasoning behind the unqualified support of government for the unbridled liberalization of our economy. The Philippines is lowering tariff rates faster than our international commitments require because our economic managers believe this will bring more boon than bane. Perhaps. But then again perhaps not. It is not likely that an underdeveloped economy – with low productivity, a weak industrial base and gaping holes in technological capability – will survive the fierce competition in the global free market. This is precisely why our neighbors who have had more than two decades of outstanding growth are not opening their economies as rapidly as we are. Again we ask, is the government's reasoning merely wishful thinking or is it based on serious analysis? I will leave this question to economists to debate upon. We will probably have the answer sooner than we think anyway because crisis situations have a way of exposing the true character of the people and nations involved.

As for East Asia, my position is that more than two decades of sustained economic growth cannot simply be dismissed as a fluke. In truth, the economic miracle in the region is a misnomer for it denies the years of painstaking work and correct macro and micro policies and programs that resulted in competent human resources and competitive national innovation systems. I believe these gains cannot easily be lost to a currency crisis. The region will survive and will emerge even better than before the crisis because of the lessons to be learned in the area of financial management and the virtue of fiscal restraint.

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My optimistic projection is not totally unfounded. The history of the world shows that currency and financial crises are recurring events. The table (next page) summarizes the more famous financial crises in the past three centuries and the important technological innovations during each period. Note that economies which were able to maintain their wealth-generating capacity in spite of the crisis were not only able to weather the storm but also rose to new heights of affluence. As argued eloquently by Adrian Berry in his book, *The Next 500 Years: Life in the Next Millenium* (1995), the "inexorable advance in prosperity" is due to two reasons: that "most people are driven by a desire to better themselves", and "that all technologies have a continuous trend towards improvement". Both these reasons will enable society to overcome the setbacks caused by human avarice (as displayed in crisis situations) and increase what Berry calls "the wealth of the race".

This long-term perspective, however, does not mean we should treat the short-term impact of financial crises lightly. Such crises result in massive unemployment and untold human suffering. They must therefore be managed properly. But dwelling too much and too long on the financial crisis while forgetting the underlying basis of long-term development foster pessimism; and widespread pessimism is not good for the economy.

For these reasons, I think this seminar is extremely timely for it deals not only with the foundation of long-term growth but also the means to it, of which R&D is an integral part. Crisis or not, society should retain its focus on the sustainability of development. Crisis or not, society should manage its technological resource ably for it is the engine of a nation's wealth-generating capacity. Although the natural tendency in time of crisis is to consolidate and cut back on forward-looking activities, the correct thing to do is to retain the foresight and be more discerning. This means R&D should not be stopped but carried out more creatively because of adverse conditions. In short, crisis situations call for better management of R&D in particular and management of technology in general. In this lecture I will discuss the role of energy, information technology and transportation in sustaining not only economic growth but, more importantly, the development of society.

What is Sustainable Development?

In 1989, J. Macneill wrote in *Scientific American* that:

> Since 1900, the number of people inhabiting the earth has multiplied more than three times. The world economy has expanded 20 times. The consumption of fossil fuels has grown by a factor of 30, and industrial production has increased by a factor of 50; four-fifths of that increase has occurred since 1950. This scale

Technological Innovations Alongside the World's Major Financial and Currency Crises

Year/Place of Crisis	Financial Crisis	Technological Innovation
1772 Britain	"One of the fiercest financial storms of the century."	Between this crisis and the next: steam engine, steam-powered train, small pox vaccine, flat-bed cylinder printing press
1825 Britain	"A panic seized upon the public such as had never witnessed before."	First passenger-carrying railway and six years later, electric generator
1837 U.S.	"One of the most disastrous panics this nation ever experienced."	Telegraph; two years later, photography
1847 Britain	"In the last nine months more reckless and hazardous speculation than any known in modern times."	First mass production of steel during the decade
1857 Britain/ Germany	"Crisis the most severe that England or any other has experienced." "So complete and classic a panic has never been seen before as now in Hamburg."	Drilling of first oil well, first underground railway, discovery of the germ theory of disease
1866 Britain	"Crisis most serious in modern times. Wilder than any since 1825."	Dynamite, bicycles and pneumatic rock drill
1873 Germany	"In 56 years, no such protracted crisis."	Electric lighting, telephone, discovery of uniqueness of fingerprints
1882 France	"Never have I seen an equal catastrophe."	Crisis followed by invention of radio waves, motor cars, motor cycles, penicillin, powered flight, liquid-fuelled rocket
1929 U. S.	"The greatest cycle of speculative boom and collapse in modern times – since, in fact, the collapse of the South Sea Bubble in 1720."	Crisis followed by invention of helicopters, jet engines, portable bridges.

Source: Adrian Berry, *The Next 500 Years: Life in the Coming Millenium* (W.H. Freeman and Co., 1995).

of development has produced a world order with new realities, realities that have not been reflected in human behavior, economics, politics or institutions of government.

These facts immediately raise the following questions:

- At what cost to the environment have we achieved this phenomenal growth?

- Have we used the earth's resources efficiently and productively to achieve this growth?

- Can planet earth support another one hundred years of this type of growth? If not, what new development pathways must we take?

- And since this growth is obviously not equitable, how do we reduce or minimize the inequity in the next century?

Scientific and environmental researches in the past two and a half decades have given partial answers to the first question and led to the understanding of the environmental consequences of our actions. This understanding, in turn, has encouraged the adoption of policies like the phased reduction and elimination of the use of CFC. On the other hand, the still incomplete understanding of the effect of green house gases on the global climate has caused strong disagreements on the level of reduction of CO_2 emissions. This is perfectly understandable because of the economic impact of such a reduction.

The answer to the second question on the efficient use of the earth's resources is inconclusive because efficient and productive utilization depends on three factors, namely: the existing scientific and technological know-how; the availability of economic resources; and the willingness of countries to commit the resources needed to support the use of such know-how. Advanced countries are more efficient in using natural resources compared to developing economies. This is reflected in their lower energy-GDP elasticity and lower energy intensity of their industries.

As for the third question, the world is slowly adopting a consensus that the 20^{th} century's growth cannot be maintained, not only because of its massive use of resources but also because of the inequity it has engendered. The inequity is most glaring in the use of energy. Citizens of developed economies use seven times more energy than citizens of developing economies do (*Scientific American*, 9/1990). The benefits of energy use, such as higher standards of living, lower infant mortality and longer life span, are enjoyed mostly by citizens of developed economies. But when it comes to bearing the negative impact of energy use, such as global warming, everybody shares the risk, with citizens of

developing countries suffering more because of their country's inability to respond to the economic consequences of the change in the global climate.

What new development pathway, therefore, must the world follow? The answer is not yet clear, given the debate on the nature and type of development and the need to address the problem of equity. But the development path already has a name – **sustainable development** – which clearly represents a reaction to the problems we face today. What is sustainable development?

The most popular definition is given by the Brundtland Report (WCED 1987), that is, "**development that meets the needs of the present without compromising the ability of future generations to meet their own needs**". Although the detailed operational meaning of sustainable development is still the subject of debate, there are nonetheless some obvious implications of this definition.

In terms of resource use, the definition implies that: *(1) Resources should be harnessed with minimal impact on the natural environment. (2) Renewable resources must be used at rates that will allow replenishment by natural processes. (3) Non-renewable resources must be used at rates that will enable humankind to find substitutes or alternatives before the resources run out.*

Science and technology play a vital role in achieving these goals. The restoration of strip-mined areas in the U.S. and multi-directional drilling in Philippine geothermal sites are examples of the first objective. The optimal use of scarce water resources for agriculture in Israel, made possible by the use of computers and sensor technology, is an example of the second. The use of optical fibers instead of copper in telecommunication cables is an example of the third objective (though this may not be an appropriate example because expanding the bandwidth and not the decreasing copper production is the reason for the shift to optical fibers). Recycling is another example of the third goal; it has the added virtue of also being a waste management program.

In terms of waste management, sustainable development requires that: *(1) waste production is minimized; and (2) wastes are properly disposed of.*

Minimizing waste production is a matter of efficient and productive use of resources. Aside from recycling, innovations in product design and the manufacturing process are important. Proper waste disposal means that wastes are segregated and disposed of accordingly. Toxic wastes, ideally, should first be reduced to their benign components before they are released to the environment. Non-toxic wastes, on the other hand, should be released to the environment at rates that allow for natural processes to act on them, making the wastes an integral component of nature again.

In terms of societal aspects, sustainable development implies that the positive rate of change of desirable attributes and the decline of negative attributes are maintained until the structural or ideal limits are attained. The desirable attributes are generally represented by such socio-economic indicators as GDP, per capita income, literacy rate, the number of telephones per 100 households, the ratio of doctors and hospital beds per 1000 population – all of which we want to improve. On the other hand, we would like to see a decrease in the inflation rate, GINI coefficient, infant mortality, crime rate, and deaths due to accidents. Achieving societal goals is not simply a matter of science and technology. It involves culture, values, the balance of political forces and political will on the part of both leaders and citizens.

Sustainable Energy Program

Sustainable development requires a sustainable energy program. Such a program must take into account the inextricable link between energy and the environment. By this we mean that all energy activities – exploration, extraction, transport, processing, storage and distribution – have an impact on the environment. Conversely, pollution is ultimately an energy problem because if we have sufficient clean energy (so as not to add to the pollution), then pollutants and toxic substances can be disposed of properly or broken down into their benign components.

A sustainable energy program has four components. These are: *(1) demand side management; (2) use of efficient and less polluting fossil fuel-based power generation technologies; (3) increased share of renewable and more environmentally benign energy sources; and (4) development of energy technologies that make use of new physical principles and advanced technologies.*

Demand side management aims to lower energy consumption without sacrificing economic goals and social programs. This is done by using more energy-efficient devices such as motors, compressors and lighting fixtures. The use of new materials such as smart windows (which let visible light in but reflect back the infra red part of the electromagnetic spectrum) and "controllable membranes" in intelligent buildings also lower energy consumption in buildings.

In industry, the main concern is lowering the energy intensity of production. For example, in the chemical industry, the energy intensity of producing polyethylene improved from 8,400 Btu/lb. in the 1940s to 1,500 Btu/lb. in the 1980s (Joyce, 1991). Indeed more improvements can be expected because the lower bound of energy consumption, which is defined by the thermodynamic limit, has not yet been reached (*Scientific American*, 9/1990).

Recycling energy-intensive materials such as aluminum, steel, glass, and plastic will reduce the energy requirement of industries tremendously. In addition, wastes in landfills will be reduced. Finally, the experience of OECD nations shows that demand side management makes economic sense because it costs less to save 1 kwhr of energy than to produce it. Add the saved environmental cost and the economics of demand side management improves even further.

The second component of a sustainable energy program, using more efficient and less polluting fossil fuel-based power technologies, is based on the realization that: (1) these technologies have a long history of reliable operation, (2) an extensive and integrated industry that not only employs millions of people worldwide but also constitutes a big percentage of any country's industrial sector, and (3) a huge global market. The International Energy Agency estimates that about 85% of the world's primary energy requirement in 1993 were supplied by fossil fuels. Furthermore, almost 60% of the world's electricity is generated using fossil fuels. Thus this component of the energy sector cannot be ignored.

On the other hand, the long history of the hydrocarbon sector makes it resistant to change. But change it must because of depleting resources and the environmental impact of hydrocarbon use. The current estimate is that there are only 165,000 quads (1 quad = 10^{15} Btu) of fossil fuel remaining, broken down as follows: coal, at 150,000 quads; oil at 7,000; and natural gas at 8,000 (*Scientific American*, 9/1990). Of the three, natural gas is the cleanest to use; it produces the least amount of NO_x, SO_x, and CO_2. This reason, plus the fact that there are technological innovations that make gas fired power plants highly efficient and less costly to put up (*Scientific American*, 9/1990), make natural gas power plants highly desirable.

The favorable use of natural gas is further reflected in the forecasts of energy consumption by developing economies in the Asian region. The International Energy Agency (1996) predicts that between 1993 and 2010, the share of solids, mostly coal, in the energy requirement of these countries will decrease from 66.3% to about 49%, while natural gas will increase from 6.6% to about 10.5% during the same period.

The third component of a sustainable energy program is raising the contribution of renewable and more environmentally benign energy sources in the total energy mix. The renewable energies are hydroelectric, geothermal, biomass, solar, wind and ocean. Hydroelectric, biomass, wind, ocean thermal, and waves are stored solar energies. Solar photovoltaic and solar thermal are direct solar energy technologies. Tidal head and tidal current energies are due primarily to the gravitational pull of the moon and the earth's rotation. Geothermal energy has its origin in the heat trapped inside the earth that is continuously replenished by the decay of trace radioactive substances in the earth's crust.

These energies are called renewable only in the sense that they are expected to last very long, in the order of geologic time scale for geothermal and billions of years for solar energy (the sun, being a middle-aged star, is expected to last another five billion years). Renewable as they are, these energy sources still need to be managed well if they are to be harnessed in large quantities. To do so, renewable energies require large areas of operation and high initial investments because of their low energy intensity. Lastly, renewable energy systems are site-specific and generally have a lower availability factor.

The International Energy Agency (1996) computed the share of renewable energy in the primary energy mix in 1993 at 3%. This is projected to reach between 3.5% and 4% by 2010. In terms of electricity output, the contribution of the renewables to the total world production in 1993 was 19.5%, mostly hydroelectric and a very small contribution from geothermal energy. By 2010, the projection is that renewables will contribute from 20.7% to 32% of the total electricity production. Hydroelectric plants again will account for the bulk of the increase.

As for the so-called new renewable energy sources, such as ocean, solar and wind technologies, their overall contribution is still very small. Wind energy contributes the most with an installed capacity of 6098 Mw, a hundred times more than the installed solar photovoltaic, as of 1996. Most of the installed wind capacities are found in only three countries, the U.S., Germany and Denmark. Wind energy systems are projected by the World Energy Council to be economically competitive with fossil fuel-based power plants by 2020.

Ocean thermal systems have only been tested up to the tens of kwe capacity. The proposed 40 Mwe facility to be put up in Hawaii has been on hold for more than ten years now and may not be built at all. To improve the economic viability of ocean thermal systems, other applications such as aqua farming (using the nutrient rich cold water), fresh water production (for the open cycle OTEC), and air conditioning of buildings near the coastline should be integrated with power generation.

Tidal head energy is extremely site-specific. It is possible only in places where there is sufficient tidal head (8 meters or above is ideal) and an enclosed large body of water with a small mouth. There are only a few such sites in the world, an example of which is La Rance, France where there is a 200 Mwe facility.

Tidal current is also extremely site-specific, requiring a certain range of water speed (the ideal is between 2-3 m/s) in a constricted area such as a strait. Although naive computations show huge amounts of water kinetic energy in some sites such as the San Bernardino Straits of the Philippines, harnessing this energy suffers from three problems. First, the economics of this energy system is still not competitive with conventional plants, its capital cost being three times

more expensive. Second, since capital cost is up-front money and the technology has not even been tried in the Mw range (experimental facilities in advanced countries are only in the tens of kw range), this energy system will not be attractive to investors. Third, the turbine technology is beset with problems such as biofouling, abrasions in the blades due to suspended particles in the water and low efficiencies.

Wave energy is available in all coastal areas. The World Energy Council (1993) estimates the energy content of waves at 8 kw per meter of coastline. At face value there is plenty of energy that can be harnessed. In practice, however, harnessing huge amounts of energy is limited by the distance from the coastline (competing use of coastline) and the current state of the technologies. There are two general types of wave energy technologies – the mechanical devices and the hydropiezoelectric. The second uses a dielectric polymer that directly converts mechanical energy into electricity. The experimental mechanical devices are still in the 10 to 100 kwe range, while the hydropiezoelectric devices are still in the 1 to 10 kwe range.

Hydropiezoelectricity and photovoltaics are examples of the fourth component of a sustainable energy program, the development of energy technologies that apply new physical principles and advanced technologies. These energy systems have potentially high efficiencies because they are not restricted by the Carnot limit. They are modular, which means they can be used as a decentralized unit but easily scaled up to connect to the grid. Finally, these technologies are more environmentally benign than the conventional ones.

For decentralized operations, photovoltaic technology is ideal. It is not economically competitive yet for grid applications but developments in materials science may lead to single crystalline, polycrystalline, thin films and amorphous solar cells with high efficiency (state of the art gives 27%, 17.8%, 14.2% and 9.1% laboratory efficiencies for each of the four types, respectively). New processes may lower the cost of production. Taken together, these two developments might just make photovoltaics economically competitive for grid applications. When this happens, the only limit to photovoltaics will be land use considerations.

In the immediate future, the most promising "new" energy technology is the fuel cell. In truth, the technology is hardly new, dating back to the 1840s when William Grove experimented with reverse electrolysis (*The Economist*, 25 October 1997). In addition to having the positive features of photovoltaic technology, fuel cell technology is also desirable for its varied sources of fuel. Biomass, coal and natural gas can be processed as fuel for this technology. Furthermore, its environmental impact is much less than that caused by directly burning these fuels. Hence fuel cell technology could be the energy technology of the future if it can hurdle the technical problems related to electrolytes and catalysts.

In conclusion, a sustainable energy program can provide the energy requirements of the world in an environmentally friendly and ecologically sound manner. But whether the resulting economic activities lead to the sustainability of development depends on other, societal factors.

Transportation and Economic Growth

Transportation, like energy, is essential to economic activities. In the 1980s the United States spent 18% of its GNP on transportation products and services (equivalent to $800 billion) and employed 10% of its workforce in transportation and related businesses (Sussman, 1991). The world, moreover, consumes 38% of commercial end-use energy for transportation (Heywood, 1991). Considering these and the environmental impact of all energy activities, an efficient transportation system is absolutely necessary for sustainable development. Such a transportation system must have the following components: *(1) It should minimize the movement of people without constraining economic and social activities. (2) It should be able to move people with minimal risk to their health and lives. (3) It should be able to move goods and people with minimal use of clean fuel.*

Strictly speaking, the first condition is not part of a transportation system but is more properly the concern of urban planners and development specialists. Innovations in information technology have made possible telecommuting, teleconferencing, distance education and other services that do not require physical transport to the site of the activity. Another measure is to design compact urban communities that promote walking or the use of bicycles instead of cars. These communities will also result in greater social interaction, which will mitigate the impersonal nature of telecommuting and distance education.

Moving people about with little risk to life and limb requires innovations in sensor technology (for navigation and early warning), properly designed roads (to minimize accidents), and vehicles made of new materials that can absorb most of the impact of collisions. The future points to the extensive use of information technology such as geographic positioning and intelligent highway systems, technologies that will make autonomous vehicles possible. Smart materials will reduce accidents because of their capacity to warn against metal fatigue and impending structural defects of the vehicle.

Fuel efficiency is of utmost importance in any transportation system because of environmental considerations. Such efficiency can be achieved in five ways. The first is by using new fuels in internal combustion engines. The use of natural gas, LPG, M85 (85% methanol and 15% gasoline) will reduce particulates and other emissions. The second is to use ceramics to raise the operating temperature of engines, thereby improving efficiency. The third is to use

information technology that will inform the driver of the traffic situation and suggest alternative routes. The fourth is to design new engines, which include electric cars, hybrid vehicles, flywheel engines and maglevs. The last method is the use of properly designed mass transport systems in urban areas.

Most of these changes are possible with present technologies; they just require more development work. The main hindrances to the implementation of these innovations are the inertia of old practices and economic considerations. With the changes that will undoubtedly take place in the field of transportation, we should keep sustained economic growth in sight as our primary purpose while at the same time minimizing adverse impact on the environment.

Information Technology and Globalization

The most immediate, striking and pervasive effects of any technological innovation thus far have come from information technology. Information technology and globalization are linked symbiotically. The development of one drives the other's growth, which in turn pushes the first toward further development. Information technology has revolutionized telecommunication and mass media, not only making people aware of the news and important events throughout the world but, more importantly, facilitating commerce and business. As international business expanded, the need for better information systems also grew, propelling developments in hardware, software and area networks. Today, even small business enterprises and middle class households in developing countries are wired to the rest of the world. At the same time, we see an increasing trend toward globalization whereby capital, management, services, technology, raw materials, goods, and labor are transported across national boundaries in decreasing order of ease.

It is important, therefore, to ask ourselves if globalization is consistent with sustainable development. This question is particularly relevant to developing economies in light of the present financial difficulty. This crisis could well be the tip of deep-seated, insurmountable problems that developing economies will encounter in competing with developed economies in the open market.

Moreover, the competition between the big (and fast) economies and the small (and slow) ones is not a fair contest. Consider the matter of intellectual property rights. Advanced countries insist on the strict implementation of the TRIPs Agreement (which updated the Berne Convention on IPR). The only concession given to developing economies is to delay, up to 2005, the implementation of such provisions as those on biotechnology-related innovations. This is hardly a concession, however, because developing economies do not have the basic science foundation to catch up with the West in biotechnology in ten years time. Empty gestures like this show that Western countries are not serious in helping out late starters. Technology, which is crucial to a late starter's

strategy of catching up with the rest, will become even more expensive under the present TRIPS, hampering a developing country's sustainable growth program.

Unfortunately, integration into the world economy is no longer a matter of choice for developing economies. It is now a must. The reality of the present global order, however, is tilted in favor of the developed part of the world. A developing economy, for instance, needs science, technology, intermediate goods, finished goods, capital, services and markets for their (low value-added) products. Developed economies have all these. Developing economies have cheap labor and raw materials, although the second is increasingly becoming scarce because of mismanagement. Unfortunately for developing economies, most developed economies also have the resources or are able to find substitutes for resources supplied by developing economies. Also, developed economies, because of their aging population, rely increasingly on machines. And the future points to the coming of intelligent machines. How then can a developing economy integrate into the world economy? How can the "have nots" reduce the economic gap with the "haves" by playing in a field where the rules are heavily stacked in favor of their developed competitors?

Clearly, globalization as it operates today will only magnify existing inequities. Since growth without equity between nations will not last, globalization poses a serious threat to sustainable development. Our options are straightforward: we either do something about the present situation or allow the current brand of globalization to take its natural course.

Proponents of the second proposition argue that the poor will always be with us because disparities in economic status are as natural as differences in physical attributes. The natural course of events is toward free market competition in which the inefficient will be weeded out or are forced to be more efficient. In the global competition, social structures tasked with looking after the common good – nation-states and their public institutions – are deemed out of tune with the times and impediments to economic progress. In their stead, the structures viewed as more responsive to economic competition are the regional-states, geographic units that have common economic interests (Ohmae, 1995). Indeed, certain events in the last ten years seem to be consistent with this picture.

The problem with the foregoing argument, however, is that it reduces the totality of society to economics. This is clearly a gross simplification of a very complex social issue. Aside from economics and geographic boundaries, societal groupings are also based on a shared history of experiences, culture, politics, goals and problems. While innovations in transportation and information technologies may easily overcome physical boundaries and economic barriers, they cannot tear down social factors such as nationalism or national identity that set peoples and nations apart and give them distinct character.

No matter how closely intertwined the world becomes through the internet, the best football players, who normally play for rich international clubs, will still proudly don their country's uniform during soccer's biggest two-week event. In the field of science, which is the most universal of all the fields of study, there are characteristics unique to some countries. The Soviet school of physics (established by Lev Landau), for example, can be distinguished from American physics education by its rigorous mathematics.

Even the world of business, which is most heavily bombarded by globalization, can be differentiated according to business practices unique to certain nations, as Charles Hampden-Turner points out (Ohmae, 1995). Americans, he says, tend to think in terms of dichotomies; for example, free trade is good while protectionism is bad, free market is good while government interference is bad. The Japanese, in contrast, balance the opposites to arrive at harmony. Thus they protect businesses only long enough until they can compete internationally; the government provides directions so that Japanese businesses can grow on their own. American businessmen prefer to see business deals in black and white, while Chinese businessmen are more amenable to verbal agreements.

These examples belie any notion of the impending demise of the nation-state and the rise, in its place, of a region-state. The "twilight of national sovereignty," as claimed by former Citicorp CEO Walter Wriston (as quoted in Bocobo, 1998), is, I believe, exaggerated. Nation-states exist not only for economic reasons; they serve many other purposes as well that cannot be eased out by globalizing technologies and economic policies.

What is true, though, is that nation-states have been slow to adjust to changes brought about by globalization. But they are not lumbering dinosaurs either as the ongoing currency crisis in Asia proves. The private sectors in Asia and the West are the perpetrators of this crisis: the former by borrowing heavily from the latter and then investing in non-performing business ventures, and the latter by abetting the wrong investments because of the quick profits to be made. When the crisis struck, the global-thinking private sectors of both sides, who all along claimed knowledge of what is good for the economy, called on their respective nation-states to bail them out. Nation-states are now digesting the lessons from this crisis and are instituting programs that will prevent the same from happening again. Perhaps one of the lessons, as Milton Friedman suggested in a recent CNN interview, is to let global financial institutions suffer the consequences of their own folly rather than have the IMF come to their rescue.

For developing economies, the nation-state is more important than ever if they are to achieve their development goals in the era of liberalized markets. One of the concerns of nation-states is to recognize the role played by regional organizations in the development of the nation. The public and private sectors in

developing economies need to work hand-in-hand and propose creative ways to balance the opposites in order to achieve the harmony needed to sustain economic growth. By working jointly, developing economies will acquire the leverage needed in dealing with huge global corporations that are not always well meaning in their business transactions. From this standpoint, therefore, only the first option is tenable, that is, to do something about the current situation. And here nation-states clearly play a crucial role.

I also wish to emphasize that in a truly global world, sustainable development requires that all nations, not just a select few, achieve their development goals. The reason is that a fully interconnected world is like a living biological system. If one part is ill, the whole organism cannot function well. The solution is neither to cut off the ailing part nor to let it suffer. Rather, the remedy is to assist the ailing part to heal so that the entire system can function ably. A fully interconnected world acting as a biological organism, therefore, is the only way to achieve sustainable development.

In a sense it is ironic that Western science and technology, which promoted a mechanistic interpretation of the world, eventually, through information technology, made possible a world that behaves more like a living system, a world envisioned by the East. Up until the early part of the second millenium, Eastern societies were more advanced than those in the West. Westerners had to go to the East to learn science and technology. The shift in fortune started in the middle of the second millenium, during the Renaissance and the Scientific Revolution. By the time of the Industrial Revolution, the West had achieved the upper hand in terms of economics, politics and science and technology.

At the start of the 20th century, the classical sciences, the foundation of second wave technologies, failed to describe the atomic world. Western institutions of higher learning stood at the forefront of research that uncovered the modern sciences, which are the basis of advanced technologies. In time modern science reached the East, enabling some countries, notably Japan, to help the West develop the technologies that now connect the world.

Yet the concept of sustainable development was formulated only toward the end of this century and its meaning continues to unfold. Perhaps it is time to consider sustainable development in the context of an Asian worldview, that is, as a living organism consisting of integral parts that have their separate functions but come together in a harmonious whole. Developed nation-states should not treat their dealings with developing economies as a zero sum game. As Krugman convincingly argues, the growth of third world countries does not hurt the developed world (Ohmae, 1995). If we were to raise current definitions of sustainable growth to the global level, how best could we define it except by the simple dictum that sustainable development means growth with equity between nations?

The full understanding of this concept and the creation of the necessary mechanisms will happen during the first century of the third millenium. These mechanisms include the total interconnection of the world, the development of technologies that foster efficient use of resources, changes in culture and outlook, and the strengthening of humane institutions. They will not come easy, but there is no doubt that they will happen because humankind does not have a choice.

When these developments start to gel, developed and still developing countries will begin to share their view of the world. This process has, in fact, already commenced. Movements in support of the environment or against the use of land mines span across the globe. In their own way, the worst disasters in the world have brought out the best of humankind. True, competition will remain an intrinsic part of global life. But domination and world hegemony are a thing of the past. Humanity will move along the path of sustainable development.

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Science and Technology Management for an Extension of Economic Partnership in the Asia-Pacific Region

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At the opening of the Third R&D Management Seminar I would like to make some remarks about the environment of R&D management for economic growth, about the roles which should be played by academia, government and industry, and about cooperation among them throughout the Asia-Pacific Region.

Introduction

The leading advanced nations reacted to the changing conditions brought about by the end of the Cold War by attaching importance to economic growth, strengthening their competitiveness, and boosting employment. Noteworthy among these are the countries that have strengthened their competitiveness by promoting science and technology. In particular, the advanced countries are dealing with mounting anxiety over the penetration of their global markets coupled with high unemployment at home by promoting innovation in science and technology and striving to foster new industries. These countries are feeling the need to plan economic expansion and secure employment through more active development of science and technology policies.

1. Expectations and Demands Concerning Science and Technology

Science and technology have expanded the frontiers in such fields as economy, society, daily life, and culture, allowing us explore new possibilities. In the future, we can expect that these frontiers will be pushed out by further, wider-ranging developments.

— Progress in Science and Technology Brings Economic and Social Development —

It goes without saying that the development of science and technology has spurred economic and social growth. The fruits of science and technology are being utilized in all aspects of our lives, in areas such as electric power generation, transportation, communications, medical treatment, health care, education, and so on.

For example, car navigation systems based on the Global Positioning System (GPS) are now available. This system calculates position from the time differences between synchronized

waves transmitted from multiple satellites. The system currently uses 24 satellites launched by the United States. Mobile telephones and personal computers have come to be used widely in recent years. In addition, information management at point of sales (POS), magnetic resonance imaging diagnosis (MRI), and audio and video manifestations using advanced multimedia technologies have become common in our daily lives.

Advances in information and communication technologies, such as those using semiconductor and optical fibers, are changing our life styles and work places. Connecting personal computers to networks has enabled us not only to get various public and commercial services using audio and visual information, but also to form forums for communication between people with common interests in a "virtual community." Technology is now making it possible for us to do our job as if we were setting at our own desks when we are away from our offices. Thanks to advances in biotechnology such as tissue culturing, we can now daily enjoy plants, such as orchids, which in the past could not be mass-produced. These advances in science and technology are the product of continuous efforts in research and development.

2. The Important Economic Effects of R&D

The economic effect of R&D is considerable. R&D activities hold the key to the nation's future economic and social growth. Economic growth is spurred by increased use of labor, increases in capital inputs, and other factors which cannot be measured using labor and capital factors (total factor productivity, or TFP). Technological innovation plays a significant role in the improvement of TFP. Because labor and capital contributions are decreasing in Japan, the TFP ratio is increasing. It has been shown that R&D investment also raises TFP (see Figure 1).

The December 1995 resolution of the Japanese Cabinet, "A Social and Economic Plan for Structural Reforms Toward a Vital Economy and Secure Life," focused on scientific and technological creativity as the basis for growth that would sustain the new Japanese economy and society. The resolution points toward the expansion of economic frontiers through the creativity of new industries, and the building of a society in which people can live active, comfortable and secure lives through the promotion of creative R&D and the effective use of science and technology in the economy and in society. Only by considerably stepping up R&D efforts to explore new frontiers while trying to find a balance between basic applied and development research, Japan will have to overcome its so-called "closeness" and lead its economy and society into the 21st century.

3. The Cultural Effects of Science and Technology

The expansion of frontiers through scientific and technological achievement does not stop at economics. The accumulation of basic scientific knowledge is the only way to learn more about the fundamental propositions of natural science, such as "What is life?", "What is the universe?" and "What are particles?", and has the potential to generate new views regarding nature and the world. The discovery that genetic information is written in DNA (in RNA in some organisms) as a code has significantly accelerated research aimed at solving the phenomena of life, and as a result the fields of immunology and embryology are thriving. Information collected from the observation of dark matter, which is said to occupy 90 percent of the matter in the universe, will better explain the history of the universe. The verification of the top quark is the last stage in confirming knowledge about the basic particles that constitute protons and neutrons. The accumulation of discoveries such as these has the potential to bring about a revolutionary upheaval in awareness, similar to that caused by the introduction of the heliocentric theory of Copernicus in the 16th century. Technological innovation in the field of telecommunications has made available computer graphics and a variety of image and sound spaces, and has had an enormous impact on art and culture. Movie actors and musicians who have not been alive for decades are reanimated on computer screens as if they were still active today. The world of fantasy is brought to life so realistically and intimately that it seems as though the dream world is within our grasp. While the semiconductors and electric instruments used for the information processing and communication necessary to produce such effects have become increasingly miniaturized, they are rigid and must be treated with great care. In the future, if *fullerene organic semiconductors are brought into use, it will be possible to produce thin and soft machines, and the constraints on usage will be reduced, paving the way for new systems to make their appearance.

*fullerene : A Soccer-ball shaped combination of, for example, 60 units of carbon. It is called " fullerene" because of its similarity to the work of architect R.B. Fuller.

4. Contribution to Daily Life and Society

Japan has always stressed the importance of the contributions made by science and technology to improving daily life and society, especially developments that have promoted the fulfillment of prosperous livelihoods. According to a March 1995 opinion survey by the National Institute of Science and Technology Policy (NISTEP), areas related to everyday living in which people think that inputs from science and technology should be stepped up include health and medical care, disaster prevention, environmental preservation, effective utilization of resources and energy, and assistance for the elderly and disabled. Areas which drew a relatively low percentage of responses included education, leisure information, and communication, as well as

consumers' concerns and household chores. From this survey, it can be seen that people want accurate answers to the most basic questions of the survival and health of mankind, and would like to see the development of science and technology to meet a variety of needs related to everyday life (see Figure 2).

5. Responding to Global Problems

Recently, demands for action to deal with many global problems, including those relating to the environment, energy, and food, have grown stronger than ever before. If these problems are not addressed soon, it will become too late to find a solution before they begin to have a serious impact on everyday life. We must clarify a reasonable course of action to solve these problems as soon as possible, and utilize the efforts of those working in science and technology.

(1) Global Environmental Problems

The mechanisms involved in the causes and processes which lead to global warming, the destruction of the ozone layer, tropical deforestation, and other worldwide environmental problems are complex and have wide ranging implications. As a result, there are still many aspects which remain unclear. It is very important that efforts are made to accurately understand these phenomena and reduce their impact on the environment.

(2) Energy Issues

According to International Energy Agency (IEA) estimates, worldwide demand for energy will be 35-45 percent greater in the year 2010 than it was in 1992, and fossil energies will account for 90 percent of energy resources. Furthermore, it is predicted that Asian countries, including Japan, will experience a 100 percent increase in demand over the same period (Figure3).

Energy is the foundation which sustains economies, societies and everyday life. The considerable increase in the demand for energy from developing nations, many of which are in Asia, and the increasing dependency on the Middle East region for energy supplies, may combine with other factors to cause mid- to long-term strains on the supply-demand relationship. To avoid this, it will be necessary to encourage R&D into energy with the long-term outcome in mind. Another important question is how to reconcile preservation of the environment with human activities that include the utilization of energy. R&D into energy must be carried out cooperatively, and from both global and long-term points of view, in order to: develop and utilize nuclear power with ensuring safety as a major precondition; diversify energy sources by promoting R&D into natural energy sources; increase the efficiency of the supply and use of energy in the entire social system; and reduce the burden on the environment

due to the immobilization of carbon dioxide emitted when energy from fossil fuels is used.

(3) Food-related Issues

According to predictions by the Food and Agriculture Organization of the United Nations (FAO), the overall supply and demand for grain will be balanced until the year 2010. However, in light of the increasing severity of food shortages in developing nations, which is likely to further push up exports by advanced nations, there are concerns that the situation will destabilize in the mid- to long-term. The population of the undernourished in East Asia is expected to decrease significantly due to economic growth, from the current 258 million people to only 77 million, but in Sub-Saharan Africa the number of undernourished people is predicted to increase from 175 million to 296 million. The undernourished population in the world as a whole is expected to fall from 781 million to 637 million (see Figure 4).

The applied technologies currently in use are limited in their ability to expand arable land area. The degree of increase in the amount of food that can be produced per unit of area will depend on the extent of contributions made by developments in science and technology. R&D that will lead to increased productivity must be continued until food production can be made secure in a sustainable system.

(4) A New Approach for Solving Global Problems

There is a growing awareness that, in order to deal with the above mentioned global problems, it will be important not only to build on all of the work that has been done thus far, but also to come up with new and comprehensive measures. From the standpoint of ensuring the long-term survival of the human race, we should examine these issues comprehensively rather than independently, re-evaluate them in order to clarify their essence, and respond to them with balanced countermeasures. Such actions will have to be trans-disciplinary efforts that transcend the individual fields of science and technology developed thus far, and must take into consideration the preservation of safety and the environment. In Japan, the Ad-Hoc Committee on International Affairs of the Prime Minister's Council for Science and Technology (CST), and other authorities in this field have initiated efforts in number of different areas, and these are expected to show progress in the near future.

6. Policies for the Promotion of Science and Technology in Japan

(1) The Science and Technology Basic Law

Reflecting heightened awareness among legislators of the importance of promoting science and technology, Diet members presented the bill for the Science and Technology Basic Law to the

134th Extraordinary Session of the Diet on October 27, 1995, stating the following:

Reasons for this proposal

Reflecting the important role of science and technology for the development of the economy and society in Japan and the enhanced welfare of the nation, as well as for the sustainable development of mankind, there is a need to establish the basic elements of a policy for the comprehensive and systematic promotion of science and technology, that is, the Science and Technology Basic Plan, in order to boost the level of science and technology in Japan. The Bill was passed by the House of Representatives on October 31 and by the House of Councilors on November 8. The Bill was officially announced and enforced as law on November 15. The Science and Technology Basic Law establishes the fundamental framework for future policy related to science and technology and will have a significant impact on the effective promotion of science and technology with the aim of establishing a Japan based on the creativity of science and technology as it heads toward the 21st century.

The Law

(1) establishes a basic direction for the promotion of science and technology: to actively promote science and technology in a way that fully develops the creativity of researchers and technicians while maintaining a harmony between people's lives, society and nature; and to balance research and development capabilities across a wide range of sectors, while promoting development that unites basic research, applied research and development research;

(2) defines the responsibilities of national and local governments in promoting science and technology;

(3) states that in establishing and implementing policies concerning universities and similar institutions, there is a need to stimulate research activity, and at the same time to keep in mind the independence of researchers and other special characteristics;

(4) requires the government to submit to the Diet "a report on policies implemented for the promotion of science and technology (annual report);"

(5) requires the government to establish the Science and Technology Basic Plan after deliberations at the Council for Science and Technology (CST) in order to comprehensively and systematically promote policies for science and technology ; and calls for efforts to ensure that the necessary measures are taken to secure the required funds;

(6) calls on the government to take the measures necessary to promote balance among a diverse range of research and development areas; secure researchers, technicians and supporting staffs; improve research facilities; promote information orientation; promote research exchange; effectively use funds related to research and development; publicly disclose the results of research and development; support private-sector efforts; promote learning related to science

and technology and international exchange.

(2) Establishment of the Science and Technology Basic Plan

With the government seeking to establish the Science and Technology Basic Plan, the Prime Minister requested relevant recommendations (Inquiry No. 23) at the plenary session of the 54th meeting of the CST held on November 29, 1995. Pursuant to this request, a general planning workshop was held and relevant discussions took place. It was recommended that the following items be drawn up:

(a) a comprehensive plan for the promotion of research and development;
(b) measures that should be comprehensively and systematically promoted by the government in order to improve the environment for research and development;
(c) other necessary items for the promotion of science and technology. In response to these recommendations, the government aims to establish the plan as early as possible, with the Science and Technology Agency preparing an internal structure to promote this establishment and concerned ministries and agencies collaborating an effective joint effort.

7. A National Strategy for the New Stage of Economic Growth

The economies of the Asia-Pacific region have now reached a new stage. Development of this region has occurred along with economic integration, which has contributed the expansion of economic growth of each country in the region. It is important for the nations of the Asia-Pacific to provide industrial infrastructure and social systems which will stimulate future economic growth. However, different countries are at different stages of economic development, and the active factors vary from nation to nation. The high performing Asian economies (HPAEs-Japan, Korea, Taiwan, Hong Kong, Singapore, Indonesia, Thailand and Malaysia) have achieved the following:

(1) sustained rapid growth;
(2) a rapid increase in exports;
(3) high rates of investment and savings;
(4) rapid improvement in productivity.

The success of the HPAEs was made possible by the existence of competent administrative organizations, the creation of professional technocrats, and adoption of varied and proper public policies. By implementing such basic polices as: (1) stabilization of the macro economy; (2) human resources development; (3) establishment of an efficient financial system; and (4)

introduction of advanced technologies, these countries have built the foundations for economic growth.

There is at present a financial crisis in some of these countries, but the active power of a nation and the energy to pursue industrial development derive in the first place from a nation's human assets. It is the synthesis between these assets and improved industrial infrastructure that results in successful economic growth. A 1994 report of the United Nations presented what it called the Human Development Index (HDI), which is calculated using factors such as the span of life, educational standards of the people, and the standard of living in a country, and it is recognized that this index gives some indication of the basic capability of a particular nation for economic growth. Governments need to allocate public capital in such a way as to promote improvement of the environment for daily living, education for the ordinary people, and the equitable distribution of income. By adopting these policies, governments will encourage the formation of a skilled labor force, well-trained engineers and the emergence of entrepreneurs, which are all vital elements for getting economic growth started. Another important requirement for the region is the creation of the infrastructure necessary for economic growth. The main objectives to be pursued in developing social and industrial infrastructure are as follows:

(1) harmonized solutions for energy and environment problems;
(2) augmentation of the transportation infrastructure to accommodate the increasing numbers of people and goods that will result from the expansion of international trade and business;
(3) the creation of an information system among countries in the region through effective use of telecommunication technologies.

In the move toward globalization, many countries in the region regard such development as essential for the creation of other new industries, and make such development an essential part of national strategic policy.

8. The Era of Mega-Competition

In all parts of the world, recognition that a new era has arrived is spreading. As the term "mega-competition" implies, national boundaries no longer segregate markets, and the products that consumers want can be manufactured anywhere, in any country, region or place. As a result, the most desirable place for a corporation to locate its key operational facilities is where there is easy access to markets and where high-quality products can be manufactured at low cost. Corporations have begun to pick countries and regions that have the environment and regulations of an industrial society. In such places corporations can efficiently make capital

outlays and develop business. It has thus become important for any national government to reshape the country's economic and social structure in order to make it possible for international corporations to conduct their business easily.

Improving social and industrial infrastructure for economic growth requires well-integrated and coordinated planning, carried out by a system that synthesizes many and varied kinds of technological developments. The most important factor in pursuing such projects is developing human resources, especially training people as project producers or managers. These people should be able to collect the most up-to-date knowledge and reliable advanced technologies, and be able to plan integrated projects and cultivate new economic frontiers.

Further, the government must provide proper education so as to produce well trained engineers and workers who can meet the demands of today's rapidly changing society and the pressures of international competition. The government must also invest in increasing the nation's intellectual assets in the fields of science and technology by adopting industrial and technological renovation policies.

9. The Purpose of this R&D Management Seminar

The purpose of this seminar is to find ways to sustain economic growth and prosperity, and to improve R&D management for academia, government and industry in the Asia-Pacific region. This time, the following points will be emphasized:

(1) to study future trends in the economic growth of the whole region;
(2) to study concrete projects that are already under way and which involve a reciprocal and cooperative relationship;
(3) to determine how to set up effective integrated projects for improving the social, economic, and industrial infrastructure necessary for a world in which society and the environment are well harmonized.

I hope that this seminar will play a useful role in exploring ways to expand economic partnership in the Asia-Pacific Region.

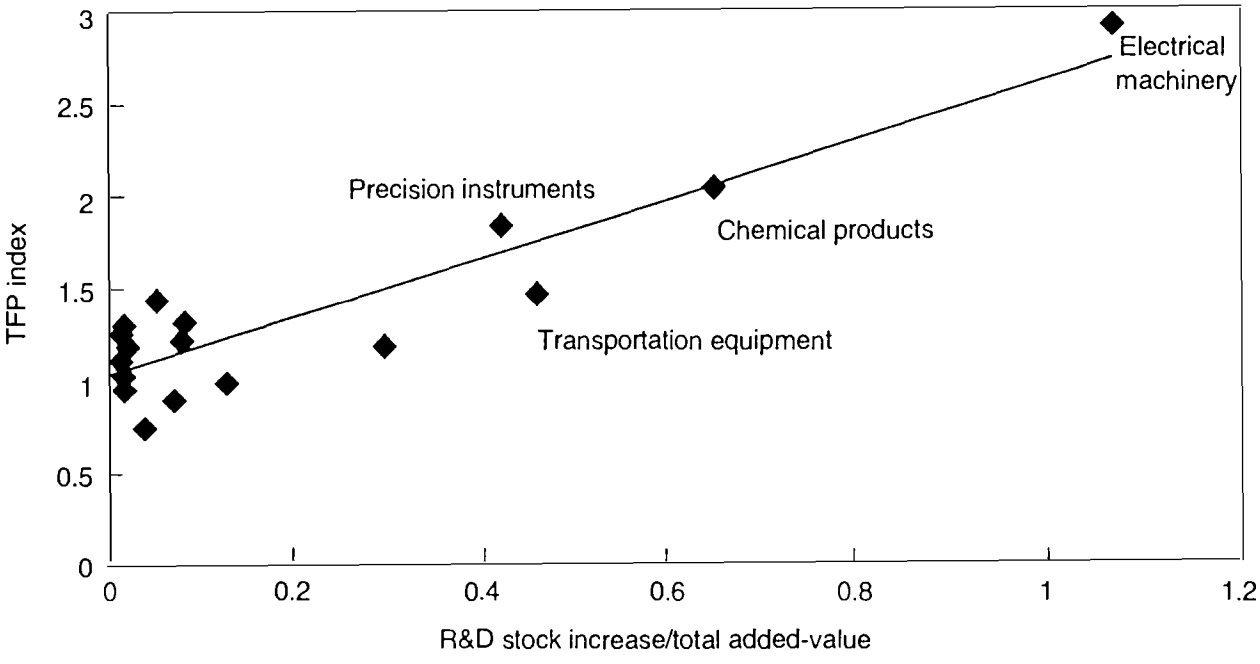


Figure 1 Relationship between R&D investment and TFP growth (1980-90).

Note: TFP index: Indicates increase in productivity of all elements
R&D stock: Indicates the amount of scientific and technological knowledge accumulated as a result of R&D investments from past to present (an estimate which considers scientific and technological knowledge which has become out-of-date and the time necessary for investment to translate into knowledge)

Source: "Effects of R&D and Innovations on the Change in Economic and Industrial Structures of Japan: An Econometric Study," Special Coordination Funds for Promoting Science and Technology (Mitsubishi Research Institute, Inc., March 1995)

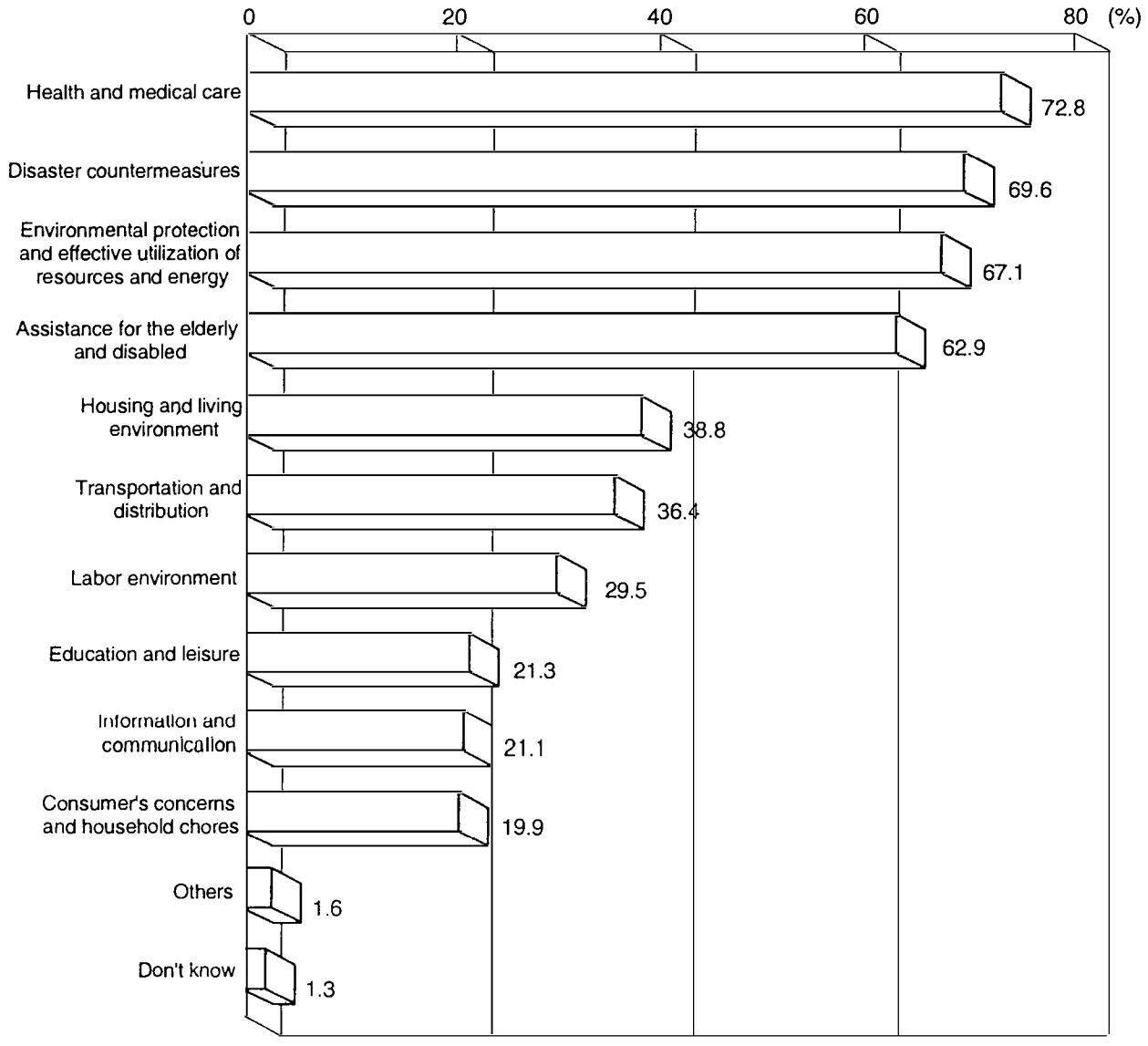


Figure 2 Areas related to everyday living in which science and technology should be stepped up.

Source: "The research on the Opinion Survey towards Science and Technology for Improving Quality of Life," by the National Institute of Science and Technology Policy, Science and Technology Agency, March 1995.

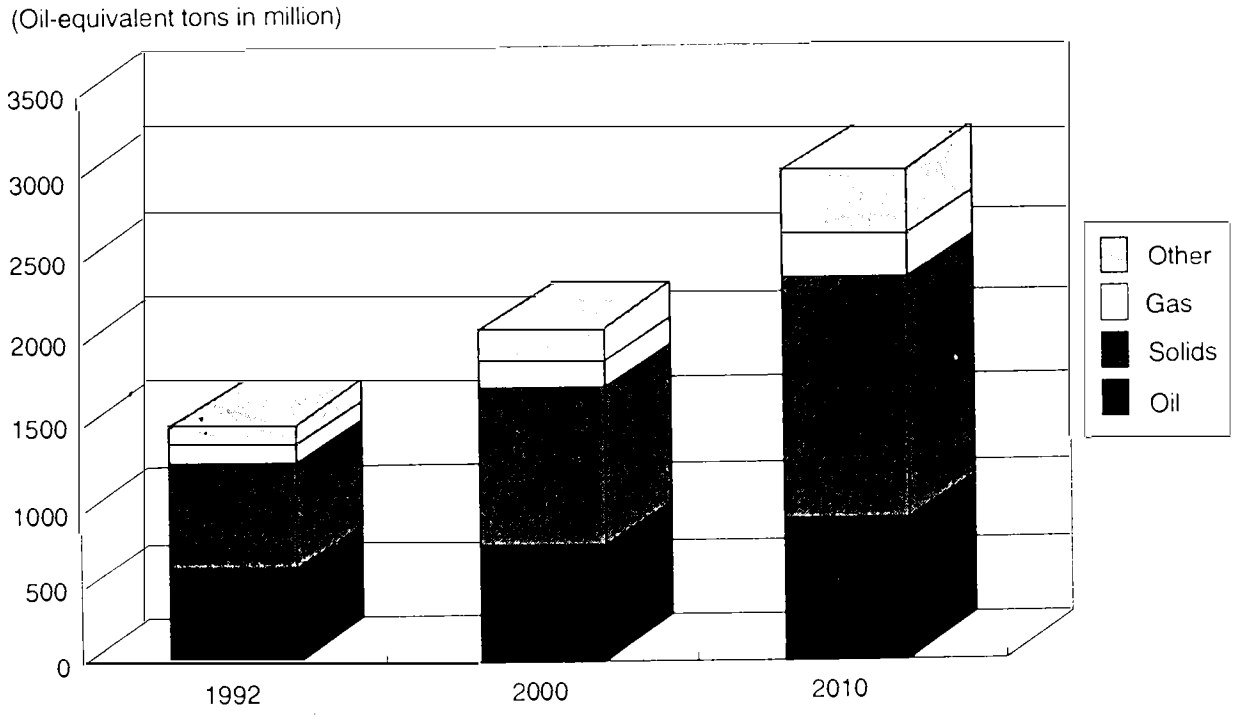


Figure 3 The outlook for energy demand in Asia.

Source: International Energy Committee of the Advisory Committee for Energy Intermediate Report (June 1995)

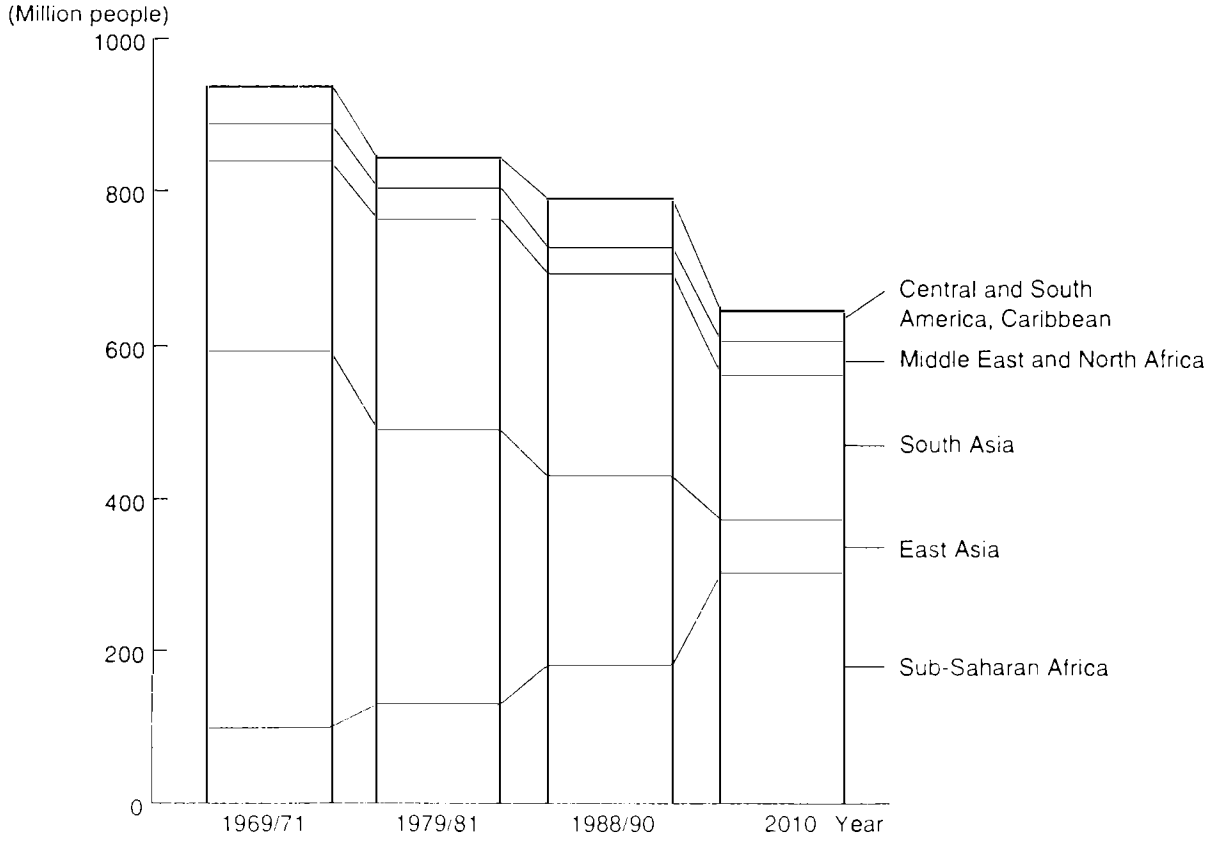


Figure 4 Trends and predictions on the undernourished populations in developing nations.

Source. "World Agriculture: Towards 2010" by the Food and Agriculture Organization of the United Nations.

Session I

Stable Energy Resources and the Environment

Supply of Electrical Energy in Japan

by

Osamu Kobayashi, The Tokyo Electric Power Company

1. History of Electric Power Industry in Japan

Commercial electric power supply in Japan began in 1883, with the small-scale thermal power. By 1912, the nationwide supply capacity expanded to 600MW, which was evenly covered by thermal and hydroelectric power. Since then until 1955, hydroelectric power had been a bulk supply source. During the period, the electric power industry itself experienced several changes, including a shift from the free competition to government control. In 1951, after the World War II, the industry was divided into nine private firms (currently 10, including the Okinawa Electric Power Company), which were granted regional monopoly but were obliged to supply responsibility. Generating capacity at that time was just 8,575MW, of which 5,760MW was represented by hydroelectric and 2,815MW by thermal power). All the thermal power plants were operated using domestic coal.

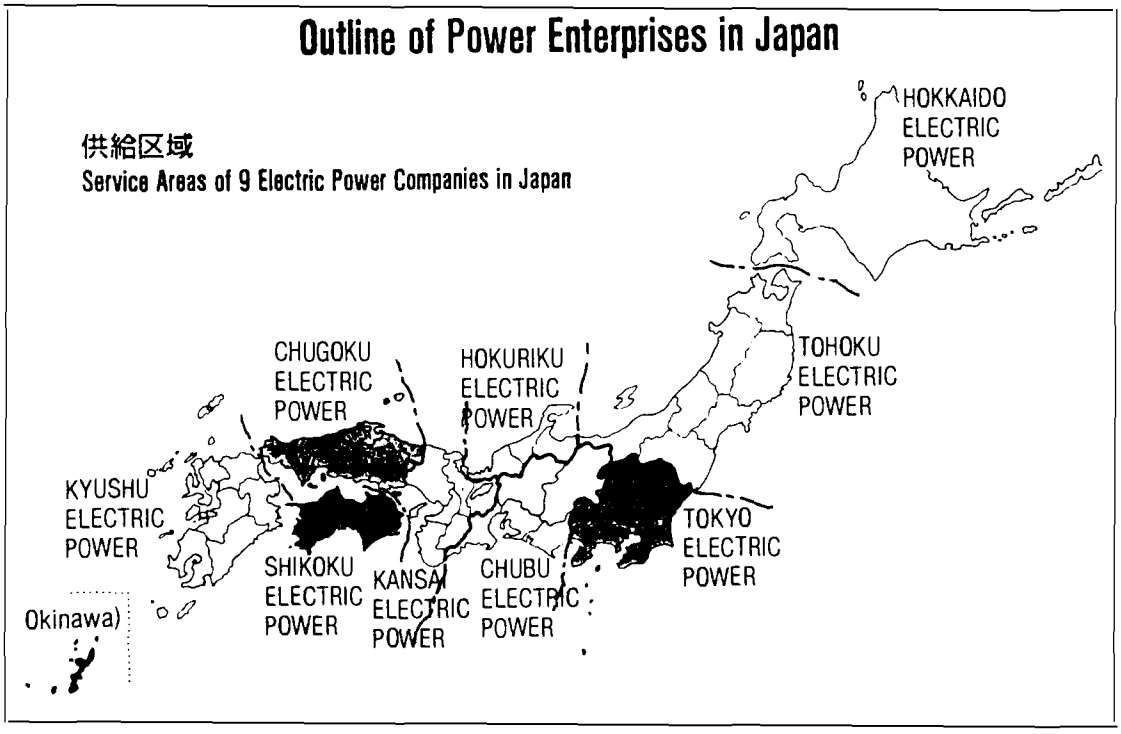
Due to the economic growth in 1970s, the industry faced a sharp increase in electric power demand, exceeded 10% per annum. Because of this growth in demand and further sophistication of the industrial structure in Japan, the high quality and supply

security became required for the electric power industry. The stable supply quantity and price degradation of imported oil provided the oil-fired thermal power the more competitive position than that fired by domestic coal. Since 1965, the electric power industry had introduced advanced thermal technologies from the West, and, by approximately 1970, thermal power became a bulk supply source, exceeding the hydroelectric. In response to the growing concerns over pollution issues associated with the urbanization and industrial development, the industry adopted the fuel oil with lower sulfur content, and, in 1970, introduced the world's first LNG-fired thermal power generation. Nuclear power plants also started commercial operation in 1966.

2. Current Status of Electric Power Industry in Japan

The electric power industry in Japan consists of the vertically integrated 10 electric power companies, which are responsible for the production, transmission and distribution of electric power. Each firm is independent and privately owned. Besides, there are generating firms, including the Electric Power Development Company, Japan Atomic Power Company, municipal generators and joint-ventured thermal power generators owned by the electric power and steel companies. In 1995, a program of new laws, deregulating the electric power industry, was enacted, and allowed new entrants to the generating sector.

Chart 1



The total assets of 10 electric power companies in Japan were 2,599 billion yen as of 1996. The number of customers in service was 75.61 million. Their peak load was 167.549 GW and electricity sales were 774,602 GWh. The revenues reached 14,530 billion yen. The number of employees was 151,907.

Generating capacity in Japan, including those from generators other than the 10 electric power companies, was 207.87 GW, of which 42.97 GW was represented by hydroelectric, 118.17 GW by thermal, 42.55 GW by nuclear power and the rest by the others. In terms of power output by source, hydroelectric accounts for 10%, coal-fired thermal for 14%, oil-fired for 16%, LNG-fired for 23% and the nuclear power for 35%.

One of the specific features of electric power industry in Japan is its outstanding supply reliability. The frequency and duration of power outages by household is 0.18 times and 6 minutes per annum, respectively. The duration of power

power outages is extremely short, even compared with that of the United States (98 minutes per annum), United Kingdom (80 minutes) and France (69 minutes).

Chart 2

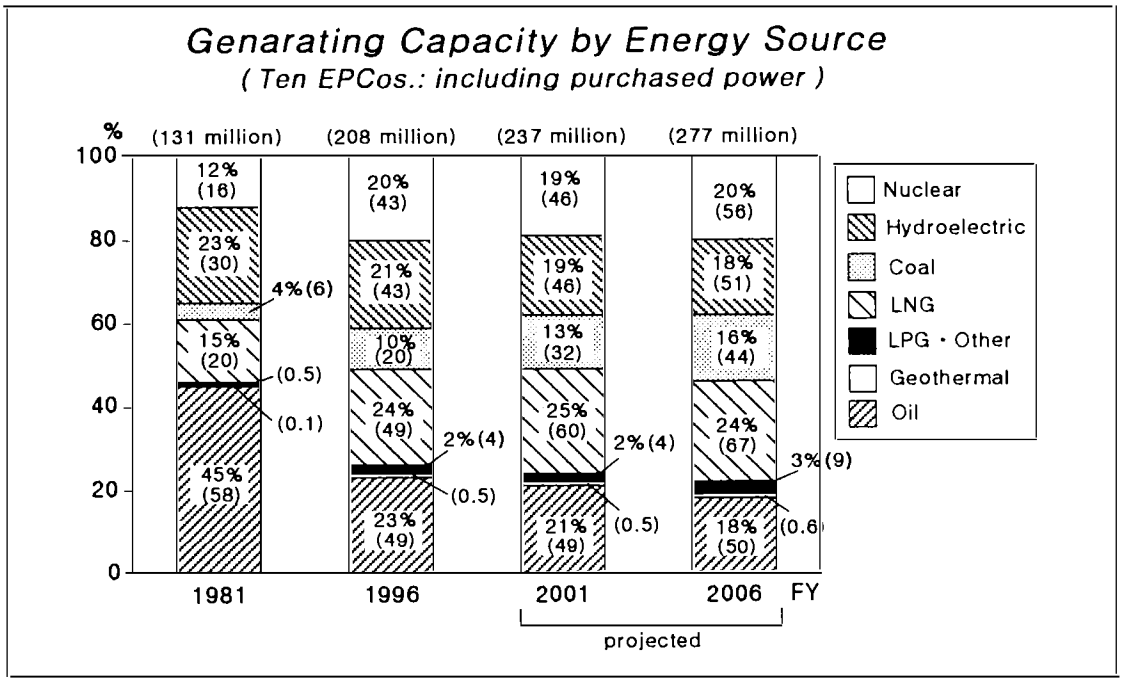


Chart 3

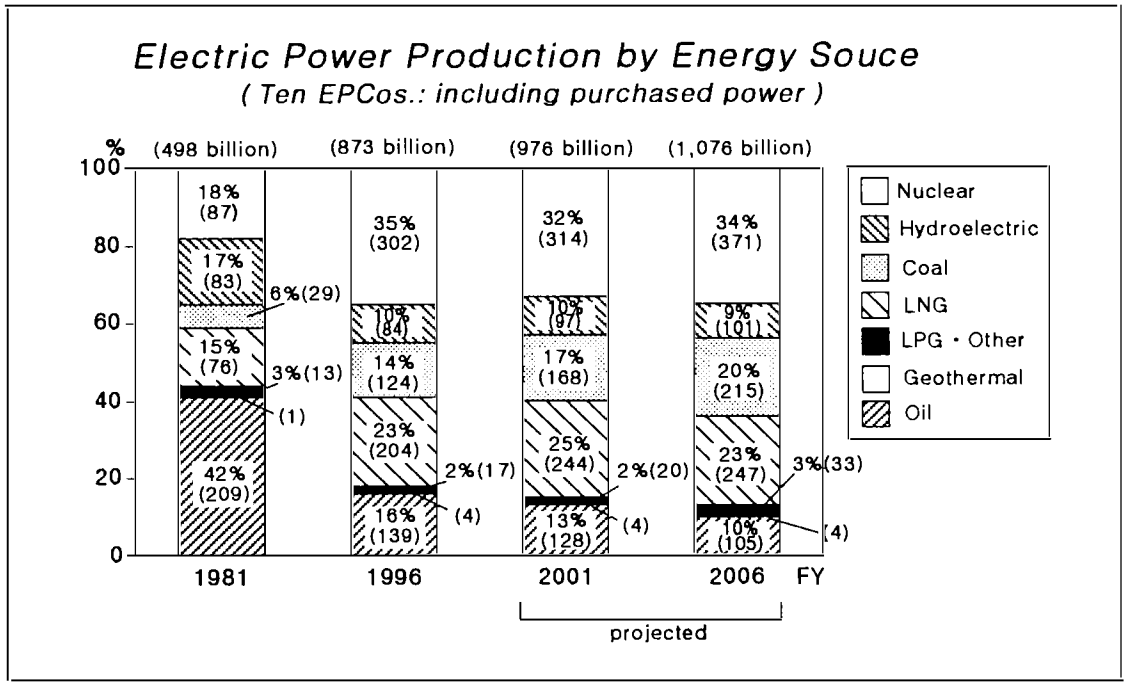
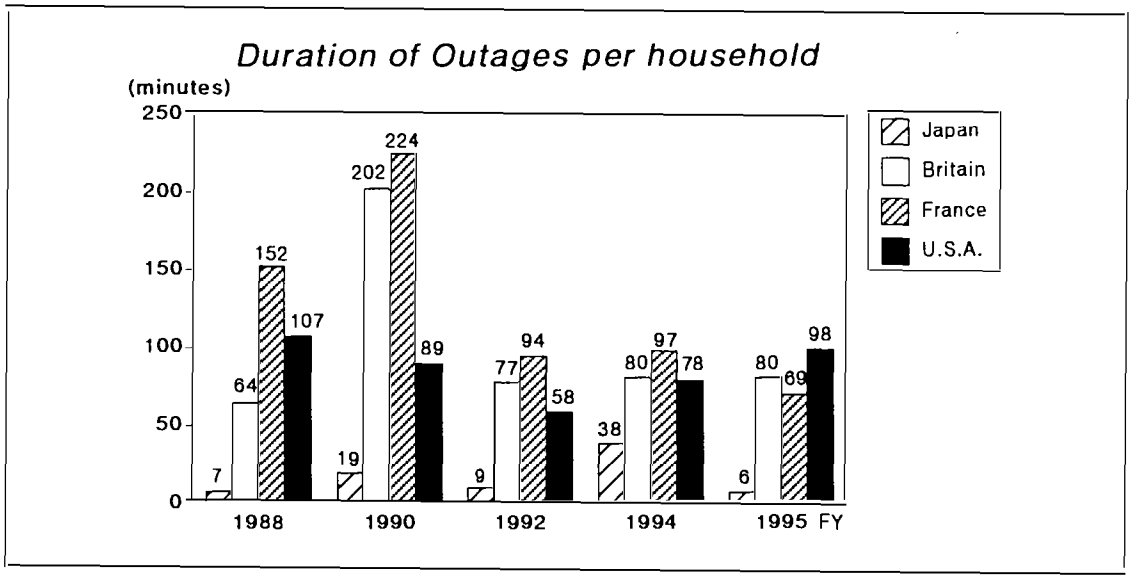


Chart 4



3. Development of Environmental Protection

Japan experienced serious pollution problems during the period of rapid economic growth after the World War II. There observed citizens suffered from the pollution-related diseases (respiratory diseases) in many regions, mainly attributed to the air pollution. The electric power industry faced social criticism. Its thermal power plants located in the major industrial districts became targets for compensation and civil lawsuit, as the causes of air pollution

Historically, the issue of air pollution by thermal power plants was initiated with soot and dust associated with the burning of domestic coal. The issue became serious when there arose the SOx issues during the period of economic growth in 1970s. During the period, the heavy and chemical industries were developed in Japan, using oil as both the raw material and energy source. In order to meet a sharp increase in power demand, exceeding 10% per annum, the electric power industry built thermal power plants, depending on imported oil, one after another.

The measures taken by electric power industry to cope with the SOx issues are; first to reduce the sulfur content in fuels, and second to implement flue gas desulfurization equipment. For example, the Tokyo Electric Power Company started to import the low-sulfur 'Minas Crude Oil' from Indonesia in 1971 and to use it at the power plants located in the vicinity of the Tokyo Metropolitan Area. The sulfur content of Minas Crude Oil was 0.1%, which was less than 1/10 of the average of that in Japan at that time. The company also succeeded in the world's first refrigerated bulk transportation of natural gas and introduced the sulfur, soot or dust free LNG in thermal power generation in 1969. Due to the further implementation of these lower sulfurization measures, the average sulfur content level in fuel has been decreased from 2.5% in 1974 to the current level of 0.4%. Desulfurization equipment has been installed in all coal-fired thermal power plants. SOx emission rate has been declined, in the past 25 years, to nearly 1/20 of that originally observe

Chart 5

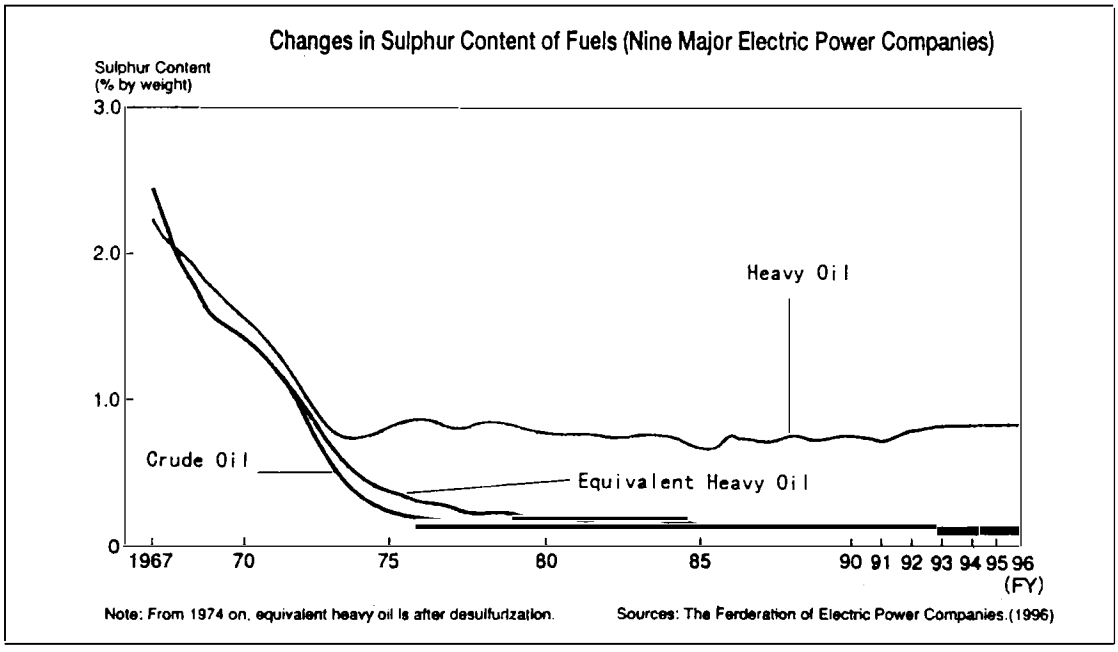
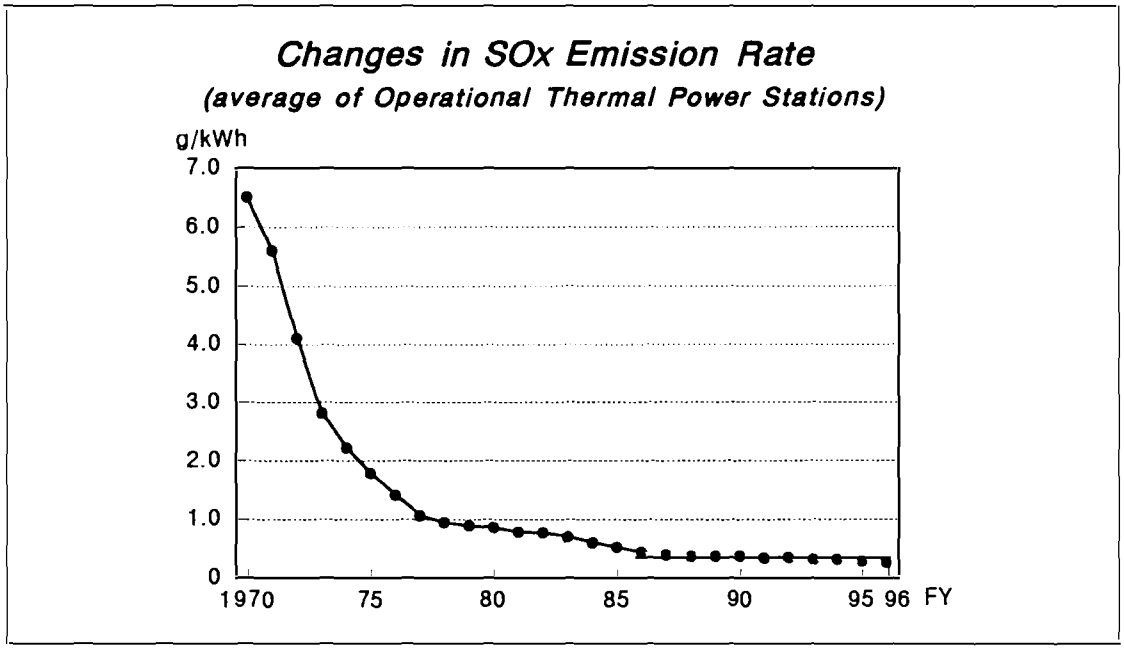
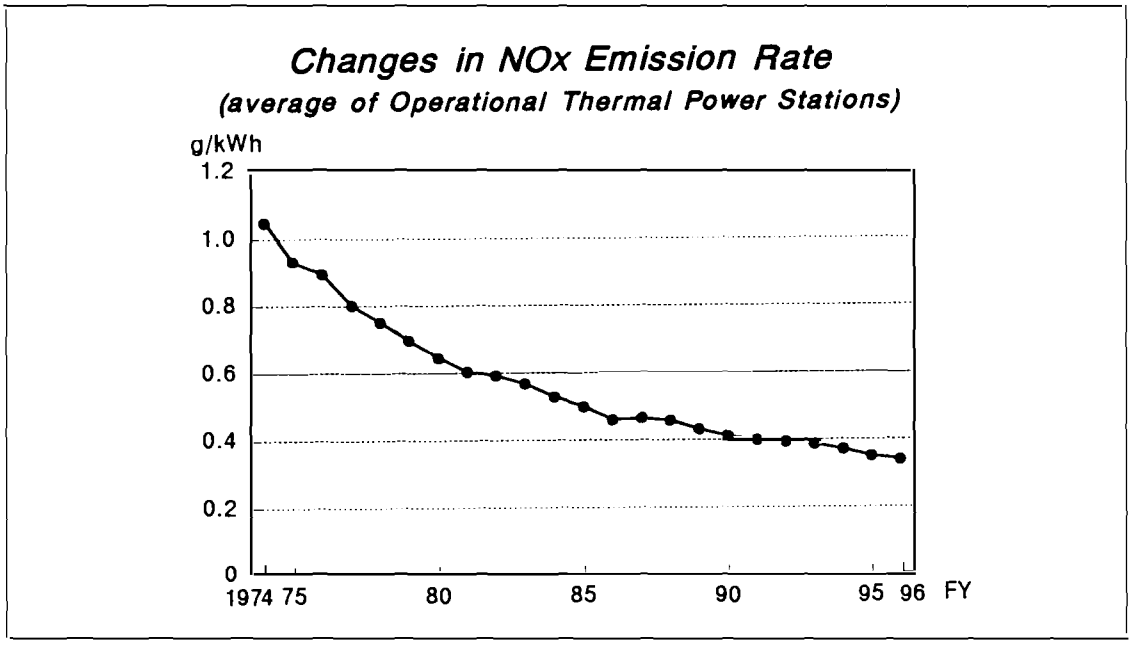


Chart 6



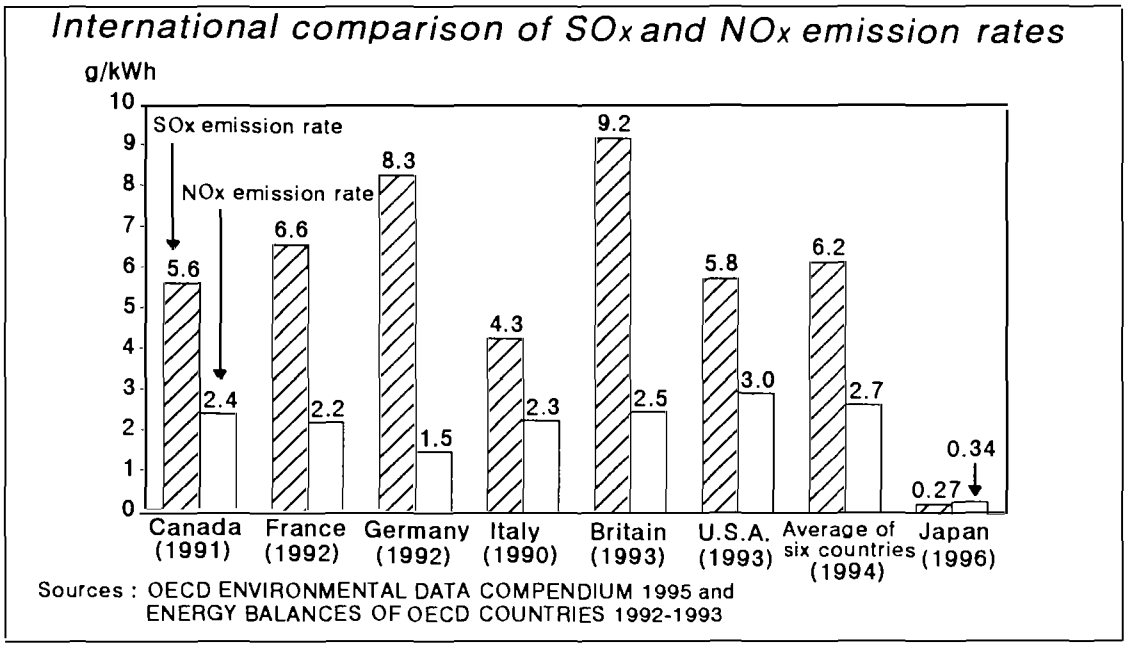
NOx emission rate has also been declined, in the past 20 years, to 1/3 of that originally observed, through the improvement of boiler combustion and installation of the flue gas denitrification equipment (installed in 160 units out of the total 309 units).

Chart 7



The above measures have contributed to attain the extremely lower levels of SOx and NOx emission rates (emissions per unit of electricity generated); 1/23 of the average of developed countries for SOx and 1/8 for NOx.

Chart 8



When the electric power industry introduced these new fuels and installed anti-pollution equipment, it took two steps; first to import technologies from the West and then to domestically produce the technologies one after another. The industry placed such importance on the anti-pollution activities that it invested, at a time, 30% of its total capital investment in anti-pollution measures.

When implementing anti-pollution measures, the Japanese industry established a rule to conclude a 'Voluntary Agreement for Pollution Prevention' with a local government. The electric power industry has practiced the rule since 1964. By the agreement concluded before the siting of thermal power plants, it has made anti-

pollution commitments, which are more stringent than laws and ordinances, in order to acquire the understanding of local citizens. This unique rule is now regularly applied to the large-scale developments.

4. Response to the Global Environmental Issues

Among the global environmental issues recently under international concerns, the issues of acid rain and global warming are particularly of the interest of electric power industry. Acid rain is a serious issue in China and the Southeast Asian Countries. The SOx and NOx reduction measures mentioned above are to effectively solve the problems, both on the regional and global levels. It is up to Japan how to make use of its past experiences in the field and appropriately transfer technologies to those countries.

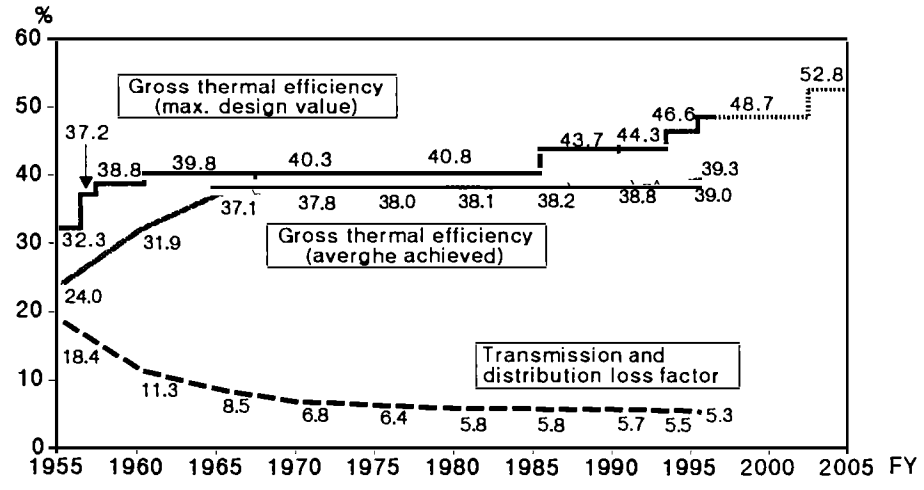
As for the global warming, no immediately effective measure is available, since the largest cause of global warming is CO_2 associated with the burning of fossil fuels. The major task for the electric power industry in the 21st century is how to control CO2 emissions from generation, while it should continuously make efforts to develop technologies for CO2 separation and fixation. The measures include; to achieve an optimal generating configuration, to improve the efficiency of electric power facilities and to promote the energy conservation on demand-side.

Efficiency improvement both on the supply and demand sides is effective in controlling CO_2 emissions and also reducing cost, which should be implemented immediately. Japan is a resources-poor country, and thus has attained the outstanding

energy efficiency after it experienced two major oil shocks. The electric power industry succeeded in improving the thermal efficiency of thermal power plants and reducing the power loss in transmission and distribution.

Chart 9

Inprovements in Thermal Efficiency (High Heat Value) and Transmission / Distribution Loss factor in Thermal Power Generation Facilities



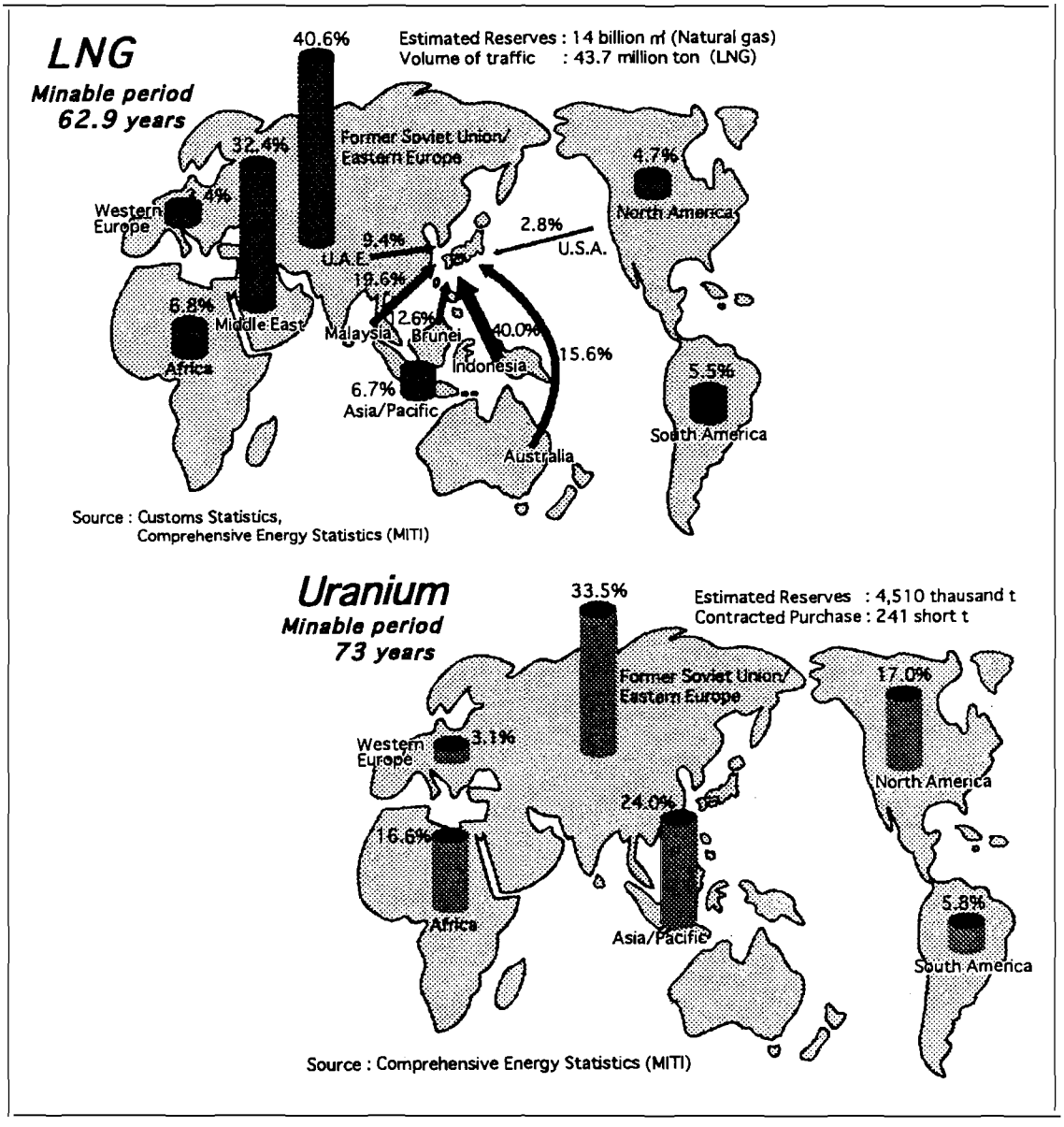
Source: Japan Electric Utilities Handbook (1997)

5. Optimal Generating Configuration

The power supply source in Japan consists of thermal, hydroelectric, nuclear, and geothermal power and the others. The optimal generating configuration is to be decided in consideration of economy, reliability in the long- and short-term supply and the environmental concerns. Reliability in the long- and short-term supply is, however, a dominant element because Japan is extremely poor in resources and relies on the imported fuels for more than 80% of its primary energy supply. Reliability in the long-term supply depends largely on the situations of global resources and international

energy supply and demand. It is necessary to operate the nuclear power up to an appropriate share in generation, providing the priority to safety issues and with the acceptance of local citizens. It is also needed to develop the proper nuclear fuel cycle. Considering the environmental aspect, natural gas draws a great expectation, but the use of coal cannot be ignored from the view point of resource availability.

Chart 10



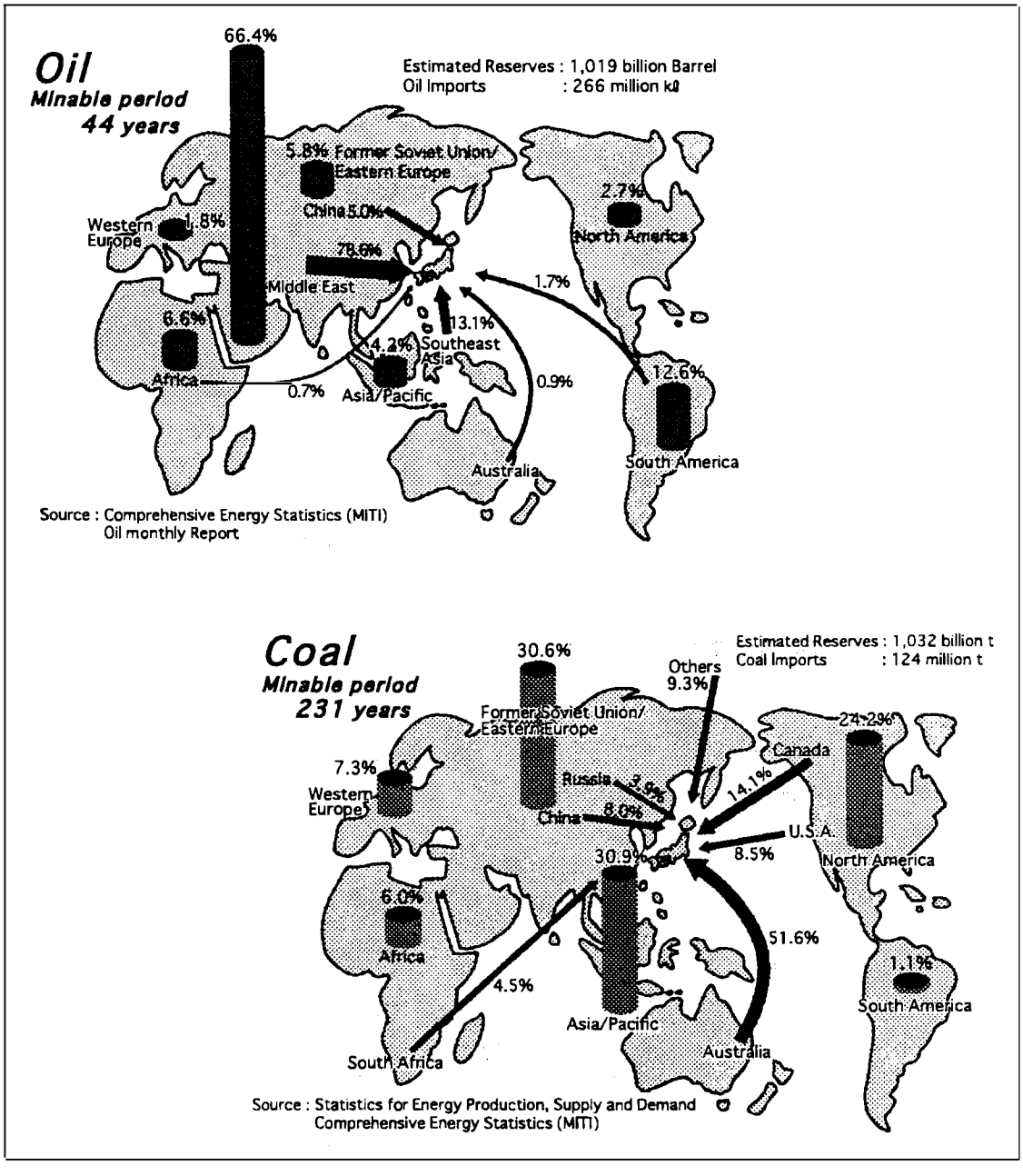
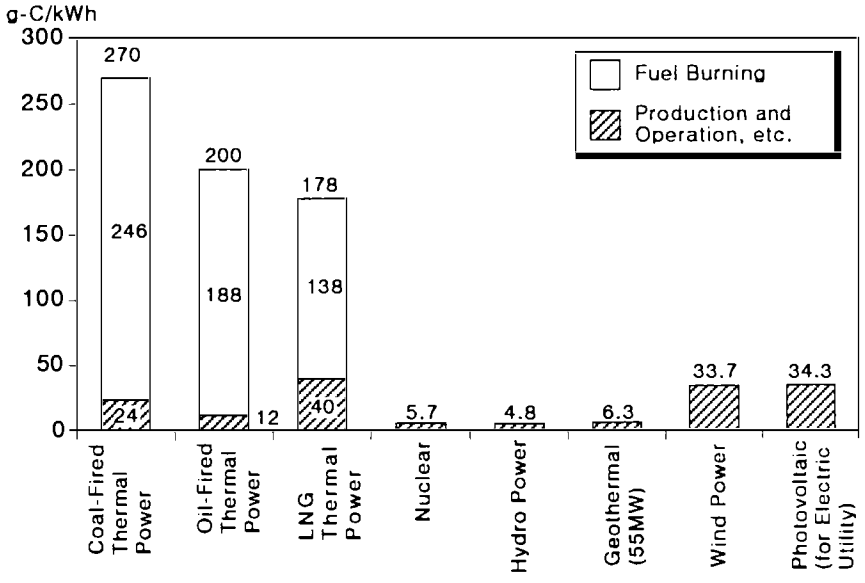

Oil
Minable period
44 years
Estimated Reserves : 1,019 billion Barrel
Oil Imports : 266 million kl
66.4%
5.8% Former Soviet Union/
Eastern Europe
China 5.0%
2.7%
North America
Western Europe 1.8%
78.6%
Middle East
1.7%
6.6%
13.1%
4.2% Southeast Asia
Africa
0.7%
Asia/Pacific
0.9%
12.6%
South America
Australia
Source : Comprehensive Energy Statistics (MITI)
Oil monthly Report
Coal
Minable period
231 years
Estimated Reserves : 1,032 billion t
Coal Imports : 124 million t
30.6%
Others
9.3%
Former Soviet Union/
Eastern Europe
24.2%
Canada
7.3%
Western Europe
Russia 2.9%
14.1%
China 8.0%
U.S.A.
8.5%
North America
30.9%
6.0%
Africa
51.6%
1.1%
4.5%
South America
Asia/Pacific
Australia
South Africa
Source : Statistics for Energy Production, Supply and Demand
Comprehensive Energy Statistics (MITI)

Chart 11

Unit CO_2 Emissions by Type of Power Generation Systems



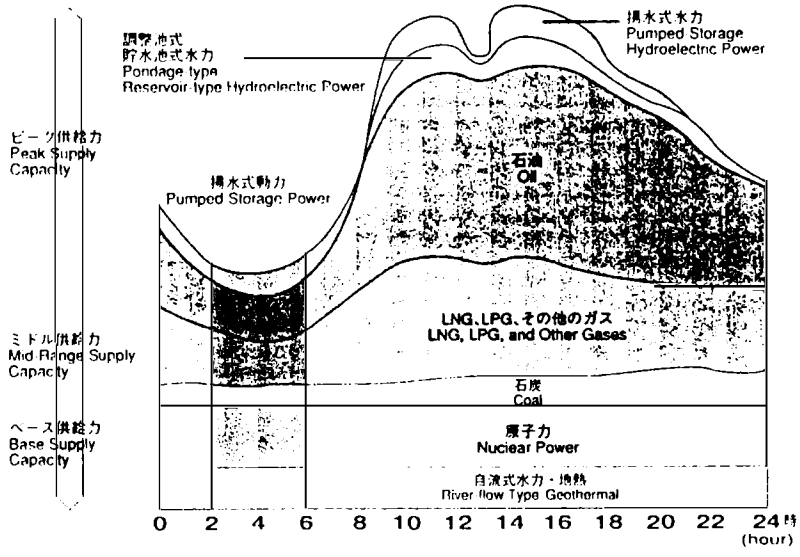
Source:"Lifecycle Analysis of Power Generation Systems," Central Reserch Institute of Electric Power Industry (CRIEPI),March 1995.

It is also important to develop new energy sources, such as the wind and solar power. The progress has been made in their research and development. It is, however, difficult for Japan to expect much from these energy sources, because of its geographical characteristics.

Storing electrical energy is very expensive, and thus it has a characteristic that its production and consumption are to occur at once. It is necessary to achieve an optimal generating configuration, taking into account of the feature of each power source, to ensure both the economic performance and short-term supply reliability, with long-term reliability as the underlying premise.

Chart 12

需要の変化に対応する電源の組み合わせ
Combination of Energy Sources to Meet Changing Demand



Through the combined efforts mentioned above, CO_2 emissions from the electric power industry in Japan have declined year by year. In preparation for the Climate Change Conference in Kyoto (COP3), the industry published its target to reduce CO_2 emission rate in 2010 by 20% below 1990 level. According to the actual performance of the Tokyo Electric Power Company, the use of nuclear and LNG-fired thermal power largely contributed to reduce CO_2 emissions.

Chart 13

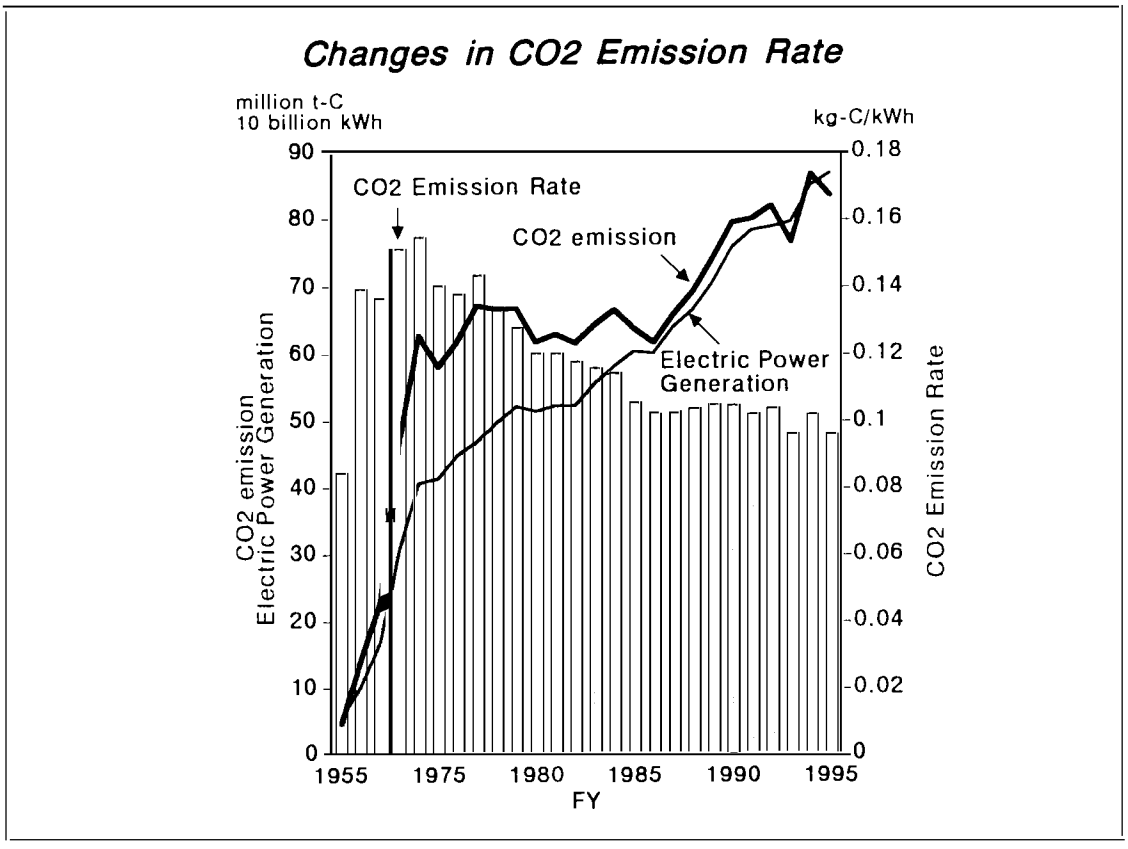
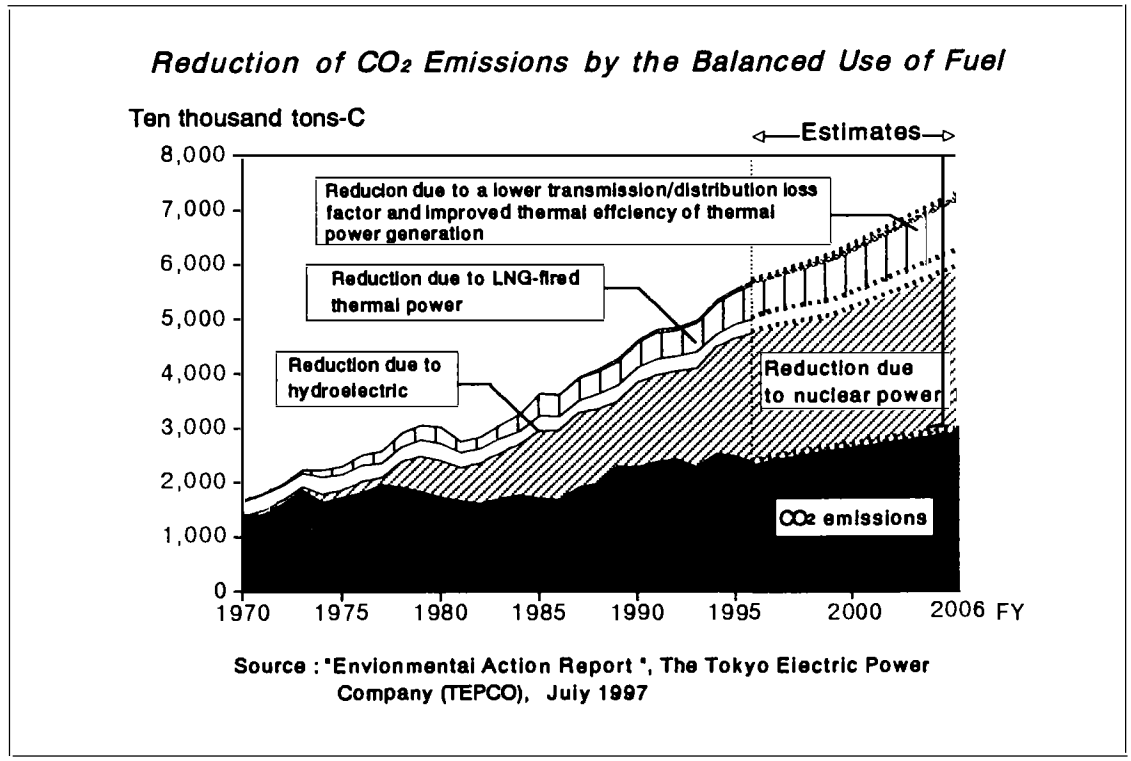


Chart 14



6. Power Development and Environmental Issues in the Asia-Pacific Region

The Asia-Pacific region shows a dramatic increase in demand for energy, especially electric power, compared with the other regions of the world. Most countries of the region have experienced remarkable progress in its electrification.

In terms of the composition of power supply sources, coal-fired thermal power is rather dominant in China and India, while South Korea has promoted the nuclear power development. Most of the other countries rely on the oil-fired thermal power. Considering the regional and global environmental issues, gas-fired thermal, nuclear power and renewables are the prospective sources.

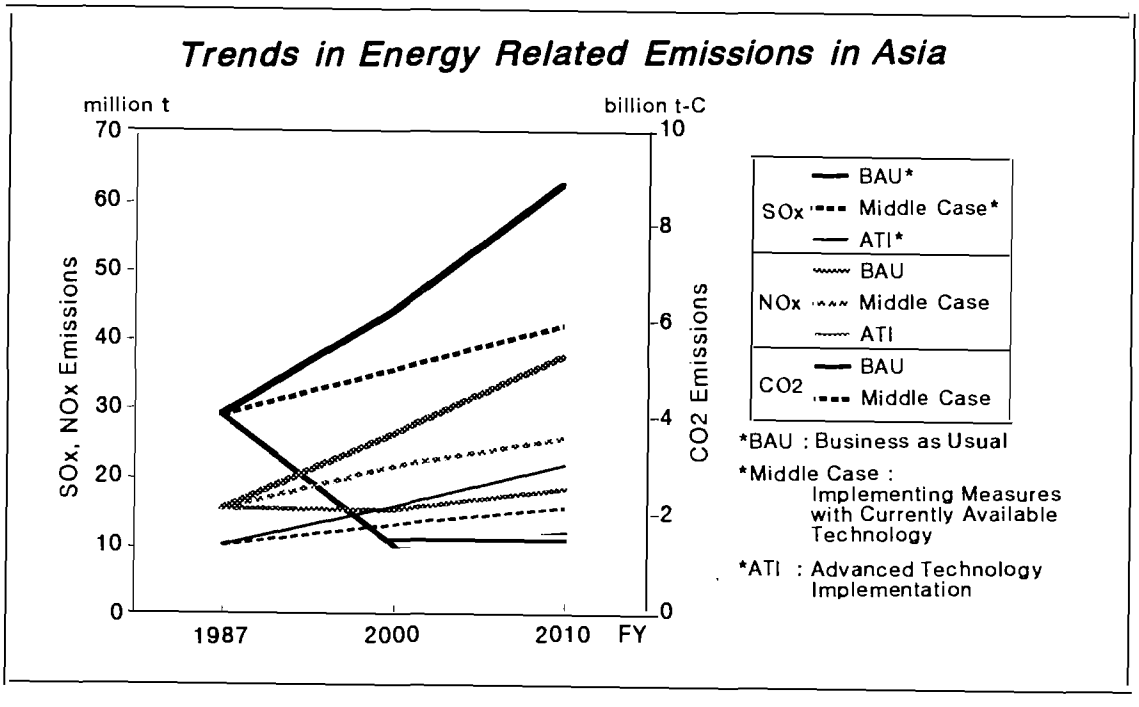
According to the study conducted by the Science and Technology Agency in Japan in 1993, per capita primary energy use in the Asian region was 592kg-oe (oil equivalent)/person in 1987, which would increase to 805kg-oe/person by 2000 and to 996kg-oe/person by 2010, based on the Business-as-Usual Scenario. If measures are taken to improve energy efficiency, the figure would be 683kg-oe/person in 2000 and 737kg-oe/person in 2010. Assuming the growth in population in the region, the total amount of energy would inevitably increase and the air pollutants might possibly increase to cause the environmental degradation.

Estimating the SOx, NOx and CO2 emissions from energy use, based on the above report, the total SOx and NOx emissions from the region would be almost doubled in 2010 from 1987 level, if no particular measure is implemented. Given that the countries in the region implement the same level regulations and take measures, such as installing the desulfurization and denitrification equipment, as Japan, these emission

levels would be even lowered than the current level. There is no established way of CO2 removal or sequestration right now. The efficiency improvement and energy conservation are the only ways to reduce CO2 emissions. Therefore CO2 emission level would possibly exceed the current level, even though some measures are taken.

All the countries are, in future, to cooperate in the research of unsolved issues of the global environment, to take most appropriate measures from the aspect of cost-effectiveness, and to implement policies contributing both to the regional and global environmental protection. We hope that 'The Institute for Global Environmental Strategies' to be established by the Government of Japan in April 1998, as well as the skill development programs for engineers from developing countries promoted by the electric power industry, would be of some help to solve those issues.

Chart 15



Research Collaboration among POSCO, POSTECH and RIST (Pohang Research Tripod) in the area of Environmental Catalytic Technology

In-Sik Nam

Department of Chemical Engineering, School of Environmental Engineering, Pohang University of Science and Technology (POSTECH) / Environmental Catalysis Team, Research Institute of Science & Technology (RIST)

The establishment of Pohang Research Tripod was conceived in 1984 by Mr. Tae Joon Park, the founding Chairman of Pohang Iron and Steel Co., Ltd. (POSCO), the world second largest steel manufacturing company, located 350 km southeast of Seoul on the East sea to the Pacific ocean. The Pohang University of Science & Technology (POSTECH), the first independent research-oriented university in Korea with both graduate and undergraduate degree programs in science and engineering was founded by POSCO on Dec. 1986. A steel-related research laboratory also established by POSCO in 1978 has been reorganized and expanded to become Research Institute of Science & Technology (RIST), the only privately-run integrated research institute in Korea and is located side-by-side with POSTECH on the campus in order to promote faculty and student participation in joint investigation with RIST research staffs.

The creation of POSTECH as well as RIST establishes Pohang Research Tripod among POSCO, POSTECH and RIST in the city of Pohang. It becomes the third major research and education center in

Korea for science and advanced technology, the other two being located in Seoul and Taejun science town established by the government. The roles of the organizations in the tripod are quite unique; the major financial support from POSCO to become the most effective steel producer throughout the world, the research space in RIST with the technical support from the permanent research staffs and the research idea generated during the education including research of graduate and undergraduate students of POSTECH. The formation of the tripod has made several successful cases, particularly in the area of environmental catalytic technology. Two typical examples will be illustrated to recognize the idea and work in Pohang Research Tripod for the development of environmental technology in two steel works of POSCO, Pohang and Kwangyang steel works.

[Example I]

Selective Catalytic Reduction of NOx from Sintering plant in Pohang Steel Works

As the regulation for the NOx emission becomes strict, large efforts have been made to find more efficient NOx removal technology. A prominent method of controlling emissions of NOx from stationary combustion sources such as utility boilers, industrial boilers or combustion engines is by the Selective Catalytic Reduction (SCR) of NOx with NH_3.

In 1987, the POSTECH/RIST deNOx Program was initiated jointly with POSCO for the application of SCR process to the steel making processes such as coke oven, sintering plant and utility boilers in a steel

mill. The program has two overall objectives. The first objective is the development of an economic and commercial process for achieving 90% reduction of nitrogen oxides. The second is the application of SCR process to the existing process by retrofitting to attain at least 50% reduction of nitrogen oxide emission.

During the initial stage of research, many catalysts were screened to evaluate their suitability for the application of SCR of NOx by NH_3. The result of this extensive catalyst evaluation indicated that the synthetic zeolite based catalysts exhibited high activity for temperatures in the vicinity of 300°C, while the natural zeolite mined from the area near to Pohang was competitive to that of the synthetic zeolite. At higher reaction temperatures approaching 400°C, natural zeolite even show higher activity than synthetic one. The addition of copper ions to the catalyst increases two orders of magnitude in the reaction rate for both zeolites [1, 2, 3 and 4]. A honeycomb type reactor is also examined for the reduction of NOx from stationary sources as a low pressure drop reactor. The reactor was prepared by washcoating zeolite type catalysts on cordierite honeycomb support with appropriate binders [5].

In 1994, a pilot scale program was launched to evaluate the low pressure drop reactor system for actual flue gas stream from a sintering plant at steel mill. The capacity is 1,000 Nm^3/hr. POSTECH/RIST is currently working with POSEC (POSCO Engineering & Construction Co.) for the design of the commercial plant handling 1,000,000 Nm^3/hr. The catalyst is mainly zeolite catalyst developed in this study. As a result of this work, POSTECH/RIST/POSCO will possess the first license of deNOx catalytic process in Korea. The application of the process developed in the present study can be expanded for the removal of NOx

from incinerators of which market will grow very fast within few years . In addition to the development of catalyst, reactor configurations and process for NOx reduction technology, this program has contributed to the effort for the research collaborations among POSCO (Industry), POSTECH (Academia) and RIST (Institute) at Pohang Research Tripod.

[Example II]

Control of SOx Emission in Tail Gas of the Claus Plant at Kwangyang Steel Works

Recent environmental concern enforces more tight regulation for the emission of SOx in Korea, Kwangyang Steel Works of POSCO, which produces steel over ten million tons per year, operates sulfur removal plants in the coke units to remove about 80% sulfur in the coke oven gas. H_2S in coke oven gas (6-8g H_2S/Nm^3 COG) is concentrated by absorbing in aqueous ammonia solution. After subsequent distillation of the aqueous ammonia solution, a concentrated H_2S (20-40%) in the distilled acid gas enters the Claus plant in which a high temperature combustion of H_2S produces SO_2 to make the ratio of H_2S/SO_2 be 2:1. The gas mixture undergoes condensation reaction in two or three stage catalytic reactors to produce elemental sulfur and water. The tail gas having unconverted H_2S, SO_2, and sulfur mist that is failed to be collected by a condenser is usually incinerated to be released into the atmosphere, resulting in the SOx emission. The SOx emission was originally designed not to exceed 800ppm of the national emission limit. Reflecting nationwide concern for the current environmental problem, however, Korean government suddenly lowered the emission limit of SOx to 300ppm from 1992.

Many processes are commercially available to treat the tail gas of the Claus plant. Old processes such as CBA[6] and MCRC[7] employ an additional Claus reaction at temperatures below subdew point of sulfur. Main drawbacks of these processes are batch or periodic mode of operation to remove sulfur. Recently developed MODOP[8] and Superclaus[9] which use direct catalytic oxidation of H_2S to elemental sulfur seem to be superior to the old processes since they can adopt a continuous mode of operation.

The TGT process developed in the present study is based on the total hydrogenation of all sulfur-containing compounds(sulfur, SO_2, and COS) in the tail gas to H_2S and returning to the raw COG (coke oven gas) line in the main cokes unit. The catalyst developed for the above reaction worked so well that almost 100% conversion to H_2S was achieved for all the sulfur containing compounds. 100% conversion of SO_2 to the mixture of sulfur and SO_2 was attained using a commercial catalyst at temperature higher than 225°C. At temperatures higher than 280°C, the selectivity of H_2S became 100%. During the pilot test for 3 months, neither deactivation of catalyst nor deposition of unconverted sulfur at the reactor outlet tubing has been observed. Based on the results, a commercial plant was built in 1995 to treat the tail gas in the Claus plant for two cokes units (160,000 Nm^3/hr COG). With an installation cost of $1.5M, the process reduces the SOx emission in the tail gas from 1500ppm to zero, since the tail gas is totally recycled to the COG line. The optimization of TGT process is still going on with the operating data observed during more than two years of operation.

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Philippine National Oil Company-Energy Development Corporation: One of the World's Biggest Geothermal Steamfield Developer

Abstract:

Born out of a crisis caused by the 1973 worldwide oil embargo, the Philippine National Oil Company-Energy Development Corporation (PNOC-EDC) has embarked on a mission "to explore, delineate, develop and exploit economically and environmentally viable resources -- to reduce dependence on imported fuel for energy and contribute to the country's sustainable economic growth". The company has since pursued the development of the country's geothermal energy resources for electrical generation.

Since its initial success in supplying steam to a 3 MWe power plant in Leyte in 1978, PNOC-EDC has grown into one of the worlds biggest geothermal steamfield developer. It operates and manages ten (10) producing fields which support fifteen (15) power stations with an aggregate capacity of 1,094 MWe. The company is also developing five (5) more fields targetting an additional capacity of 350 MWe by the year 2002.

To maintain its eminent standing in the international geothermal community, well into the next millennium, PNOC-EDC has considered vital its goals (1) to pursue sustained expansion in domestic and overseas operations and (2) to intensify conduct of R & D to enhance technical and financial competitiveness of geothermal.

Presentor:

Serafin E. Garcia

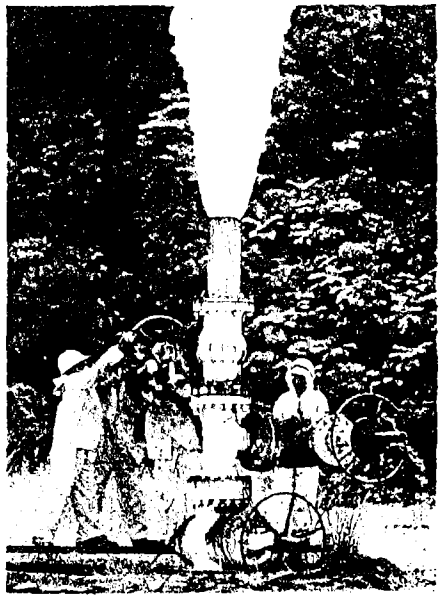
PHILIPPINE NATIONAL OIL COMPANY - ENERGY DEVELOPMENT CORPORATION: ONE OF THE WORLD'S BIGGEST GEOTHERMAL STEAMFIELD DEVELOPER

Presentor: Serafin E.Garcia

PNOC Energy Development Corporation

Mission:

"To explore, delineate, develop and exploit economically and environmentally viable resources - - to reduce dependence on imported fuels for energy and contribute to the country's sustainable economic growth."



COMPANY PROFILE

DATE OF INCORPORATION	→	March 5, 1976
SHAREHOLDER	→	PNOC (100%)
MANPOWER (excluding construction casuals)	→	2,843

FINANCIAL PERFORMANCE (1996)

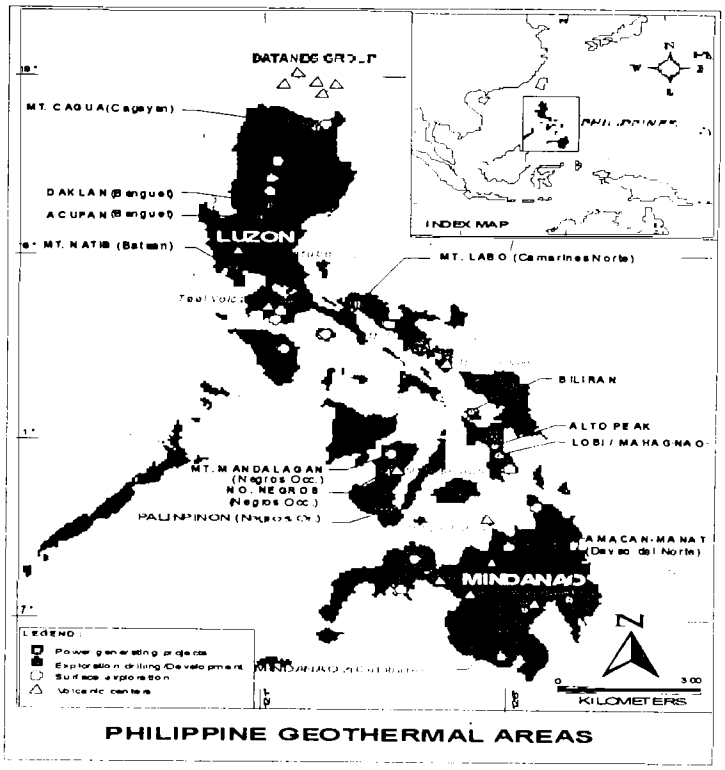
TOTAL ASSETS	⇗	P 34.986 BILLION
NET SALES	⇗	P 2.920 BILLION
NET INCOME	⇗	P .797 BILLION

CURRENT THRUSTS AND PROGRAMS

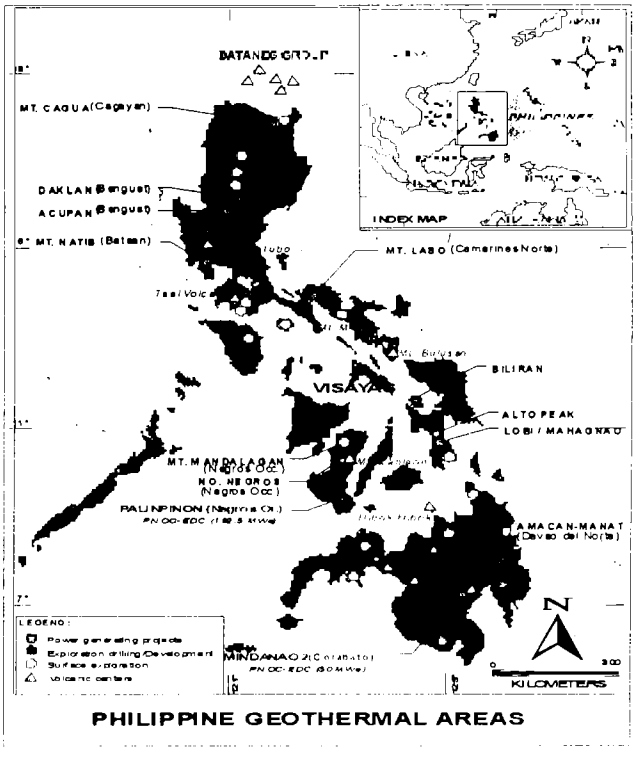
- SUSTAINED OPERATION AND MANAGEMENT OF TEN (10) OPERATING GEOTHERMAL FIELDS SUPPORTING POWER STATIONS WITH AGGREGATE CAPACITY OF 1094 MW

- INSTALLATION OF ADDITIONAL 350 MW CAPACITY BY YEAR 2002

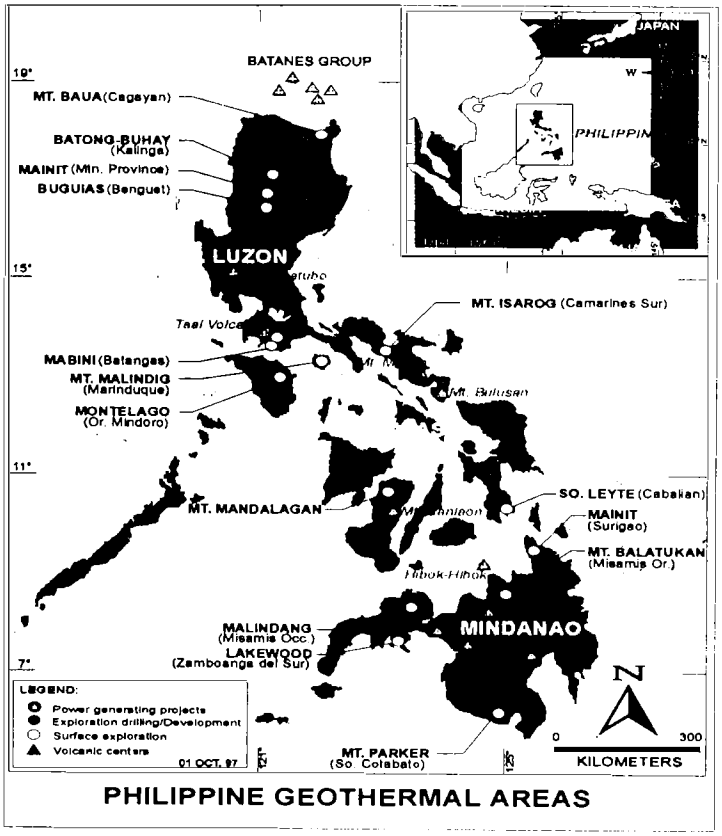
POWER GENERATING PROJECTS



EXPLORATION DRILLING/ DEVELOPMENT



SURFACE EXPLORATION



PHILIPPINE GEOTHERMAL AREAS

GEOTHERMAL INDUSTRY IN THE PHILIPPINES

Installed and Commited Generation Capacity (to 1999)

GEOTHERMAL FIELDS	CAPACITY: INSTALLED	CAPACITY: FUTURE	CAPACITY: TOTAL	COMMISSION DATE	POWER PLANT OPERATOR
1 MAKBAN					
Bulalo 1 to 6	330			1979-1984	NPC
Bulalo 7 to 9	15.7			1994	NPC
Bulalo 10 to 13	80		426	1996	NPC
2 TIWI					
Tiwi 1 to 8	330		330	1979-1983	NPC
3 BACON MANITO					
Palayan	110			1993-1994	NPC
Cawayan	20			1994	NPC
Botong	20			1998	NPC
Binary Plant	12		162	1998	NPC
4 LEYTE					
Tongonan-I	112.5			1983	NPC
Upper Mahiao	125			1996	CalEn
Malitbog	77			1996	CalEn
S. Sambaloran	154			1997	CalEn
Mahanagdong	180			1997	CalEn
Tongonan-I (Topping)	17			1997	Ormat
Malitbog (Bottoming)	14			1998	Ormat
Mahanagdong (Topping)	18		698	1997	Ormat
5 SOUTHERN NEGROS					
Palinpinon-I	112.5			1983	NPC
Palinpinon-II (unit 4 & 5)	40			1994	NPC
Palinpinon-II (unit 6 & 7)	40		193	1995	NPC
6 MINDANAO					
Phase 1	52			1996	Oxbow-Marubeni
Phase 2		50	102	1999	Oxbow-Marubeni
TOTALS	**1880**	**50**	**1910**		

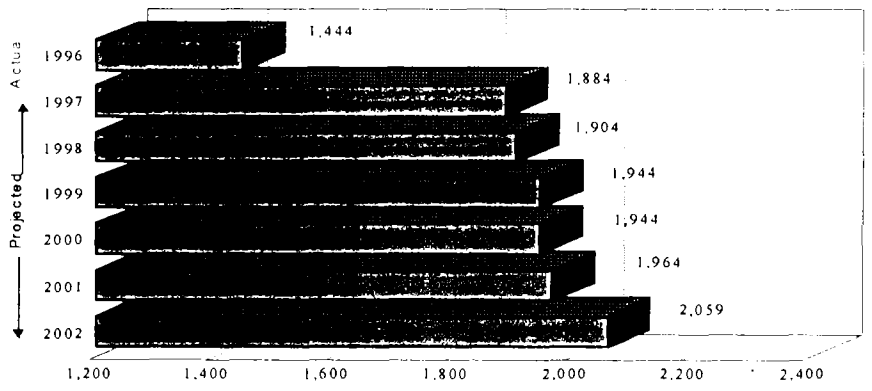
Steam field operated by Philippine Geothermal, Inc. (PGI)

Steam field operated by PNOC-EDC

WORLD'S LEADING GEOTHERMAL STEAMFIELD DEVELOPERS

Seamfield Developer	Geothermal Fields	Country	Installed Capacity (MWe)	Total (MWe)
1. UNOCAL (USA)	Makban	Philippines	426	
	Tiwi	Philippines	300	
	Salak	Indonesia	330	
	Sarulla	Indonesia	110	
	Geysers	USA	1021	2217
2. PNOC-EDC (Philippines)	Bacman	Philippines	180	
	Del Gallego	Philippines	120	
	Leyte	Philippines	700	
	Southern Leyte	Philippines	110	
	Palinpinon	Philippines	193	
	Mambucal	Philippines	40	
	Mt. Apo	Philippines	102	1445
3. FEDERAL COMMISSION FOR ELECTRICITY (CFE) (Mexico)	Cerro Prieto	Mexico	778	
	Los Azufres	Mexico	228	
	Los Humeros	Mexico	78	
	La Primavera	Mexico	50	1144
4. CALEN (USA)	Salton Sea	USA	217	
	Coso	USA	290	
	Beowawe	USA	16	
	Desert Peak	USA	10	
	Dieng	Indonesia	95	
	Patuha	Indonesia	59	683
5. CALPINE (USA)	Geysers	USA	413	
	Heber	USA	47	460

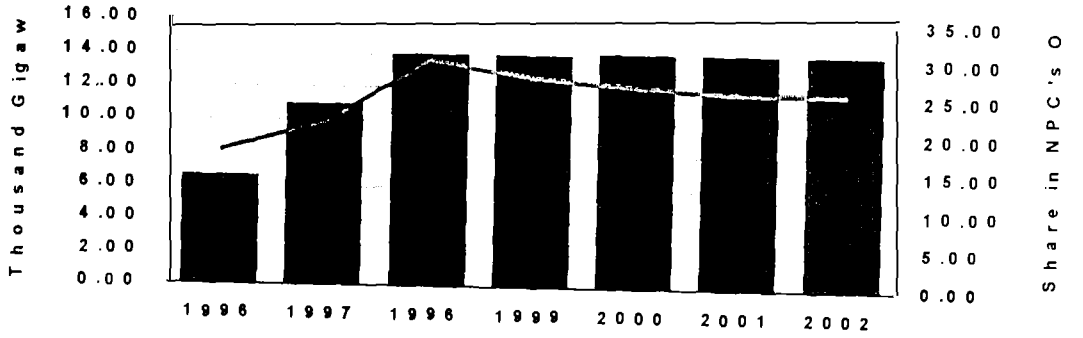
CUMULATIVE INSTALLED CAPACITY
(IN MEGAWATTS)



* *Cumulative installed geothermal capacity includes PNOC-EDC's project programmed for completion between 1997-2002*

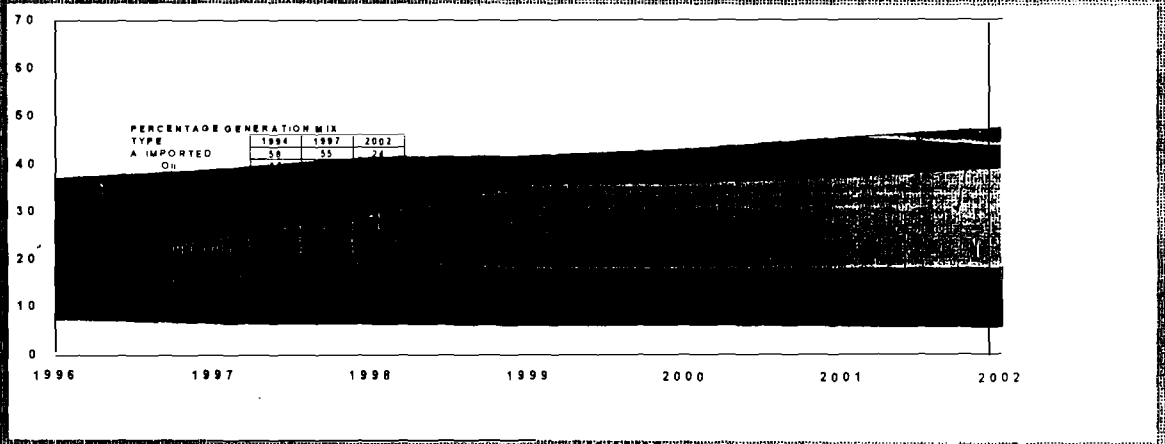
Source: DOE's 1996-2025 Phil. Energy Plan (PEP) Update
NPC's 1997 Power Dev't. Program (PDP)

GENERATION LEVELS



Gross Generation		6.56	10.95	14.01	14.01	14.11	14.11	14.11
Share in NPC's Output (%)	—	17.87	21.66	29.91	27.70	26.59	25.88	25.81

POWER GENERATION MIX



	1996	1997	1998	1999	2000	2001
Hydro	7,005	6,298	6,108	5,852	6,154	6,144
Geothermal	6,560	8,363	12,303	11,515	11,464	11,802
Coal	5,234	9,760	11,167	18,372	18,461	19,623
Oil/Diesel	17,920	14,189	11,552	5,829	7,040	8,031
Gas	0	0	0	0	0	0
Total	36,719	38,610	41,130	41,568	43,119	45,600

STRATEGIC VISION

- MAINTAIN EMINENT STANDING IN COUNTRY'S GEOTHERMAL ENERGY SECTOR
  - SUSTAINED EXPANSION IN DOMESTIC & OVERSEAS OPERATIONS
  - CONDUCT OF R & D TO ENHANCE TECH'L. AND FIN'L. COMPETITIVENESS OF GEOTHERMAL

STRATEGIC VISION

- ADDRESS NEW OPPORTUNITIES & CHALLENGES IN DOMESTIC ENERGY MARKET
  - DIVERSIFYING NON-GEOTHERMAL POWER PRODUCTION (LNG, COAL, etc.)
  - PARTICIPATION IN INDUSTRIAL AND ENVIRONMENTAL ENHANCEMENT AND COMMERCIAL ACTIVITIES
  - INVOLVEMENT IN POWER DISTRIBUTION IN ISOLATED ISLANDS IN THE COUNTRY

EXPERTISE IN GEOTHERMAL ENERGY PRODUCTION

- DEVELOPED TECHNOLOGY & TECHNIQUES TO LOCATE, EXTRACT AND DELIVER GEOTHERMAL
- EXTENSIVELY EXPLORED AND SURVEY UNDEVELOPED GEOTHERMAL SITES
- LARGEST AND MOST EXPERIENCED DRILLING CONTRACTOR IN THE PHILIPPINES

EXPERTISE IN GEOTHERMAL ENERGY PRODUCTION

- IN-HOUSE ENVIRONMENTAL MANAGEMENT UNIT AND RESEARCH AND DEVELOPMENT CENTER
- WORLD BANK/ADB CERTIFIED
- HIGHLY COMPETENT AND EXPERIENCED SENIOR MANAGEMENT TEAM

AREAS OF EXPERTISE

1. OPERATION OF DRILLING RIGS

2. RESOURCE ASSESSMENT

AREAS OF EXPERTISE

3. GEOTHERMAL CONSULTANCY

- Geology, Geochemistry, Geophysics
- Reservoir Engineering
- Design of Fluid Collection and Distribution System (FCDS)
- Preparation of Environmental Impact Assessment (EIA)
- Analysis of rock, water and gas samples

AREAS OF EXPERTISE

4. TRAINOR SERVICES

- Geothermal Drilling Operations
- Geothermal Steamfield Operations
- Geothermal Power Plant Operations

5. ENVIRONMENTAL MANAGEMENT SERVICES

INTERNATIONAL EXPERIENCE

JAPAN

1985- 1988	SURFACE EXPLORATION SURVEYS IN MT. KUJU, MT. WAITA AND KURISHIMA VOLCANIC COMPLEXES
1988	GEOLOGICAL & GEOTECHNICAL ADVISORY SERVICES FOR DRILLING OPERATIONS IN KYUSHU, JAPAN
1997	CONSULTANCY SERVICES FOR KUJU VOLCANIC COMPLEX GEOTHERMAL PROJ.

INTERNATIONAL EXPERIENCE

INDONESIA	1997-1998	PT SORIBOR JAKARTA LEASE OF DRILLING RIG DRILLING MANGT. SRVCS
	1997-1998	PT PROMOSINDO JKRT DRILLING MNGT SRVCS
IRAN	1997	CONSULTANCY SRVCS FOR THE EXPLO AND DEVT OF THE KHOY GEOTHERMAL PROJ

PROSPECTS FOR COOPERATION

1. Joint Research and Development Projects

a) Boron Abatement Systems for Geothermal Steam Condensate

b) Material Selection for Components of Geothermal Systems in Acidic Steam Fields

c) Innovation in the Instrumentation and Control Systems of Fluid Collection and Disposal Systems (FCDS)

d) Calcite Inhibition Study

e) Study on Shallow Injection and Spring Interference

f) Warm Reservoir Utilization

g) Application of the Los Alamos National Laboratory's Hot-Dry Rock Technology to Improve Reinjection Well Permeability

PROSPECTS FOR COOPERATION

1. Joint Research and Development Projects (cont'd.)

h) Geosciences Data Management

i) Study on Deep Shallow Hydrology of the Geothermal Fields and its Impacts on Geothermal Development and Exploitation

j) Gas Removal System, Particularly CO2

k) Corrosion and Scale Deposition for Acidic Geothermal Fluids

l) Field Application of Reverse Osmosis System in the Treatment of Geothermal Waste Water Brine

ON-LINE STEAM QUALITY MONITORING SYSTEM
(Patent Pending)

- ✦ CONTINUOUS REAL TIME DATA MONITORING
- ✦ UTILIZES SODIUM AS INDICATOR OF STEAM PURITY
- ✦ ACCURATE MEASUREMENT UP TP 0.01 PPM Na
- ✦ SODIUM LEVEL IN STEAM IS DIRECTLY MONITORED IN CONTROL ROOM
- ✦ LOW SYSTEM MAINTENANCE COST
- ✦ EASY INSTALLATION AND USE

SILICA SCALE INHIBITION USING GEOGARD SIX (Patent Pending)

- APPLIES TO BRINE WITH SiO_2 LEVEL UP TO 1400 PPM
- EASY APPLICATION AND ENVIRONMENT FRIENDLY
- CONTROL SILICA SCALING UP TO 99% EFFICIENCY
- NON-CORROSIVE CHEMICAL
- EASY INSTALLATION AND LOW SYSTEM MAINTENANCE COST
- ADDITIONAL POWER GENERATION

CURRENT THRUSTS AND PROGRAMS

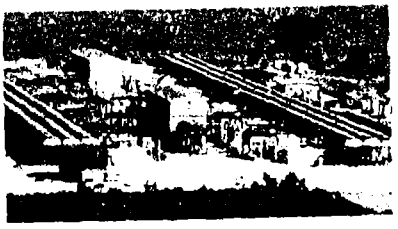
- EXPANSION OF GEOTHERMAL EXPLORATION AND DEVELOPMENT OPERATIONS IN THE PHIL. AND ABROAD INCLUDING THE CONDUCT OF RELEVANT R&D ACTIVITIES

- PRIVATIZATION INCLUDING DIVERSIFICATION INTO NON-GEOTHERMAL POWER PRODUCTION

PROJECTS IN OPERATION/ UNDERGOING COMMISSIONING

GEOTHERMAL FIELD (ISLAND): LEYTE

PROJECT	INSTALLED CAPACITY (MW)	POWER PLANT OWNER/BOT OPERATOR
TONGONAN I	112.5	NPC
UPPER MAHIAO	125	CALENERGY
MALITBOG		
UNIT I	77	CALENERGY
UNIT II & III	154	CALENERGY
OPTIMIZATION		
TOPPING	36.5	ORMAT INC.
BOTTOMING	14.6	ORMAT INC.
MAHANAGDONG	180	CALENERGY/
TOTAL	699.8	

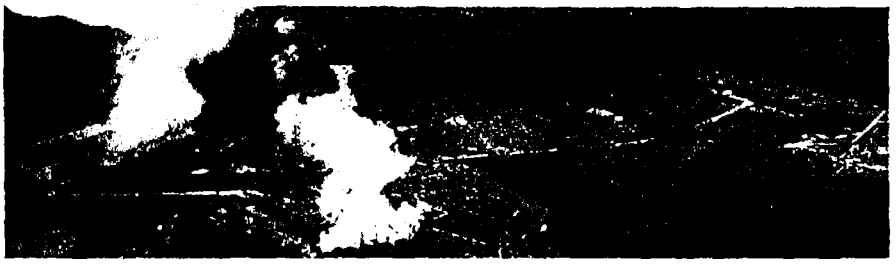


PNOC

PROJECTS IN OPERATION/ UNDERGOING COMMISSIONING

GEOTHERMAL FIELD (ISLAND): PALINPINON (NEGROS)

PROJECT	INSTALLED CAPACITY (MW)	POWER PLANT OWNER/BOT OPERATOR	COMMENCEMENT OF OPERATION
PALINPINON I	112.5	NPC	1983
PALINPINON II	80	NPC	1993-1995
TOTAL	192.5		



PROJECTS IN OPERATION/ UNDERGOING COMMISSIONING

GEOTHERMAL FIELD (ISLAND): BACON-MANITO (LUZON)

PROJECT	INSTALLED CAPACITY (MW)	POWER PLANT OWNER/BOT OPERATOR	COMMENCEMENT OF OPERATION
BACMAN I	110	NPC	1993
BACMAN II			
MODULE I	20	NPC	1994
MODULE II	20	NPC	1997
TOTAL	150		

PNOC Energy Development Corporatio

PROJECTS IN OPERATION/ UNDERGOING COMMISSIONING

GEOTHERMAL FIELD (ISLAND): MT. APO (MINDANAO)

52 MW MINDANAO I Phase 1
Commissioned in MARCH 1997
Operated by OXBOW / MARUBENI

PROJECTS UNDER DEVELOPMENT

Geothermal Field (Island)	Project	Installed Capacity (MW)
Mindanao (Mt. Apo)	Mindanao (Phase II)	50
Southern Leyte	Mt. Cabalian	110
Del Gallego (Luzon)	Mt. Labo	120
Bacon-Manito (Luzon)	Rangas Tanawon	30
Mambucal (Negros)	Northern Negros	40
		350

Energy, the Environment and the Recent Trends of Automobile's R&D in Japan

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1. Introduction

There will be no petroleum for the use of automobile's fuel at the end of the 21st century. According to the increasing population in the world and the rising level of living, the concentration of CO_2 on the earth will increase steadily. It is estimated that the average temperature of the earth will rise by 2 degrees centigrade at the end of 21st century, if any action for the reduction of CO_2 will not be carried out. To keep the air in cities clean, automobile's exhaust emissions will be required to be nearly zero levels at the early 21st century. It is said that 20～30 years are needed to replace all the current cars in a country with the cars of new technologies. In this sense, it is required to build up rapidly innovative car technologies which meet the future requirements.

Last December, the 3rd session of the conference of the parties to the United Nations flame work convention on climate change, so called COP3, was held at Kyoto in Japan. This conference has called Japanese people's attention to the global warming, and they have had a considerable understanding on environment issues. So, the Japanese automobile industries have been focusing challengingly their R&D in the innovative items on fuel economy improvement, exhaust emission reduction and next generation vehicles such as electric vehicles and hybrid electric vehicles. And also they actively have put electric vehicles and hybrid electric vehicles on the Japanese market recently.

In this paper, firstly, energy related to the automobile industries, CO_2 emission resulting in the global warming and exhaust emission are shortly explained. Secondly, the innovative technologies related to the above items are described. Finally, the recent change of R&D management in Japanese automobile industries are mentioned.

2. Prospect of Energy and the Environment of Vehicles

The reserves of oil in the world are shown in Fig.-1. Oil is the most useful fuel for vehicles, since it is high in energy density and easy to handle. The ultimate recoverable resources including undiscovered resources and improved oil recovery from the discovered oil field are about 2.2 to 2.5 trillion barrels. The amount of oil consumed to date

is about 0.7 trillion barrels, so the remainder of oil is only two or two and half times as much as the oil consumed to date. The increasing ratio of oil demand in the world is estimated about at 1.8 % per year. An accumulated oil production will be estimated to reach 50 % of the recoverable reserves near 2010 year when using the above increasing ratio.

Figure 2 shows the estimation of future oil demand and oil production which is calculated by using the assumption that oil production decreases after reaching 60 % of the recoverable resources. From this figure, the oil which can be supplied with today's cost will decrease their production after about 2020 year, and the tensions between supply and demand of oil will appear.

According to the second evaluation reports on global warming by Intergovernment Panel on Climate Change (IPCC) held in December, 1995, it was estimated that the average temperature of the earth would rise by 2 degrees centigrade as shown in Fig.-3 and the average surface of the sea would rise about by 50 cm, if any action for the reduction of CO_2 would not be carried out, and that, as a result, a large climate change would occur in local places.

It was decided at the Kyoto COP3 held last December that developed nations have to reduce the greenhouse effect gases at least by 5 % compared with that of 1990 year, and the reduction requirement for Japan is 6 %. Under the decision, a 20 % reduction in fuel consumption of passenger vehicles over that of 1995 until 2010 year has been planed in Japan.

On the reduction of automobile exhaust emissions which concerns to the air pollution particularly in urban areas, a severer standards will be effective in Europe, U.S.A and Japan in early 2000 year. In Japan in November 1997, the central environment council submitted a report that the standards which required the reduction of NOx and HC in exhaust gas about by 70 % would be effective at early 2000 year. European and U.S.A. governments will also carry out a severer standard for NOx and HC until 2005 year.

3. Trend of R&D in Japanese Automobile Industries

3.1 Innovations in Engine and Transmission Technologies

The targets of R&D in Japanese automobile industries have been focused recently on the items of fuel economy improvement, exhaust emission reduction and next generation vehicles. Fuel efficiency of recent conventional gasoline engines has been improved approximately by 25 % over the similar engines produced in 1978 through steady and substantial efforts for the improvement as shown in Fig.-4. To improve fuel economy by

30 % more, innovative technologies are needed for the R&D. Recently several automobile companies have put innovative engines on the Japanese market. The technology is a stratified charge combustion technology by a direct gasoline injection. The fuel is injected directly into the combustion chamber to position a readily ignitable mixture in the vicinity of the spark plug forming a surrounding air layer that contains little fuel. This process thus accomplishes a stable combustion of overall lean mixture. As shown in Fig.-5, a direct gasoline injection engine employing stratified charge combustion can operate leaner mixture and improve the fuel economy by 25% to 30 % over the conventional engines in low load condition.

A major reason that the Japanese automobile companies have made success in the development of direct gasoline injection engines is attributed to the significant progress achieved in the fundamental technologies for analysis and electronic control. The analytical technologies include , for example, technologies for flow and combustion simulation and visualization of mixture formation with a laser-induced fluorescence method (Fig.-6). The other innovative technology is a continuously variable transmission (CVT). A belt type of CVT are shown in Fig.-7. The advantages of CVT are remarkably smooth power delivery, outstanding fuel economy and power performance. As these performances fit customer's needs very much, CVT will be a promising future transmission. CVT improves fuel economy by 20 % over a conventional automatic transmission.

3.2 R&D for Next Generation Vehicles

The R&D for next generation vehicles, including alternative fuels, that is, electric vehicles, hybrid electric vehicles, fuel cell vehicles, natural gas fueled vehicles and hydrogen fueled vehicles is being accelerated today in Japan. Several automobile companies have put these vehicles into the market to aim at getting a good image of the companies. Because Japanese people are much concerned about environmental issues recently and the sales competition among automobile companies is very sever.

The key components of a electric vehicle are the electric motor, the electric motor controller and the batteries. These technologies have been improved remarkably in performance and cost. The electric motors developed recently become smaller and lighter, for example, the weight is reduced to about one-third compared with that produced 3 years ago. The major key component of electric vehicles is the batteries. The advanced high performance batteries, that is , nickel-metal hydride battery, lithium-ion battery have now reached the level of practical automobile use. These advanced batteries provide approximately two to three times as much as the energy density of a lead-acid battery, and have more reliability and longer life.

The hybrid electric vehicle (HEV) consists of the combination of an electric motor

and an engine as shown in Fig.-8. HEV is the most promising candidate for the next generation vehicles which have the performances with remarkable fuel economy improvement and very low exhaust emissions. Toyota motor company began to sell their HEV last December. The HEV consists of a gasoline engine and an electric motor and shows excellent performances which are two times as good as the fuel economy and one-tenth lower exhaust emissions compared with ordinary gasoline engine vehicles. HEV are considered as one of ideal next generation vehicles, because they show the excellent performances obtained by combining the strong points of both engines and electric motors.

Recently, fuel cell (FC) electric vehicles are also considered as a promising candidate for the next generation vehicles. The reason is that the performance of polymer electrode membrane (PEM) fuel cell has been remarkably improved in the last three years, and Daimler-Benz showed the possibility to use the fuel cell for the power source of vehicles. So, Japanese automobile companies have taken priority of their R&D on fuel cell. The performance of fuel cell efficiency and the amount of emission for fuel cell is varied with the kind of the fuel used. Pure hydrogen is a ideal fuel, which shows the best fuel efficiency and no amount of CO_2 emission, however, the storage of hydrogen in the vehicles and delivery infrastructure have some difficulties.

Methanol as the fuel for fuel cell has been proposed, in this case, a methanol reformer system which converts methanol to hydrogen and carbon dioxide is needed additionally. And the fuel efficiency decreases to some extent which depends on the efficiency of methanol reformer system and carbon dioxide is emitted. Fuel cell electric vehicles are continuously compared with HEV with engines based on in the performance, the adaptability to the environmental issues and fuel economy in the future.

4. Change in R&D Management

The R&D management in the Japanese automobile industry has been being changed by reason of the expanding number and fields of technology for the R&D. The technology field expand year by year as shown in Fig.- 9 . It is very difficult to have researchers and engineers required for all the technology fields except for the top maker company.

The method to overcome the difficulties mentioned above is to make cooperation with other companies which have superior technologies from the early research stages. The examples of the case are the cooperation of Nissan and Sony for the joint development of Lithium-ion battery and the cooperation team of Daimler-Benz and Ballard for the development of fuel cell vehicles. The cooperative R&D among companies in other technologies fields will become more popular in the Japanese automobile industry.

And also, it is difficult for one company to have the fundamental technologies in the wide field. So, joint researches have started in the limited area, such as Next Generation Catalyst Research Institute, Co., Ltd. and New ACE Institute Co., Ltd. (Research of New Diesel Engine Combustion Concept) in Japan.

Cooperative researches among companies and academia have had little achievement in the automobile area in Japan. Both the automobile companies and academia have to make efforts toward raising the potential of fundamental technologies in the academia and getting good results through the joint research in the near future.

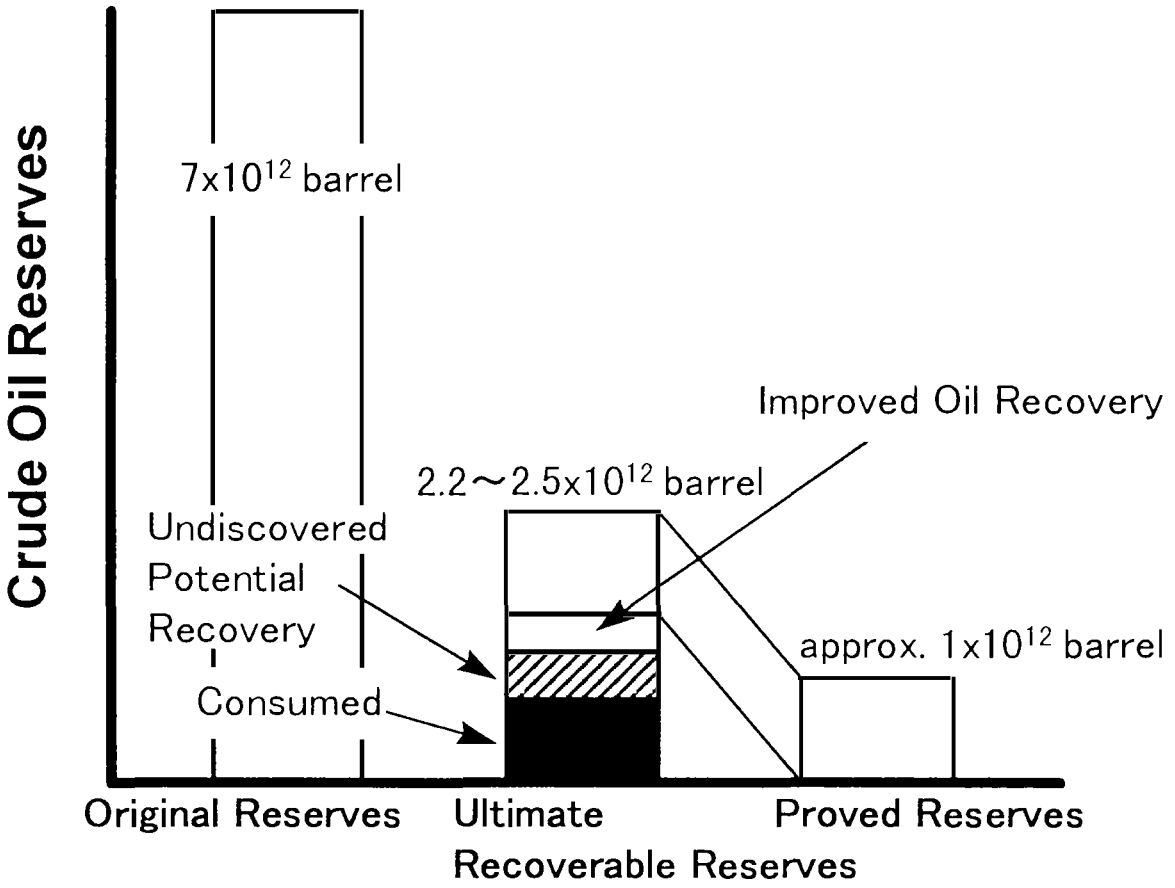


Fig.1 Crude Oil Reserves

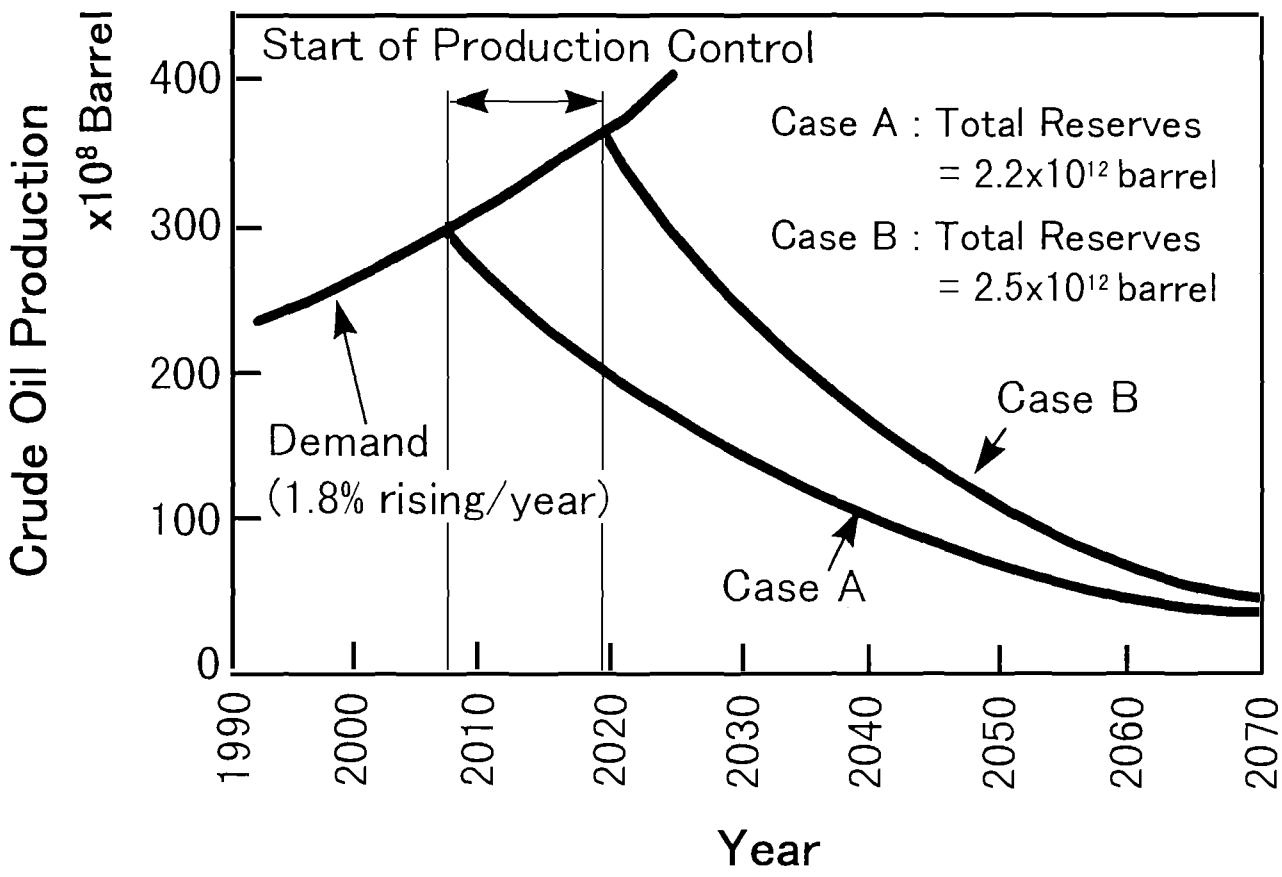


Fig.2 Predicted Demand and Supply of Crude Oil

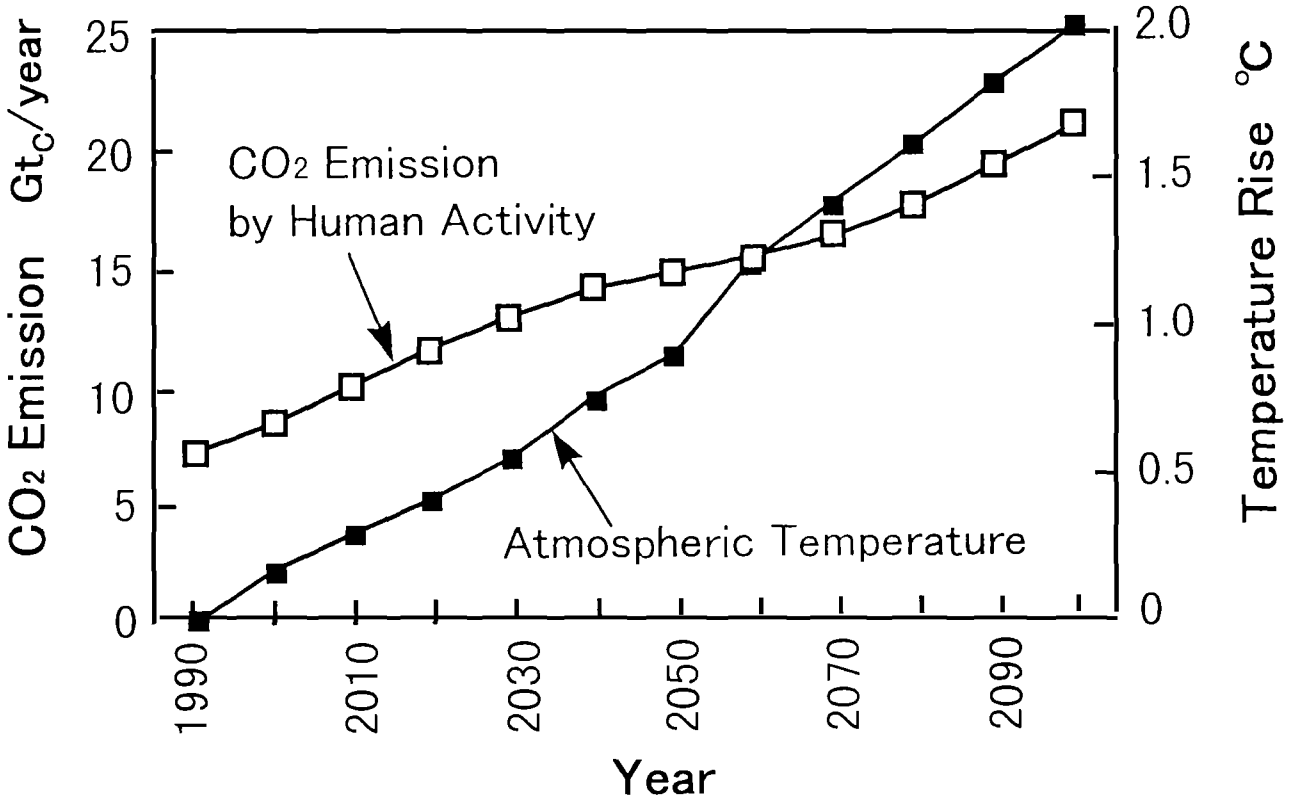


Fig.3 Prediction of Atmospheric Temperature and CO_2 Emission by Human Activity

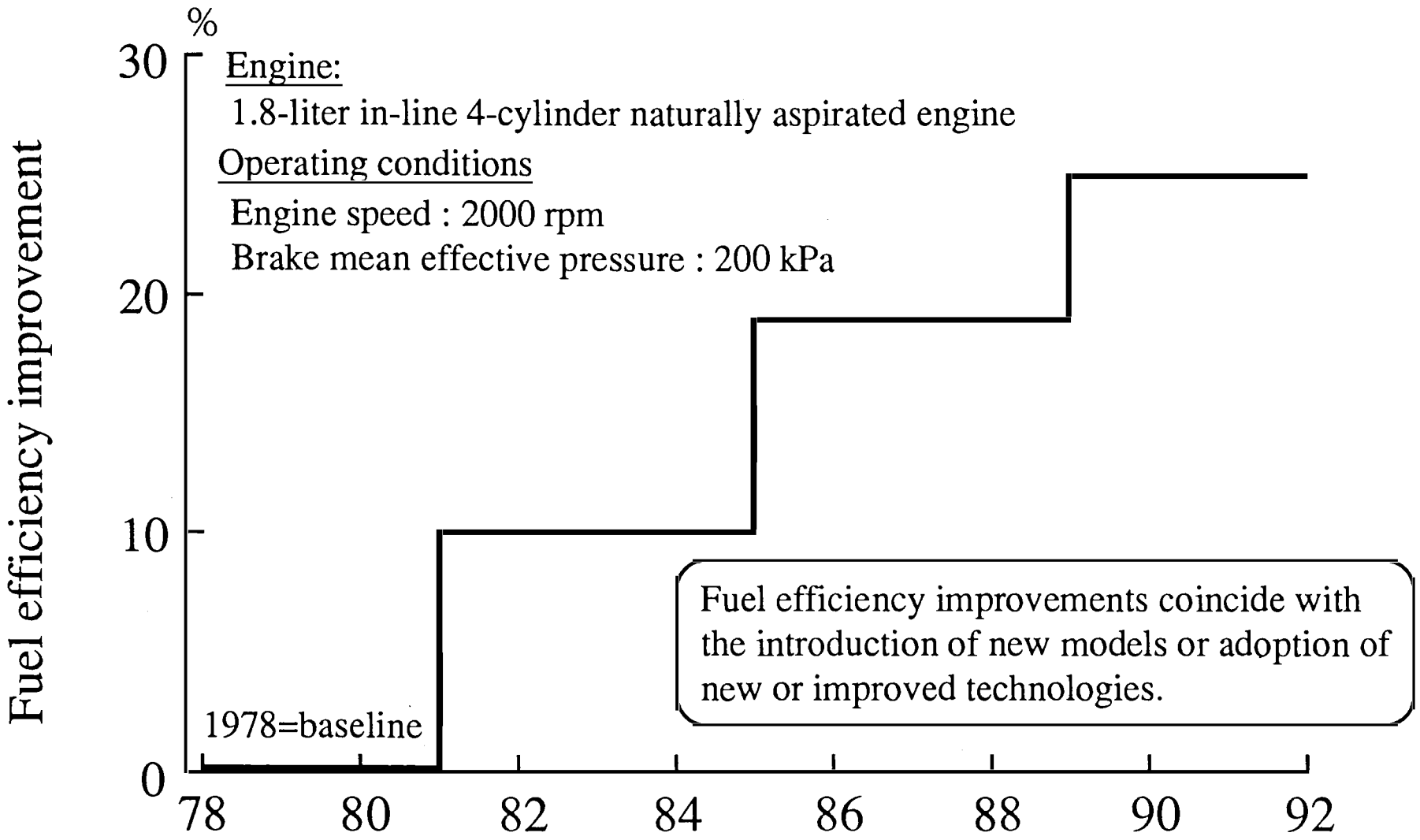


Fig.4 Trend in Engine Fuel Efficiency

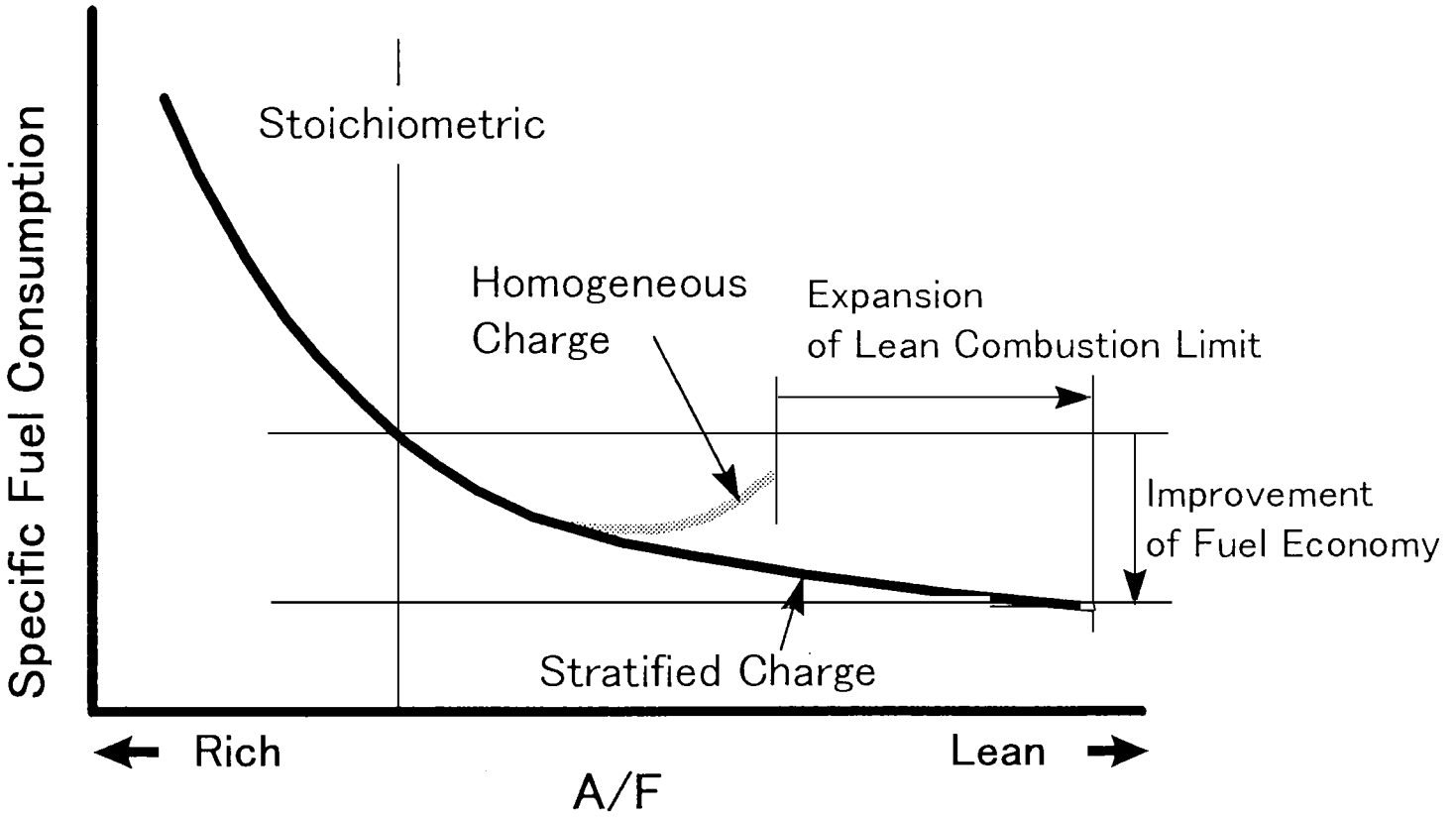
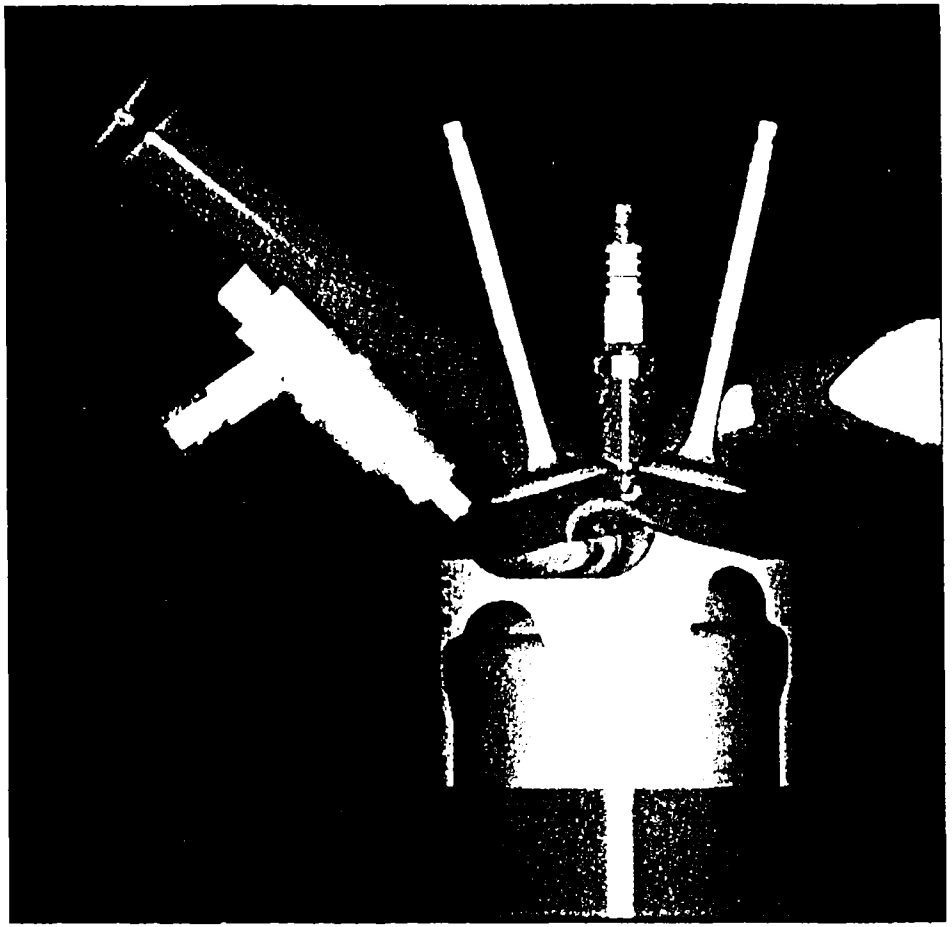
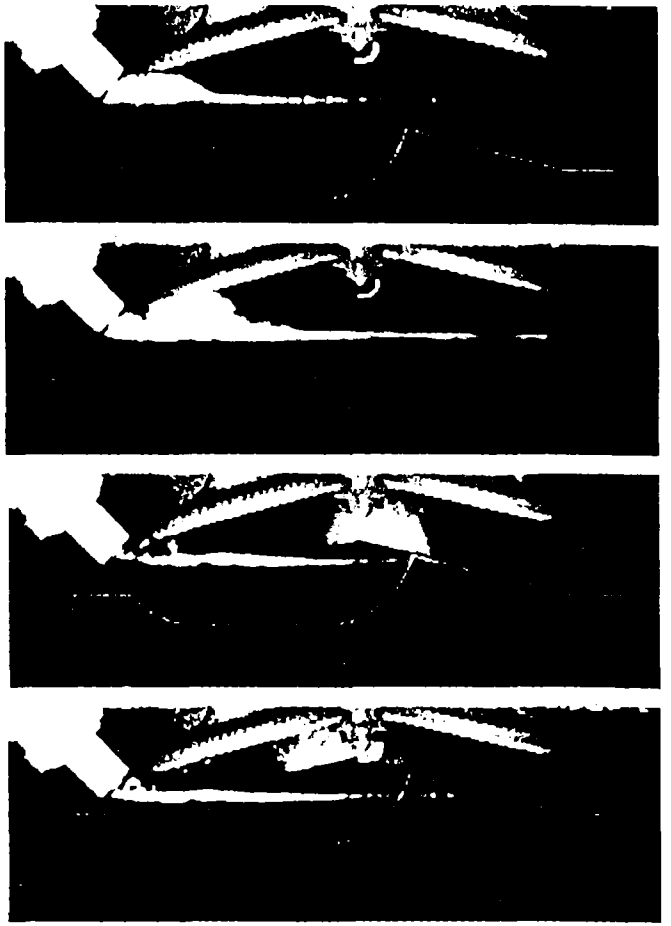


Fig.5 Thermal Efficiency Improvement by Lean Combustion



Simulation analysis of mixture flow



Transition in the mixture flow

Fig.6 Simulation and Visualization of Mixture Flow

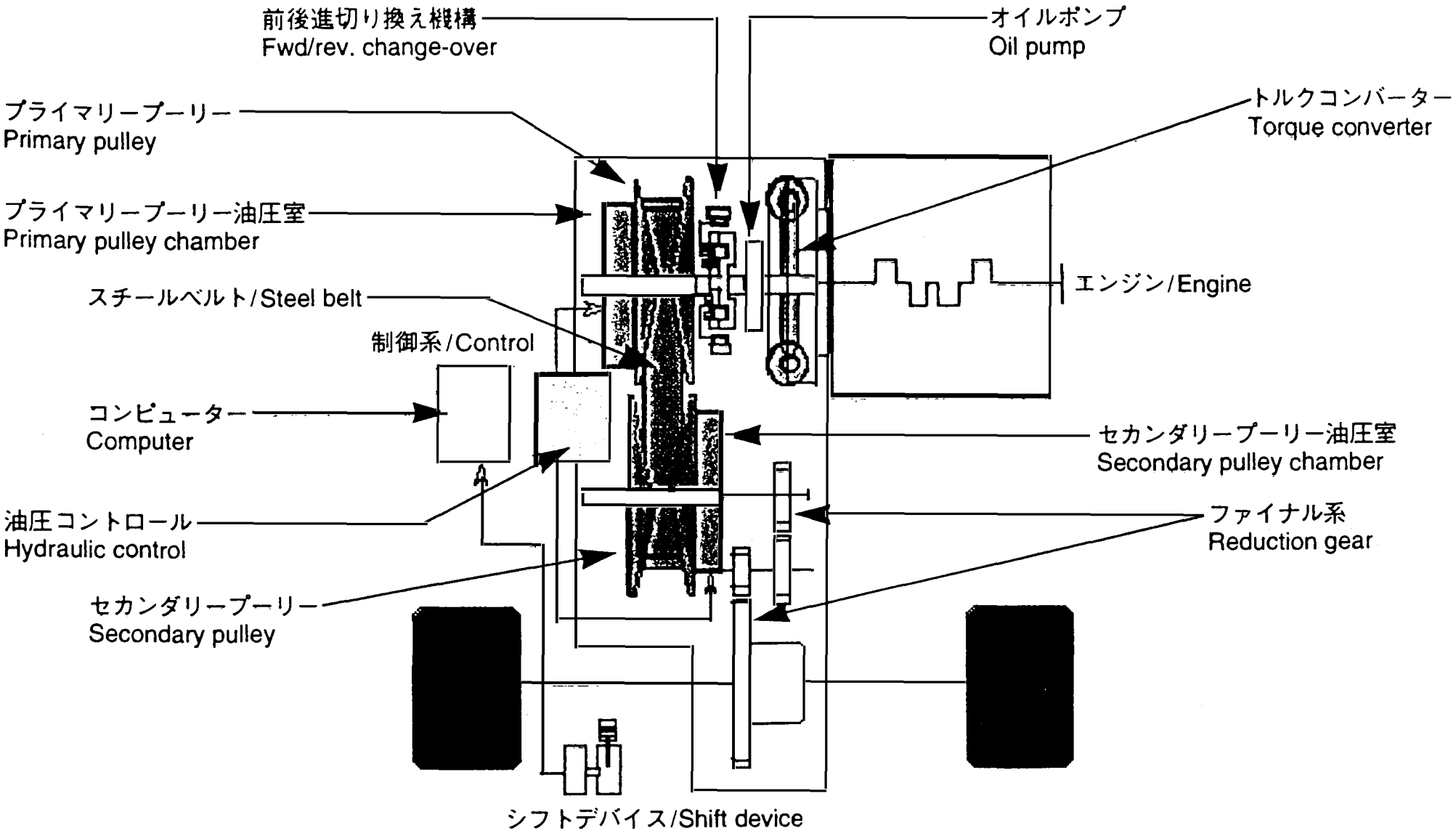


Fig.7 CVT Systems

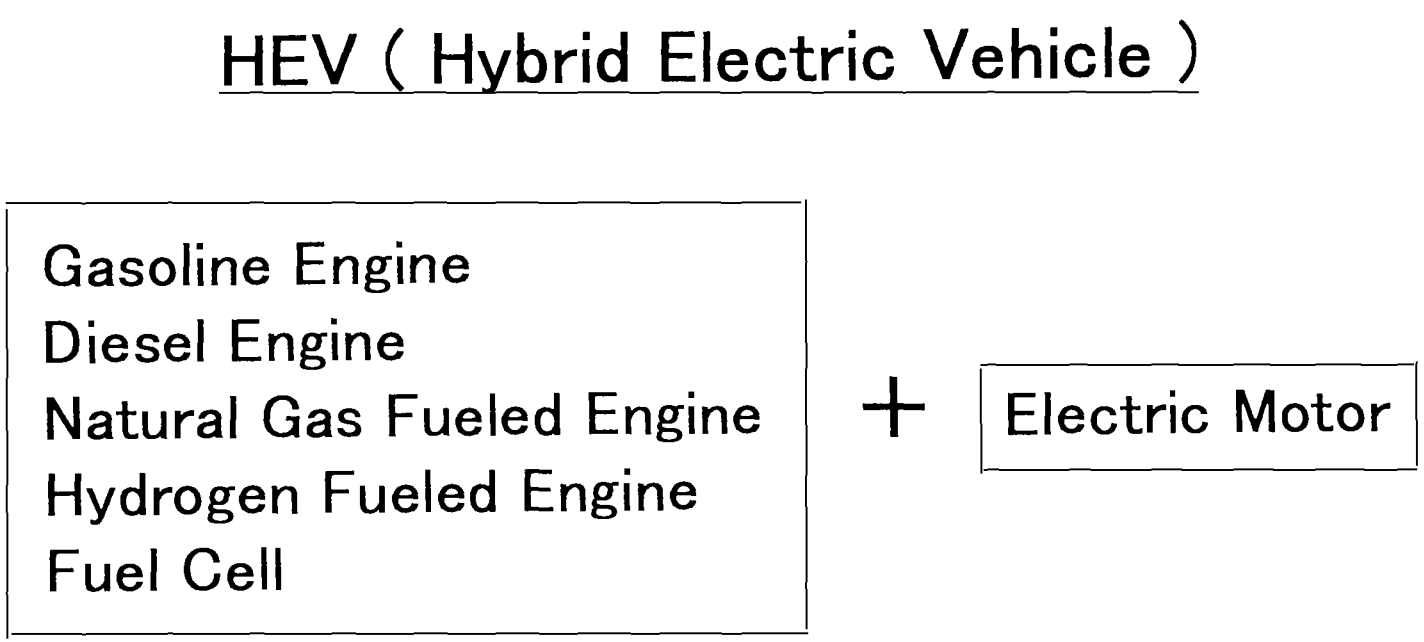


Fig.8 Hybrid Electric Vehicle System

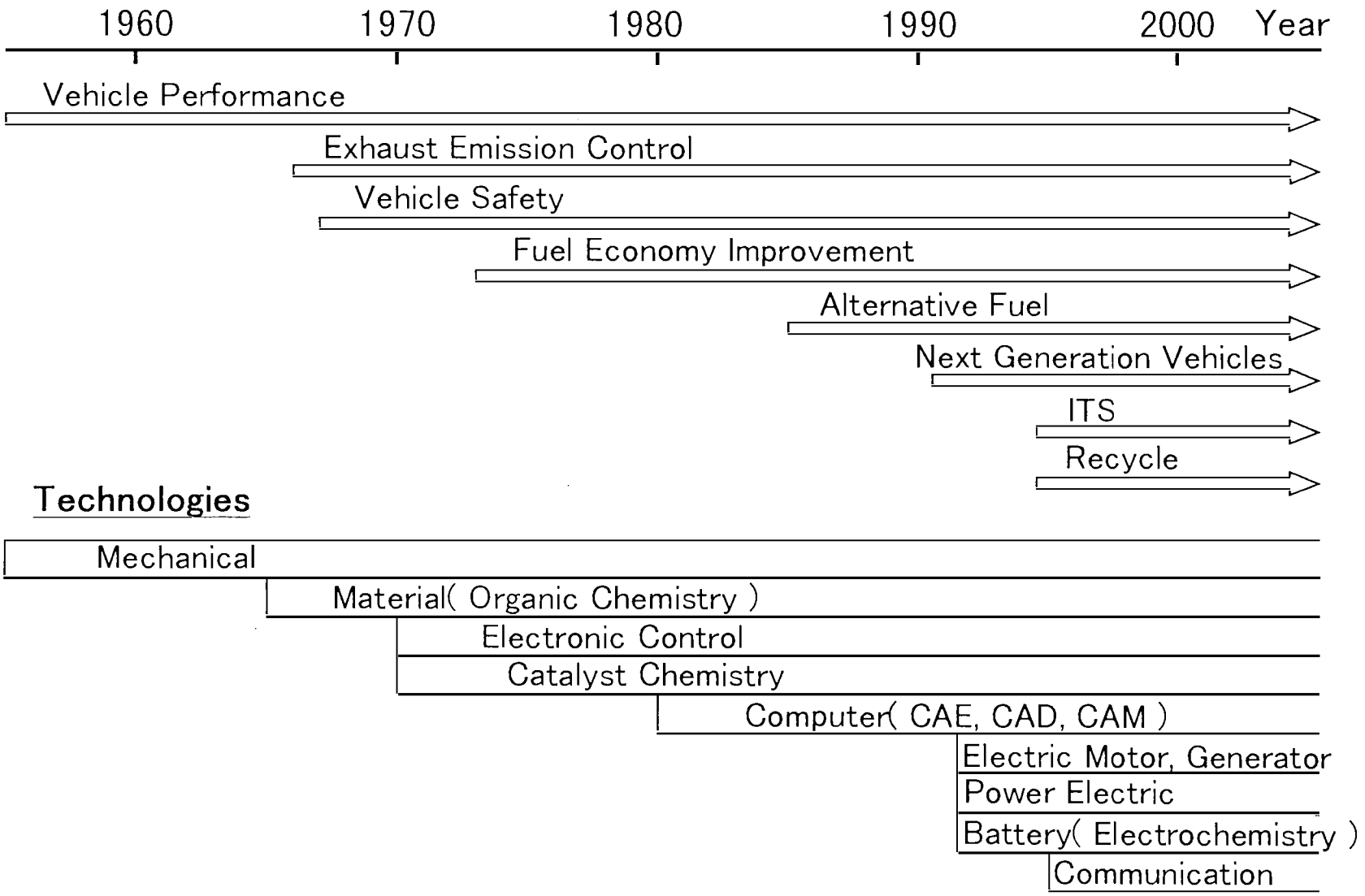


Fig.9 Expansion of Technology Fields in automobile Industry

PHOTOVOLTAIC APPLICATION IN THE 8TH NATIONAL SOCIAL AND ECONOMIC DEVELOPMENT PLAN OF THAILAND (1997-2001)

Assoc. Prof. Wattanapong Rakwichian, Mr. John O'Donoghue , Mr. Herbert Allen Wade
Solar Energy Research and Training Center (SERT)
Naresuan University, Phitsanulok, Thailand

INTRODUCTION

Thailand has long used photovoltaics for many purposes. As early as 1976, communication systems powered by photovoltaics were in use in Thailand followed shortly by PV powered water pumping stations and other applications where remote power at low levels was needed. Since 1990, the falling cost of photovoltaics has prompted wider use of photovoltaics to power village power grids, increased use of solar powered pumping and household battery charging stations. By 1997, the total installed capacity of photovoltaics in Thailand exceeded 3.7 MWp including telecommunications, water pumping systems and rural power systems for household use.

The experience with photovoltaics in Thailand has generally been good and with the continuing fall of PV system costs, the application areas appropriate for use of photovoltaics continue to expand with photovoltaics now offering lower cost power for rural households than standalone diesel generation and power costs approaching suitability for peaking power in large scale grid systems.

In 1997, the National Energy Policy Office (NEPO) of Thailand contracted with SERT to examine the existing uses of solar photovoltaics around the world and recommend which of those uses would best fit into the Thailand conditions and what support would be needed to begin large scale commercialization of PV in Thailand during the 8th National Social and Economic Development Plan (1998-2002).

BACKGROUND INVESTIGATION

The first phase of the SERT investigation was to examine in detail PV projects around the world which have been in place sufficiently long to provide useful information about the technical and socio-economic aspects of the projects. Site visits, interviews with responsible persons and literature studies were made on numerous solar PV projects around the world which have been in place and operating for five years and more. It was clear early in the investigation that two basic classes of PV projects are appropriate in Thailand. The first consists of systems connected to the grid to support and supplement power generated by

conventional sources. The second uses systems for standalone power at sites beyond the economic reach of the grid. Since very different technical systems and institutional systems are needed for the two classes of PV projects, the SERT investigation was split into two parts, a standalone projects section and a grid connected projects section. Projects in rural electrification in Sri Lanka, Indonesia, Zimbabwe and Kiribati were examined in detail and grid connected projects in Japan, Europe and the United States were examined is detail.

STANDALONE PROJECTS RECOMMENDED FOR SUPPORT

In the standalone class of projects are solar home systems for household electrification, water pumping power for village water supply and irrigation, battery charging stations for the charging of automobile batteries to operate lights and small appliances in homes, and power for public facilities such as government offices, rural clinics and temples.

As of late 1996, the Provincial Electricity Authority (PEA) estimated that there were 668,800 households not covered by the grid. Of those, some 403,700 households are included in PEA's plans for electrification. The remaining 265,100 households are prime candidates for PV electrification because of the high cost of connecting them to the grid due to remoteness and isolation. Further, experience indicates that the amount of energy likely to be used in these remote households is small, usually less than 15 kWh/month, and is primarily used for basic lighting, TV and radio use. Analysis by the World Bank and other international organizations indicates that household PV systems are more cost effective than other means of standalone electrification for energy uses under about 35 kWh/month and are significantly lower in cost for 15 kWh/month per household levels.

The problems faced by SERT in making recommendations to NEPO for support of standalone systems were (a) the technical approach, whether to electrify through small solar powered grids, battery charging stations or individual systems on houses; and (b) the institutional approach, whether to finance the sale of the PV systems to villages or households or to sell the electricity from the PV systems with ownership by PEA. To make this determination, projects of various types in other countries were examined and analyzed. The result of this effort was the clear finding that individual household systems provide the best quality rural electrification service at the lowest cost. Further it was determined that projects around the world which depend on selling the solar systems to users have been much less sustainable in the long term than projects which retain ownership of the PV components and sell power to users. The difference is due to the lower monthly cost of service attained though the long term finance possible to leasing and utility companies and to the higher quality of maintenance of systems when ownership is kept within a service oriented rather than sales oriented organization.

STANDALONE SYSTEM RECOMMENDATIONS

Based on the analysis of existing projects and the conditions prevailing in rural Thailand, a project to install SHS in 50,000 of the remaining non-electrified homes was proposed. The project would be managed by PEA who would own the systems and sell the electricity generated by the systems to users for a monthly fee commensurate with the service desired. Experience in other countries indicates although a wide range of sizes are needed to meet varying user needs, that the average size of SHS needed to meet the usual rural electrification needs is about 100 Wp panel capacity. Therefore the 50,000 home systems would total about 5 MW in total capacity. With NEPO providing a 50% capital subsidy to PEA who would own the systems, the fee charged by PEA to users for sufficient electricity to operate four to five lights, a small TV and a radio would be less than US$10 per month, an amount found in other countries to be affordable by rural families since many families already spend more than that on the purchase of the dry batteries and kerosene which will be offset by the PV system. The US$10 fee would be sufficient to cover capital payback of 50% of investment and all maintenance costs including frequent visits by local technicians for the preventive maintenance so necessary to long, reliable life of the storage batteries used in the systems.

An additional 5 MWp of photovoltaics is proposed for community level projects such as water pumping, education, government facilities, temples, public health and agriculture related activities. This would be a continuation of existing programs in the use of PV in rural areas and would be administered by the government agencies responsible for the facilities or for the type of activity supported by the electrification.

GRID CONNECTED PROJECTS

With the rapid growth of electricity demand in Thailand, it will become increasingly difficult and expensive to generate the needed power through conventional means. Therefore, consideration is being given by EGAT to non-conventional means of generation including solar thermal and solar photovoltaics.

Although current costs of PV generation is about twice the cost of the highest cost power currently used for meeting peak demand in the Thailand electricity system, the cost is falling steadily and projections indicate a probable cross over of PV and peaking power costs within five years. To fully take advantage of this bright future for PV in grid connected systems, experience needs to be gained by EGAT in the use of medium to large PV systems connected to the grid. Therefore, SERT recommended 10 MW of PV be supported by NEPO for grid connected systems.

Analysis of grid connected projects around the world indicated a division into two classes: (1) distributed systems mounted on customer property and (2) centralized systems located on utility property. The two approaches have individual advantages and disadvantages but as has been found in Europe, Japan and the USA, it appears that distributed systems have more benefits and less risk than large central systems. While central systems offer lower maintenance costs, "roof top" systems help reduce distribution system losses, are partially financed by users, require no additional land, and provide a more even level of power generation than a central plant. Therefore, SERT recommended that 6 MW be in the form of "roof top" grid connected systems and 4 MW be in large centralized PV plants for producing grid power. For all grid connected systems it was recommended that EGAT own, maintain and operate the systems.

SUPPORT ACTIVITIES

It was recognized by SERT that the sustainable commercialization of photovoltaics in Thailand requires development of specialist support structures. Therefore additional support projects were also proposed to NEPO to support the primary projects. These include (1) development of high quality lights, batteries, power converters and charge controls specifically for the Thailand conditions and for manufacture by Thai companies; (2) expansion and improving competitiveness of Thai PV panel manufacturers; (3) development of permanent training facilities for all levels of photovoltaic technical personnel; (4) public information programs; (5) development of the necessary technical standards; and (6) development of adequate test, evaluation and demonstration facilities.

CONCLUSION

The recommendations made to NEPO for support of solar PV commercialization in Thailand include 10 MW of standalone systems and 10 MW of grid connected systems plus sufficient support activities to insure that the PV systems will remain well maintained and provide reliable service and that the institutional structures for both standalone and grid connected systems will be self sustaining in the long term. With continually falling prices for PV systems, this 20 MW of projects will provide a strong base for PV commercialization in Thailand in the future and the experience gained in this initial effort will be of great value to Thailand and to the region.

R&D Management for Improving Existing Radwaste Treatment Systems and Problems in Technology Transfer

16 February 1998
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M. Matsumura, JGC Corporation

Abstract

In 1970, GE in the United States was awarded two construction projects for 1,100 MWe BWR plants by Japanese electric power companies. JGC Corporation won two projects for constructing low-level radwaste treatment facilities for these BWR plants from GE. JGC is an engineering firm with forty years of experience in plant construction. Prior to branching out into nuclear business, JGC dispatched many discipline engineers to an architect engineering firm in the United States in order to acquire nuclear-related technologies. After that, JGC researched and developed radwaste treatment processes suited to the conditions of Japan, and delivered many processes to nuclear power plants in Japan. Such delivery records attracted attention, and JGC was awarded a project for renewal of existing radwaste treatment facilities by Virginia Power in the United States.

This paper covers:

① the fields of technologies acquired from the United States, and problems in actual job execution,

② aims and philosophy in the R&D activities,

③ the scope and procedure of technology transfer and problems in exporting radwaste treatment plants to the United States,

④ difficulty in technology transfer in general, and others.

1. Introduction

Japan has very few energy resources and depends practically on import. Diversification of energy sources is, therefore, an important theme to Japan. Presently in Japan, electric power generation depends on atomic energy, and one-third of the whole power generation is provided in this way.

At present, the problem of CO_2 gas emission is attracting worldwide attention from the standpoint of global warming, and reduction of CO_2 gas emission is a heavy burden to every nation. Fortunately, nuclear power generation is advantageous in that the influence on the environment is comparatively small, including CO_2 gas emission. Nuclear power generation, however, has a great problem in radioactive waste disposal.

Of the 1,100 MWe BWR plant facilities U.S. GE delivered to nuclear power stations in Japan, the low-level radwaste treatment facilities were directly awarded to JGC by U.S. GE.

JGC had forty years of experience in plant design and construction, but had no experience in construction work related to nuclear power plants. To make preparations for expanding business into the nuclear industry prior to winning this project from U.S. GE, JGC dispatched various discipline engineers such as project engineers and process engineers to EBASCO, which is an architectural engineering firm in the United States, with a view to acquiring nuclear-related technologies. After winning the project, we judged that GE's low-level radwaste treatment technology did not suit the conditions in Japan, and we reviewed GE's original treatment processes and researched and developed radwaste treatment processes suited to these conditions. As a result of the R&D activities, we could deliver newly developed treatment processes to existing nuclear power stations in Japan. In parallel with these deliveries, we constructed a stand-alone radwaste treatment facility which totally expanded the planned 1,100 MWe BWR plant radwaste treatment facility which was already constructed by JGC. Our experience of this project was appreciated later by an electric power company in the United States, and this led to the construction of a low-level radwaste treatment facility in the United States.

This paper describes our approach to nuclear business from four aspects. (1) First, what was our philosophy on technology transfer in the first introduction of nuclear-related technologies from the United States? What were the difficult areas? What problems occurred in the actual design and construction processes? (2) Secondly, in the R&D process, what matters were given attention in developing low-level radwaste treatment processes? What management technique was adopted? What were the difficult areas? (3) Thirdly, how was technology transfer carried out in exporting our technology to the Unites States? What were the problems? (4) Fourthly, what are problems in technology transfer in general?

Radwaste treatment technology will be described in brief because it is not the subject of this paper.

2. Preparations for introducing low-level radwaste treatment technology

JGC is a total engineering firm specializing in plant construction. It has more than forty years of experience in plant construction, but has no experience in the design and construction of nuclear power plant facilities. Therefore, JGC took the following steps to introduce engineering techniques for such facilities.

(1) Acuisition of U.S.(EBASCO)'s engineering techniques

U.S. EBASCO has executed architectural engineering in nuclear power plant design in the United States. JGC dispatched more than ten engineers to U.S. EBASCO to observe their technologies. The engineers dispatched consisted of project engineers, process engineers,

nuclear safety engineers, piping engineers, instrument engineers, electrical engineers, civil engineers, QA engineers, and others. During the dispatch period, they learned the design philosophy which formed the basis of nuclear power plant technologies at that time, applicable U.S. codes and regulations, regulatory guides, and so on. They also studied design documents including process design and quality assurance documents.

(2) Survey in Japan

① Visit and survey/investigation of existing radwaste facilities of nuclear power plants in Japan.

In radwaste facility design for nuclear power plants in Japan, great pains were taken over the following two points:

a. More stringent aseismic design requirements than in the United States
b. Layout design in which ease of maintenance and minimization of personnel exposure must be considered. In nuclear power plants, radwaste facilities are peripheral facilities for reactors. In the U.S. design, therefore, adequate consideration was not given to layout design, resulting in unsatisfactory facility-layout in terms of maintenability.

② Study for obtaining license from authorities concerned in Japan

License obtainment from authorities concerned in Japan was painstaking work in that the licensing procedure was troublesome and no changes were allowed. Great pains were taken to obtain a license for the construction work. JGC was unfamiliar with business practices in the nuclear industry, and once design documents were filed with authorities concerned, no design changes were accepted.

3. Difficulties in usage of transferrd technology

① We had difficulty in understanding the concept of quality assurance for nuclear-related facilities and in having manufacturers understand such quality assurance. In Japan, manufacturers' individual workers have a high level of manufacturing skills, and are trained to enhance the quality of products. On the other hand, quality assurance in the United States places importance on management techniques and procedures. Japanese manufacturers think spirit is important to enhance quality (that is a traditional philosophy from the Edo period), and they have doubt as to whether good procedures will always enhance the quality of products. Thus, it took much time and cost to implant the concept of quality assurance in their minds.

② All engineers involved in the project underwent on-the-job training in order to acquire the basic design philosophy and work execution techniques for nuclear power generation facilities. There was no shorter way but on-the-job training to acquire nuclear-related engineering skills. Although there was some failure in minor matters, the on-the-

job training was successful as a whole throughout our first construction work. It seems that this is because JGC has long experience and a firm technological base in plant construction.

4. R & D of low-level radwaste treatment facilities for Japanese market

4-1 Basic R&D philosophy

Japan is the only nation which has suffered from atomic bombing in the world. For this reason, the basic R&D philosophy was based on the following three points:

(1) Minimization of radioactive material release to the environment

The people of Japan have an aversion to nuclear material and are most afraid of sustaining exposure to radioactivity. Therefore, the people of Japan will not accept nuclear-related facilities unless they are designed based on the philosophy that radioactive material released to the environment will be reduced as low as reasonably available (ALARA).

(2) Volume-reduction of radwaste shipped to disposal site

Japan is limited in land space and has a high population density throughout the land. This makes it difficult to find a site for low-level radwaste disposal and requires much cost for the construction of a disposal site. Thus, radioactive wastes will be volume-reduced as low as reasonably available..

(3) Maintaining the integrity of solidified waste

The presently planned disposal site is very rainy and has a high groundwater level. Radioactive solidified products are required to maintain integrity to prevent radioactive matter from leaking from the products.

4-2 Basic approach to R&D activities

(1) Adoption of proven technologies

Processes whose operability has already been proven in general industrial plants were adopted.

(2) Thorough investigation of radioactive wastes

A thorough investigation was made on radioactive wastes generated at the nuclear power plant for which this radwaste plant project was planned. And it was verified that the adopted system was applicable to all radioactive wastes generated under every condition of the power plant (during operation, maintenance, and other periods).

(3) Integrity of solidified products

It is required that solidified products to be sent to the disposal site should maintain integrity. We therefore approached our project with the idea of producing a kind of disposable product, not waste.

4-3 Study results

(1) Reduction of low-level radioactive material released to the environment

In the original radwaste plant, the amount of low-level radioactive material released to the environment was 1Ci/Y. As a result, the release of low-level radioactive material was reduced below the detectable level (Zero release).

(2) Volume-reduction of low-level radioactive wastes

Compared with the conventional radwaste system , the new system reduced the volume of solidified waste to one fifth and secondary waste generated from the waste treatment to one seventh.

5. Reexport of new radwaste treatment system

5-1 History of project winning, selection of U.S. subcontractors, and determination of their scope of work

JGC's record of delivering a new radwaste facility for Tokai Unit II was appreciated by Virginia Power who were planning to improve their existing radioactive treatment system. JGC was awarded a new radwaste facility construction project by Virginia Power on a turn-key basis. To smoothly execute plant construction in the U.S. market, JGC selected, on a competition basis, ① a medium-scale engineering firm familiar with licensing application in the United States and ② a construction firm with much experience in plant construction.

In addition, the following procedures were followed to smoothly execute engineering work.

① JGC will prepare a basic design package, and detailed design will be executed by the U.S. engineering firm.

JGC's design package contained not only process know-how (properties of radioactive wastes, properties of solidified products, unit operation, and other process data) but also technical know-how such as minimization of personnel exposure and layout design in which ease of maintenance was considered. Detailed design engineering was executed by the U.S. engineering firm.

② Piping layout drawings which form the basis of piping design will be prepared by JGC, and detailed piping design will be carried out by the U.S. engineering firm.

At first, JGC planned to provide them with piping layout drawings only, but in fact JGC prepared a plastic piping model and provided it to them. The U.S. engineering firm carried out detailed piping design on the basis of this piping model, using the 3D-CAD technique.

③ License obtainment from U.S. authorities and engineering work relating to applicable codes and regulations will be within the U.S. engineering firm's scope of work.

5-2 Problems in technology transfer

In the job execution with the unfamiliar engineering firm, various problems occurred as the job

proceeded, due to differences between the two companies, such as differences in engineering work procedures, discipline engineers' scope of work and way of thinking. However, JGC got over this difficulty by long-term dispatch of JGC discipline engineers. Points of large difference will be described below because they seem to cause similar trouble in project execution in Asian and Pacific areas.

JGC has long executed various projects under the concept of concurrent engineering with a view to shortening the period of construction. To execute concurrent engineering successfully, JGC has project engineers who play a special role. Problems in applying concurrent engineering are described below.

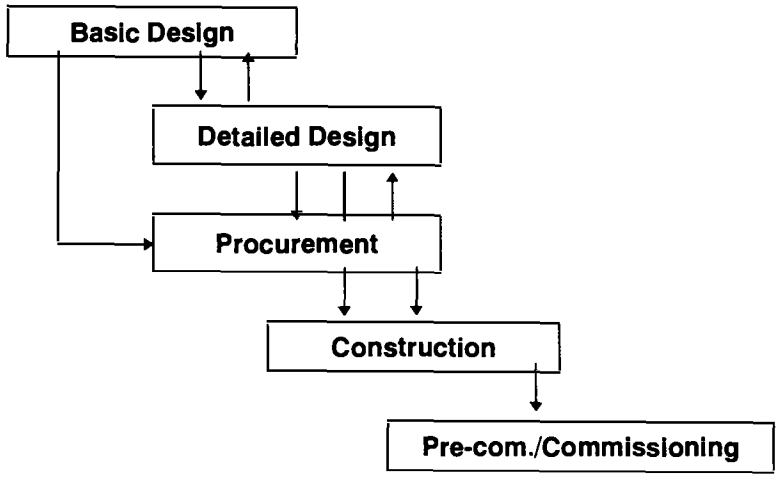
Project execution process usually adopted in the United States

Usually in the United States, projects are executed with phase-by-phase completion as shown below:

Basic Design	Detailed Design	Procurement	Construction	Pre-com./Commissioning

Japanese-style project execution process – concurrent engineering

In Japan, work in the subsequent phase is concurrently executed before the current phase is completed. In such method, work in the subsequent phase is started in spite of a lack of engineering information, and engineering work is executed based on documents which must be revised when necessary information is obtained. Therefore, concurrent engineering requires engineers to give necessary information to discipline engineering departments as soon as it is obtained, and project engineers meet this demand. As a matter of course, project engineers' role also includes drawing necessary information from inside and outside as early as possible.



The engineers of the U.S. engineering firm were used to work execution procedures in the United States, but not used to the concurrent engineering method in Japan. The discipline engineers did not have the practice of extending their work territory and exchanging information with other discipline engineers or accomplishing design work by advance design. In the Virginia Power project, therefore, JGC project engineers were virtually engaged in coordination work right to the end. Also in plant construction projects in Asian and Pacific areas, it seems that project engineers who control much engineering information will be unavailable. Even in Japan, it is difficult and takes much time to train personnel as project engineers. Under the circumstances, training as project engineers will become a great theme of personnel training in the future.

5-3 Problems in operation and maintenance work

JGC provided operation and maintenance services for the delivered radwaste plant over a period of two years. JGC engaged NAVY-trained submarine crew (engineers having experience of operation and maintenance) through a manpower supply company. They had the capability to overcome difficulties by themselves, and their engagement was a great success.

6. Problems in personnel training in general

In executing plant construction projects, JGC performs such work as management of its subsidiary companies who execute engineering work, in addition to training of clients' operators. Through such work, JGC has recognized personnel training as the most difficult work.

Problems in personnel training, though they are various, are here narrowed down to two points.

① Many years of tradition rooted among Japanese people regarding quality

We, the Japanese, have a long tradition of industrialization. Although Japan is an insular nation, for at least 1,000 years we have paid attention to overseas trends and have immediately put goods imported from abroad into domestic production on a commercial basis. We have handled imported goods with great care and have made efforts to produce goods of better quality than the imported goods. Apart from the good quality, we have manufactured more refined goods than imported ones. It is easy to instruct Japanese people regarding quality, but we find difficulty in instructing other nationalities on quality improvement, especially the "spirit" of quality improvement.

② Company personnel

Japan's postwar growth basically lies in the fact that personnel have long remained in their companies and conveyed technical know-how from generation to generation as tacit

knowledge. It is not easy to pass on know-how in a form understandable to everyone. Especially, Japan has adopted the on-the-job-training method instead of the method in which seniors teach juniors. In the on-the-job training method, newcomers acquire know-how through the process of failure and success while watching seniors doing their work. The success of this method depends on whether personnel settle in their companies. The greatest difficulty lies in the fact that in other countries, on-the-job-trained personnel do not remain in their companies because they are often scouted by other companies.

On the other hand, in Japanese companies, know-how is recognized as an asset of the organization and positively conveyed within the company. In some countries, however, there is a tendency to handle obtained know-how as the individual's knowledge. Thus, each time a person in charge changes, it is necessary to convey the know-how again.

7. Summary

(1) In technology import, it is effective to dispatch personnel, narrowing what they should learn. You need to survey the problems of importing the technology in your country and understand how and where the imported technology is short. It is the point to make the imported technology match the domestic environment. In case you can not get such matching, you will need a research and development.

(2) In our R&D activities, importance was placed on how imported technology should be developed into a system suited to the conditions in Japan. In addition, it was very important to make a thorough investigation of radioactive wastes generated at different nuclear power plants.

(3) In plant export, it is important to tie up with an engineering firm familiar with applicable codes and regulations in the client's country, understand the differences in engineers' quality, and consider how such differences should be coordinated in job execution. What are the key points in technical tie-up? What difficulty is involved in technical tie-up? It is necessary to investigate and study these matters in advance.

(4) The most important point in human resource development is to keep trained human resources in companies. In addition, the training of project engineers is an important theme.

Questions and Answers

Question: To Mr. Kobayashi
As you mentioned in your presentation, nuclear energy produces the minimum percentages of SOx and NOx. I wanted to know why we are not going for the nuclear energy production more rather than thermal energy.

Reply:
There are several reasons for that. First of all, Japan doesn't have any material resources for energy production. It is very appropriate for us to get appropriate distribution of energy sources. We don't want to heavily rely on one source. That's one reason. Considering the results for each field, we think that the appropriate share of nuclear power generation is about 40%.

Question: To Mr. Kobayashi
I'm Vishwanathan from India. I do see in your paper a small mention about the solar and wind energy. It mentions that Japan's geographical characteristics do not show promise for these resources to be significantly developed. In the global context, some of us share the view that these energy resources, particularly solar energy, have a great promise to a very large number of developing nations. I wonder if Japan has any organized program for this even though they may not directly benefit.

Reply:
I don't say that we are not doing any research on solar power generation. We are doing some research on thermal power, and eventually, Tokyo Electric Power Company will cooperate with the Indonesian government to construct a solar plant in Indonesia. In domestic power generation in Japan, the efficiency of solar power is very rare. The government and electric companies are doing some experimental research or maybe demonstration programs, but we don't expect this to develop into commercial operation in the future.

Question: To Mr. Kobayashi
A small question. I'm from the Philippines. You should know that the SOx and NOx emissions of Japanese power plants are much lower than those of the West. My question is, what is the cost of mitigating the SOx and NOx in terms of the percentage of power plants? Also, I'd like to know the cost per kilowatt hour in Japan compared to that of the West and that of the United States.

Reply:
First of all, the cost depends very much on what kind of fuel you are using. For example, for LNG, you don't need to pay much, but for coal or oil you have to invest some money. The most expensive anti-pollution measures are for coal power plants. The production cost per one kilowatt hour is about 10 Japanese yen. The desulferization equipment cost accounts for about one-tenth of that cost, and the denitrification accounts for about 8%. In terms of the cost, a comparison is difficult. There are so many different power companies in the United States, and

each power company has different generating costs, so it is very difficult to simply compare the cost with that in Japan.

Question: To Dr. In-Sik Nam
I would think that the graduate students and undergraduates in POSTECH are also used for these research projects.

Reply:
Right.

Question: To Dr. In-Sik Nam
Are they using some sort of cheap labor also?

Reply:
Of course. That's the whole idea of building up the university down there.

Question: To Dr. In-Sik Nam
In making the technologies the real things from the beginning of the idea of zeolite, what was the most difficult stage for the people in developing this particular technology? Was it the initial concept, or the material design? What was the most difficult part for you to develop this?

Reply:
I think the most difficult part is to try to persuade the host, I mean the POSCO to be a commercial plant. But so far, at the stage of development, we got full support from the POSCO. They support us with money as well as spiritual support. But right now, the problems we have with their process still can meet the current regulations. So, they are still waiting to tighten up the regulations. But the commercialization, I think, is the most difficult part so far.

Question: To Mr. Kobayashi
I want to ask some questions for Mr. Kobayashi. Is the geothermal energy production that you explained earlier exclusively for electricity generation?

Reply:
Yes, exclusively in Japan

Comment: Dr. Garcia
Yes. Let me explain. Although we have been using geothermal energy for electrical generation, we've done some other try with the help of the UNDP. We right now have in Negros a crack-drying plant to provide assistance to farmers in that area.

Question: To Dr. Garcia
Then, I'd like to ask two simple questions. Would you tell me the cost of electricity generation by thermal plants, and would you tell me also the life of the thermal plant?

Reply:
For the first question, it varies depending on when the power plants committed, the time of

commissioning. If you look at Makban or Tiwi field which have been operating since 1978, it costs about 90 centavos per kilowatt hour. For our new plants commissioned last year it is higher.

Question: To Dr. Garcia
How long do you expect the operation of geothermal plants?

Reply:
It's still running and producing at 90% load factor in Makban, the best fields in the world right now, and run by PGI. Our field in Negros and Tongonan have been running one-on-one in Polimpy Minuan since 1983. We expect more than 25 years, but we've pegged everything to 25 years.

Question: To Dr. Garcia
Mr. Kawasaki from Japan. I'm very much interested in your presentation, especially regarding geothermal. At this moment, roughly 21% of your electricity may be covered by geothermal power generation. Is this correct; 20% of total energy?

Reply:
Yes. We expect by the year 2002 to hit 26%. In fact, we went up 25% before, but coal plants are being constructed more quickly than geothermal now by the national power corporation.

Question: To Dr. Garcia
In relation to this higher average of electricity generation through geothermal, do you have any problems regarding natural preservation.

Reply:
The Department of Environment and Natural Resources are very strict with the compliance with environment protection. Before any project can be pushed through, it has to obtain the environmental compliance certificate, and that will require a lot of environmental impact assessment, a lot of permits and approval from the local development councils.

Question: To Dr. Garcia
Do you carry out environmental assessments?

Reply:
Yes, on all our projects. We've done everything even at our most controversial field, Mt. Apo in Mindanao.

Question: To Dr. Garcia
In Japan, there are some places which may have potential for geothermal, however, there is strong opposition from the environmental naturalists. This is quite difficult.

Reply:
Yes, we have that experience.

Question: To Dr. Garcia
Therefore, I am very much interested in how you overcome such problems.

Reply:
Well, it takes several years. We do a lot of public consultations, public hearings, before we even step into an area. However, in Mt. Apo there was some controversy because we were there as early as 1986 to 1988, to do exploration well. The controversy started when we started developing. We were being questioned on the tribal groups and our compliance with the Department of Environment and Natural Resources. So, we had to start all over again in 1993 to complete all the requirements; even public acceptance through public hearings.

Question: To Dr. Garcia
The questions from Dr. Kawasaki and Mr. Kobayashi are certainly related to resource assessment, which you mentioned in your view graph. How accurately can the resource assessments be done recently? This is related to life expectation as well.

Reply:
Well, we do a lot of reserve engineering work, simulation, which is included in the resource assessment. Resource assessment comes after drilling exploration wells. Normally, it will take three exploration wells to come up with the resource assessment. And based on our experience, we expect a life 25 years for a geothermal field, based on the life of your wellheads, your pipes, your casings. That is a standard figure of 25 years, although we have seen in other places in the world that geothermal fields can last more than 25 years. The Guyssen in the United States has been existing since 1959, and the New Zealand field in White Rock since 1960, and they're still producing the same amount of energy.

Question: To Dr. Garcia
Have you defined a life in terms of economy, or sort of a physical life such as the silica deposition and so on?

Reply:
Yes. The key, we believe here, is a proper reserve of management. We involve multidisciplinary groups who handle the reserve management.

Question: To Dr. Garcia
I think you are exploring in the world in terms of geothermal energy. I hope that you have a promising field.

Reply:
I've already said that we do work with other companies and institutions, especially the academia.

Question: To Prof. Nakajima
Well, since Japan is excellent as far as miniaturization is concerned, would it be possible in the near future, do you think, that a small nuclear power plant will be miniaturized and run to operate something like an electric-powered car? Is that possible? We see nuclear power

reactors in submarines and ships. Why not miniaturize it to the point where you could use it to run electric cars? You mentioned that our supply of fossil fuels is running out, right?

Reply:
I studied nuclear energy in college, but I think that is very difficult, even if not impossible.

Question: To Prof. Nakajima
Well, Dr. Nakajima, you could touch on your specialty in hydrogen energy.

Reply:
Well, nuclear energy utilization in a car would be very difficult, because of the people who use cars. Drivers are not always engineers. So, very dangerous! In regard to the other question, I researched hydrogen chemistry in school, and we learned that there was some difficulty in how to drive the car with hydrogen fuels. That is a point. The other is very similar to gasoline.

Question: To Prof. Nakajima
My first question is seeking a little elaboration about the hybrid electric vehicle. I'd like to understand a little more about the role of the electric motor driving a vehicle, and how you achieve twice the double fuel efficiency? One hundred percent improvement in fuel economy is very impressive, but on the other hand, the reduction of emissions does not appear to be very impressive from what is stated apparently; it's just about a 10% reduction in emission. What is the goal in getting much better reduction in emission rates?

Reply:
Gasoline engines idle when the vehicles are stopped, but with electric motors you stop all the power. Also, in the deceleration condition, ordinary gasoline continue running and emitting hydrocarbons, but with a hybrid car the power stops, and also the deceleration energies are recovered. So, emission goes down.

Question: To Prof. Nakajima
Well, the question pointed out that compared with the reduction in energy consumption, the reduction in emission was not so impressive. So, he wonders if there is technology which can possibly improve this in the near future. It is possible, isn't it?

Reply:
In my opinion, if you improve the hybrid electric vehicles, then maybe I think the emission of that vehicle may reach stationary power plant's emission. But the USA said that a zero-emission vehicle is possible.

Question: To Prof. Wattanapong Rakwichian
Did you say that your government helped develop the system by funding as much as 50% to the people who buy the system?

Reply:
Yes, I did. For people who buy the system, 50% is subsidized by the government.

Question: To Prof. Wattanapong Rakwichian
We offered industry the use of our photovoltaic system for a number of applications. I just want to know if Thailand has a vision of photovoltaic systems for different applications, not only just power generation or pumping and so on. On a worldwide scenario, have you sort of application in your mind? I think there is a lot of discussion that I have come across on the photovoltaic systems as strong candidates for the future century in terms of energy supply. So, I wonder if there is any paper, or any product, or any strategy taken in Thailand for the worldwide scenario of the application of photovoltaic systems.

Reply:
This applies for the government from the national energy of Thailand. They would like to promote photovoltaic systems in my country, because in the future it would be impossible to supply energy to a lot of provinces. Especially in the remote areas, there are many people without electricity. The official report is about 80,000 families, but the real report is about 1 million families in the remote areas without electricity. The photovoltaic one in the remote area is about 10 megawatts in the city for the rooftop. If you see the pattern load in ten years, for only in the evening, but today the pattern load is at the same season good for the PV for connection in the daytime.

Question: To Prof. Wattanapong Rakwichian
Is there any paper describing what you are doing available? In our country, Japan, MITI subsidizes as much as 3 million yen per house for the purchase of solar roof systems within the limited years that they are still helping. Right now, it's still expensive.

Reply: To Prof. Wattanapong Rakwichian
Thank you very much. Before I started this project, I started many projects in the world for PV rooftops and the PV stand-alones --in the Philippines, in Indonesia and so on. And also in PV rooftop I have studied 7,000 rooftops in Japan and 10,000 rooftops in Germany. It is very successful in Germany and Thailand. Rooftop is 3 kilowatts, and we installed 4,000 rooftops in Thailand, subsidized from the government. We installed 10 rooftops in Bangkok for the demonstration. For that fifty percent was subsidized by the government.

Question: To Prof. Wattanapong Rakwichian
You will have 10 megawatts, a great connected system. How large a surrounding area would you be using for that one?

Reply:
For that one, it depends on the kind of PV system. For 3 kilowatts on the roof we need about 50 to 100 square meters.

Question: To Prof. Wattanapong Rakwichian
I have researched photovoltaic energy in Thailand. Especially in remote, rural areas, we need the renewable energy like solar energy, or biogas, or clean energy. So, we need a policy for developing these kinds of renewable energies, but I don't know even in Thailand about the cooperation with these kinds of energy and why they would choose solar energy.

Reply:
I reported from my center for research in solar energy, and we proposed solar energy to the government. This system is very easy and better than biogas or biomass, which are very difficult to promote. And the technology in PV is better than that in biogas, and it's better for the people. So, we studied for a long time and proposed it to the government, and the government agreed to start the policy for the PV rooftop panel.

Question: To Mr. Watanabe
It is quite impressive that you once imported technology from the United States, then you developed it further, and then you could export the technology back to the United States. Very impressive. One thing I'd like to ask you is, what is the scenario for the Japanese side to store the nuclear waste from the power plant? With what you were talking about today, they are really stored on the site?

Reply:
Yes.

Question: To Mr. Watanabe
There are three levels of waste: high level, medium level, and low level. You can handle, maybe, low level waste, but supposing you have the medium level and high level, then what are you going to do? As far as I know, the United States even couldn't find a site to store the high-level nuclear waste. Could you tell us a kind of scenario of the Japanese government on how they're going to handle the nuclear waste?

Reply:
In Japan, we have two kinds of waste. One is the high-level waste, and the other is the low-level waste. Actually, the medium level of waste was stored in the nuclear power plants, but now it is separated into two kinds. Maybe all of the medium level waste after some kind of treatment becomes higher and lower. As you know, for the high-level waste, we are now constructing a spent nuclear fuel reprocessing plant in the northern part of Japan. Also, the power company selected a low-level waste disposal site in the northern part of Japan next to the spent nuclear fuel reprocessing plant. Also, in the United States, they don't have a special nuclear reprocessing plant; they just only store the spent nuclear fuel at the reactor site. So, the US has only low-level waste disposal sites.

Question: To Mr. Watanabe
As far as I know, they are planning to have a storage site in the desert of Nevada. In Korea, two Ministers of Science and Technology resigned when they decided the site for the sewage of the radioactive waste. I think this type of work, and the area of ASEAN that has power plants should work together and find one solution. As far as I know, they also have some kind of trend to have more nuclear power plants in China, and in Korea too. It may not be the case in Thailand or the Philippines, but I think we better work together and find out one huge site that we can use together. Maybe the site can be in Siberia in Northern Russia. Although the Russian people are here, nobody lives there, and we may work together and find a place. Do you have any comment on that?

Reply: (Mr. Kawasaki)
I was involved in the nuclear business in the Science and Technology Agency on that occasion. I have some knowledge about such high radioactive waste question. You suggested the possibility of the Philippines or some other Southeast Asian countries building up some nuclear power plants. But the question is about the reprocessing plant, especially regarding the high radioactive waste. Currently in Japan, one of the greatest organizations of power generation—and also the Nuclear Fuel Development Corporation and the Japan Atomic Energy Research Institute are conducting two ways to handle high radioactive waste. One is the engineered system, and the other is a fully disposable system in the natural condition. The first type is just like the Swedish one. However, that is only under research or survey, and the plan is not fully determined. The other one, the engineered is a preliminary small-scale test bed that is constructed in the northern part of Japan. Currently, a small portion of the high radioactive waste has been accepted from the French and also the UK where the Japanese spent fuel was reprocessed. But, the volume was not quite so large, only a small test bed. And those two approaches are mainly processed by the classification of the waste. And naturally, this activity is still under R&D, not taken to the point of demonstration, not commercialized, so therefore the questions remain. And the second point, especially regarding the Pacific Asian countries, it is relatively reluctant, because from the safeguard aspect, the reprocessing plant is quite crucial. Especially this spent fuel reprocessing plant will reproduce some of the separated plutonium. Therefore, most of the countries have concerns about the horizontal proliferation of nuclear material. From such point of view, a reprocessing plant is not imagined to be constructed at the moment. Therefore, in my personal view, there is no concrete plan to buildup a reprocessing plant in these Asian countries. That's my comment.

Question: To Mr. Watanabe
I made three observations, with one little question at the end of each. It was a very interesting paper. The first observation was in regards to achieving the quality where the emphasis on one end of the world is on the spirit, and the emphasis on the other end of the world is on procedures. Some of us in the middle part of the world feel that both are important, and among the two, we feel that spirit is more important than the procedure. It was very interesting to see that you could get the Japanese engineers to understand the need and importance for procedures, but when you transferred the technology back, you did mention that there was a little problem in making the American engineers understand the need of the spirit. I would still like to know how successful you think you were in making them understand that spirit is as important or more important than the procedure in order to achieve quality.

Reply:
Thank you very much for your question. I understand what you said. Japanese people place more importance on spirit than on procedure. But Japanese people also think about another thing. Do you understand? We Japanese people are not willing to explain our spirit to other people. In my presentation, this story started from 1967 and finished in 1992, so I joined in for only part of it. I don't know how to explain our spirit to US people. Maybe this kind of plant became a success, so maybe our staff transferred their spirit to the US people, but I don't know how to translate this.

Question: To Mr. Watanabe
Perhaps the long-term stay for a Japanese engineer in the US gives them a little bit about the spirit aspect, maybe. Just two other aspects. The second one is on concurrent engineering. What little we have read and learned about concurrent engineering is all from the US literature. I was surprised to hear your observation that Japanese are more attuned to doing concurrent engineering than the Americans. That apart, my specific question here was to understand how much you think the productivity cycle is improved, or how much of the cycle time for executing a product is reduced by practicing concurrent engineering. We have seen view graphs, but I thought since here is a practical example, I would like to know, if we had followed the part of phase-by-phase engineering versus the concurrent engineering approach, how much time shrinkage would there be?

Reply:
I'm not sure about your question. The US people are doing their projects phase by phase. On the other hand, Japanese are doing their projects concurrently. Therefore, there is much difference between our engineers and the US engineers in this procedure. If US people are doing it phase by phase, their role is very limited, and the space is only a very limited area. On the other hand, Japanese engineers also have some specified limited area, but our engineers have some kind of gray area included, so the Japanese engineers also individually coordinate each other and understand what other people are thinking. But the US engineers are always saying, "It's none of my business" facing the gray area. So, we thought that coordination among the US engineers was necessary, so we had the project engineers deal with all the information, and we stayed longer in order to coordinate this engineering method.

Question: To Mr. Watanabe
My specific question was about time reduction in this project because of the practice of concurrent engineering. I fully share the views on the strength in doing concurrent engineering. In fact, we have also attempted to practice and see how much we could achieve in terms of time reduction apart from a quality crew that comes in because of what you just described as the gray-area knowledge. Instead of having it highly compartmentalized, you will be subject. I wanted to know your view as to how much reduction one can achieve in terms construction time.

Reply:
I don't know how much the construction period is reduced. I established the project schedule in concurrent engineering, so I don't know much about the phase-by-phase schedule.

Question: To Mr. Watanabe
The last observation was in regards to the recruiting people in the companies, which I consider very important. I think that there is a lot of merit in it, but there's also a lot being said about the mobility. In general, the mobility seems to help an individual grow and affects the organization. On the other hand, over the longer term it helps the organization, but it does not necessarily help the individual grow. Is there any conscious policy or practice in Japan by which both practices are taken into account; where not only the company benefits, but the individual also feels that he is growing professionally.

Question: To Prof. Nakajima
I have two very simple questions for Professor Nakajima. We feel that the link between industry and academia is very important in the country and should be strengthened. You made the statement that cooperate research among companies and academia have achieved little in the automobile area in Japan. What are the reasons behind this poor linkage between academia and industry, and what solutions do you propose to involve more academia?

Reply:
That's a difficult question. Automobile technology is very expensive, and it is very expensive for academia to develop. It is a very wide field, and system engineering is very difficult. So, academia and the automobile research somewhat differently. We talk to academia, and the level is somewhat different, so it is not useful now. But, if academia can find a way to cooperate with the industry, some special research themes will be very important for automobile companies, and there will be some cooperation in some areas. But now there is very little.

Comment: from Chairman:
Are saying that once you specialize in an issue such as fuel cells, then academics may penetrate into your region, but otherwise, because of expense and the widespread characteristics of the people from academia, they don't have a good chance to get involved in various ways?

Question: To Prof. Nakajima
Well, I gather they are asking for high compensation, or they don't know much about the automobile industry. Which of the two? Or both?

Reply:
First of all, engineering departments in Japanese universities don't have automotive engineering. This mismatching is very problematic. I am working to collaborate with academia and other companies.

Question: To Prof. Nakajima
I thought my question was simple. Maybe it's like the case of Pohan where the academia is allowed to work with or in the industry. So, maybe if people also allow students also to work on research within the industry, then maybe that would help in the situation.

Reply:
I feel it also depends on the situation and what your situation is, although the professors in the university right now should measure. I mean it all depends. As far as I know, in Japan, they have strong collaborations between university and industry. Maybe Nissan had a bad experience with the university, but in most cases, as far as I know, they have strong collaborations. They gave universities very specific projects that they can work out.

Comment: from Chairman
Well, Dr. Nakajima is a good example of the combination.

Comment:
I'm Ishak from the Ministry of Science, Technology, and the Environment of Malaysia. I've

had experience working in industries and then working as an academician. I think the industries are taking the following approach. Because academicians are by nature very individualistic and they don't have the sort of discipline that is required of people working in industries, for the very expensive, high-capital, high-tech projects, the industries normally modularize the research into smaller components and then let academicians handle these smaller components. The industries would normally take this component and integrate it into their own base, into their own research. They will never give a central element of that research to academicians, because I'm sure we all understand what academicians are. They are very individualistic, in a sense. Thank you very much.

Comment:
I'm Jusman from Indonesia. I work for the car industry, and will tell my experience working in projects in this car industry. I have two experiences about the concurrent engineering projects I have worked on. First, we do concurrent engineering for the mechanical parts, then second is the sheet metal process. In the mechanical parts we have what we call an 'experience guide,' from Kawasaki Company in Japan. He leads us to develop a theme in the concurrent engineering in doing the mechanical parts. You see a reduction of about 25% in time compared to phase-by-phase. Second, in the sheet metal process. A Korean American from the United States came to Indonesia and then also met a collection of people doing the computer aided designs and made the tooling for the sheet metal process. The achievement is that the lead time is reduced by 10%. We don't know yet. It depends. The first doors are from the sheet plane, and the cultures are from the complexity of the problem itself, whether it's 10% or 20%. But the basic material is the young engineers from the developing countries. That is one experience.

The second experience we have is that when we made our first efforts in Indonesia to create the parts industry, we had no specialist engineers in that area, so we invited a teacher to increase the skill level of the young engineers. Then, for the first time, as mentioned before, the 'undisciplined or the innovative creative academicians' prolong the project, but from the economic cash flow, they are making something like 'unsatisfactory results.' But from the technology cash flow, in terms of human resource development, the academicians can create more people to help them do the job because it creates more competitive groups to resolve one problem. That's the key. After that, the academician can go into two directions. First, if an academician has the capacity to compromise the business environment, then he at least becomes an industrialist in that sense. But if an academician cannot compromise his creative work, then he stays in the university and learns. Therefore, it seems that we cannot split the academician from industry, and vice versa.

Question: To Mr. Watanabe
Now, there are two technologies must be patented. My first question is, whether during the filing of the second patent, there was any conflict between JGC and EBASCO or not. The second question is, don't you think that by this way, EBASCO has created a competitor for themselves in the same technology area? Also, is JGC is considering to further transfer the same technology to some other country or not?

Reply:
Thank you for your question related to the patent. We obtained just the engineering technology, and it was not related to any patent, so there was no problem. EBASCO is only doing nuclear power plant architecture engineering. They are not familiar with the waste treatment, so we develop a lot of technology in the radio active waste area, and we had the intention to export our technology into other countries. Unfortunately, recently, General Atomics exported an advanced BWR-type reactor to Taiwan. The DGC was one of the candidates to execute this system in Taiwan.

Comment: from Prof. In-Sik Nam To Dr. Rakwichian
I'm In-sik Nam from Pohan, Korea. I was so impressed by the presentation Dr. Rakwichian from Thailand. In a country like Thailand, which is using solar energy for the production of electricity in remote areas, I was impressed. Korea is more like a developing country, and we don't want to use solar energy for the production of electricity like now simply because it is much more expensive than the production of electricity by other methods like thermal, or oil-fired generators. But a country like Thailand decided to use solar energy as a source of electricity. I really admire your effort to maintain the earth for our next generation. It seems to me that in Thailand, you don't have to worry about the environment; you'd really be better off worrying about foreign currency; the value is falling down. For the moment, you have a jungle, and as far as you can maintain that jungle, I believe. I'd like to give them a big hand for maintaining the environment of the earth for the next generation. Give them a big hand!

Summary of the Session I by Chairman:
Well, just briefly, we started out with the presentation and discussion on the energy resources and the environment. In tomorrow's session, we will have presentation on the multimedia information communication system as well as the transportation system, and the means for the preparation of infrastructures for our coming generation, maybe in the 21st century. So, this is a good beginning, with so many issues now in mind. But today, we had three presentations which dealt with the energy power supply. Mr. Kobayashi emphasized the importance of the reliability and stability of a power supply as a fundamental aspect of the power supply company. He also talked about the difficult issues to overcome in environmental programs considering the economical growth in time. He mentioned the importance of a best mix of resources to make the stable supply of power possible.
Then, Mr. Garcia talked about geothermal power supply and the importance of thermal power supply in the Philippines –it will reach almost 30% of total power supply by the year 2000. We talked about the technical issues there, and somebody mentioned that maybe resource assessment of geothermal wells is important. If you privatize the system as a private industry, economic reasoning becomes more important, and life expectation and resource assessment may be critical issues.
Then we had a presentation by Dr. Rakwichian about photovoltaic application in Thailand. Those three presentations indicate the importance of local conditions, culture, social system, with not only just technology, but also the acceptance criteria for the technology for each country, and the lesson of each country, indicating the harmony between technology and social systems.
Then we had the next three presentations. First, Dr. Nakajima told us about the improvement

through automobiles. Today he discussed energy saving through the development of technology, but still he insisted on the importance of networking in R&D throughout the similar field. However, because of the time limitations, he did not talk about the productivity of resources and materials. In the next few days, I think he will talk about this.
Dr. In-sik Nam introduced us to one of the good collaborations among industry, a research institute, and a university covering the idea and the market even within those groups. Again, he indicated the importance of collaboration among different fields, particularly when we deal with the environmental issue.
Finally, Mr. Watanabe discussed the technology transfer over the cultural barriers, and even though he thought about the local conditions, still he has to think of the different cultures to make the technology transfer back to the United States. Those three presentations simultaneously indicated the importance of a variety of collaboration, and this gives us a hint for the session that we have tomorrow. Sorry for taking time for my summary, but I would now like to welcome additional comments, suggestions, and questions to the speakers which you did not have time for earlier.

Session II

Information and Society

Multimedia Super Corridor: Transforming Malaysia's Economic Development

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Abstract

Malaysia is a resource rich country and a major socio-economic force in the Asia-Pacific region. Historically, the economy of Malaysia was based on agriculture and natural resources. In its efforts to transform Malaysia to a developed and industrialised country, the Malaysian government started to focus on industry and high technology in the 1980s. By the mid-1990s, the manufacturing sector has become the most important sector of the economy, accounting for 35% of the GDP and more than 80% of total exports.

In 1991, the Malaysian government announced Vision 2020, a plan which calls for Malaysia to become a fully developed and an information rich society by 2020. To realise that vision, Malaysia will have to undergo a major restructuring of its economy, and to move from input-driven growth to productivity-driven growth. The Multimedia Super Corridor (MSC) is a national project designed to bring about the change in Malaysia's growth path, from one driven by labour and capital intensive industries to one led by high value-added information-based economic activities. This presentation will provide an analysis of the role of information technology in economic development and the salient features of the MSC. The challenges faced in implementation will be highlighted.

Background

1. Malaysia is a resource rich country and a major socio-economic force in the Asia-Pacific region. Historically, the economy of Malaysia was based on agriculture and natural resources. In its efforts to transform Malaysia to a developed and industrialised country, the government started to focus on industry and high technology in the 1980s. A key area of focus was Information Technology (IT).

2. Throughout the 1980s, a series of policies were initiated to promote the use of IT in both the private and the public sectors. The policies addressed IT infrastructure, education and training, research and development, use of IT in the public sector, and fiscal incentives (Venugopal, 1992). These IT policies and the broad economic and industrial policies implemented during this period had a positive influence on demand for IT products and services, number of IT professionals, number of telephones per 100 population, and IT production and use.

3. The experience gained in formulating and implementing IT policies in the 1980s have paved the way for more definitive policies and co-ordinated approach to IT in Malaysia for the 1990s. For example, the importance of IT was formalised recognised when an IT programme was formally incorporated in the Sixth Malaysia Plan covering the period 1990-1994. The government also adopted an aggressive plan to liberalise the telecommunications sector with the aim of developing a world class telecommunications infrastructure (Raman and Yap, 1996).

4. This emphasis on IT was reiterated by the Prime Minister Dr. Mahathir Mohamed in 1991 when he announced "Vision 2020", a plan which calls for Malaysia to become a fully developed and an information rich society by the year 2020.

   "In the information age that we are living in, the Malaysian society must be information rich. It can be no accident that there is today no wealthy, developed country that is information poor and no information-rich country that is poor and undeveloped. .... No effort must be spared in the creation of an information rich society."

5. When the Multimedia Super Corridor (MSC) project was announced in 1996, the regional countries and the global IT sector were taken by surprise. Many expressed their doubts about the viability of the project and the ability of Malaysia to turn the vision into reality. Even today, many still do not understand the objectives and the rationale for the MSC.

6. The Multimedia Super Corridor is not a single project. It is multi-faceted and covers development of both "hard" and "soft" infrastructures. It involves physical development of townships within a new 15 x 50 kilometres "corridor", provision of an advanced telecommunications infrastructure, enactment of an up-to-date legislative framework for the information age, as well as the implementation of several large-scale public sector multimedia systems development projects.

The Rationale

7. The rapid economic development of Malaysia in the past was driven initially by exports of commodity products such as tin, rubber, palm oil and petroleum, and later by rapid industrialisation. To achieve the goals of Vision 2020, Malaysia needs to sustain an annual growth rate of 7% up to the year 2020. It is expected that the manufacturing sector's contribution to the GDP will peak at around 38 per cent by the year 2005. Malaysia therefore needs a second engine of growth for the economy. We believe that this second engine of growth will come from a thriving IT and multimedia industry that will, in turn, fuel productivity in other sectors.

8. Over the past few years, economists have pointed out that South East Asia, and that includes Malaysia, will not be able to grow along the existing path at the same rapid rate continuously because the growth over the past two decades was input-driven and hence not sustainable. Therefore, to achieve the goals of Vision 2020, Malaysia has to change course. It has to move away from low-cost, labour and capital intensive

manufacturing into high-tech, high value-added industries. At the same time, Malaysian government and businesses must increase their productivity through effective application of technology.

9. It is within this context that the Multimedia Super Corridor was conceived. The objectives are to create a new IT and multimedia industry in Malaysia and to catalyse the use of IT and multimedia technologies in government, businesses, and society to increase productivity and competitiveness.

10. The ideas behind the MSC are not new. Economists have long pointed out the contribution of the information industry to national economies, particularly in the OECD countries. These developed nations have long recognised the importance of the IT sector and now dominate the global IT market. Similarly, it is common knowledge that if applied appropriately, IT can be used to improve productivity and competitiveness. The role of IT in economic development is well documented (APO, 1990; Sisodia, 1993; Odedra-Straub et al., 1995).

11. What is new or innovative about the MSC is the way it is planned, managed, and implemented. It brings together the key elements of success for large-scale public projects:
    - Development of both hard (physical and telecommunications infrastructures) and soft (legislation, human resource development, and fiscal incentives) infrastructures
    - Involvement of both public and private sectors
    - The projects are co-ordinated through a single, high-powered agency, the MDC
    - This project has the full support and commitment of the Prime Minister himself.

The Multimedia Super Corridor

12. The key elements of the MSC are:
    - Top-quality urban development in Cyberjaya, the first MSC-designated cybercity designed from the ground up.
    - Leading-edge soft infrastructure, including highly attractive incentives, unrestricted import of foreign knowledge workers, the world's first comprehensive framework of 'cyber-laws', world's first Multimedia Convergence Act, and a sharper focus on multimedia education.
    - World-class IT network consisting of a high-speed backbone, and the most cost-competitive telecommunication tariffs offered to MSC companies.
    - MDC as a high-powered, one-stop super-agency.

13. To lead the development and management of the Multimedia Super Corridor, the Multimedia Development Corporation (MDC) was established. The MDC is incorporated under the Companies Act of Malaysia and is owned and funded initially by the Government. It is run as a private company but has the authority of a high-powered government agency. It is empowered to ensure that companies interested in the MSC get what they need to succeed by providing information and advice on the MSC, and assisting in expediting permit and license approvals.

Physical Environment

14. The physical and environmental infrastructure provisions will ensure that an attractive "garden corridor" is created with custom-made commercial, residential, civic, institutional, and recreational precincts. The highlights of the MSC's physical environment include:
    - Cyberjaya, a garden city of 7,000 hectares, is the first major MSC-designated cybercity. As the nucleus of the MSC, Cyberjaya will offer a full package of incentives and facilities - including high-speed fibre networks, a balanced development of enterprise, residential, commercial and public precincts, world-class homes, restaurants and shopping facilities, and large open parks. Cyberjaya also aspires to be a "near-zero emission city" through strict zoning policies and environmental guidelines.
    - Putrajaya, the new seat of Government and Administration, is designed as a paperless environment in a bold experiment at electronic government. The office of the Prime Minister of Malaysia is scheduled to move to Putrajaya before the end of 1998.
    - The Multimedia University, currently operating in Malacca with 1200 students, is scheduled to move into its MSC campus in October 1998. The university will introduce multimedia-specific programmes and cater to the skills requirements of companies located within the Corridor. It aims to be a world leader in the promotion, acquisition generation and application of knowledge in areas related to multimedia.

Telecommunications Infrastructure

15. Supporting the MSC is a high-capacity, digital telecommunications infrastructure designed to the highest international standards in capacity, reliability, and pricing. Key telecommunications network features that will link the MSC to regional and global centres include:
    - A fibre-optic backbone with an unprecedented 2.5-10 gigabits per second capacity, which is more than enough network power to support virtual boardrooms, remote CAD/CAM operations, and live multimedia internet broadcasting.
    - High-capacity links to international centres to ensure that information, products, and services flow freely and quickly between MSC companies, their overseas partners, and export markets.
    - Open standards, high-speed switching, and multiple protocols including ATM that bring power and flexibility to the development and implementation of multimedia applications.
    - Best-in-class performance guarantees including installation of telephone services within 24 hours, ATM circuits within five days, and a 99.9 per cent service availability.
    - Competitive telecommunications pricing including flat-rate, low pricing for basic network services and an open-entry policy for value-added network services to ensure the MSC maintains its competitive edge.

Policies and Cyberlaws

16. To support companies undertaking electronic commerce and to provide the appropriate legal framework for electronic transactions, Malaysia is transforming its legal and regulatory environment. The major acts that have been or are being drafted include:
    - The Multimedia Convergence Act which creates a framework for the convergence of the broadcasting and telecommunications industries. The Act will be implemented in 1998.
    - The digital signature cyberlaw enables businesses and the community to use electronic signatures instead of their hand-written counterparts in legal and business transactions.
    - The multimedia intellectual property cyberlaw gives multimedia developers full intellectual property protection through on-line registration of works, licensing, and royalty collection.
    - The computer crime cyberlaw provides law enforcers with a framework that defines illegal access, interception, and use of computers and information; standards for service providers; and outlines potential penalties for infractions.
    - The telemedicine development cyberlaw empowers medical practitioners to provide medical services from remote locations using electronic medical data and prescription standards, in the knowledge that their treatment will be covered under insurance schemes.
    - The electronic government cyberlaw allows politicians, public servants, and the public to communicate electronically with each other using established and secure formats and standards.

MSC-Status Companies

17. All companies that create, distribute, integrate, or use multimedia products and services can apply for MSC Status. The MDC guarantees a 30-day turnaround for applications and coaches companies through the selection process. Companies awarded MSC Status enjoy the government's Bill of Guarantees and other incentives including:
    - Substantial financial incentives, including 0 per cent income tax for up to 10 years or a 100 per cent investment tax allowance, and no duties on multimedia equipment. The right to tender for key implementation contracts for Flagship Applications. Only companies with MSC Status will be able to apply for these contracts.
    - Support from the MDC's one-stop client centre that will expedite visas and other licences and permits. Direct access to Malaysia's top leadership through membership of the MSC's International Advisory Panel, chaired by the Prime Minister, and the Founders' Council, chaired by the Deputy Prime Minister. First movers to the MSC are invited to sit on these high-level councils.

Bill of Guarantee

The Malaysian Government commits the following to companies with MSC Status:

1. Provide a world-class physical and information infrastructure.
2. Allow unrestricted employment of local and foreign knowledge workers.
3. Ensure freedom of ownership by exempting companies with MSC Status from local ownership requirements.
4. Give the freedom to source capital globally for MSC infrastructure, and the right to borrow funds globally.
5. Provide competitive financial incentives.
6. Become a regional leader in intellectual property protection and cyberlaws.
7. Ensure no Internet censorship.
8. Provide globally competitive telecommunications tariffs.
9. Tender key MSC infrastructure contracts to leading companies willing to use the MSC as their regional hub.
10. Provide a high-powered implementation agency to act as an effective one-stop super shop.

Flagship Applications

18. To jump-start the development of the MSC, seven primary areas for multimedia applications have been identified. These Flagship Applications are:
    - Electronic Government
    - Multi-Purpose Card
    - Smart Schools
    - Telemedicine
    - R&D Cluster
    - World-wide Manufacturing Web
    - Borderless Marketing

19. The development of the Flagship Applications is driven by the relevant government ministries and agencies. These agencies work in close partnership with leading international and Malaysian multimedia companies to clarify the concepts and create detailed implementation plans. Joint government-private sector teams developed concrete proposals for each Flagship Application between December 1996 and June 1997. Fifteen Concept Requests for Proposal were issued in July 1997. A team of experts evaluated proposals submitted by vendors and the projects have now entered the implementation phase.

20. The Flagship Applications are an important part of the MSC initiative. Through these applications, we hope to increase the productivity of the public sector and improve the quality of service delivered to the public. As part of this initiative, all employees in the civil service will be retrained so that they are IT-literate. Some of the projects aim at reengineering the government, streamlining procedures and improving service delivery. Hence, besides jump-starting the MSC, these Flagship Applications also help

to catalyse the diffusion of IT into various sectors of the economy.

The Challenges

21. The success of the MSC depends very much on the availability of knowledge workers in the country. It has been pointed out that there is a shortage of skilled IT manpower in Malaysia. However, this problem is not unique to Malaysia; there is a global shortage of computer programmers (Business Week, August 4, 1997). For the MSC, current projection is that about 7,000 knowledge workers are required each year.

22. The Malaysian government has taken a number of initiatives to address the human resource challenge. First, under the Bill of Guarantee, MSC-status companies are allowed to bring in their own knowledge workers without any restrictions. In fact, the Multimedia Development Corporation will assist these companies in the application for work permits. Second, the government has greatly increased the enrolment of students in publicly funded universities. The intake in 1997 was 40% more than that in 1996, and the intake will increase by a further 15% in 1998. The target is to have 20% of the 19-22 year-old cohorts enrolled (for age group 19-22) into institutions of higher learning by the year 2000. Third, the government has extended the privileges of the MSC-Status to institutions of higher education, with the aim of encouraging further investment in IT and multimedia education. In addition, there is an ongoing effort to attract overseas Malaysians to return to serve the nation. Many MSC-status companies will also be providing in-house training to their employees.

23. Another area that is crucial to the long-term sustainability of the MSC is Research and Development. For the MSC to be sustainable there must be a critical mass of R&D activities within the MSC. With an active R&D culture, there will be cross-fertilisation of ideas and collaboration between the MSC companies. Only then will they be able to produce new and innovative multimedia products for the global markets. With revenues from global sales, these companies will be able to expand further their R&D activities to produce the next-generation products and technology.

24. To realise this objective, we need to have a pool of R&D manpower. This is by no means easy, given that there is a global market for such skilled and scarce manpower. Recognising the importance of R&D, the Malaysian government has initiated several incentive schemes to encourage R&D activities not only in the universities and publicly funded research institutes, but also in the private sector. For the MSC, a special incentive programme, called the MSC Research and Development Grant Scheme (MGS), has been implemented. The MGS has been given an initial allocation of RM100 million to encourage R&D activities by MSC-Status companies that are majority Malaysian-own. Besides the MGS, efforts are being taken to create a capital market to provide funding to technology-based companies. Venture capital funds are now available and have provided funding to several MSC-Status companies. A stock market for technology-based companies, the MESDAQ, is expected to be launched in June 1998. These funding mechanisms will help to nurture techno-preneurs and create a vibrant R&D culture within the MSC.

Conclusions

25. The Multimedia Super Corridor is a large project initiated by the Malaysian government. Barely 18 months after its announcement in August 1996, the MSC is rapidly taking shape. The vision has been turned into reality: infrastructure development is one year ahead of schedule, four cyberlaws have been passed by Parliament and more than 180 companies have applied for the MSC-Status. These companies collectively will invest more than RM4 billion over the next five years. The contribution of the multimedia industry to the Malaysian economy will no doubt become more important and highly visible in the years to come. As the Flagship Applications are implemented over the next two years, its impact on the public sector and the citizens will be felt. The multimedia industry has become an engine of growth and is rapidly transforming the Malaysian economy from input-driven to productivity-led.

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Telecom Network Digitalization

- How it is done in Japan –

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(Written on March 20, 1998, on the basis of the Presentation at the
Third Asia-Pacific R&D Management Seminar,
Manila, Philippines on February 17th, 1998)

1. Introduction

On December 17th, 1997, NTT completed the digitalization of its Telecommunications Networks in Japan, turning all local and transit switches and transit trunk circuits into digital. This laid a solid infrastructure for Japan to enter into the Information Age of the 21st century. It also brought forth significant merits in the form of reduced cost and improved quality. This paper reviews how this significant achievement was initially visioned, planned and achieved, with an emphasis on building the human resource infrastructure.

2. Overall review of the digitalization process

In order to review the history of telecom network digitalization in Japan, we have to go back to the early 1970s, when the last winter olympic games were held in Sapporo in 1972. (Figure 1) In early 1970s, R&D activities were started on various digital technologies at the NTT's Laboratories, in cooperation with the manufacturers and other academic and research institutions. (Figure 2)

Seeing the great potential of digital technologies, NTT announced the INS (Information Network System) Vision, presenting a concept and overall planning for the offering of new telecom services and applications based on the digitalization of telecom networks. (Figure 3) The INS Vision identified merits of digitalization (Figure 4), key technologies on which intense R&D activities were needed and how human resources were to be developed (Figure 5) . In addition to giving first-hand experience to young, best and brightest engineers a working opportunity with manufacturers, specific measures taken included exchange of personnel between R&D Centers and Business Departments, Regional Offices and Company In-House Training Colleges. (Figure 6)

These measures to develop human resource infrastructure were extremely useful in securing the right people at the right positions in various parts of the telecom manufacturing industries and telecom network operators.

3. The Asian Multimedia Forum (AMF) and Cooperation with Asian Countries

The INS Vision which NTT announced in late 1970s was a precursor to such concepts as the Global Information Infrastructure (GII) of US Vice President Al Gore (1994) and the recent trends toward the Multimedia Age/Society. Reflecting important key words such as Global and Multimedia, NTT proposed to organize the Asian Multimedia Forum (AMF) , which was established in 1997 with 19 founding members from 8 Asian countries. (Figure 7 and Figure 8) More than 10 projects were under way at the AMF, with a view to finding promising multimedia applications in Asia. (Figure 9)

4. Required Ability for Project Managers

It is hoped that, through the projects at AMF, not only promising applications would be identified, but also harmonized multimedia infrastructure be built, and human resource development take place through people from different countries working together for common projects. In doing so, it is still my personal belief that the basic characteristics of developing human resource apply not only to domestic projects, but also to cross-border projects such as those of the AMF. (Figure 10)

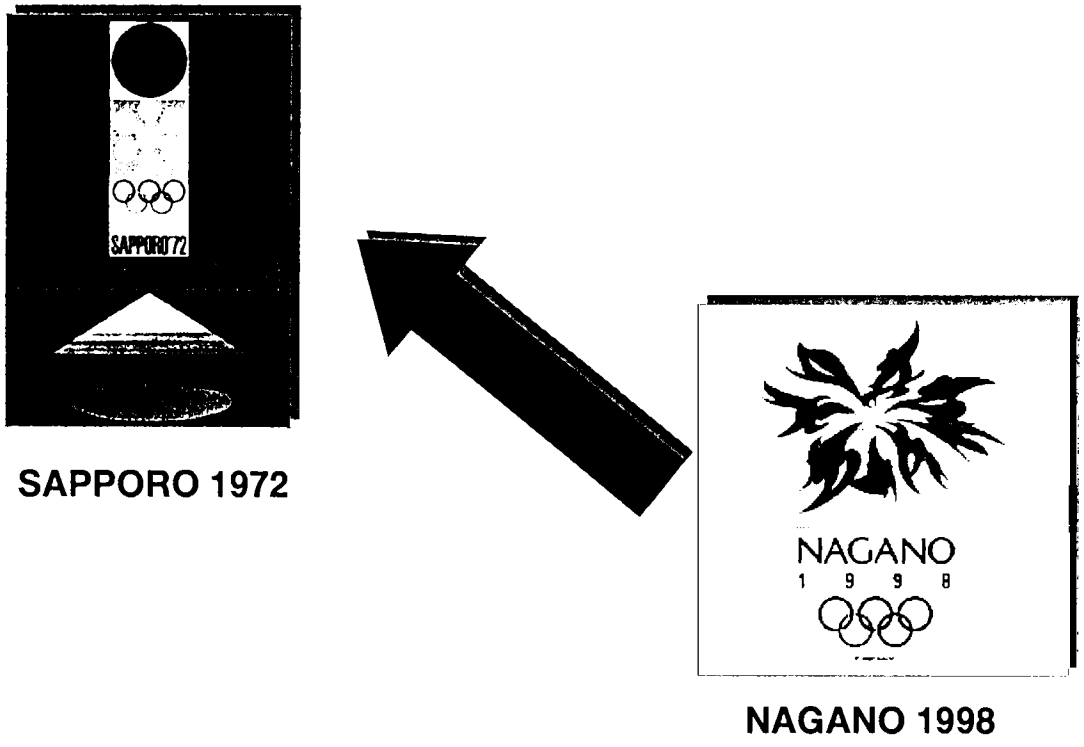
5. Conclusion

A big project such as telecom networks digitalization requires:

1) Vision and Over-all Long-term Planning
2) Research and Development
3) Careful Implementation, and
4) Human Resource Development to Support All the Above Efforts/

(Figure 12)

Figure 1. Back to the 1970s in Japan ...

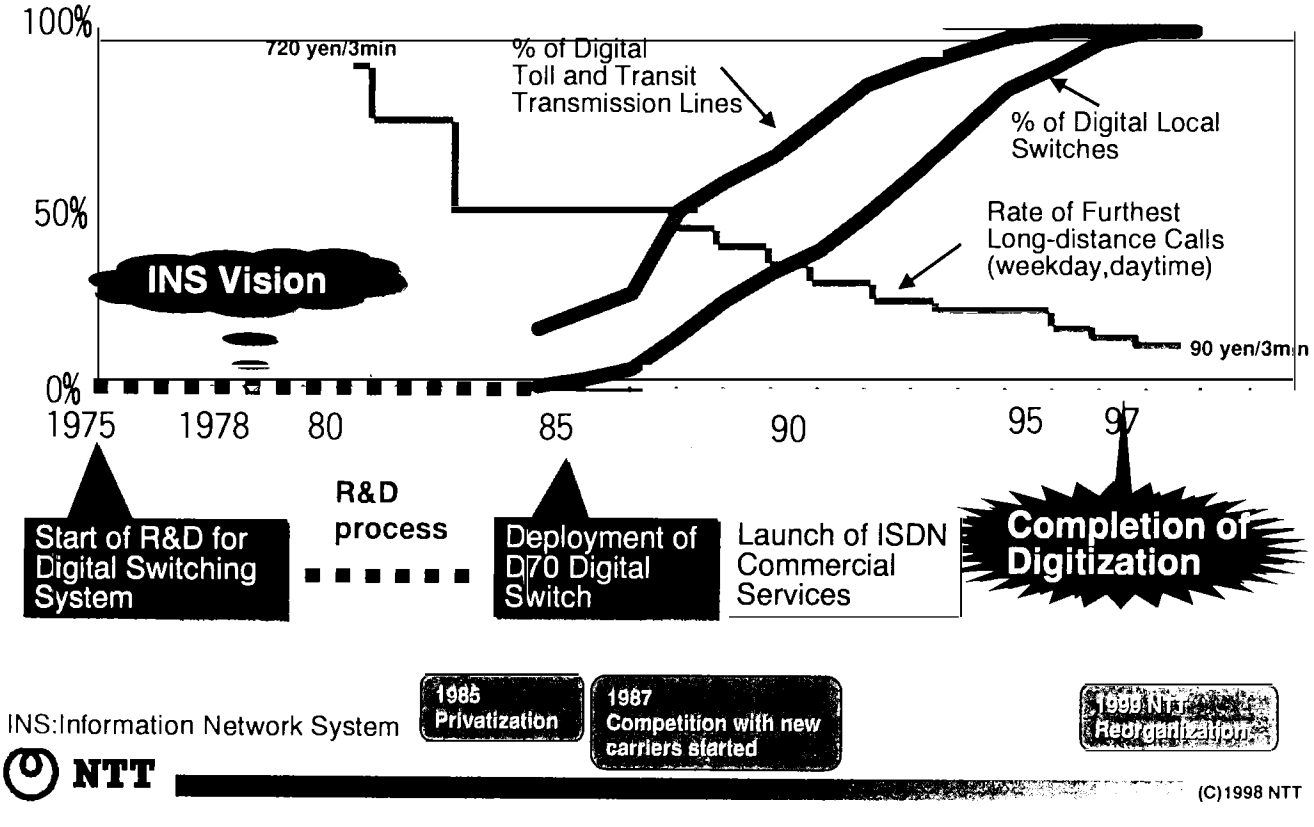


SAPPORO 1972

NAGANO 1998

NTT

Figure 2. 22 Years Digitalization Process



INS:Information Network System

NTT

Figure 3. Vision and Activities toward Digitalization

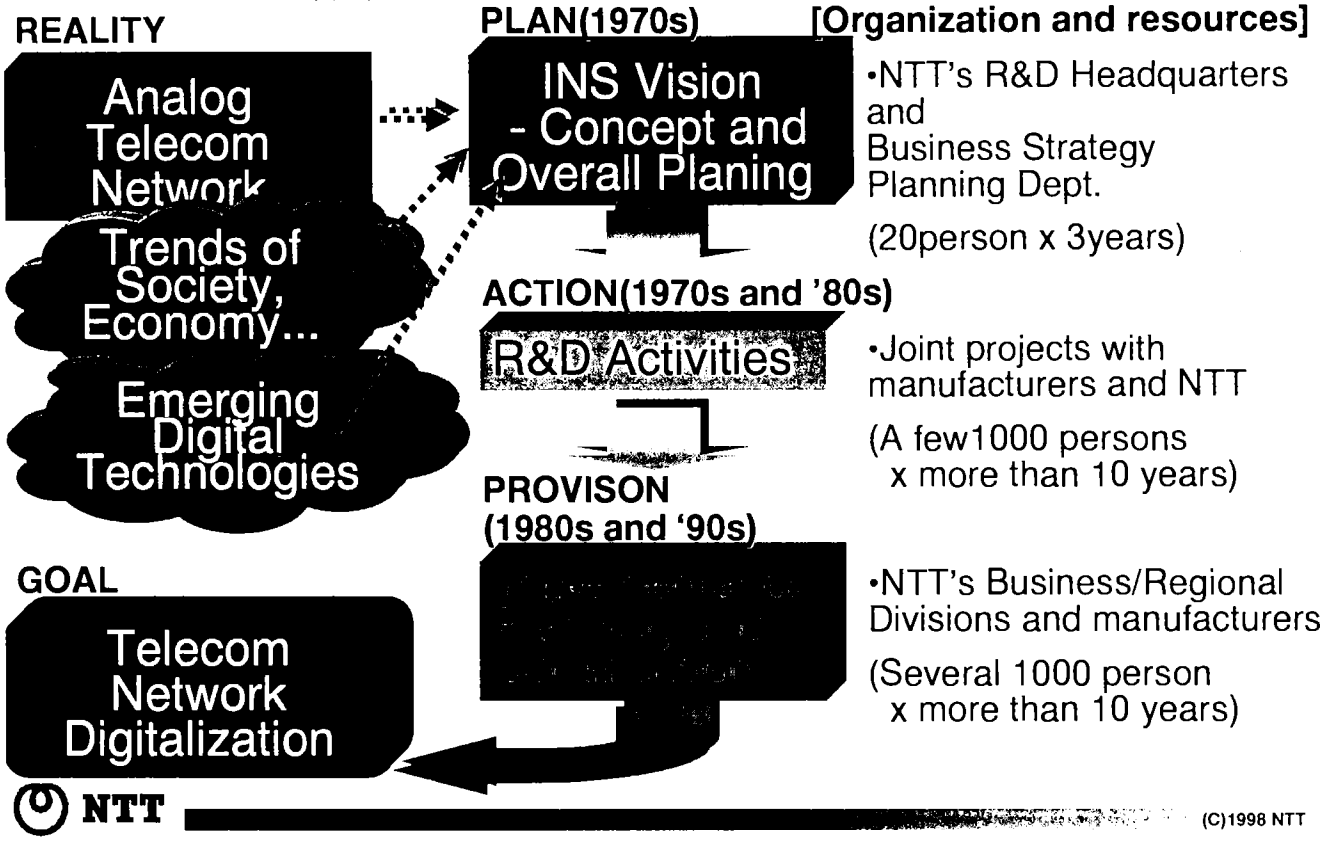


Figure 4. Digitalization brings ...

- High network quality & performance
- Standard and open network architecture
- New network services
  - ISDN Services
  - Many useful telephone services
- Cost reduction for maintenance
- Downsizing of equipment

- Competitive environment
- Long distance rate cuts
- Introduction of multimedia services including the Internet

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Figure 5. Key Management Issues - Building the Human Infrastructure-

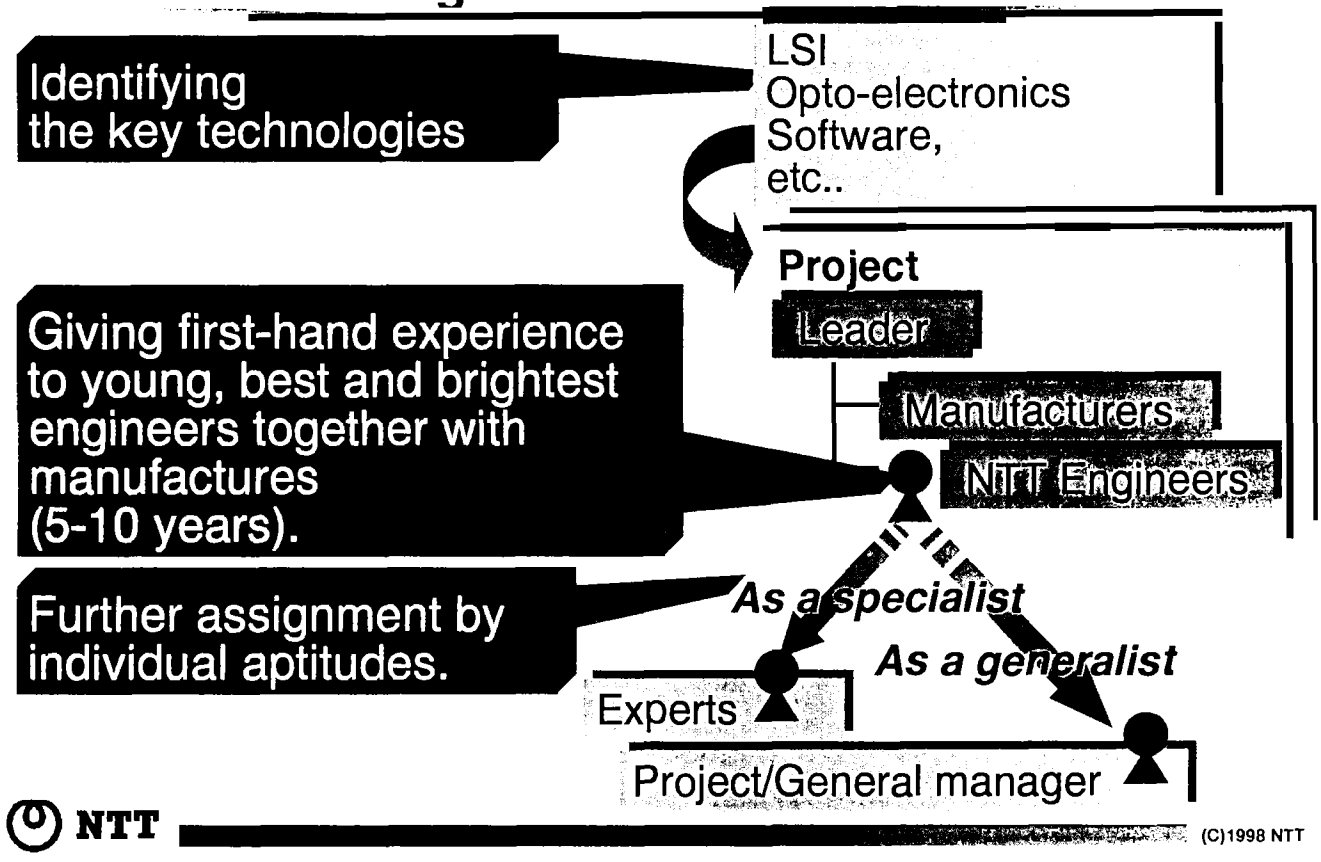

Figure 6. Example:Specific Measures for Human Resource Development

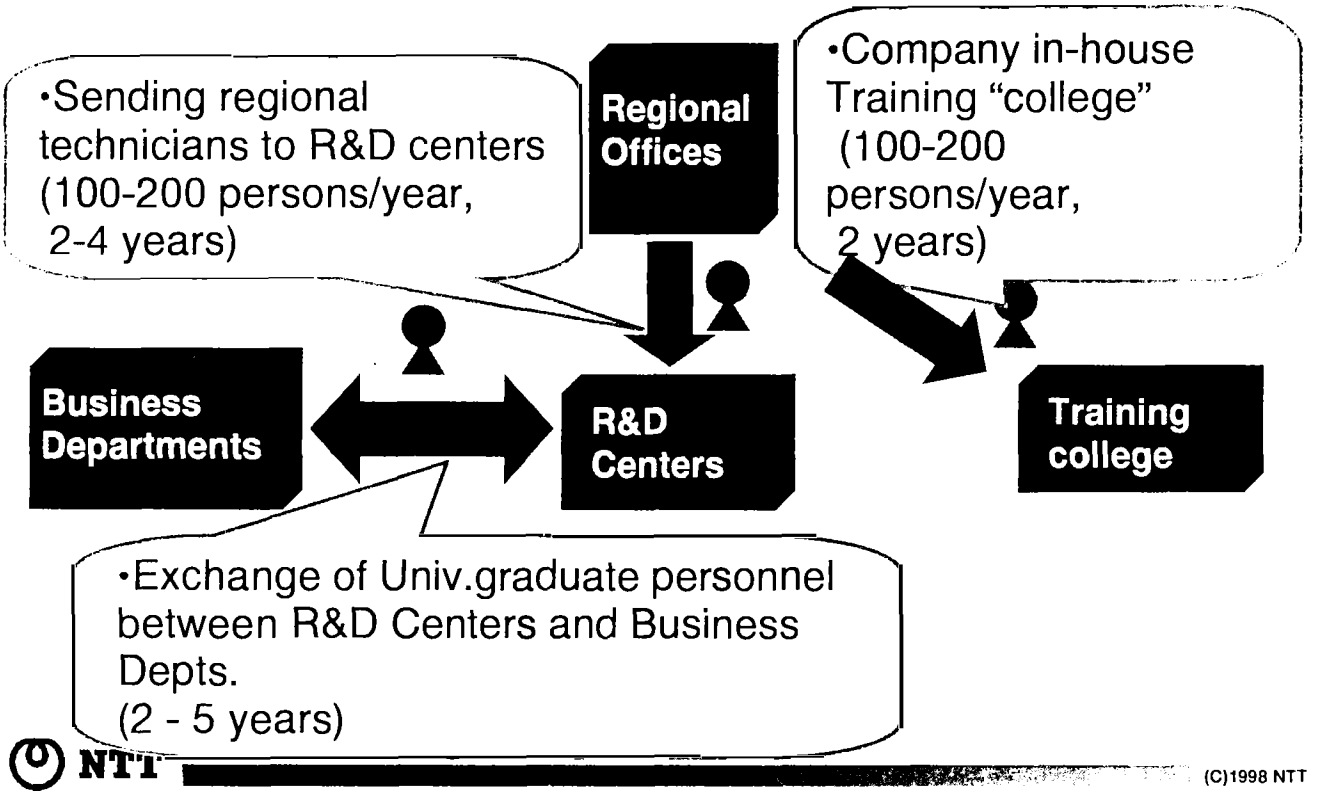

Figure 7. Asian Multimedia Forum (AMF)

- Identifying specific needs in Asia
- Developing appropriate services/applications
- Developing network/application platforms
- Promoting the implementation and usage of the platforms/services/applications
- AMF founding members:
  19 organization 8 countries

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Figure 8. AMF Founding members

(Alphabetical order)

HONG KONG
- Hong Kong Telecommunications Ltd.

INDONESIA
- PT Indonesian Satellite Corporation
- PT Telekomunikasi Indonesia

JAPAN
- International Digital Communications Inc.
- Internet Initiative Japan Inc.
- Japan Satellite Systems Inc.
- Nippon Telegraph and Telephone Corporation

KOREA
- HYOSUNG GROUP
- Korea Telecom

MALAYSIA
- Binariang Sdh Bhd
- MIMOS Berhad
- Multimedia Development Corporation
- Telekom Malaysia Berhad

PHILIPPINES
- Smart Communications, Inc.

SINGAPORE
- 1-Net Singapore Pte Ltd.
- Singapore Technologies Telemedia Pte Ltd.
- Singapore Telecommunications Ltd.

THAILAND
- Telephone Organization of Thailand
- The Communications Authority of Thailand

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Figure 9. Major Projects of the AMF

- Network Library System
- Low-Bit-Rate VTOA Communication System
- Hong Kong Telecom IMS (Interactive Multimedia Service) Access
- InterSpace (3-D Virtual Space)
- Distributed Intelligent CAI (Computer Aided Instruction) System
- Internetphone Gateway
- Push-type Information Delivery System
- Multihoming VPN(Virtual Private Network) Service
- Video & Audio Mail System
- ISDN Videophone
- Multilingual AMF Website

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Figure 10. Required Ability for Project Managers

[When Young]	[Later]
First-hand technical experience when young. First-hand experience as a manager of a small project. One or two failure experiences desirable	• Knowledge and experience of system integration. • Philosophy and passion for the project. • Knowledge and insight on social, economic, policy matters affecting the project

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Figure 11. Building GII/GIS of the 21st century

GII:Global Information Infrastructure
GIS: Global Information Society

- Global trends
- Products knowledge on a global scale
- Awareness of / Working towards Global Standards
- Social/Economic/Policy Awareness
  - Electronic commerce, Tele-education,...

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Figure 12. Conclusion

"Rome was not built in one day"

- A big project such as telecom networks digitalization requires:
  - Research and Development
  - Careful implementation
  - Human resource development
  - Vision and Overall Long-term Planning.

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EVOLVING NEW INFORMATION SOCIETY - AN INDIAN PERCEPTION

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EVOLVING NEW INFORMATION SOCIETY : AN INDIAN PERCEPTION

There is a little doubt that the world is currently in transition. The current world order is going out and a new world order is setting in. Unlike many other upheavals in the world, the current transition is happening in the very smooth manner. One might term this as a silent revolution in the making. What one witnesses as economic crises, political instabilities, scandals and scams in different part of the world are perhaps a part of the chaos that usually precedes a new order.

What is in store for us in the new world order is anybody's guess at present? However, a few indicators seem to be apparent, which include :

* Humane aspects of Science and Technology
* Restoration of human values and societal considerations
* Information Technology (IT) at the centrestage
* True partnership with nature

In this talk, I would like to cover the possible role Information Technology may play in the new world order. Firstly, let me take a look at what is likely to happen in the near future, the 21st century of the first quarter of the fourth subcycle of the 28th cycle of creation.

1. Society of the 21st Century

Rapid advances in information technology have unleashed forces which are shaping and affecting the basic structure of our society. Information Technology which hitherto has been considered as an enabling technology is now moving over to occupy a centre stage role. It appears that information and connectivity would be the central theme of human endevour in the ensuing centuries. In the light of this, new perceptions would emerge on how to organise work, how to produce and trade, how to manage, and how to create wealth. Clearly in the 21st century, a global information society

with electronic information as the central commodity sustaining life and creating new life styles would emerge. Networking and connectivity are the basic infrastructural requirements of such a society. The building blocks of such an infrastructure are the computer and communication components offered by Information Technology. One might term the society of the 21st century as **"Networked Society"**

2. Life Style in the 21st Century

What would life be like in the networked society? What occupations will people pursue? Will there be schools for children to gather and learn? Will there be offices for people to go and work? Will the networked society automatically solve some of the problems of environment such as pollution that threaten the very existence of humanity at the present time?

What will be the impact of the networked society on the culture of people all over the world? With the Global Information Infrastrucutre (GII) evolving and the networks spanning all over the globe, will the concept of borderless nations become a reality?

It is interesting to ponder about points such as the above. For example, I have personally wondered and discussed with many professionals around the world about what one would do as a daily routine in a networked society, where there may not be offices or institutions to work in. By far the most apt answer that I have received is that the daily work routine of the people would consist of connecting oneself on the network and receiving or rendering services on the network. Thus **connecting oneself** may become the way of life in the 21st century.

3. Characterisation of a Networked Society

The network society can be characterised as "A" raised to the power of five :

- anyone
- anytime
- anywhere
- any information
- any format

A full-fledged networked society implies that every human being on the planet has an access to the network. Network connectivity to home would become an essential infrastructural facility much as electricity or water supply connection. When fully developed it should be possible for the man from the poorest of the villages in the world to access resources in the richest of the cities in the world.

Network infrastructures which are expected to operate 24 hours a day and 365 days a year would make time zones and holiday patterns irrelevant in the life style of people. Cost of accessing resources across the nations may become independent of time of access or day of the week. What would matter is the need and convenience of the person accessing information. "Any time" facility would foster the growth of "on demand" culture enabling greater flexibility in the life style of individuals and communities.

"Anywhere" has implication for persons who are accessing information as well as for the information resources being accessed. It should be possible for a person from anywhere in the world to access an information resource located anywhere else in the world. The concept of location independent access would become a reality when a person would be able to access information from anywhere in the world irrespective of his place of residence. Implementation of such a scheme would call for universal identification of individuals, which remains permanent for the life time of the individual. In fact, a child may be assigned an universal code as soon as she/he is born and would be identified by that code throughout her/his life on the planet. These ideas sound somewhat far fetched but are not unrealisable.

With more and more emphasis towards right to access information, any information should become available to any individual on the planet. Some information may be priced whereas some others may be free but access to any information should be a reality. A shift to this scenario is already visible in the information policies of different nations.

A networked society should pose no transborder barriers and be able to communicate information in any format that is assimilable by the recipient. Real time machine translation may become a

reality. In this context, an intermediate language to represent knowledge becomes very important.

The present day communication environment is predominantly broadcast in nature : newspapers, magazines, journals, television, radio etc. In the networked society, the environment will be predominantly interactive.

4. Realising a Networked Society

How practical is the realisation of a networked society? Today, one tenth of the world population that exceeds five billion has access to a telephone which may be considered as the minimal connectivity required in the network society. Under one per cent of the population has access to Internet type of connectivity today. Under the circumstances, turning the world into a networked society is not a simple task. For the past over 120 years since the first telephone exchange was established in USA in 1879, the society has burying copper under the earth to establish connectivity. The length of telephone wire pairs buried underground is estimated to be twelve times the distance between sun and the earth, and works out to be 1.8 billion km. To achieve over tenfold increase in the connectivity length to reach every nook and corner of the world is certainly not an easy task, although, not impossible. It is, in this context, that technologies for the networked society become important.

There are three communication technologies that are expected to play complementary roles in shaping the networked society of tomorrow; optical fibres, satellites and short-haul radio. Each is capable of meeting certain important requirements of the networked society : optical fibres provide the bandwidth, satellite communication provides quick remote area connectivity and the short-haul radio links promise to be excellent last-mile links. Thus, all of them are expected to co-exist happily in tomorrow's world.

Optical fibre is fast replacing the traditional copper wires in certain segments of telecommunications because of its extremely high data carrying capacity. According to present theoretical estimates, a single optical fibre can support a bandwidth of 10 tera (10^{13}) bits per second. However, the performance of the commercially

available systems is limited to about 5 Gigabits per second. The main hurdle is in the electrical-optical interfaces whose operating speeds are limited in today's technology. With continuous advances in photoelectronic technology, bit rates of the order of 20 Gigabits per second or higher are likely to become feasible in the near future. Even so, we are nowhere near exploiting the full capacity of the fibre. Perhaps, this is a boon in the sense that the growth path in the fibre technology appears to be unlimited at least for a century or two.

Taking fibre to home or to the street kerb appears to be a long term dream. Japan is the only country in the world which hopes to bring fibre to home in the near future. The segments where fibre can be easily introduced are intercontinental, intercountry and intercity trunk links.

While laying fibre appears to be a formidable task, establishing connectivity via satellite links is by far the quickest. Even remotest areas can be brought on to the world network map in a matter of few hours by using satellite links. But the satellite bandwidth is limited as of now. There are about 100 communication satellites in the sky at present and by the year 2000 there would be about 500 of them. The aggregate bandwidth of all these satellites would be less than one-hundredth of the bandwidth that can be offered by a single fibre. Clearly, the strength of satellite communication lies in providing quick connectivity but not large bandwidth.

Fibre can provide the bandwidth and the satellites the connectivity to remote areas. But, how about the connectivity to home? Problems in laying fibre preclude its reach to home in the near future. Limited bandwidth of the satellite would not allow a dish to be mounted on the top of every house except for one way broadcast reception applications. The networked society which demands interactive connectivity needs a different solution for bringing the end-user (homes and offices) on to the network. This is where short-haul microwave radio links have a great promise.

In most of the countries, the frequency range of 2 to 4 GHz is not covered under regulatory rules and hence a radio link in this band can be set up fast without any clearance issues. Radio links once

established are highly reliable and cost-effective. Unlike VSATs there are no recurring charges on bandwidth utilization. Advancement in radio modem technology has facilitated high bit rates on radio links. Commercial systems are available today which support bit rates upto 8 Mbps comfortably.

The present areas of applications of short-haul microwave systems include intra-city transmission, radio LANs, home-to-fibre connectivity, LAN-to-LAN links and others. As a result, short-haul microwave radio links promise to eliminate the 'last mile' problem posed by the present cable technology and bring high bandwidth links to homes.

Recent studies across the world have shown that the characteristics of Samskrit are most suited for being an intermediate language for knowledge representation in computers. In this context, two features of Samskrit are most striking. The structure of Samskrit sentence is such that the word ordering is unimportant. Irrespective of the order in which the words appear in a sentence, the meaning convyed by the sentence remains the same. A quick reflection would reveal that this is not the case in English. As a consequence, the parsing complexity of Samskrit in the computer turns out to be of polynomial order whereas that of English is of exponential order. Secondly, Samskrit words are self-expressive as they all are derived from about 4000 basic roots. They are usually a combination of two or more roots. Once the meanings of the roots are known and a word is split into its basic roots, the meaning of the word becomes derivable and thus is self-expressive. In effect, this amounts to saying that the dictionary of Samskrit can be limited to 4000 words as long as the rules for combining roots and splitting words are unambiguous which in fact is the case. When an intermediate language concept is adopted it would only be necessary for any language to be supported on the network to have translation facility from the language to the intermediate language and vice-versa.

India is preparing in its own way for the networked society. Internet is fast spreading and the people are learning to use and distribute information using network infrastructure. Web based technology is picking up and the Government of States in India are planning on establishing state information centres which would be second to none in the world.

The Government of India has set up a task group under the Cabinet Secretary with the involvement of 13 departments to plan and realise National Information Infrastructure (NII). The task group consists of all related departments so that a smooth development of NII can take place.

The Department of Telecommunications in India is moving fast towards optical fibres. India has already over 50,000 km of optical fibres laid. Videsh Sanchar Nigam Limited which has the responsibility of overseas communications in India is working on a plan to move towards the goal of total connectivity as early as possible.

India is already using extensively satellite interactive networks. Indian satellite communications is also being opened up. Over 5000 VSATs have already been established in India and are working with the Indian National Satellite Systems (INSAT) or one of the foreign satellites available for use in India. The preferred band of utilisation currently is C-band or extended C-band. Plans are under way to move to Ku-band shortly with a new series of INSAT systems.

Cellular mobile telephone services are already functional in a number of cities and States of the country. These services started about two years ago and a good number of customers are being served through these services currently. The customer population is continuously growing.

5. Impacts of the Networked Society

The networked society can bring about dramatic changes in the life style of the people. Some of the areas in which significant changes might take place are as follows :

* Education
* Work Culture
* Environment
* Health

The very concept of education as understood today may change. From the institution-based education, the emphasis may shift to

home-based education with every home connected to a variety of educational resources, libraries and teachers. Education may turn into a process of more personalised pursuit of gaining knowledge in an area of direct relevance and interest, freeing the mind from the agony of assimilating superfluous information for the sake of passing an examination or career prospect. More significantly, education may get delinked from the current clamour of acquiring degrees. Learning would then become non-competitive and would have the sole objective of gaining knowledge for social contribution. The goal of **"Education for All"** may be rewritten as **"Quality Education for All".**

Going by the indication of the fact that 35% of the corporate workers in the United States are telecommuters today, it appears that the networked society would definitely result in less-travel society if not **travel-less** society. Physical location may become irrelevant for being able to receive or deliver services. This would bring about radical changes in work culture. Telecommuting culture is likely to promote home-centred activities leading eventually to a home-centred economy.

The direct impact of less-travel society is less polluted cities in the world. For example, in the city of Delhi, more than 66% of the atmospheric pollutants come from vehicular traffic. If 30% of Delhi's workforce becomes telecommuters, the citizens of Delhi would indeed breath much cleaner air. A similar situation would obtain all across the globe.

With the likely scenario of home-centred economy operating, one may expect better attention being given to plantation, gardening and environment by the society. Environmental protection would become a natural concern and the environmental problems would be addressed through more efficient use of resources and energies. One may witness the emergence of natural stress on sustainable human development without disturbing the eco-systems of the nature.

Interestingly, a networked society can lead to better health. Firstly, the day-to-day stress of travel and time may not exist. Increased access to information would bring about better knowhow of different things that would eventually lead to relaxed way of living. There are, however, some fears that aspects like information

anxiety and information overload can bring about stress in the society and thereby affect the health of the people. In my opinion, this fear is unfounded as the information seeking behaviour would completely change from an era of **"waiting for information to arrive"** to an era of **"asking for and getting the information".** This should result in better contentment on the part of human being and greater confidence in the social fabric. With better transparency and access, fear of the unknown which is the main cause of stress may significantly reduce.

6. Preparing for the Networked Society

Realisation of a networked society depends on the growth of information technology industry in the world. It is known that this industry is one of the fast growing ones at present. The present estimated compounded annual growth rate is about 15% and the industry is poised for even greater growth in the coming years.

Keeping pace with such a fast growing industry calls for extensive retraining and continuous updating of knowledge of professionals. In the context of the networked society, even common man needs to be made familiar with the use of information technology gadgets. It is estimated that at the present level of growth, the world will require about 500,000 additional IT professionals by the year 2000. Compounded to this demand is the Y2K problem that requires to be handled on a war footing. Obviously, extensive educational and training programmes have to be instituted all around the world in the field of information technology, management, services, systems and sciences.

Recognising the above need, India has instituted strong education and training programmes in the non-formal sector as well as the open university and open school systems. India today has six open universities which have an enrollment of over 600,000 students consisting about 13% of the total enrollment for higher education. Open schools are also attracting a large number of candidates. In the non-formal sector, Department of Electronics, on the recommendations of a national working group of the All India Council for Technical Education - the Statutory Body for Technical Education in India - has instituted a variety of courses

at different levels covering students who have completed schooling, diploma, a university degree in science or arts, or an engineering degree. The Department of Electronics also accredits institutions in the non-formal sector for providing training which lead to acquiring proficiency at the different levels defined by the department.

Regular universities also cater to the educational needs in the information sector. India has about 220 universities of which 67 of them offer courses in information science either at the bachelor's level or at the master's level or both.

In addition, a large number of national institutions including Indian National Scientific Documentation Centre (INSDOC) offer a variety of training and educational programmes to meet the immediate needs of the networked society.

7. Virtual Reality : A Boon or a Bane?

Virtual reality is considered as the ultimate evolution of a networked society. It is not clear whether one should move towards virtual reality at all when we are very concerned about not partnering with nature adequately. As an example, in a virtual reality environment, a person may go for a swim in one of the most exotic swimming pools of the world and experience the pleasure and pain of swimming during the virtual reality session. At the end of the session, the fact would remain that the person had not actually entered the water. Should one take the society towards such a non-realistic virtual world? I feel that the role of virtual reality should be limited to training human beings to handle hazardous operations like operating a nuclear plant or flying a fighter bomber. At least, I am not in favour of the direction in which virtual reality is now evolving.

In conclusion, I may say that the networked society promises to bring about a new style of existence for the humanity. Such an existence may be a solution for a large number of problems experienced by the society presently. However, ills, if any, of the new society is a matter that needs to be pondered upon.

SingaREN - A CASE STUDY ON GOVERNMENT-INDUSTRY PARTNERSHIP IN TECHNOLOGY-PUSH STRATEGY

ABSTRACT

Singapore's High Speed Testbed (HSTB) project was initiated by NSTB (National Science & Technology Board), NCB (National Computer Board), ITI (Information Technology Institute), ISS (Institute for Systems Science) and Singapore Telecommunications Ltd in early 1995. One of its primary goals was to spur industry to develop new products and services based on the emerging ATM (Asynchronous Transfer Mode) technology.

Conceived initially as an experimental network, this HSTB quickly assumed a catalyst role in manpower and capabilities development that helped jump-start the implementation of Singapore-ONE (S-ONE), the nation-wide broadband network infrastructure. A number of services were trailed on the Testbed before migrating to S-ONE, and products based on emerging standards were also developed.

As the first phase of HSTB drew to a close in Dec 97, a new test environment and technology centre are being set up. This new infrastructure, called SingaREN, aims to broaden its support for S-ONE as well as strengthen linkages with industry and with other advanced networks. SingaREN is once again a government-industry partnership, bringing together resources from the National University of Singapore (NUS), ITI, ISS and the core network operator for the S-ONE, 1-Net. Other companies are also invited to set up subnetworks that provide specialised services so as to enhance the overall support capability of SingaREN. SingaREN is the first overseas network to be linked to vBNS (very high performance Backbone Network Service) in the US. Other links to other advanced networks are being planned.

This presentation traces the transition of the HSTB, highlighting its role in pushing broadband multimedia technologies, as it evolves from a nationwide network to an international infrastructure.

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BACKGROUND

IT2000 and National Information Infrastructure

Singapore's IT2000 vision encompasses an island-wide infrastructure capable of reaching out to every home and office. By the mid 90's, the World Wide Web has become a ubiquitous infrastructural technology for disseminating information with heavy multimedia content. Other edutainment applications like video-on-demand and multimedia distance learning as well as time-critical video-conferencing provided added impetus for a new network infrastructure capable of supporting high speed traffic. Besides the capability to transmit data, audio and video traffic concurrently, such a network also has to be scalable to accommodate ever rising traffic volumes as the subscriber base expands and the number of services provided multiply in response to demand. There are also technical goals of seamless interoperability with legacy networks and providing a migration path for all existing networking technologies.

In the early 90's, the most promising solution that addresses these needs was found to be the asynchronous transfer mode (ATM), a relatively new broadband technology capable of delivering multimedia information at data rates of 622Mbps and beyond. ATM also has other commendable attributes like quality of service guarantee, interoperability with other networking technologies and relative ease of implementation. The downsides were that ATM switches were then relatively costly compared to those of more mature technologies and standards were still evolving. The local industry was hardly ready for an ATM infrastructure. Only a handful of ATM-related research projects were being pursued at the Universities and public research institutes.

Moreover, no country in the world then had yet committed to an operational ATM infrastructure on a nation-wide scale. During this period, technologically advanced nations in North America and Europe were in the midst of evaluating ATM technology by setting up testbeds which varied in size from the state-wide New York Network (NYNET) to continental-scale CANARIE which spans the east and west coasts of Canada.

Hence, in order to maximise Singapore's chances of succeeding in multimedia networking research and applications development, the challenge was to set up a government-industry partnership to drive an ATM network testbed. This testbed was intended to galvanise companies and research institutes/centres to commit to training manpower and developing multimedia networking products and services. The lessons learnt would hopefully be transferable to an operational national information infrastructure subsequently.

THE FIRST PHASE

A Government-Industry Partnership

The National High-speed Testbed (HSTB) was intended to be driven by a partnership of public and private sector organizations. The government was represented by the National Computer Board (NCB), the main driver of IT2000; the National Science and Technology Board (NSTB), the funding agency for R&D, science and technology infrastructure, and S&T manpower development; Information Technology Institute (ITI) and Institute of Systems Science (ISS). Singapore Telecommunications Ltd, as the sole private sector partner, agreed to sponsor up to 24 155Mbps lines for companies to link up with the HSTB.

Objectives and Strategies

The objectives of the HSTB were thus defined :

a. To serve as an integration and verification platform for high-speed hardware and software products and services;
b. To build core competencies in high-speed networking and multimedia networking;
c. To enable development of product niches of network equipment as well as customer premises equipment, producing economic spin-offs;
d. To serve as a platform for training.

One major goal was to involve universities, research institutes and industry to work collaboratively wherever possible. Core competencies would be strengthened through development work on multimedia software and hardware networking products. The HSTB would then provide the environment for thorough evaluation of products and applications. Manpower development was emphasised in view of the dearth of local specialists in ATM technology.

The objectives did not emphasise on pushing the state of the art in broadband or specifically, ATM, technology. The exclusion of heavy-duty R&D on development of network switches was also deliberate. It was perceived that neither local capability nor market was readily available for Singapore industry to enter this highly competitive segment of the communications business. Instead, the technology strategy was to focus on niche areas of multimedia services, middleware and service management systems. Opportunities were also identified in multimedia PCs/workstations, storage, applications and services.

Implementation

The deployment strategy was to set up a number of networking clusters and interconnect the clusters. The networking clusters comprised tightly interconnected workstations and

PCs through a network of ATM LAN switches. Hence, the HSTB network would be architecturally simple yet sophisticated enough to support a wide range of application and service trials.

Project selection was based on the suitability of the application / product / service, commitment to manpower development, whether the application served to raise industry awareness of ATM technology, along with other reasons.

Foreseeing interoperability problems, the HSTB provided a free testing and evaluation service for equipment suppliers. Apart from application trials and product development, the HSTB also stimulated interest in other technologies associated with the information superhighway. The HSTB was connected to the Internet via one the local Internet Service Provider's (ISP's) cluster to support and stimulate R&D projects on integrating high-speed networks with the Internet.

THE ADVENT OF SINGAPORE-ONE (S-ONE)

Expanded roles

About a half year after the launch of the HSTB, preparatory work began for S-ONE. S-ONE was conceived to be an operational national ATM network infrastructure that would deliver multimedia services to companies and households. The Telecommunications Authority of Singapore (TAS), NCB and NSTB were to jointly drive this key infrastructural project. In addition to providing technical advice to the S-ONE Steering Committee, NSTB and the research institutes perceived the need to encourage companies to develop products and applications that could be deployed in the S-ONE network.

Initially, when the S-ONE core network was not yet operational, the HSTB was used for applications and service trials prior to deployment. Subsequently, the HSTB was re-positioned as a resource for trialing new applications and technology that might "stress" the operational S-ONE network. The HSTB thus assumed its new role as the cradle for new applications, middleware and network protocols which would eventually be deployed on S-ONE.

Research and Applications Development

A special grant scheme called the Broadband R&D Grant was conceived to incentivise the development of innovative products and services that could subsequently be deployed on S-ONE, and to encourage more researchers to work on the newer broadband networking technologies and standards.

This scheme was launched in December 1995. It rapidly attracted several large MNC and local companies. Some of the projects supported by this grant included :

- Virtual LAN
- SKIP (Simple Key Management for IP) Network Security
- Video-on-Demand
- Interactive Multimedia Video conferencing, MM archive, MM Mail.
- Testing of CATV link between HSTB and home.
- Internet Cache
- Virtual Travel System
- Virtual Shopping Mall
- DAVIC middleware and applications
- Remote ATM-based security and monitoring system
- Distance Learning

THE SECOND PHASE

Next Generation Networks

In the US, the phenomenal success of the Internet has resulted in the need for a quantum upgrade in bandwidth to handle the traffic. A consortium of leading universities has been formed to develop next generation Internet 2 technology and to implement an advanced R&E (research and education) network platform via vBNS (very high performance Broadband Network Service). Basically, the vBNS backbone (which supports data rates at 622Mbps) will connect GigaPOPs (gigabit point of presence) which are local hubs for research and education links. Elsewhere, Canada has also established CA*NET which is operated by CANARIE (Canada Association Network for Advancing Research, Industry and Education). CA*NET II also serves as Canada's link to the emerging Internet 2.

SingaREN (Singapore Advanced Research and Education Network)

In line with developments in the advanced countries, an upgraded test environment, under the acronym of SingaREN, was conceived to support nationwide experimental, research and educational activities related to broadband networking and applications. The main users of this network will be the universities, research institutes, and companies with advanced applications for testing. SingaREN will initially be implemented as a virtual private network on the S-ONE infrastructure. SingaREN is to be positioned as a broadband technology resource that works with companies to strengthen their capabilities in developing products and services, drawing on locally developed technologies and from linkups with advanced international networks.

Beyond research, providers of broadband network equipment and services need to evaluate new technologies and standards before deploying them in the operational environment. To provide comparable facilities as other overseas networks, the SingaREN Technology Centre (STC) was set up to support an R&D network comprising local and international links and be responsible for project management, training, broadband technology promotion and other

advanced consultancy services. International linkages to other advanced broadband networks overseas in particular, the vBNS, will be supported at 10Mbps initially and scaled up as demand for bandwidth grows.

Objectives of SingaREN

In recognition of its expanded roles, SingaREN's objectives have been broadened :

a) To facilitate the development, deployment, operation and technology transfer of advanced, broadband multimedia applications and network services

b) To drive cluster development in broadband technologies and multimedia networking at Universities, research institutes and industry

c) To foster research collaboration between Singapore and other countries on next generation high performance network technology and services.

Management

SingaREN will be managed by a team of full time managers/engineers based at the STC to be hosted at KRDL (Kent Ridge Digital Labs created from the merger of ISS & ITI). The management team will report to the SingaREN Director. The management structure covers :

- Network and Operations : To manage the install, commissioning and upgrade of the SingaREN network and services; to provide interoperability testing services;
- Projects : To drive the many collaborations and application trails that are expected from local and international sources;
- Business : To drive business activities such as spin-offs and technology transfer and licensing;
- Research : To develop and adapt technologies for commercialisation and provide consultancy services to companies;
- Technology Promotion : To promote SingaREN to industry and international organizations.

The SingaREN network, comprising both local and international links, will be managed jointly by the STC and 1-Net, the core network operator. It is also the intention to outsource the network operation centre (NOC) to the private sector, possibly Internet service providers. The responsibilities of the NOC will include management of ATM connectivity to US and other international networks.

International Links

A formal agreement was signed in November 97 between NSTB and the US National Science Foundation on joining the NSF-sponsored vBNS. A number of research collaborations between local universities / research institutes and leading US universities and organizations have been identified. These collaborations cover several key

technology areas including Immersive Virtual Reality, Bioinformatics, Tele-Manufacturing, Tele-Education, Tele-Medicine and Tele-Architecture.

Links to other networks such as CaNet*II, DANTE (Delivery of Advanced Networking Technology to Europe), APAN (Asia Pacific Advanced Network) and ASTNET (ASEAN S&T Network) are also being planned.

A New Collaborative Framework

A more flexible framework for industry collaboration has been envisioned. As S-ONE will soon be fully operational, it is a key objective for SingaREN to contribute to its success, both in terms of technical support for the infrastructure in order to operate effectively as well as expanding its outreach to local industry and international research collaborators. On the operations side, there is also a need to work closely with the core network service operator(s) and other ISPs. New products and protocols to be added to S-ONE need to be evaluated for compatibility and interoperability. Research and applications development also have to be driven and supported by providing consulting services.

Companies are invited to participate by setting up their own subnetworks that are independently operated but connected to the SingaREN network to draw on additional resources. For example, a company may set up its own subnetwork for interoperability and integration testing. Companies can also attach their engineers at the research institutes to work with the researchers there in order to master new technology. University students, mainly those pursuing graduate degrees, are also offered opportunities to undertake research projects either at the research institutes or with participating companies.

STRATEGY AND OPERATIONAL SHIFTS

#1. Infrastructure and Management

HSTB :

- National network
- Implementation and interoperability issues pre-dominate
- Free links and service to industry
- Small technical support team

SingaREN :

- Both national network and international linkages
- Oriented towards collaboration with industry and international partners
- Revenue generation from services
- Full-time professional management and technical team of 15 people

#2. Technology Development Strategy

HSTB :

- Product and service oriented projects for evaluation and subsequent deployment on Singapore ONE
- Focus on implementation & interoperability issues

SingaREN :

- Longer term, next generation technology development in collaboration with leading international universities and research institutes
- Operational support for Singapore ONE

#3. Partnership Strategy

HSTB :

- Industry is focused on products and services, not infrastructure
- Private sector provides lines; government provides funding for projects
- University and research institutes develop technology

SingaREN :

- Industry is involved in developing and managing some segments of infrastructure
- Industry is encouraged to create subnetworks as enhancement to government-funded network
- Government funds research and some critical links

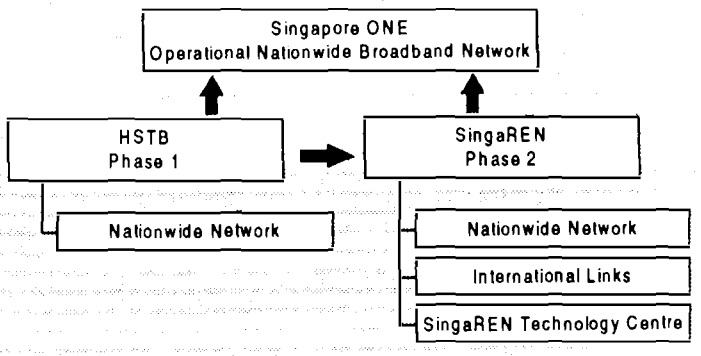
CONCLUSION

Only 3 years back in 1994, broadband technology and applications were being experimented in small laboratory projects by splintered academic research groups. Today, through a determined push by key government agencies and private sector companies, the world's first nationwide broadband infrastructure has been successfully installed and put into operation in Singapore. Applications are being rapidly added in response to subscribers' demand, and additional infrastructure such as satellite links are being planned to complement terrestrial/submarine lines.

For Singapore, deploying applications alone will not suffice. New broadband technology and products have to be nurtured and testbedded. Present capabilities and skills too have to be upgraded to meet the needs of the broadband era. Just as the HSTB has risen to the earlier challenges, its successor, SingaREN, will strive to spearhead Singapore's thrusts into next generation networks.

A CASE STUDY ON GOVERNMENT-INDUSTRY PARTNERSHIP IN TECHNOLOGY-PUSH STRATEGY

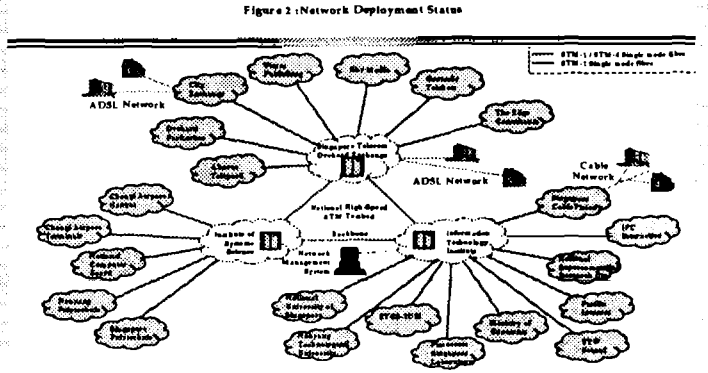
Network Acronyms



HSTB (Phase 1)

- Technology push strategy on broadband technology
- Partnership arrangement
  - Industry Involvement
    - Free lines and installation
  - Government Funding Support
    - R&D Grant
  - Research institute-driven
    - Technology transfer to industry
  - Joint ownership & decision making
    - Coordinated technology strategy

HSTB - IMPLEMENTATION AND DEPLOYMENT



HSTB Achievements

- Network Testbed with 24 nodes
- Linkages between Universities, public research institutes and industry
- Local and MNC projects supported
- Manpower development
- Spin-off to industry
- Technology capability development and technical support for S-ONE

Singapore ONE
(*O*ne *N*etwork for *E*veryone)

A national high-capacity network platform that delivers a potentially unlimited range of multimedia services, with rich graphic and video content, to the workplace, the home and the school

- Phase 1 (1996 - 2001)
- Phase 2 (Apr 1998 - 2004)

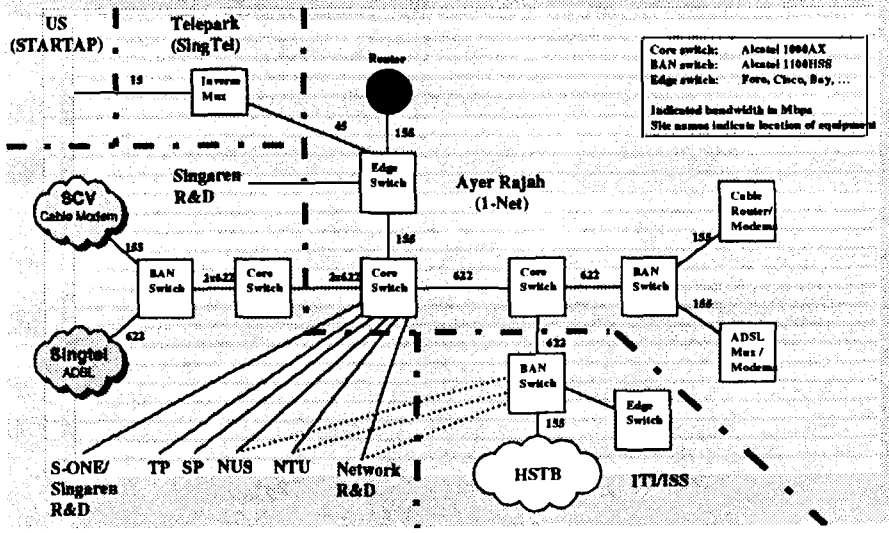
SingaREN Objectives
(Phase 2)

- To facilitate the development, deployment, operation and technology transfer of advanced, broadband multimedia applications and network services
- To drive cluster development in broadband technologies and multimedia networking at Universities, research institutes and industry
- To foster research collaboration between Singapore and other countries on next generation high performance network technology and services.

SingaREN Overview

- Encompasses HSTB
- Hosted by KRDL (Kent Ridge Digital Labs)
- International links managed by team based at NUS
- First link to vBNS (very high performance Backbone Network Service) outside North America
- SingaREN Technology Center as one-stop service centre for Singapore ONE
- Industry participation (eg outsourcing of network operations centre)

Singapore-ONE & SingaREN Network Configuration



Infrastructure & Management

- HSTB
  - National network, implementation-oriented
  - Small support team of 2 professional staff
  - Free lines and services to industry
- SingaREN
  - International linkages, collaboration oriented
  - Full-time professional management team plus University support
  - Revenue generation from services

Technology Development Strategy

- HSTB focus :
  - Product and service oriented projects for evaluation and subsequent deployment on Singapore ONE
  - Implementation & Interoperability issues
- SingaREN focus :
  - Longer term, next generation technology development in collaboration with leading international universities and research institutes
  - Operational support for Singapore ONE

Partnership Strategy

- HSTB
  - Industry focused mainly on products and services, not infrastructure
  - Private sector provides lines; government provides project funding
  - University and research institutes develop technology
- SingaREN
  - Industry is involved in developing and managing some segments of infrastructure
  - Industry is encouraged to create subnetworks as enhancement to government-funded network
  - Government funds research and some critical links

Some International Collaborators

- Collaborators :
  - MIT
  - Carnegie Mellon University
  - Stanford University
  - Scripps Molecular Institute
  - Boston Children's Hospital
  - Japan Cancer Center
  - University of Pennsylvania
  - University of Illinois
- Collaborations :
  - Global design studio
  - Telemedicine
  - Collaborative design and telemanufacturing
  - Virtual reality sharing of protein structural data
  - Data integration & data mining
  - Future digital libraries

SingaREN Global Network

- International Linkages
  - vBNS
  - CANARIE/CA*NET II
  - APAN
  - VSAT link to JSAT Satellite
  - DANTE

Conclusion

- Government and Industry should be partners for successful technology push
  - Broadband technologies a good candidate
    - Lack of user demand, government services used to generate momentum
    - Entry costs (infrastructure costs) are high
    - Technologies are inter-related with a host of multimedia applications
    - Skilled manpower initially in short supply

Thank You & Have a Nice Day

WEB-SITES :

◆ Singapore ONE -
http://www.s-one.gov.sg/html/mainmenu.html

◆ SingaREN -
http://singaren.net.sg/

Questions and Answers

Comment: From Chairman
We could understand that the MSC has such a comprehensive concept for changing into the 21st century of Malaysia, including the other one. And especially, we need several of the keywords presented by Dr. Yap. It is quite interesting that the productivity, leadership, and also the global village between Malaysia. And also the MSC has quite a dominant meaning to kickoff the 21st century of Malaysia. From that point of view, MSC is not only information technology, but also other social and economical structural changes. From that point of view, it is quite interesting to me. Thank you very much, indeed.

Comment: From Dr. Kurihara
The Asian Multimedia Forum is openly accepted. For example, this forum meeting will be held in Hong Kong. The AMF opened last year, and many experiments will be started this April and extended through next year. Every company will be accepted.

Question: To Dr. Kurihara
The AMF is founded through privatized companies?

Reply:
Not only. If you want to know about AMF, I will show you the AMF homepage afterwards.

Comment: From Mr. Wang
I am from the Ministry of Communications in China. I will give you some information. Now, China wants cooperation with the better developed countries in information technology. We have a cooperation with the European Union. We are now establishing a science and technology network between mainland China and the European Union. We want you to come to mainland of China, and negotiate with the science technology committee. We want cooperation with abroad.

Comment: From Dr. Kano
Yes, we are looking forward to cooperation with mainland China on a large scale as well. In this multimedia information infrastructure activity shown in my presentation and in Mr. Yap's presentation, there are so many networks of collaboration, just like the gentleman from China mentioned. We also formulate collaboration with the European Union –they have the so-called ACTS program– and also with the United States in many ways, one of which is collaboration for next-generation Internet and high-performance netware. But the important thing perhaps we shouldn't forget is that we tend to look for Europeans and north Americans on a separate basis from Asia. Perhaps we Asians can get together and discuss this among ourselves. Thank you.

Comment: From Prof. Hooper
I am Professor Paul Hooper from the University of Sydney. Just an anecdote about the Australian women. My daughter is seventeen years old. She's not making love on the net, I

hope, but she certainly has boyfriends all around the world, and that is leading much greater dialog. But more seriously, one of my colleagues at the University of Sydney is doing some work on telecommuting, and I think there are some issues there that I would like you to think about, and perhaps comment on. Certainly corporations are finding that their staff is more productive working at home; they don't spend so much time walking outside the building to smoke their cigarettes, they don't spend so much time going to the coffee machine and talking to other staff, and they tend to put in longer hours at home. But the other side of the equation goes back to the days before the industrial revolution, with piece work going on, and it could lead to issues of exploitation of workers. Certainly, another dimension is that we have found that it actually leads to trip-making overall and increases greenhouse emissions, because people working at home will get in their car because they desire social interaction, and after they had their cup of coffee, or tea, and read their newspaper, perhaps they get in their car to go to buy the newspaper deliberately so they can say hello to somebody; because we do desire contact with human beings. So, we are finding that it doesn't necessarily lead to the conclusion we might like, a reduction of greenhouse gas emissions; it is in fact increasing it in some cases. Thank you.

Comment: From Chairman
A few points again. I have no intention of debating that because it is a point of transition. But it is possible. Much as the way that we started out with paperless offices that ended using more papers, a less-travel society will probably end up having more travel. I don't know.
Maybe the following points raised by Prof. Vishwanathan will be discussed together with the other three speakers' presentations, because the three speakers will present some of realities of society in technological social structure. It is quite an interesting point.

Question: To Dr. Yap
How much has the government spent on the R&D plan you showed in that slide?

Reply:
We asked for 3.5 Singapore dollars, out of which 3.2 million has actually been committed. The reason for this small figure is that we weren't planning for a very big project. We were looking for relatively small projects like those in a range of $100,000 to $200,000 for two or three researchers working on products or services.

Comment: from Chairman:
Naturally, the four presentations have quite unique features, so it is a little bit difficult to sum up with only one conclusion, or one suggestion. However, I would like to try to give some hints for our consideration in the future.
Dr. Yap's presentation gave us quite a comprehensive view of socioeconomic planning for the new century, and the key technology issue is information technology. The other two presentations from Dr. Kano and Dr. Wu were on relatively technology oriented problems. Such technological projects may result in some changes of socioeconomic structure. Anyhow, the goals of those projects are reaching up towards some of the restructuring of our society. From that point of view, there are similar items to be considered. Then, Professor Vishwanathan presented a bird's-eye view of the information society question, and pointed out

some of the advantages of new technology, and some of the considerations about the negative points or points of concern about the new society. However, each of these three projects has a history. From such a historical view, my personal interest is in the model 1 or model 3. From the creation of a project concept, who is the creator of the project, the government or private companies? That is one of the ideas of the consideration, and such a model maybe reflecting upon the socioeconomic structure today. The second point is the initiator of that project. The third point is the management of that project. The fourth point is the carrier of the project. The fifth point is the financial source –the last question to Mr. Wu. And those items may show us some of the specific features reflecting on today's socioeconomic condition in each country. From such point of view, those analyses maybe used for better mutual understanding. That is only my suggestion.

Comment: From Dr. Kano

In addition to the classification between government and private sector, I would also like to propose another classification which I feel strongly about these days. This is between technology and human beings. Which is more important, and which should play the role of prima donna, if you like? I was interested in Professor Vishwanathan's presentation. When he talked about virtual reality, some of the directions that current virtual reality are taking are a concern to him, and I share his concern. I consider myself a technologist, and about thirty years ago when I was a young engineer, there was a discussion between design automation and computer-aided design. By design automation, we thought that everything could be done by machine, but when we found that that was not possible, we decided that computer-aided design was the way to go. By this, it is meant that the designer, the human being, is the prima donna, and the computer should aid him. In this virtual reality, I especially liked the two examples given by Professor Vishwanathan. One is this coexistence with nature, and use of sunlight in lighting. I fully agree with him that we are shutting off the natural light here and recreating a manmade environment here, and that this is not what we should be following. He cited the library building example in Denmark, and we also have some examples in Japan where actual optical fibers are used to take light from the top of a tall building and delivered each room in the building and even down to the basement. In this case, nature should play the prima donna role, and technology should assist human beings to enjoy the nature. Also, in virtual reality, we should not take, in my opinion, the privilege of human beings to have physical contact and to have physical relationships. But also, technology could be used to prevent human beings from being in a dangerous situations like operating in a nuclear reactor. Also, in my occupation, laying the telephone cables in high-rise buildings or telephone pole, the jobs can be done by robots. So, we should really prevent human beings from entering dangerous areas. So, again, I think some technologists are so ambitious to replace human beings by computers, but I should say that is the design automation approach which has already failed, and that we should take the computer-aided design approach, which is, the prima donna is the human beings, and the technology is there to help us. Thank you.

Question: To Dr. Yap

Paul Hooper at the University of Sydney. My line of question or comment is about the interaction between projects, and I address this really to Dr. Yap. It is about the Multimedia Super Corridor, and the initial takeoff phase, with the initial targets of I think about 50 large

projects or corporations. Do you have some feel for the center of gravity that you need in order for a project like this to take off? What is the number of organizations that you need in one place to make this successful? I'm reminded here of some of the work by Michael Porter, talking about agglomeration economies, and a theme which I will introduce after lunch, competitive cities. Do you need a collection of these in one place in order to be successful?

Reply:
Yes, thanks for the question. Yes, definitely. Very quickly we tried to attract a lot of companies. The fifty are big, world-class companies. We classified as world class, but at the same time, we wanted to attract local companies to participate, because at one stage before, there was constant doubt about whether our operation was going to be a foreign anchor, just for foreign companies. Luckily for us, it turned out that there is a lot of local participation from local companies and so on, and the mix of companies that we have is pretty good. Have we reached a critical mass? We don't know, but the momentum is now carrying on very rapidly. In just months, we have attracted at least 180 applications, and 80 of them have actually started operations in various parts. We do not force all of them to come into Cyberjaya immediately because the infrastructure is not ready. So, they are all given a two-year grace period to operate wherever they like, but within two years, as our infrastructures are built up, they will need to be within that area to have this collaborative effect. Thank you.

Comment: From Vishwanathan
I was very happy to hear from Dr. Kano on the use of optical fibers for lighting the interiors of buildings, or bringing the natural light into the interior of the building. I think that is an excellent example of obligation of technology in partnership with nature. I must mention something here now that we have a little time. The first time I came across this phrase of 'world in transition,' it was also from a Japanese document where I read a lot about the humane aspects of scientific knowledge. This was the telecom policy of the government of Japan. In the Indian context I happened to read the telecom concept from many countries. When I read the telecom of Japan, there were very interesting portions. Telecom for working women, telecom for the handicapped. This meant the application of telecommunications to the societal aspects are being looked into in such detail at the policy level. The general telecom policy talks about how many more telephones must be incorporated in the next five years, how much more money must be invested, etc., etc., and rarely talks about the humane aspects of the applications. So, I was very interested to see this document which talks about this, and I think it's very important to recognize this particular aspect of wanting to apply science and technology for the real good of the human beings with partnership in Asia. Thank you.

Comment: From Dr. Yap
Can I just add one little point since fiberoptics lighting was mentioned. At the MSC, we also have a patent with a US company called RSLI, remote soft lighting Instrument, where we are actually using fiberoptics for the lighting. It's not using sunlight, but there is a light pump, and all the light will go to all the fiberoptics, and it's energy saving. All the work is down at the pump level --it's not an individual pump-- and there's no heat, it's cold, so it is much more efficient. We are using that in Cyberjaya, and we are going to promote that in this region.

Comment: From Chairman

Thank you. The question is, what is the goal, and also, by what means can we attain the goal? The innovative technology is to some extent one of the goals, however, most of the innovative technology must contribute the goal over human kind. From such point of view, we share some common goal in the 21st century. 'Information Technology' is a keyword, and through it, maybe there's some chance to find collaboration among us. That is my hope, and also my expectation after this seminar.

We still have time, however, I personally have a little hunger. So, we would like to take a good lunch time. Bon appetit. Thank you very much for your cooperation

Session III

Transportation and Economic Development

TRANSPORTATION AND ECONOMIC DEVELOPMENT

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The Tyranny of Distance

The expression "tyranny of distance" was used effectively by one of Australia's eminent historians and is one that comes easily to mind in any discussion about transport and its relationship with development. Australia is populated by fewer than 19 million people, most of whom live in coastal cities. Modern communications and air transport have done much to overcome the tyranny of distance, but the fact remains that Australia's two largest cities lie 10-12 hours apart by road, but air transport reduces this to one hour and 20 minutes. Flights from Sydney to Perth are scheduled to take just less than 5 hours, 50 minutes more than it takes to fly from Perth to Jakarta. Darwin and Cairns are closer to major cities in Melanesia and South East Asia than they are to the major population centres in Australia. International passenger shipping ceased to be a force within a few years of the commissioning of the Boeing 747 and liner ships disappeared from Australia by the mid-1970's. The nation is dependent upon its air transport services to maintain links with the rest of the world.

Table 1: Distances between selected cities (in nautical miles)

From	To	Distance	From	To	Distance
Sydney	Cairns	1,970	Sydney	Auckland	2,164
	Darwin	3,154		Jakarta	5,490
	Denpasar	4,624		London	17,036
	Melbourne	707		Los Angeles	12,065
	Perth	3,284		Manila	6,257
Cairns	Port Moresby	841		Singapore	6,302
Perth	Melbourne	2,707		Tokyo	5,306
	Jakarta	3,000	Darwin	Denpasar	1,766
	Singapore	3,909		Manila	3,180

Note: One nautical mile is equal to 1.852 kilometres.
Source: Department of Transport and Regional Development, Australia.

Australia is well aware that it needs efficient transport systems to maximise its development potential. During the 1980's and 1990's, government policy has been to expose the sector to increased competition, to involve the private sector in the provision of transport infrastructure, and to play a role in wider regional initiatives such as APEC. The guiding principle has been that the transport system should be designed to serve the interests of all Australians and that sectional interests should not dominate policy.

This paper describes how this approach has been put into action with particular reference to the air transport sector. Government airlines have been merged and privatised, more than one carrier competes internationally, a single aviation market with New Zealand has been formed, and the domestic airline industry has been deregulated. Furthermore, the nation's airports are

being privatised. Air transport is vital in a country of Australia's size and location. This is demonstrated by examining the role that a major airport (Sydney) plays in the economy. In addition to the employment generated by the airport and by the airlines, an efficient air transport system promotes trade.

The air transport sector is a useful example because it highlights the challenges ahead in dealing with potential constraints on development that arise because of congestion points. Air traffic growth poses particular problems because of the difficulty of expanding airport capacity in established cities. However, infrastructure is not the only constraint on development. It takes time to train and educate the people required to cope with the growth that is occurring in trade and travel in the Asia Pacific region. This paper discusses multilateral human resources development initiatives being pursued within APEC, particularly the proposal to establish a "virtual centre" for transportation research, education and development. Reference is made to Australia's experience in establishing centres of excellence and networks of institutions.

Transport Policy in Australia

Microeconomic reform

For at least three decades leading up to the 1960's, the prevailing view around the world was that economies of scale were so significant that only one supplier could survive in the long run, that transport was a natural monopoly. Alternatively, it was believed that transport would tend to destructive competition. The sizeable investments in assets had little value in other uses and the low marginal costs of operating meant that operators would continue to drop their prices below profitable levels. Chronic unprofitability, a lack of new investment and declining service and safety standards would result if government did not nationalise the industry or at least regulate it. The result was that governments played a major role in the provision of infrastructure and in operating services. In emerging transport modes such as trucking and aviation, the approach was to regulate entry to the industry, to control access to market, to set fares and perhaps to provide subsidies.

Australia adopted transport policies that were common in other parts of the world, but there were some notable differences. For example, it was policy to prevent the emerging mode of road transport from competing with the government rail systems. The argument was that the railways had a technical superiority for carrying freight over longer distances and that trucks were more suitable for local pick and delivery. However, a court interpretation of Australia's Constitution in 1954 opened the way for intermodal competition provided goods were being transported from one State to another. The interstate road transport industry expanded rapidly and took advantage of improvements to Australia's system of National Highways. One of the by-products of this era was the growth of very large and aggressively competitive freight forwarders. During the 1980's these organisations became some of Australia's most successful multinational companies.

The railways and coastal shipping lost a considerable amount of their most valuable traffic and throughout the 1970's these modes struggled to survive. There had been a lack of funds to upgrade the railways and service standards were declining. At the same time, costs were escalating in an era of high inflation and substantially higher fuel prices. Australia's general freight and passenger railways were becoming a major financial burden on government and there was a recognition that major reforms were necessary. In the maritime sector, the large investments required to introduce containerisation and a sizeable reduction in the size of the waterfront workforce were not sufficient measures to overcome inefficient work practices and a reputation for unreliability.

New attitudes about public sector management emerged during the 1980's and all governments in Australia turned their attention to reform. A high priority was to corporatise government business enterprises (GBE's) by applying private sector models of governance. The GBE's were

structured to report to a Board of Management that was accountable to the shareholder (ie. The government). Performance against targets and objectives were monitored on an on-going basis and managers were given incentives similar to those existing in the private sector. It was recognised that the GBE's were called upon to provide services that were not commercially viable, but the way of dealing with this for the government to compensate the GBE for its "community service obligations". In some cases, corporatisation was a step towards privatisation. Simultaneously, governments were dismantling much of the regulation that was specific to particular industries and was relying more on more general approaches to monitoring prices, trade practices and consumer protection. Protection of industries was being dismantled as more and more industries were exposed to competition. The key guiding principle adopted by government was to maximise benefits to the nation rather than to protect sectional interests

The transport sector was a particular target for these reforms (Hensher, 1993; Scrafton, 1997). In May 1988, for example, the Federal Government embarked upon a comprehensive set of reforms for its transport GBE's. These included Qantas Airways, Australian Airlines, the Australian Shipping Commission (ANL), the Australian National Railways Commission, Federal Airports Corporation, Civil Aviation Authority, Australian Maritime Safety Authority (Cronin, 1990). The State Governments that typically owned railways, ports and public transport services were pursuing similar initiatives. Thorough investigations were undertaken into every major transport activity and a sample of these reports in Table 2 testifies to the depth and breadth of the knowledge and experience that has been developed.

One of the major developments in policy in the 1990's has been the introduction of a new and wide-ranging competition policy. Following the publication of a major report on this topic (Hilmer, 1993), the Council of Australian Governments agreed in April of 1995 to jointly implement a national competition policy. These reforms are based on the presumption that competition delivers benefits to the public and they increase the scope for the private sector to compete with GBE's. For example, private sector transport operators now are able to operate trains on rail track owned by governments. This has necessitated the establishment of new organisational structures so that conflicting interests can be resolved. The GBE's also have been made accountable to competition law, particularly the Australian Competition and Consumer Commission (ACCC) which was formed in November 1995. The full implications of this policy are still being explored.

Table 2: Selected Government reports dealing with reform of the transport sector in Australia

Sector	Organisation	Year	Title of report
Multiple sectors	BTCE	1987	The Transport Sector in the Australian Economy
	BTCE	1990	Financial Performance of Government Business Enterprises in the Transport and Communications Portfolio 1977-78 to 1988-89
	PSA	1993	Discussion Paper on Price Capping
	PoA	1994	Building For the Job. A Strategy for Australia's Transport Network (National Transport Planning Taskforce)
	PSA	1994	Price Capping: Design and Implementation Issues
	BIE	1995	Issues in Infrastructure Pricing
Maritime	BTCE	1987	Trans-Tasman Shipping
	IAC	1988	Coastal Shipping
	BTCE	1988	The Pricing of Port Services
	BTCE	1990	The Costs of Waterfront Unreliability in 1988
	PoA	1992	Warehouse to Wharf. Efficiency of the Interface Between Seaports and Land Transport
	IC	1993	Port Authority Services and Activities
	BTCE	1995	Review of the Waterfront Industry Reform Program
	BIE	1995	International Benchmarking – Waterfront 1995
Rail	ARRDO	1981	Report on Rail
	IC	1991	Rail Transport
	BIE	1992	International Performance Indicators. Rail Freight
Road	BTCE	1981	Some Characteristics of Truck Ownership in Australia
		1981	Road Grants Legislation in Australia: Commonwealth Government Involvement, 1900-1981
	PoA	1984	National Road Freight Industry Inquiry
	I Com	1986	An Investigation of Cost Recovery Arrangements for Interstate Land Transport
	I Com	1987	The Review of Federal Registration Charges for Interstate Vehicles
	IAC	1988	The Efficiency of Interstate Transport Arrangements. Second Report, Harmonisation of Road Vehicle Regulations in Australia
	BTCE	1988	Review of Road Cost Recovery
	I Com	1990	Road Use Charges and Vehicle Registration
	BTCE	1992	The Cost of Maintaining the Australian National Highway System
	BIE	1992	International Performance Indicators. Road Freight
	BTCE	1992	Road Transport Reforms - Implications for Rural and Remote Areas
	NRTC	1992	Heavy Vehicle Charges Determination
	BTCE	1993	The Road Freight Transport Industry
	BTCE	1996	Traffic congestion and road user charges in Australian capital cities
Air	PoA	1985	Independent Review of Economic Regulation of Domestic Aviation
	BTCE	1988	Instrastate Aviation: Performance and Prospects
	BTCE	1991	Deregulation of Domestic Aviation: The First Year
	BTCE	1991	The Costs and Benefits of a Single Australasian Aviation Market
	BTCE	1992	Quality of Service in Australian Passenger Aviation
	PSA	1993	Inquiry Into The Aeronautical and Non-Aeronautical Charges Of The Federal Airports Corporation
	BTCE	1993	The Progress of Aviation Reform
	BTCE	1993	International Aviation
	BTCE	1994	Adequacy of Transport Infastructure: Airports
	BIE	1994	International Performance Indicators. Aviation
	BTCE	1995	Deregulation of Domestic Aviation in Australia: 1990-1995
	PSA	1995	Regulation of Airport Pricing - Is the New Zealand Approach Applicable to Australia?
	PSA	1995	Price Oversight Arrangements For Federal Airports Post Leasing
	BTCE	1996	Code Sharing In International Aviation: A Discussion Paper
	BTCE	1996	International Aviation: Trends and Issues
	ACCC	1996	Movements in Average Air Fares: 1990-1995
	Industry Commission	1997	The economic impact of international airline alliances

Notes: ACCC = Australian Competition & Consumer Commission; ARRDO = Australian Railway Research and Development Organisation; BIE = Bureau of Industry Economics; BTCE = Bureau of Transport and Communications Economics; IAC = Industries Assistance Commission; IC = Industries Commission; I Com = Interstate Commission; NRTC = National Road Transport Commission; PoA = Parliament of the Commonwealth of Australia; PSA = Prices Surveillance Authority.

Aviation policy

The changing policy environment in Australia can be appreciated by examining developments in one sector, aviation, in more detail (Hooper and Findlay, 1997). Economic regulation of the domestic airline industry commenced in the early 1950's when the government feared a monopoly would emerge. It adopted a policy that supported two airlines, one in the private sector and the other owned by the Government. Fares were regulated, capacity was controlled, the airlines were required to consult on important commercial matters and no other airlines were allowed to import jet aircraft. The two airlines were placed on an equal footing and the only major changes over the next three decades were in the way fares were determined. Since 1974 the Federal Government had set fares using a formula approach incorporating a 'flag-fall' and a 'distance' component. By the late 1970's, though, there were widely held views that Australian airfares were too high, especially on the longer routes.

The Government made two important concessions in 1981. It agreed to conduct a thorough evaluation of the advantages and disadvantages of deregulating the domestic airline industry, and regional airlines were given some scope to introduce jet aircraft and to expand their services to non-trunk routes. In addition, it set up the Independent Air Fares Committee (IAFC) which reduced prices on long-haul and on short-haul routes and permitted the airlines greater scope to introduce promotional discounts. One of the regional airlines, East West Airlines (EWA), took full advantage of its new opportunities and it began to compete indirectly for traffic between Sydney and Melbourne with fares half those of the established, trunk route carriers. This heightened the public's expectations about what would be possible in a deregulated market. When the evaluation of airline regulation was completed in 1986 it was clear the majority view was in favour of deregulation. The Government gave the airlines three years' notice and dismantled its two-airlines policy in October 1990. The relevant regulatory bodies (safety issues aside) now were the Prices Surveillance Authority and the Trade Practices Commission (now combined under the banner of the Australian Competition & Consumer Commission). Industry-specific regulation had been replaced by general rules on competition and consumer protection.

Since deregulation, there have been two successful attempts to start a new airline. Both failed within a year of commencement, but they did have an impact. The established airlines have had to change strategies and management approaches. Fares have fallen and the market has expanded greatly, especially in the non-business segment that has been the target of promotional fares. The impact of these changes has been felt most on the longer routes and at tourist destinations. Restricted access to infrastructure was cited as a factor that contributed to the failure of the new airlines, but the flawed strategies were evident (Nyathi et al., 1993). Though the result has been no change in the number of competing airlines, there has not been any great pressure to re-regulate. To the extent that there have been challenges to the Government's policies, the most significant problems have arisen with the interface between the domestic and international airlines.

A key development occurred in 1991 when the Government decided to privatise Qantas and Australian. At first it intended to sell its two airlines as independent entities, but financial advisers provided convincing arguments that they should be merged. In 1992, Qantas acquired Australian Airlines and set about creating 'a seamless domestic and international airline service'. In 1993, Qantas was allowed to sell its spare capacity on domestic legs of international flights in the domestic market. In March 1993, British Airways acquired 25% of the shares of Qantas and by the end of 1995, Qantas had been fully privatised.

At the same time that it was deregulating the domestic airlines and privatising, Australia was changing its approach to international aviation. Up until the mid-1980's, most of the travel to and from Australia was undertaken by Australian residents. Australia was reluctant to enter into air services agreements with other countries that could not offer reciprocal benefits and protection of Qantas was a key consideration in negotiating air services agreements with other economies. The increasing competition in the 1970's and the introduction of large, wide-bodied aircraft on long-haul routes made it progressively more difficult to control international air fares, but entry of

new airlines and additions to capacity continued to be regulated. The rapid growth in international visitors to Australia in the 1980's, however, changed the perspective. The tourism sector began to exert pressure on the Government to change its policies and, in 1989, it was announced that aviation policy would be guided by assessment of benefits to the nation. The protection of Qantas remained important, but it would be set against the benefits of promoting tourism through more liberal approaches.

When it merged Australian and Qantas, it was inevitable that the Australian Government would approve multiple designation. It established the Independent Air Services Commission to allocate commercial rights agreed under air services agreements and the way was open for Ansett Airlines, and any new entrants, to compete with Qantas and other international airlines. Australia has 9 international gateways spread around the coastline and Qantas had a competitive advantage through its integrated domestic and international operations. Ansett had no option but to enter international markets. However, it did so with considerable disadvantages. In addition to the problems it faced in capturing market share in the international markets, its two owners, TNT and News Corporation, were not willing to finance re-equipment and expansion and it had lost market share to Qantas on domestic routes. When Air New Zealand agreed to purchase TNT's half share, the Government was forced to re-examine the issue of a single aviation market with New Zealand. The outcome has been that the New Zealand carrier has become a half-owner of the domestic part of Ansett and a single market has been agreed.

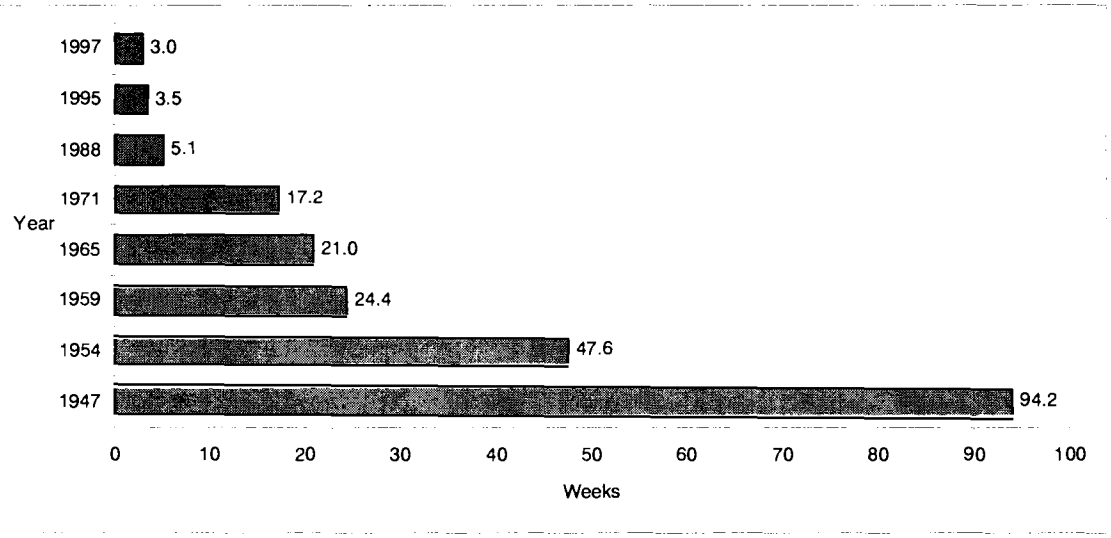
Aviation policy is continuing to evolve. The USA has been signing open skies agreements with several Asia Pacific economies and this is giving its carriers a competitive advantage through their greater access to passenger and freight traffic between second and third countries. At the same time, global alliances are being cemented. Qantas is linked to British Airways, and the Independent Air Services Commission had deep misgivings about approving an extension of the code-share agreement between these two airlines in 1997. Ansett is linked to Air New Zealand and both are strengthening their ties with the Star Alliance incorporating United Airlines, Singapore Airlines and Lufthansa. Australia, through its Industry Commission, currently is conducting an investigation into its current policies and procedures. This inquiry will report in September 1998, but it will do so against the background of an airline industry in turmoil with the economic problems in Asia Pacific. The experience of the past decade suggests, though, any changes in policy will be designed to give airlines greater commercial freedom to deal with competition with the proviso that any changes will aim to produce net benefits for the nation.

Aviation and Economic Development

More than one-third of the value of all international trade now is transported by air. Air transport provides the speed necessary to support modern business practices that rely on global sourcing and marketing within efficient supply pipelines. However, the most important economic role of air transport in the latter part of the 20th Century has been to expand international tourism. Rising incomes and an increasing taste for travel have been key driving forces, but the falling costs have removed international travel from the almost exclusive domain of business people and the very wealthy to the broader community.

The following chart illustrates this by showing how many weeks of pay an Australian worker on average earnings would have to set aside for a return air fare between the United Kingdom and Australia over the past 50 years. In 1947, the air fare was equivalent to almost two years of pay, but within a decade this fell to approximately half a year. The introduction of the B747 and the emergence of aggressive airlines in South East Asia in the 1970's brought the equation down to only 5 weeks of pay by the commencement of the 1990's. More efficient aircraft and increasing competition have reduced prices to the point where the worker on average earnings only has to save the equivalent of 3 weeks pay to undertake a holiday in Europe.

Figure 1: Affordability of international air travel – weeks for average worker to pay for a return trip from Australia to the United Kingdom



Sources: Qantas Airways, Australian Bureau of Statistics.

The World Travel and Tourism Council has estimated that, globally, tourism generates 212 million jobs (one in nine) and that it makes up 10.9% of the value of world output (WTTC, 1995). Raguraman (1995) has estimated that an additional weekly B747-400 service by a foreign carrier from Los Angeles to Manila would generate 11,300 jobs in the Philippines (assuming 425 seats with a 65% load factor). These jobs would exist because the visitors carried by the airline would make a direct contribution of US$13 million to the economy while the airline would spend another US$3 million. This economic activity flows on to the rest of the economy and the final impact of an additional flight per week on this route would be a US$30 million increase in total output. A foreign carrier operating a weekly A310 service between Tokyo and Bangkok would add 1,800 jobs in Thailand. In this case, the expenditure by the visitors has been estimated to be US$4.5 million, airline expenditure as US$0.8 million, and a total direct plus multiplier impact of US$7.9 million on output.

Efficient and effective airline services and airports have become vital elements in the economic infrastructure of any nation. Rapid growth in air traffic, the long planning horizons required for major additions to capacity, and public opposition to airport developments pose challenges for policy makers and airport managers. It is important the economic role of airports be well documented and that the debate about airports proceeds with full knowledge of the facts. To illustrate this point, consider the case of Sydney International Airport. In many ways its location only 15 kilometres from the central city is an advantage. Travellers in many other cities face time-consuming and costly trips in getting to and from the airport. However, the other side of the equation is that there are densely populated residential areas under flight paths and the recent opening of a new runway led to strong opposition to any further expansion of the airport's capacity.

Without wishing to minimise the significance of the environmental problems posed by airports, let us focus on the economic issues. First, the airlines and the airport give rise to a varied set of activities. This is illustrated in Table 3. In total, it has been estimated that the airport-related sector in Sydney directly employs 33,500 people and that another 33,000 jobs are generated through flow-on effects (Hooper *et al.*, 1996). These flow-on effects occur because the organisations involved in the initial impacts purchase inputs from other organisations and because some of the income generated in the region re-enters the spending cycle. For example, the airline catering establishments purchase fresh foods from other suppliers, cleaning contractors assist airlines and the airport operator, and smaller engineering contractors perform specialised services for the airlines. Studies of the linkages that exist between the airport-related

businesses and other suppliers reveal that the flow-on effects diffuse broadly throughout the entire economy. Australia had a practical test of this when it experienced a protracted airline pilots' dispute in 1989 and many businesses learned that they were relying to a significant extent on the flow of visitors (Faulkner and Poole, 1989). At the same time, the business community found it difficult to maintain normal levels of activity. Normal face-to-face contact with clients and agents could not be maintained and intra-organisational communications suffered.

Table 3: Examples of airport-related activities

Type of Activity	Functional Relationship	Examples	Region of Influence
Airport bounded	Primary airport services	→ Air traffic control → Refuelling → Aircraft maintenance → Cleaning of terminals	On the airport
	Secondary airport services	→ Freight forwarders → Customs → Airport buses → Duty-free stores	Immediate vicinity of the airport
Airport using	Cargo	→ Cool stores → Warehouses	Within 10 kilometres
	Passengers	→ Accommodation → Tour operators	Within 50 kilometres
Airport susceptible	Cargo	→ Shippers who use air freight for some or all of their products → Businesses receiving supplies/components by air	Within 100 kilometres
	Passengers	→ Executives → Sales persons → Skilled staff	Within 100 kilometres
	Indirect user (prestige)	→ Technology parks	Up to 5 kilometres

Source: Adapted from van den Berg (1996).

Competitive Cities in the 21st Century

These are sizeable impacts, but it is important that they are not taken for granted. Typically, airport impact studies provide little more than a snapshot at a point in time. It is more useful to think in terms of the airport as a catalyst for economic development and to consider how air transport plays a dynamic role in a changing economy.

A key structural problem for Australia has been its high unemployment rate that has tended to decline slowly when the economy is in a growth phase and then increases sharply in each subsequent recession. A major objective of government has been to achieve more stable management of the economy. However, any period of sustained growth has resulted in additional demands for imports and exacerbates the current account deficit on Australia's balance of payments. Debt levels rise and this leads to increasing interest payments and higher interest rates. One way around this debt cycle is for government to use its fiscal and monetary instruments to slow the growth in the economy. Australia's debt levels, through the demand for imports and the balance of payments, act as a constraint on growth in the economy that can be eased by the nation becoming more competitive internationally. Sydney International Airport, as Australia's number one gateway, is a conduit for trade and tourism and as such is a key part of the infrastructure supporting the Government's economic policies. What matters is that the

airport remains attractive to the major airlines and this requires adequate capacity to cater for growth in demand as well as efficient operations.

Europe's experiences in adjusting to the oil price shocks in the 1970's and 1980's and the new conditions in the European Community and an era of global business are revealing. Sutton (1993) argues that "many of Europe's great cities died in the 1970's" and the centre of economic gravity shifted to the south of France and Germany while the older, industrialised cities in northern Europe went through a painful process of restructuring. With the economic upturn in the 1980's a new pattern emerged in which the old core of industrialised areas was supplemented by a new core incorporating southern Germany, northern Italy, south-eastern France and central-eastern Spain.

Over this period there has been wide variation in the performance of individual cities. Older metropolitan centres have continued to attract international financiers and service providers, but the newer suburban areas of older cities have become the focal points for high-technology industries and producer service industries. Cheap land, plentiful labour, less congested conditions, access to research institutions, and cleaner environments with better life styles have been the sources of competitive advantage, but typically a critical factor in the location decision with these "footloose" businesses is proximity to an airport with good connections. Sutton argues that the improvement and expansion of the transport and telecommunications infrastructure, including airports, within Europe has created greater freedom of locational choice.

Michael Porter has used the term "competitive cities" to illustrate the nature of modern business with advantages being derived through concentrations of complementary economic activities in the one place. Location theory suggests that transport improvements make it possible for a business located in a "competitive city" to extend its markets and that this generates growth in the node. A related argument is that the variety and concentration of services and sources of supply in larger cities reduce production costs and this becomes the source of further growth that strengthens the competitiveness of the "central place". Furthermore, those urban areas that can provide an adequate supply of labour and materials, low production costs, and access to markets on favourable terms through efficient transport and communications provide a source of external economy (Norris and Golaszewski, 1990). Cooper (1990) cites evidence that proximity to an airport is one of the top five locational factors required by R&D firms and there is a tendency for biotechnology firms to locate themselves near airports and major research centres. Transport infrastructure and services determine whether cities can be good places to do business

Several European cities such as Manchester have found that the airport can become the focal point of a strategy to regenerate an industrial area. In Sydney's case, the airport lies in a region to the immediate south of the central city and adjacent to the port. This region historically was a centre for heavy manufacturing, a sector of the Australian economy that has been hit hard by reductions in tariff protection and by competitive imports. At the same time, many of the industries have been moving to the periphery to get access to land and to avoid congested conditions. The airport has been a growth sector in a region of the city in decline, a region with many industrial sites that have not been suitable for redevelopment for non-industrial land uses. The airport and associated activities have been a positive force for economic regeneration. The construction of a new airport rail link is being viewed upon by planning authorities to create new residential and commercial growth poles around stations. The decision to construct the rail line can be attributed directly to the existence of the airport, yet it will play an important role in urban renewal.

Human Resource Development

Some general observations

The rapid growth in the Asia Pacific region over the past decade has put considerable pressure on supporting infrastructure of ports, airports, roads and railways. Not surprisingly, there has been a good deal of attention placed on the bottlenecks in the system (APEC, 1997). It is not clear what impact the current set of economic conditions will have on the region's congestion points, but it is more than likely the pressure has been eased only for several years. Long-term planning has to continue in the knowledge that a long lead time is required to undertake significant expansion of capacity. A new airport, for example, normally takes 7 years from decision to proceed and ultimate operation. What is less well understood is that the human capital has to be developed with similar lead times. Up until 1997, forecasters were predicting air travel in Asia Pacific would double within a decade. Consider the demands this places on human resources development. Pilots, aircraft maintenance engineers, air traffic controllers and managers have to be trained with sufficient time for them to accumulate the necessary experience to take the industry forward. In the remainder of this paper, comments will be made on initiatives being undertaken by APEC on a multilateral basis and Australia's situation will be reviewed.

APEC Centre for Research, Development and Education

APEC Transport Ministers at their meeting in June 1995 raised the idea of establishing a Centre for Transportation Research, Development and Education and requested its Transport Working Group to analyse the feasibility and viability of such a centre. The intention was for the Centre to play a key role in improving the productivity, skills, entrepreneurial capabilities and the efficiency of labour and management in the transport sector. Several concepts have been considered, but interest has developed in the formation of a network of institutions/organisations that provide research and development and/or human resource development in the transport sector. It was envisaged that institutions in the network could work independently or in co-operation within the network on specific projects. Member economies are in the process of investigating how best to proceed with a "virtual centre" that could be set up in a developing economy.

Taking stock of the providers of transport research, development and education in APEC

Individuals involved in transport research tend to be dispersed widely through universities, government agencies and private sector organisations. A reflection of the importance of transport in all of the economies is that there are few universities that do not have at least one researcher who is conducting applied research on transport topics. However, many of these researchers work in isolation to the extent that they do not have daily contact with other transport researchers. This is as true in developed economies such as the USA, Canada, Japan, New Zealand and Australia as it is in developing economies such as Indonesia, the Philippines and China.

These individuals make a substantial contribution to transport research, but their teaching role is limited to the provision of specialist subjects on transport within broader programmes in engineering, mathematics, economics, or geography for example. However, some universities have had sufficient commitment to form transport research centres. Often they have grown out of civil engineering schools where there has been a strong interest in construction and maintenance of infrastructure and in traffic engineering and safety. Increasingly, economics and management schools have formed transport research centres and some have resulted from coalitions of researchers across several disciplines within a university. These are relatively common in North America, the Centre for Transportation Studies at the University of British Columbia is an excellent example as is the Institute of Transport Studies at the University of California (Berkeley, Irvine and Davis). Non-American models include the Transport Research Centres at the National University of Singapore and Nanyang Technological University. In Australia, there are several

centres of this kind, but the formation of the National Centre of Teaching and Research in Transport Management is the result of an alliance between a management school at the University of Sydney and a civil engineering faculty at Monash University.

Few of these university groups operate on a sufficiently large scale that they are able to maintain specialist education programmes. The exception is North America where there are transport programs in at least 20 of the leading universities. If the field is widened to incorporate logistics management, there is an even larger set of centres. For example, the Centre for Transportation Studies at the University of British Columbia is linked to the Faculty of Commerce and Business Administration and its members contribute to undergraduate and postgraduate programmes. Another example is the Institute of Transport Studies at Berkeley, Irvine and Davis campuses where staff are seconded to the Institute from engineering, geography and economics where they teach in undergraduate and postgraduate programmes. Moving across the Pacific to New Zealand, Massey University offers a diploma in transport planning. In Australia, the Royal Melbourne Institute of Technology offers undergraduate and graduate courses in transport and logistics.

In some Asian economies the approach is different. In particular, transport studies at the undergraduate and postgraduate level are provided within universities that have been linked to the various modes of transport. In Korea, Hankuk Aviation University is owned by Korean Airlines.
The maritime area is served by specialist universities, colleges and institutes in a number of economies, including the Australian Maritime College, the Korea Maritime University, the Ocean University in Taiwan, Qingdao Ocean University and the Shanghai Maritime University (China) and the Singapore Port Institute. The focus in the past has been on technical training for shipping and port operations, including seafarer training.

In many countries, institutes of technology, polytechnics or equivalent institutions provide diploma level courses in transport administration or in other technical areas of transport such as maritime operations and in traffic management and safety. Professional bodies such as the Chartered Institute of Transport (Singapore, Malaysia and Hong Kong) and the Institution of Engineers provide additional training and education opportunities. Other training providers include, for example, the Singapore Aviation Academy, the Port of Singapore, the Malaysian Airports Berhad Training Centre and the PNG Trainmar Centre. Also, the larger organisations conduct in-house training programmes of their own.

Some of the APEC economies maintain government research institutes. Examples include the Bureau of Transport and Communications Economics in Australia and the Korean Transport Institute (KOTI). As with the university sectors, most governments employ people who carry out some transport research and development. The Malaysian Institute of Maritime Affairs (MIMA) has been established to undertake research on maritime matters and to advise the Malaysian Government. The Korea Maritime Institute also undertakes maritime research and advises government. Similarly, the Japan Maritime Research Institute provides a strong research capability in that economy.

International agencies such as the Asian Development Bank and ESCAP have played an important role in strengthening institutions in the transport sector through their on-going work and commissioned studies. Other research, development and education occurs under the auspices of organisations such as ICAO and IATA.

In the private sector, there have been some significant commitments to research over time. For example, the Mitsui Research Corporation provided a substantial contribution to a study about transport, telecommunications and transport (Triple-T) carried out under the auspices of PECC in 1989. The NYK shipping line in Japan is an example of a private sector organisation with a commitment to research. In the main, though, private sector research addresses specific problems faced by sponsors. The same can be said of training programmes, many of which have been developed by consulting businesses.

A network of institutions or organisations?

The variety and coverage of educational and research programmes illustrates the breadth of the transport sector. This makes it difficult to set specific objectives for an APEC Centre for Transportation Research, Development and Organisation. However, it is possible to build upon existing formal and informal networks of transport educators and researchers. For example, the Pacific Economic Cooperation Council (PECC) has formed a Transport Advisory Committee and it is intended this will convene an annual conference to focus on regional transport issues. The first such conference was hosted in Seoul by KOTI in December 1997. Delegates attending the conference agreed the exchange of views achieved at the meeting was highly valued and consideration is being given to how frequent PECC should convene these conferences.

The concept of a network of institutions raised in the Australian economy paper allowed room for flexible arrangements, institutions could work independently or they could work in cooperation. Universities and other similar institutions tend to be open-minded about cooperative modes of operation. Many have signed formal memorandums of understanding that allow for the exchange of staff and students. The Institute of Transport Studies (Sydney and Monash), for example, includes members of other transport institutes on the Advisory Board of their Key Centre. Massey University (New Zealand) and the Singapore Aviation Academy co-operate to provide a degree in aviation.

Such arrangements encourage the sharing of information and exchanges that result in improved understanding. However, a general point about the management of "strategic alliances" needs to be appreciated. To the extent that the participating institutions have different governance structures and different cultures, it is not a straightforward as often as it is assumed that such groups can work on a collaborative basis. For example, experience with joint research initiatives across universities in Australia and elsewhere is that performance can be highly variable. Universities seem to have better prospects of working together than, say, international airlines (for which strategic alliances are in vogue), but it is not a step that should be taken without some forethought. Nevertheless, if research and education follows the pattern of global business, it is inevitable that networks will be constructed so that expertise can be sourced from those institutions that possess comparative advantages in their fields. Possibly, APEC will be able to provide a framework within which this co-operation can be fostered.

Australia's approach to human resources development in transport

Australia has developed a diverse set of programmes in transport ranging from driver training to doctoral research studies covering all modes of transport. Governments at the Federal and State levels provide a large share of the funding of these programmes, but they also have played an important co-ordinating roles with universities, colleges and industry. The following sections describe some initiatives that illustrate the nature of the training and education programmes that have been developed in Australia.

The Australian Key Centre of Teaching and Research in Transport Management

The Institute of Transport Studies (ITS) was established at the University of Sydney in 1991 and offered a Master of Transport Management and a Graduate Diploma in Transport Management. Shortly after commencement, it developed special certificate programmes in transport management in cooperation with the New South Wales Bus and Coach Association and the New South Wales Ministry of Transport to ensure that operators are equipped to fulfil their obligations under the *Passenger Transport Act*.

By 1995, the Institute had 80 students enrolled annually on a full or part-time basis in the Masters and Graduate Diploma degrees, 200 students in the Certificates of Transport Management and 13 doctoral research students and it employed 18 people on its teaching, research and administration staff. The funds to support this expansion had been generated from fees on award and special courses, research grants, industry-sponsored research and consultancy and donations.

Also, the Institute maintained strong links with other university research groups in Australia and abroad. The relationship with the Monash Transport Group (MTG) in the Department of Civil Engineering at Monash University was particularly effective. The MTG was recognised nationally as the premier graduate program in traffic engineering, demonstrating its commitment to transport education and research for a quarter of a century. MTG has over 30 graduate students each year in its MEngSc program in transport and another 8 students in its doctoral program. The group has made major research contributions in land use and environmental modelling, transport policy, engineering teaching, freight movement, parking systems, intelligent vehicle and highway systems. MTG ran training and short courses on a regular basis for the Institution of Engineers, and recognised and acted on the need to expand the transport management and policy area of teaching in transport engineering.

In 1995, ITS and MTG were successful with a joint proposal to the Australian Government to be designated jointly as a Key Centre of Teaching and Research in Transport Management. The aim of the Centre is to provide Australia with a nationally and internationally recognised programme of teaching and research in transport management. This encompasses economics, planning, marketing, operations, forecasting, design and evaluation - in which the key outcomes are enhanced human resource skills, improvements in the tools required to undertake applied research, and their delivery into industry and government organisations. The Key Centre's emphasis is on transport management skills, transferred through teaching and research.

Key Centres are elite groups within Australian universities and are designated by the Australian Government's Department of Education, Employment and Training. The Department designated only seven centres in 1995 after each university submitted up to three proposals. The evaluation process was rigorous and it is the first time in Australia that a transport research and education group has been accorded such a high level of recognition.

The Centre's priorities have been to integrate existing graduate transport programs at the University of Sydney and Monash University, to introduce a new certificate program in freight and logistics management, and to play an expanded role in transport management and policy formulation in the Asia Pacific region. The research program is focused on three specific areas: (i) urban and long distance freight, (ii) urban and long distance domestic passenger travel, and (iii) international transportation with particular reference to Australia's links with Asia and the Pacific Rim.

The five essential requirements identified by the two universities that have led to success are:

1. An effective organisation and management structure, guided by an advisory committee of committed individuals from industry, government and universities.
2. A strong core of teaching competence for all styles of delivery of a teaching program.
3. A strong depth and breadth of expertise capable of undertaking scientific tasks required to establish. maintain and disseminate the outputs of research.
4. An ability and preparedness to respond to others' definitions of issues as well as forming its own views on what issues are important.
5. A reputation for quality work and a strong focus on meeting the needs of client groups.

Networks – government, industry and educational institutions

Australia provides two excellent examples of networks incorporating government, industry and educational institutions that co-ordinate education and training in the aviation and maritime sectors. Australia has been a pioneer in aviation and now has more than 1,600 airports and

airfields, including 9 international gateways, 11 primary domestic hubs, 14 major regional airports and 8 major airports serving general aviation. Australian companies have a strong track record in successful airport development projects in more than 50 countries.

With the close collaboration of the Australian Trade Commission (Austrade), the Airports Industries Australia Inc. (AIA) was formed so that the diverse interest groups could co-operate to serve the needs of international clients for the funding, design, development and operation of regional and international airports. AIA is able to offer clients a total package from planning, project management, human resources development through to commissioning. In addition, Aviation Training Australia (ATA) Inc. was established in 1994 as a joint Government-industry initiative, to promote the capabilities of Australia's aviation training industry. Members of ATA Inc. include Airservices Australia, airlines, universities, flying colleges and many other aviation training providers. Through its promotional activities, ATA has earned an excellent reputation both in Australia and overseas for the world-class aviation training capabilities of its members. Aviation training in Australia is able to take advantage of excellent flying conditions, cost-competitive training institutions and a safe, pleasant and multicultural environment for overseas students. Australia supports a world-class aviation training industry with courses that meet international standards including training in airline management, air traffic management, engineering, airport management, English for aviation, maintenance and pilot training.

As an island nation with a large coastline, the maritime sector is of vital importance to Australia. The Australian Maritime College is a leader in human resources development in this sector through its courses ranging from certificates to masters degrees and doctorates in fields as diverse as fisheries and naval architecture. In every State in Australia there is at least one college of Technical and Further Education offering a variety of courses along with private sector training courses. In 1995, a national network of the principal providers of maritime training and education was established. Known as Australia Maritime Training its member institutions are able to offer:

- Stevedoring
- Seafarer training
- Navigation for ships' masters
- Marine engineering
- Trade courses in shipbuilding skills through to advanced studies in ship construction, project management and technology
- Maritime and international law
- Business management
- Trade and finance and the maritime sector

Australia has a strong and expanding maritime training agenda in the Asia-Pacific region. In order to develop Australia's maritime training capabilities and to contribute to the twin objectives of the International Maritime Organisation (IMO) of Safer Oceans and Cleaner Seas, Australia-Maritime Training continues to co-ordinate activities. A-MT has been delivering maritime training programmes in APEC economies to assist in meeting the challenges of developing people to cater for the growth in trade. For example, the Australian Maritime College and the Australian Marine Oil Spill Centre have been training Indonesian maritime officials and trainers in the areas of port management and pollution control. In another project, the Australian Maritime College and the Law Faculty at Monash University are working on a project to improve local understanding of the benefits to be gained nationally and regionally from implementing international maritime conventions. In particular, this cooperative project is focusing on IMO conventions by developing a training strategy utilising teaching techniques such as participatory workshop modules and facilitated discussion sessions. An additional regional initiative is being conducted with Indonesia to identify maritime education and training requirements in Eastern Indonesia.

Concluding Comments

Australia has not been alone in its reform of the transport sector to cope with an increasingly competitive global economy, but it has accumulated a considerable amount of knowledge and experience in the process. Thorough investigations and public debate have preceded major changes in policy, and there has been extensive monitoring of performance and revision of policies where necessary. The extent of the changes is exemplified in aviation where Australian air transport policy has been turned upside down over the 1990s. Australia now has

- a deregulated domestic market (free entry for Australian and NZ airlines)
- privatised carriers
- easier foreign ownership restrictions
- unified Australian and NZ market
- the introduction of multiple designation
- a shift in regulatory structure towards competition authorities
- a change in government policy towards competition in international markets.

Key lessons from the Australian experience have been that the private sector is ready to finance and operate transport infrastructure and services and that economic regulation is difficult to maintain in dynamic markets. Moreover, international competitiveness requires a continuing commitment to change based on assessments of benefits to the nation rather than sectoral interests. What matters is that the transport sector can deliver best practices and provide efficient infrastructure. The challenges in Asia Pacific are to improve regional transport linkages and to overcome the problems of goods and people passing through the region's congested cities.

It is useful to think in terms of the contribution of air services to the competitiveness of cities in the era of globalisation and outsourcing. Cities that are served by efficient transport infrastructure have a competitive edge in attracting and keeping businesses that are parts of global supply chains. Examples are given for Australia and other countries where air transport has had a major impact on location decisions. The term "tyranny of distance" has had a special meaning in Australia, but distance is not the enemy it once was. Efficient infrastructure and communications are building blocks for transport operators to adopt world's best practices so that they can play their part in global supply chains.

Finally, it is imperative that efforts be devoted to preparing the region's people to manage in a dynamic environment. The paper has drawn attention to the on-going work in the APEC Transport Working Group dealing with this challenge. In particular, it is exploring the concept of networks and the paper has indicated ways in which Australia has been successful in the maritime and aviation sectors. Based on Australia's experience with its centres of transport research, development and education and networks, key lessons have been that:

- Transport requires a multi-disciplinary approach, but it is possible to forge relationships that span traditional university structures
- It is possible to work within existing structures to develop highly visible and effective centres of excellence without the need to construct purpose-built facilities
- Networks between universities located in different cities can be established - distance need not be a barrier
- The need for transport centres does exist and this is expressed in student demands as well as demands for research and development by the private sector and government
- A relationship of mutual trust, respect and commitment can be fostered between universities and the private sector and government and financial support can flow to support the activities of a transport centre - there is scope for at least some activities to be self-supporting
- Governance structures can be devised to satisfy the interests of client groups and to guide the development of centres of excellence

Acknowledgements

The advice and assistance provided by officers of the Australian Department of Transport and Regional Development in preparing this paper is gratefully acknowledged.

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Learning from the History of the Japanese National Railways

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Abstract

I would like to talk about some lessons that we can learn by analyzing the history of the Japanese National Railways (the JNR) spanning over 100 years from 1872 to 1987, in which I developed a half of my career.

The history of the JNR can be roughly divided into four periods, each of which was studded with unforgettable events that brought about breakthroughs in Japan's railway systems and outstanding people who lead the times.

These leading people were not necessarily high-ranking executives but those of rather younger generation such as 30's and 40's, who dared to proceed untrodden paths and achieved successful results. In other words, they were trained as leaders by continuously challenging new tasks.

As can be seen in these examples, it is of critical importance for fostering excellent working force to have them accumulate experiences in building new systems and trying new methods of works.

The Railway Technical Research Institute, which I am currently serving as senior advisor, constantly accepts researchers from Asia and Europe and developing tight relationship with overseas rail organizations through various research collaboration projects. It will be great pleasure for me if RTRI can serve your country in any way.

Today I would like to talk about some key innovations in the development of the railroad by discussing the history of Japanese railroad development.

From a global standpoint, railroad operation is stable and successful only in the areas of highspeed rail, metropolitan transit or commuter rail, and long-distance and heavy-freight rail. In Europe, as you know, there is highspeed rail, such as the TGV and ICE trains; subways in Paris and London; and freight railroads, connecting the eastern and western portions of the European continent. These are all doing very well commercially, carrying many passengers and hauling a lot of freight. In the United States, trains do not do very well in long-distance inter-city passenger service. However, subway and commuter service in some cities, such as New York and San Francisco, are successful. Freight trains, hauling heavy cargoes across the continent, are also enjoying profitable operations. In Japan, highspeed passenger rail service, represented by the Shinkansen, or "Bullet Train," and commuter service in such large cities as Tokyo and Osaka, are very profitable.

Japan's railways were first constructed in 1872 under the guidance of an Englishman, named Edmond Morell. The next 100 years marked the history of the development of the Japanese railroad, which I think can be approximately classified as follows:

Phase 1: 50 year era of railroad construction.
Phase 2: 25 year era of technological advancement in designing and manufacturing locomotives domestically.
Phase 3: 12.5 year era of promoting the electrification of the railroad.
Phase 4: 12.5 year era of introducing information and computer technology.

The 15 years, following the end of Phase 4 in 1972, can be described as a period of technological stagnation, due to problems associated with labor-management relations. The most recent 10 years are noteworthy in railroad history, because the regional division and privatization of the Japanese National Railway (JNR) system has proven very successful.

The first 50 years of the 100 year period in Japan's railroad development can be classified as the "Railroad Construction Age." Japan was rather behind in introducing the railroad, in comparison with other Asian countries, and we had to ask for the assistance of the foreign engineer from England, whom I previously mentioned. However, during the first 20 to 25 years from 1872, we built railroads very vigorously

and the skeleton of the existing rail network was laid during this time . Much of this rail network was built with private investment. Later, the Japanese government realized the importance of railways for military interests, and the government purchased private railways and nationalized them. Naturally, civil engineering technology for tunnel and bridge construction played a vital role, and made great progress during this period.

The next 25 years of Phase 2, lasting until around 1947, can be characterized as the era of technological advancement in designing and manufacturing locomotives domestically. Until then, most of the trains were hauled by imported foreign locomotives, although the first steam locomotive for mass production in Japan had been completed in 1913. It was, for the most part, designed by Japanese engineers - Yasujiro Shima and his son, Hideo Shima. The senior Shima had studied U.S. locomotives and introduced the two most important factors of railroad technology at that time, the air brake and automatic couplers. His son, Hideo Shima, had become an expert on steam locomotives, by designing most of the steam locomotives in Japan. Realizing the limits of steam locomotives, he came to the conclusion that electric multiple-unit trains would be the next generation of alternatives to steam locomotives. He, therefore, tried to develop them for use in the Shinkansen system.

I have to mention one other important railway engineer, Shiro Seki, who promoted the very important technology of electrification prior to the development of the Shinkansen system. He thought, during World War II, that the direction of Japanese railways should be towards electrification. He prepared a plan to electrify 10,000 km of the railroad, although a small portion had already been electrified. He took a chance and began electrification work in the six months immediately after the War, fearing that U.S. occupational forces would oppose the electrification policy, because they wouldn't see the need for it. Electrification of the Japanese railway marks the third era of railroad development.

He started electrification with the Joetsu line, an important trunk line. The reason why the Joetsu line was selected was because coal consumption for its steam locomotives exceeded that of any other line. In fact, Japanese National Railways was the largest consumers of valuable coal at that time. One-third of Japan's entire consumption of coal went to the railroads.

Mr. Seki also promoted alternating current (AC) electrification, replacing the

conventional direct current (DC) electrification. For this, it was necessary to complete the following three technologies, namely:

1) technology to develop the small-size silicon rectifier to be put onboard a car,
2) technology for the development of a higher frequency (around 1000 HZ) power source for signals, in order to eliminate electric magnetic interference,
3) communication technology to eliminate communication interference, by making use of SHF

The most important event in the fourth phase was the construction of the Shinkansen. Coinciding with the construction of the Tokaido Shinkansen, which put to use the aforementioned technologies, Ei Hosaka returned from studying at MIT in the U.S. He studied computer technology at MIT, and, upon his return, was engaged in the research of applying information technology to railroads. Mr. Hosaka's research efforts created the basis for seat reservation and operation management systems, called COMTRAC (computer aided train control). Both of these systems were indispensable for the development of the Shinkansen. Most of the other important basic technologies necessary for the operation of the Shinkansen had been well developed prior to the start of construction. For example, the researcher Sei Matsudaira, greatly contributed to enabling trains to run safely at the unprecedented speed of over 200 km/hr. He had become confident that Japan was ahead in the development of highspeed passenger rail, after discussing the subject with European engineers.

Another important figure in Shinkansen success was Shinji Sogo, who was the president of Japanese National Railways, at that time. Although he was not an engineer, he prudently insisted on an exclusive high speed line using a standard gauge, as opposed to a narrow gauge. JNR engineers' plans were to construct a Shinkansen line between Tokyo and Osaka using a narrow gauge. Our engineers at the Railway Technical Institute supported and promoted Mr. Sogo's idea, defying engineers at JNR headquarters, by holding a symposium titled, "The Possibility of Three Hours Between Tokyo and Osaka via Super Speed Trains." Previously, conventional express trains, traveling between Tokyo and Osaka, were taking eight hours to make the journey.

The construction of the Tokaido Shinkansen, thus, became the impetus for the creation of high speed train in other parts of the world.

In reviewing Japanese railroad history, the following events brought about major

innovations in railroad technology: 1) electrification, 2) development of the Shinkansen, 3) privatization of JNR. Most of the railroad engineers, who contributed major developments to Japanese railroads, were between 30 and 40 years old and had experience in studying abroad. They were very aggressive in learning from foreign railroads and introducing new technologies.

Last December an international conference on Global Warming was held in Kyoto. At this time, UIC began a campaign to extol the virtue of railroads as an environmentally friendly means of transportation. They estimated that fuel consumption by railroads is half that of automobiles, and one-third that of airplanes. Toxic emissions from trains are one-third and one-fourth that of cars and airplanes, respectively. I believe the perception that railroads are a superior means of transportation will grow more and more popular in the future.

The importance of railroad improvement and reform, from an environmental viewpoint, will also continue to grow in Asian-Pacific countries. As I told you today, the passion, determination, and technical competence of young engineers were very important to Shinkansen development. Therefore, I believe it will be necessary to nurture and train young railroad engineers in Asian-Pacific countries.

At RTRI, where I serve as a special advisor, engineers from Asia and Europe are engaged in various kinds of railroad research under the fellowship program, sponsored by the Japanese Science and Technology Agency. We will be very happy to receive young engineers from Asian-Pacific countries.

The Integration of Technology, Human Resource and Economic Development

In Emerging Country

20 Years Experiences of PT IPTN - Indonesian Aerospace Industry

Jusman SD

1 Introduction :

Pulling out from the poverty line and improving quality of living standard : Tourism and Airtransportation industries

1.1 Indonesia : A maritime continent that triggers tourism industries

In the next 25 years, the target of our nation is to pull the remaining 15 percent of our people who are still living below the poverty line out of it and to increase the quality of those who are already living above that poverty line. We believe that this target can be achieved only if the following Infrastructures are established namely,

(1) Infrastructures for the human resources development
(2) Economic infrastructure
(3) Science and technology infrastructures.

By developping the above mentioned infrastructure and optimizing it toward the achievement of a low cost economy, competitive high added value product for the captive domestic market as well as the regional and global market could then be developed.

In carrying out the independent, competitive industrial transformation, especially on the economic infrastructures, air transportation play very significant roles.

This is due to the fact that the geography of Indonesia is very unique. Indonesia is a nation consists around 17000 islands spreading over a huge territory spanning 5120 km east-west and 1760 km north-south. In totality the area of Indonesia is comparable to the area of the whole United States of America.

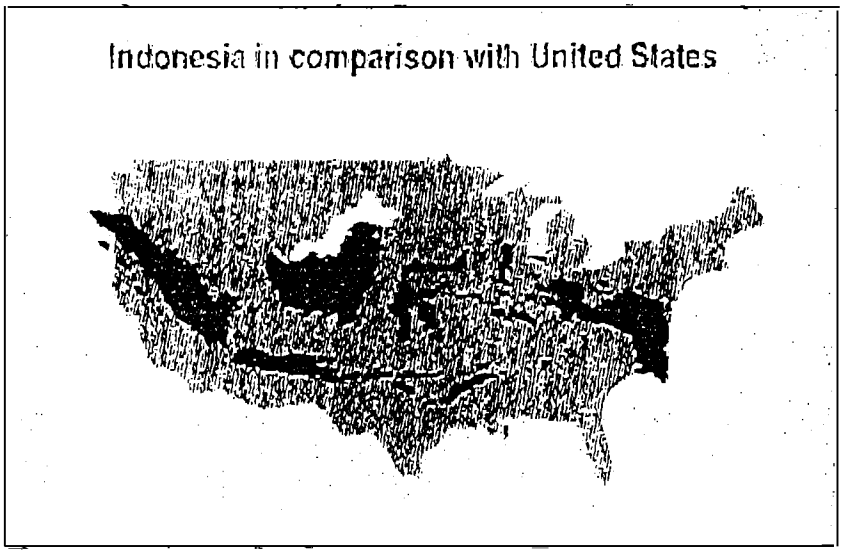


Fig 1. Geographical Comparison

Although most of the territories consist of water which is about three fifth of the total areas, the depth of the seas surrounding the islands are mostly very shallow around 150 meters. More over considering the fact that most of the islands and seas lay on the southern peninsula of Eurasian plate makes the Indonesia archipelago as a subcontinent of a water territory. NASA and NOAA called this unique geography of Indonesia a Maritime Continent. Looking to the whole structures of our planet Earth, it is cleary shown that Indonesia is the only maritime continent in this globe.

Hence this type of geography can only be unified if there is an integrated air transportation industries supported by a self reliance, competitive and internationally recognized integrated aerospace industries.

The natural prosperity of the maritime continent of Indonesia is believed to be the main factor in driving the migration of peoples from mainland Asia, such as from China and India, to populate this continent thousands of years ago.

They came into some of the island, established settlement there and since then, developed their society, some mix with the native at an isolated environment from each other islands. For thousands of years the society development on some of the island evolved into different ethnics, where each has their own cultures, language and sometime also believes.

In modern Indonesian these diversities of ethnics and cultures become one of the strength of Indonesia and also offer great potential for the development of the tourist industries.

As a matter of fact 60 percent of Indonesian population today still lives in Java and the rest are scattered on other islands, with the following compositions.

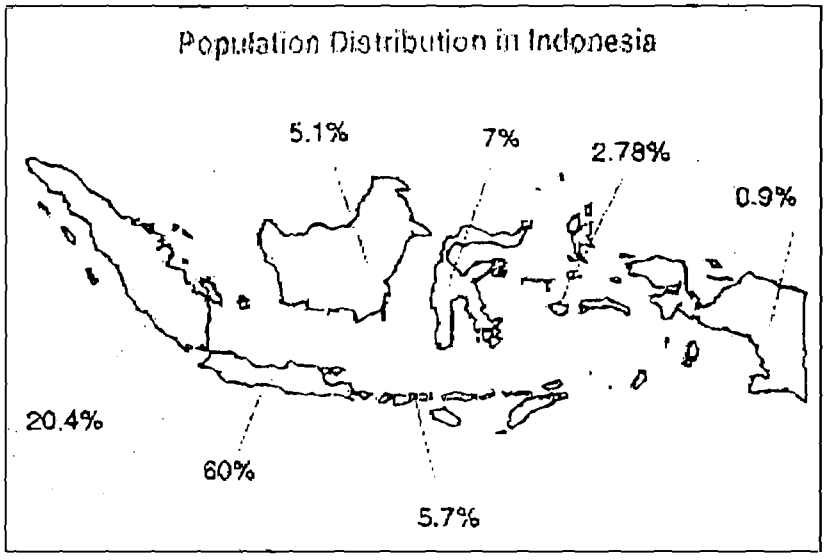


Fig 2. Distribution of Population In Indonesia

Fifteen percent of the total population who lives on these islands are today still living below the poverty lines and located at remote areas.

We strongly believe that one of the most efficient and quickest way to pull our people who are still living in remote areas out from the proverty line, could be done by the development and promotion of the tourist industries.

Important for the Tourist Industries are the existence of :

- A beatiful landscapes of natural environment and diversities of cultures
- A security and political stability of the region
- A high quality of services and facilities.

In the first 15 years of the last two decades the Tourist Industries development was very slow, but due to the development of the above mentioned infrastructure in the last five year of the last two decades the tourist industries developed exponentially. It also shows that the tourist industries is becoming today one of the big five foreign currency industrial earner in Indonesia.

Fig 3. Incoming Dollar from Tourism

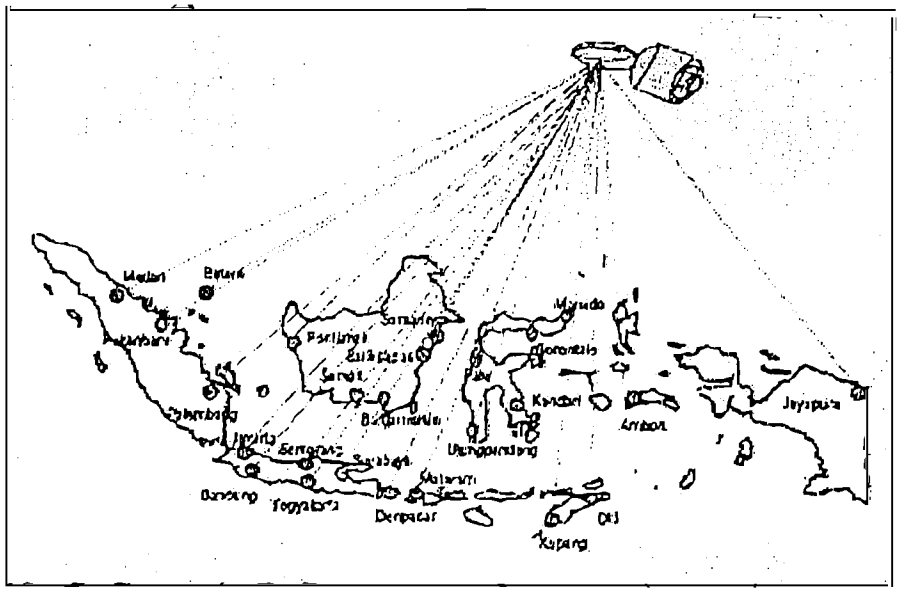
To support blossoming of the tourist industries, infrastructures should be more developed and established.

1.2 Tourism in maritime continent, a challenge for Aerospace Industry

Infrastructures to support tourist industries, should be a system assuring the safety and security for the tourists, especially by increasing the quality of communication and transportation services.

A good communication link is the one which cover the whole area of the maritime continent and being able to provide a quick un-interrupted exchange of informations through the use a geostationary telecomunication / TV satellite.

This is the main reason why eighteen years ago the Indonesian government undertake a bold step toward utilizing domestic communication satellite system "Palapa" for radio and TV broadcasting, data information links and other related maters. Since then, a self reliance hardware and software industries related to the above mentioned communication system has been developed in an accelerated pace quite successfully in Indonesia.



Flg 4. The Palapa Network

Diversities of cultures in remote areas are very potential to be exploited for the tourist industries. However, due to the remoteness of the tourist industrles location, this can not be realized without using high technology product.

One of the fastes and efficient way to bringtourism in and out of java into tourism site without distrurbing the virginity of that site is by air transportation which can be realized by using airplanes supported by appropriate ground support equlpment and operational system including a reliable aerial navigational system.

There are two segment that has to be considered in establishing air transportation system. The first is the air segment. In this segment, the type of aircraft has to be carefully selected for operation over the maritime continent Indonesia.

Due to a diversity of the size, airfield and wheather condltions on each island an operational capabillty of short field performance on a semi unprepared or even unprepared runway will be the main requirement in selecting the type of aircraft. More over due to the fact that the islands are spread at an average distance of 100 nm from each other, a small to medium size aircraft having capacity to carry between 20 to a maximum of 130 passengers and a range between 100 to 1100 nm is required.

The second segment Is the ground Infrastructures to support the airplane operation, including navlgatlonal system for air traffic control. Installing this facilities particularly navigational system at each island will be very expensive. One of the alternative feasible solution to reduce cost and risk is to employ a global positioning satellite system (GPS) for air navigation. In this case the infrastructures that has to be erected on ground can be kept at a minimum level.

Therefore it can be concluded that, to pull the remaining 15 percent out of the poverty line, aerospace products such as aircraft, satellite, for information and data processing and for air navigation, plays a very decisive roles.

This tourist industries will stimulate our people who lives at remote areas to find the means to increase their standard of living. At the same time this tourist industries also offer a big captive market to the Indonesian aerospace industries to be developed for.

2. Four strategic phases of transformation : begins from the final and ends at the start. The case of Aerospace Industries, IPTN

When in 1974 the Government of Indonesia decided to boost the development of the aircraft industry as part of its national development program, a strategy for industrial transformation was progressively formulated. Indonesia's general policy for national development is focused on the three main goals of increasing basic capital, utilizing resources optimally for self reliance, and applying science and technology in conformity with demand and priority. The establishment of the presently known PT Industri Pesawat Terbang Nusantara (IPTN) marked the initiation of the strategy for industrial transformation. This strategy, reformulated in the inaugural address of the author as an Honorary Fellow at The German Aeronautical Society, DGLR in 1978, in essence is aimed to develop the technological capability of Indonesia as a backbone for its national development appropriate to its socio-cultural setting in the modern word by starting from the end product and ending with its generic elements.

The ultimate objective of the industrial transformation strategy is transforming the nation from an agriculturally based society into and industrial based society, and additionally, for IPTN, to achieve world wide recognition as a viable aircraft manufacturing company.

The strategy for industrial transformation has been formulated in four strategic phases.

This phases begins with the efforts to master skills necessary to manufacture and assemble an aircraft as its final stage of its production process that is from the sub to final assembly. The phase ends up with the effort to acquire basic science which form the back bone of the technology for aerospace industry.

Phase one : Technology Acquisition through the transfer of existing technology to achieve an added value process, capitalizing on the acquisition of manufacturing capability of advanced technology product already in the market. The aim of this phase is to attain and develop skill and technological ability with regards to the technical aspects and the production of advanced industrial countries. This phase has been successfully carried out at IPTN since 1976. The results are among others : Licensed program for fixed wing aircraft such as NC-212; Rotary Wing aircraft such as NBO-105, Super Puma, Nbell-412 and weapon system such as SUT torpedos and FFAR missiles.

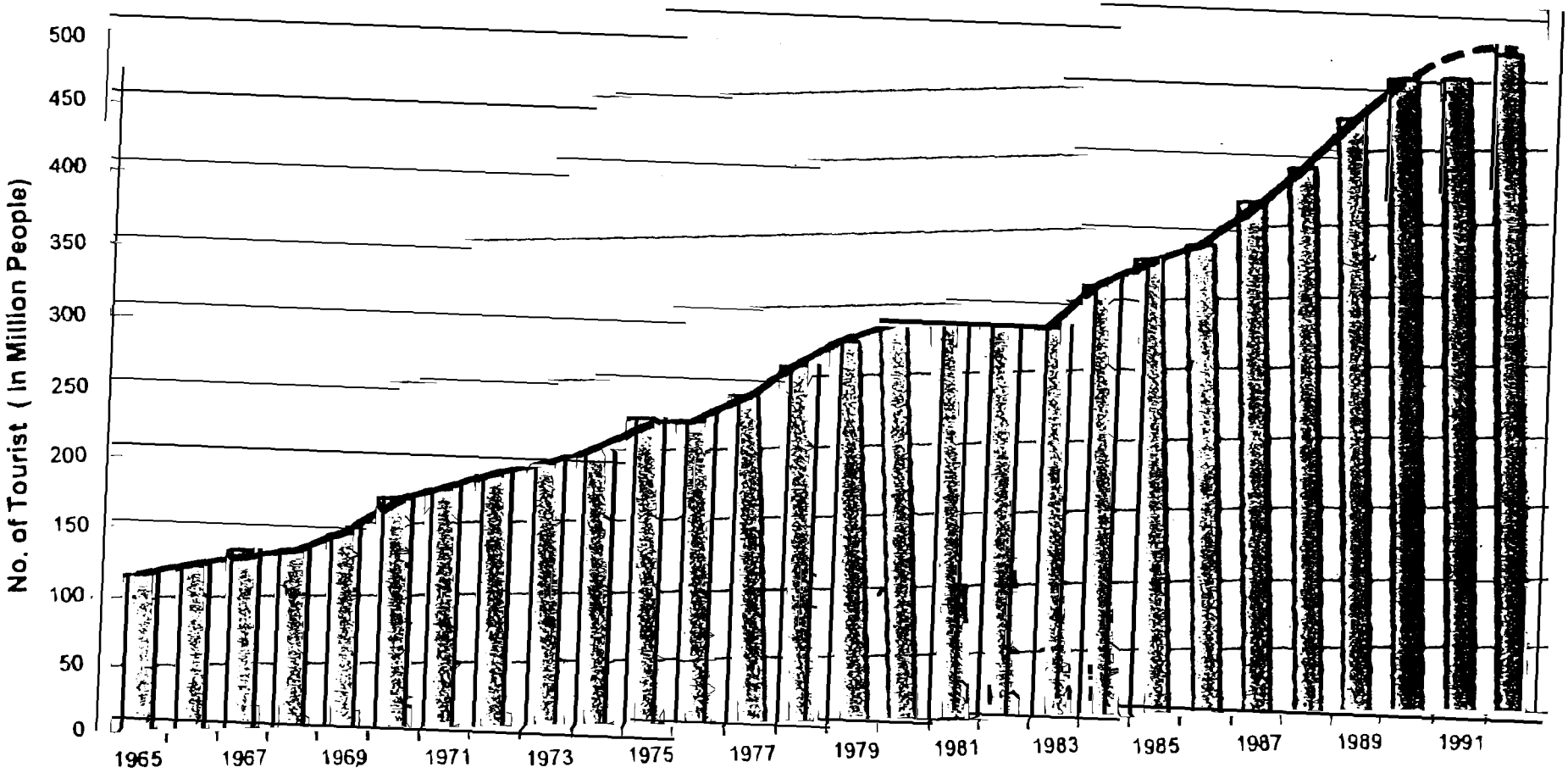
The first phase since then, continued to advanced aerospace component production. The results are among other, component subcontract program from : Boeing for Boeing 737 and 767, General Dynamics for F-16 A/B, British Aerospace for Rapier, Fokker for Fokker-100, Hughes for Commercial Satellite HS-601 for Palapa C.

Phase two : Integration of acquired and existing technology into the design and production of completely new products to be introduced in the International market. This second phase emphasized the abillty to design particularly the ability to integrate and optimize the design of components for a new system. The capability to test and certify newly designed products is also developed in this stage.
CN235 joint design production between IPTN of Indonesia and CASA of Spain can be shown as a living example of this phase.
This second phase since then, continued to development of our own version of CN235, such as CN235-MIL equipped with advanced cockpit compatible with NVG (Night Vision Goggle) for tactical night flying capability, CN235-MPA with integrated mission avionics and FLIR (Forward Looking Infra Red); modified NBO-105 with digital cockpit and EFIS (Electronic Flight Instrumentation System).

Phase three : Development of existing and new technology into the design and production of completely new products to be introduced in the international market. During this third phase, innovations will be introduced, and new technologies are created to produce the latest and most modern products based on market needs.
At IPTN this phase is realized by a new subsonic commuter aircraft development program the N-250. Which is plan to roll out on November 1994 and first flight expected at the first quarter of 1995. The third phase will be followed by a family of improved and modified N250 series and a newly design transonic commuter aircraft program, the N-2130. All of these product will utilize the most state of the art aerospace technology.

Phase four : Acquisition of large scale basic research capability and the implementation of basic research as a key element in the introduction of competitive generic technologies.
The aerospace industry, IPTN is the spearhead of other strategic industries, its program can be expected to spin-off to non aerospace program such as land and ship industries.

Tourism's Growth



Source : World Tourism Organizati

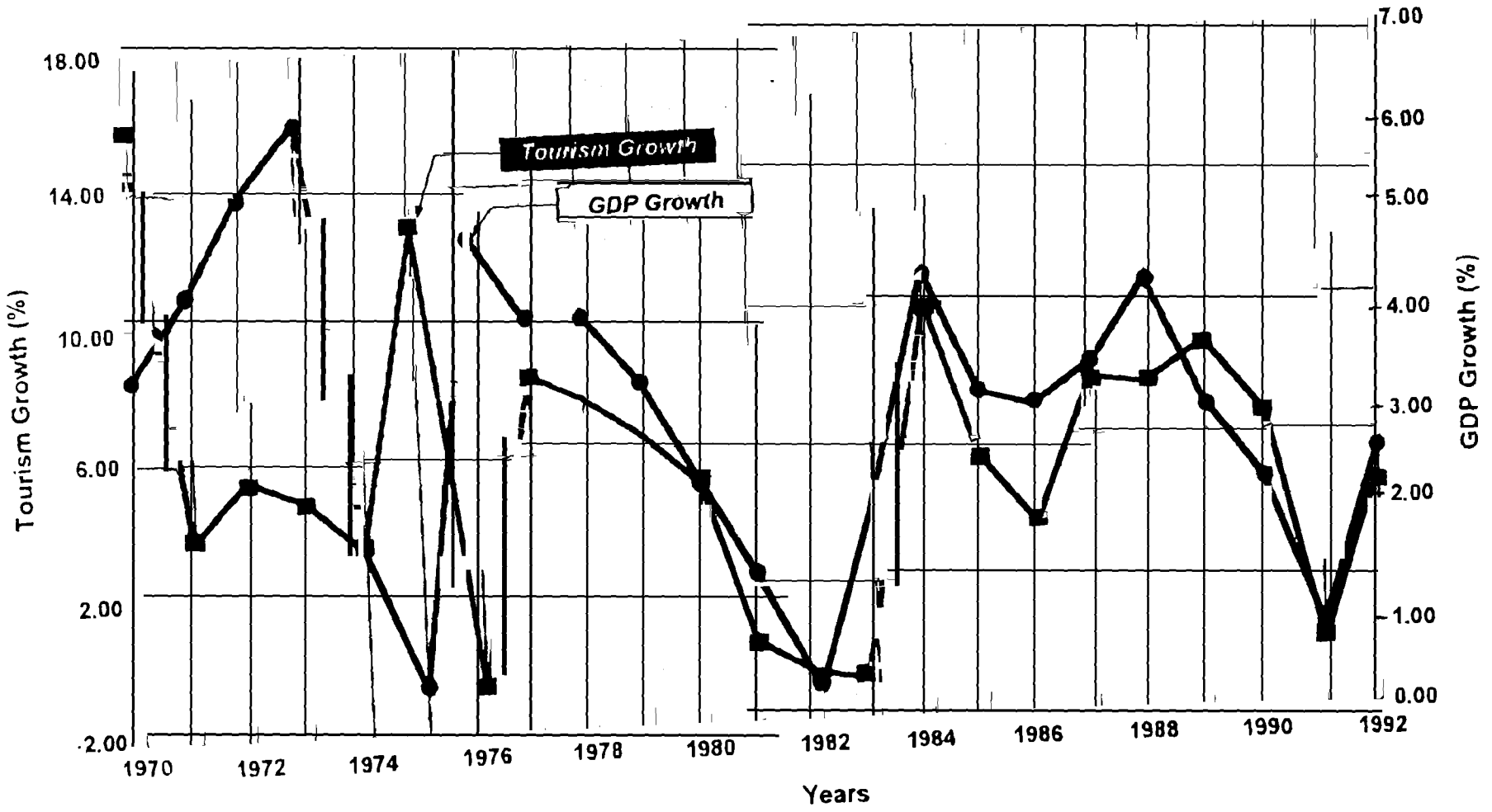
Number of International Tourism to Asia Pacific Region

Nation	1982 (Number of Tourist)	1991 (Number of Tourist)	Growt (%)
Indonesia	592,046	2,569,870	334.1
Australia	1,003,764	2,370,000	136.1
Hong Kong	2,587,773	6,032,071	133.1
Thailand	2,218,042	5,086,899	129.3
Malaysia	2,766,441	5,543,376	100.4
Singapore	2,947,001	5,414,651	83.7
Hawaii	3,935,000	6,850,070	74.1
Philippine	788,223	951,365	20.7

Source : World Tourism Organization

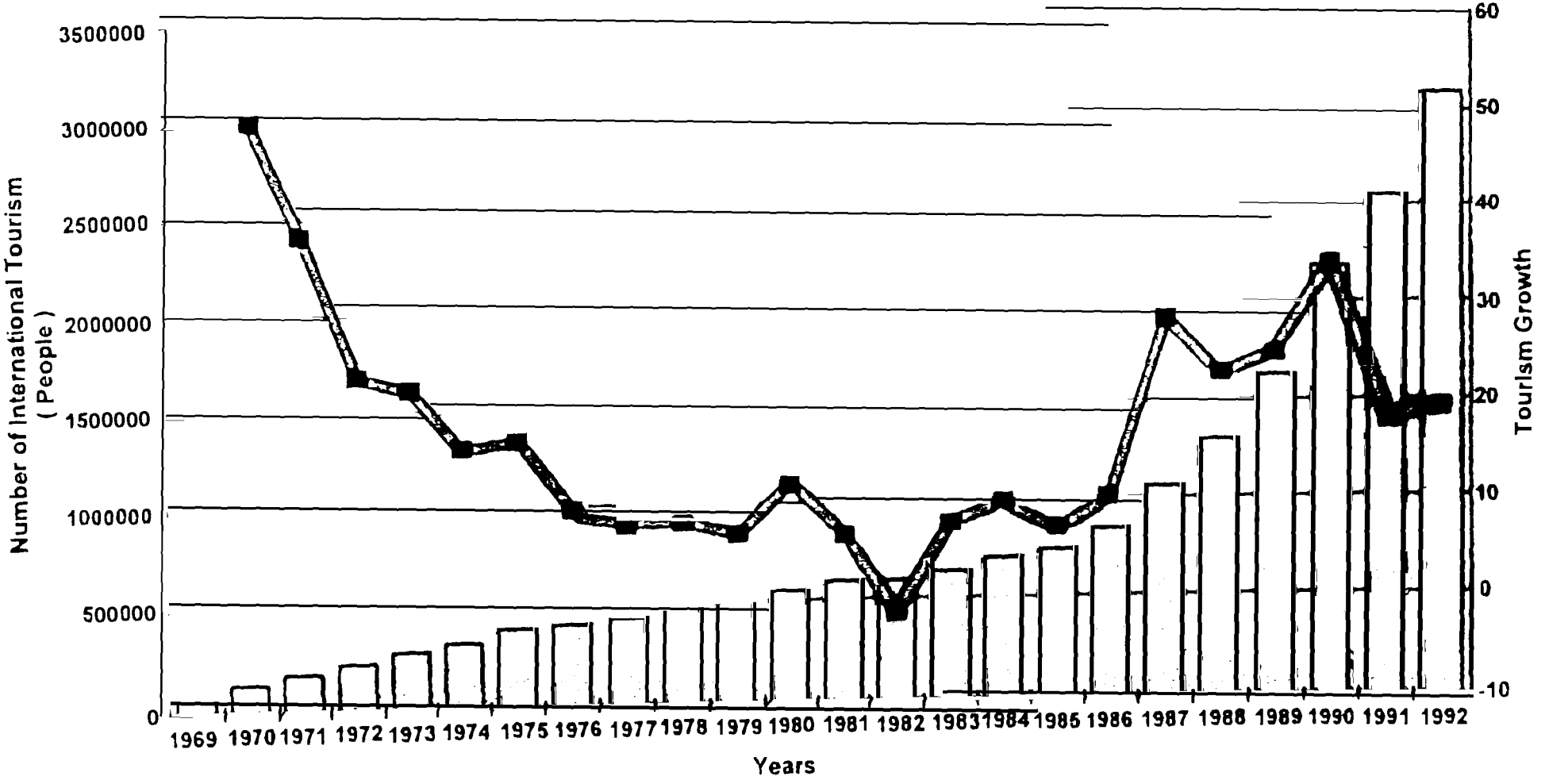
File Name : Tabel Tourism to Asia, October 1996

World's GDP Growth vs Tourism



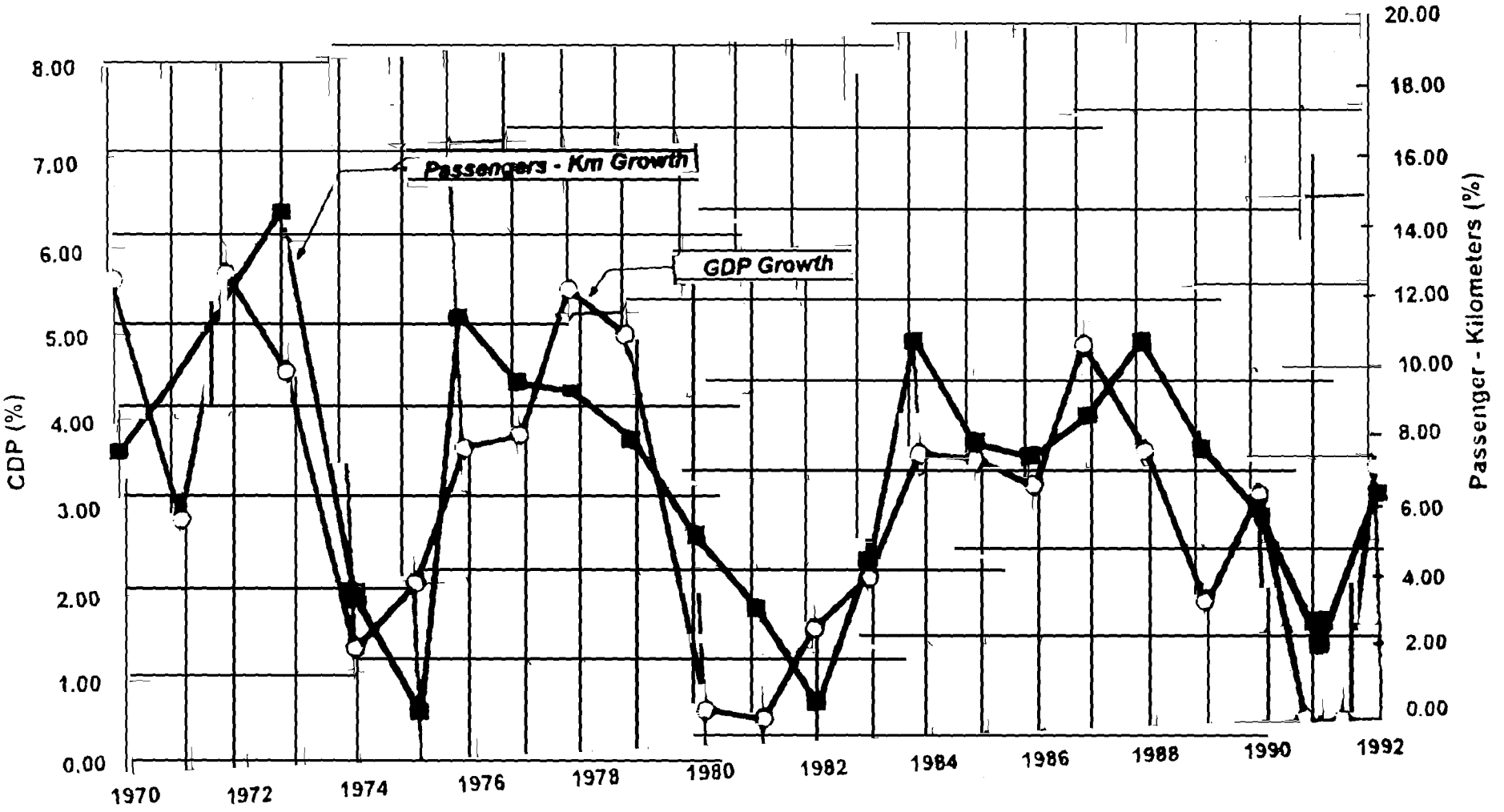
Source : Worlds Tourism Organization

International Tourism to Indonesia



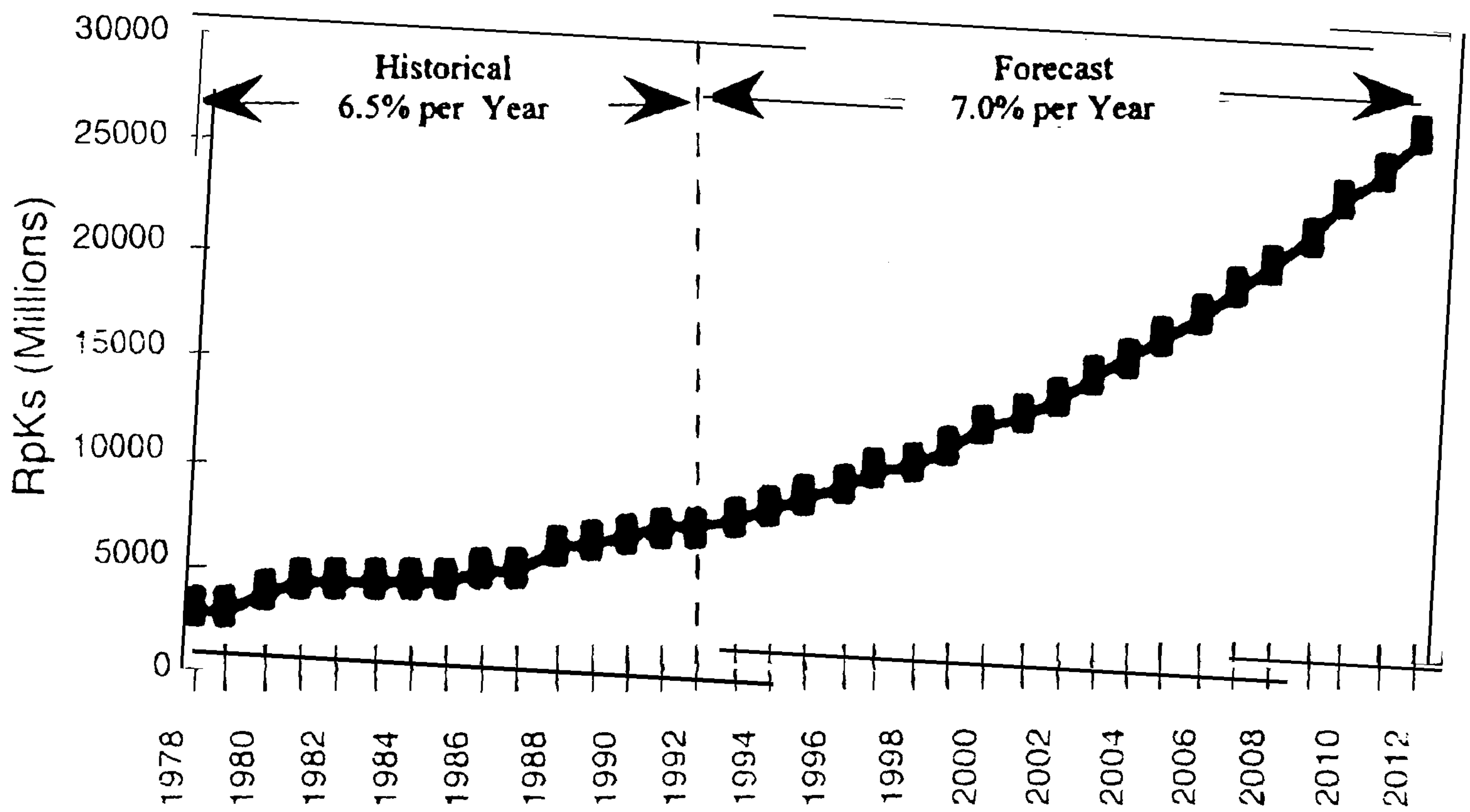
Source : Biro Pusat Statistik

World's Economic Growth vs Passenger - Kilometer Growth



Source : Boeing WEFA

Indonesia Domestic Market Scheduled Service



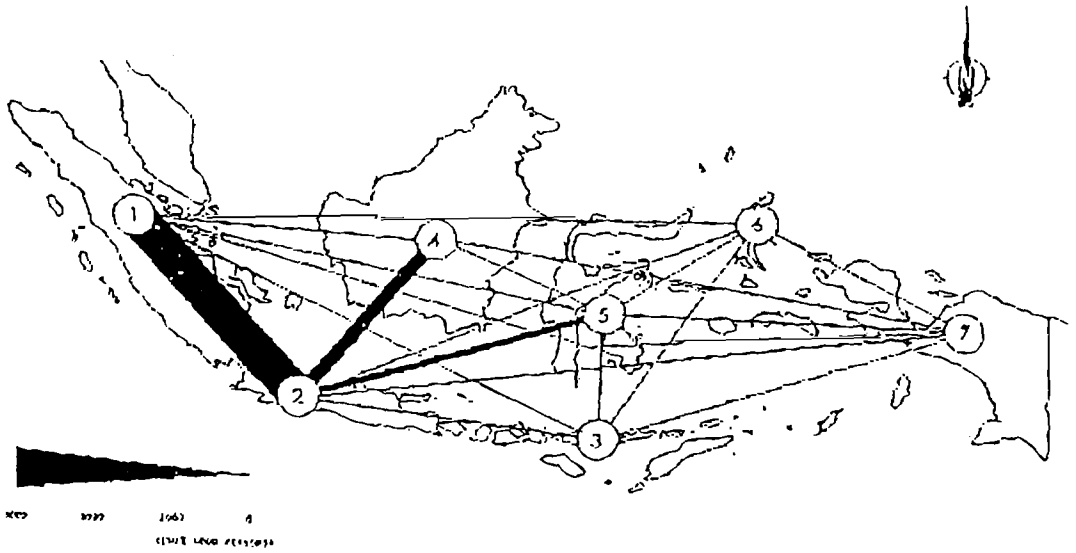


Figure A-3 Future Desire Lines for Passengers Carried by the Air Transport in 2004

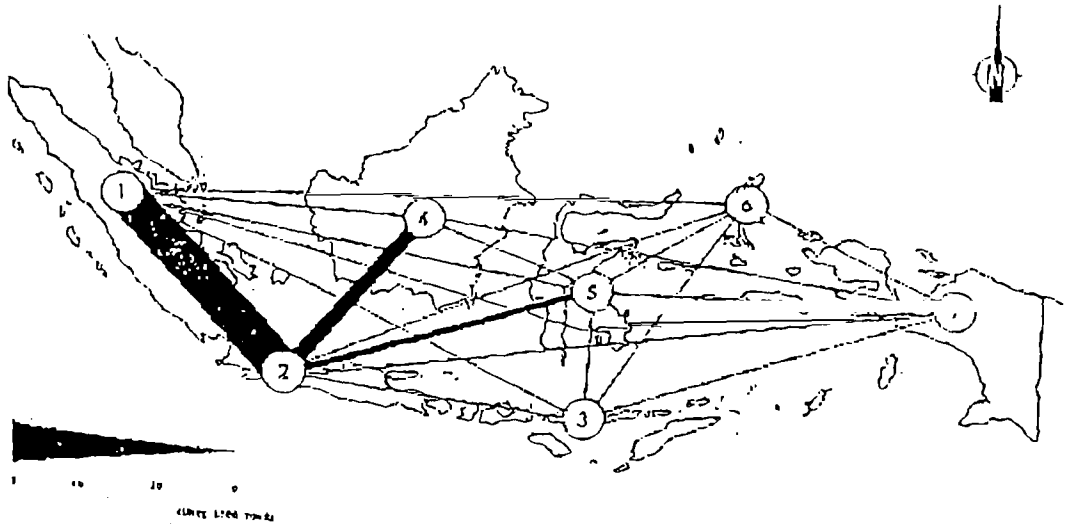


Figure A-5 Future Desire Lines for Cargoes Carried by the Air Transport in 2004

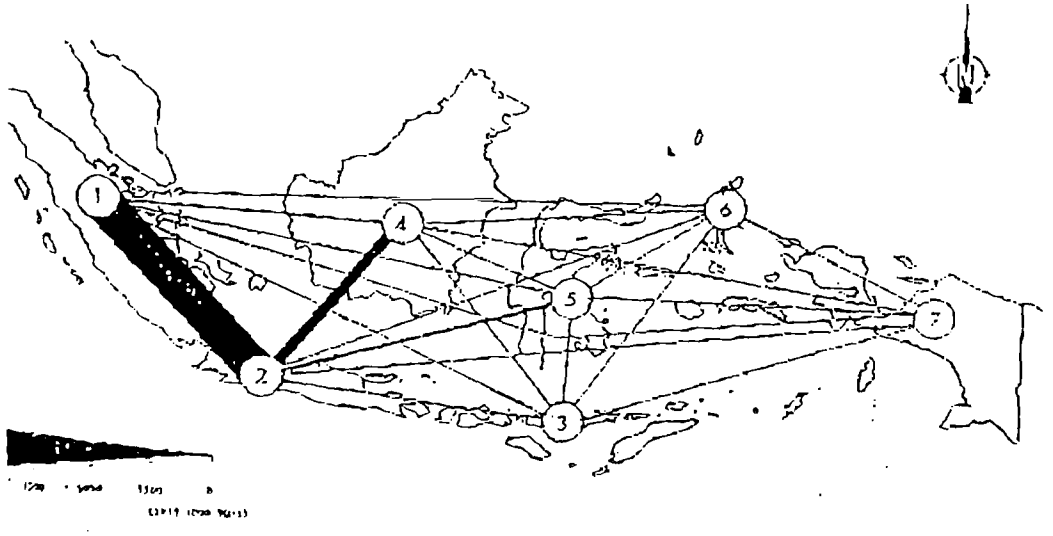
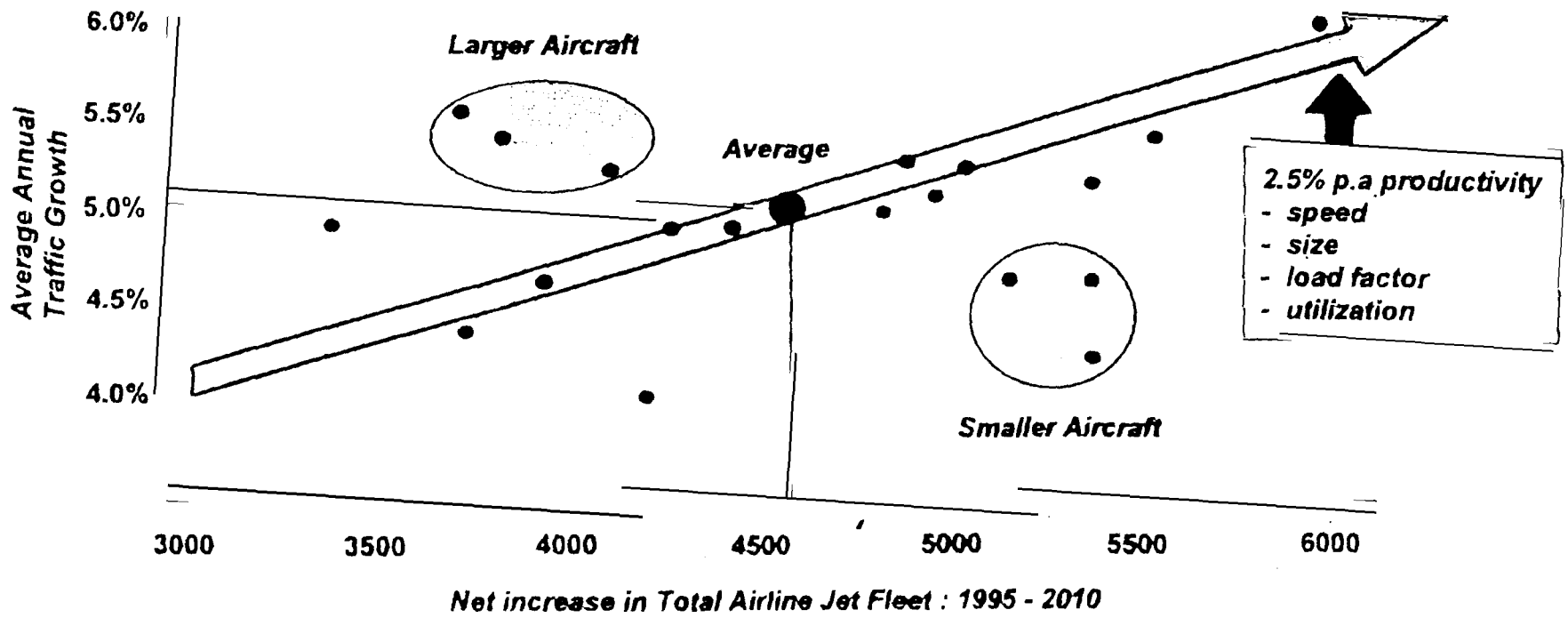


Figure A-6 Future Desire Lines for Cargoes Carried by the Sea Transport in 2004

Industry Growth Prospects throught 2010: Net Fleet Increase
Results of 20 Independent Forecasts



Net Fleet Growth Is Driven Primarily by Traffic Growth and Views on Average Aircraft Size Versus Frequency and Congestion

Source : GE Capital Aviation Services

China Economic, Transport and ITS

Wang Xiaojing
Deputy Director, Research Institute of Highway, Ministry of Communications, P.R. China

Abstract

China is one of the countries in the world with the fastest economical development. Economical development inevitably needs and promotes correspondent transport development. Now transport has become ever more closely linked with social economic life. Road and air transport have become more and more important transport modes. To meet the demand of transport it is mainly dependent on provision of more transport infrastructures particularly improvement of road network system, railroad and airline transport system. The demand, however, will still have to be constrained by actual situation, and to meet the demand it will depend on advanced telematics technology to great extent. Despite the fact there will be more infrastructures to be built in China, it is no longer the only solution to ease traffic congestion. Along with rapid development of Intelligent Transportation System (ITS), China is confronted with the decision of choice among various solutions to meet the ever increasing demand for transport.

The development and application of intelligent transport system (ITS) mark the beginning of a new era of modern transport. For several decades transport has become ever more closely linked with social economic life . For developing China, to meet the demand for transport it is mainly dependent on provision of more transport infrastructures particularly improvement of road network system. The demand, however, will still have to be constrained by actual situation, and to meet the demand it will depend on advanced telematics technology to great extent.

1. Economic taking-off and transport

China is one of the countries in the world with the fastest economic development. 1996 saw continuous implementation of the opening and reform policy as well as improvement of people's living standard. Preliminary statistics shows that GDP reaches CNY 6,779.5 billion, increased by 9.7% over 1995, of which the output value of the first industry is increased by CNY 1,355 billion with growth rate of 5.1%, that of second industry increased by CNY 3,314.8 billion with growth rate of 12.3%, that of the tertiary industry increased by CNY 2,109.7 billion with growth rate of 8%; with per capita GDP of CNY 5,569 and the labour productivity of CNY 9,902 increased by 8.6% and 8.3% respectively taking into account of inflation rate.

Economic development inevitably needs and promote correspondent transport development. The added value of transport industry reaches CNY 247.9 billion in 1996 with growth rate of 9.19% over 1995. The transport volume shared by different

transport mode has been changed over the years with greater growth rate for road and air transport; with passenger-km volume by railway decreased greatly and a little increase of ton-km freight volume by railway. Table 1 shows the transport volume by different transport modes.

Table 1 Transport volume by different transport modes in 1996

Mode	Freight volume		Passenger volume	
	Billion Ton-km	Growth rate (%)	Billion Passenger-km	Growth rate (%)
Railway	1,289.5	0.5	335.7	-9.4
Road	500	6.5	5.6	1.9
Waterway	1,776	1.2	16.8	-2.3
Air	2.5	13.6	75.2	10.4
Total	3,627.1	1.5	933.7	3.7

Although great progress has been made for all the five modes of transport industry in China, including railway, road, waterway, airway and pipeline, still it can not meet the demand arising from the economic development. At present China is still at the stage of insufficient of transport infrastructures more capital construction is needed and underway. Meanwhile transport management needs strengthened urgently. The main issues to be dealt with at the moment are as follows.

(1) Infrastructures facilities

By the end of 1997, road mileage reached 1.21 million km in China, of which 4,735km are expressway accounting for 0.39% of the total. Table 2 shows the international comparison of the expressway mileage per 1000 people.

Table 2 International comparison of expressway mileage per 1000 people

State	China	U.S.	Germany	U.K.	Japan	France
km/1000people	0.0039	0.338	0.137	0.056	0.045	0.156

Railway in China is the most heavily used railway in the world, with total mileage of 64,569km (1996), annual freight volume of 1,289.5 billion ton-km, i.e. 20 million ton-km per km, ranked in the second place in the world, but the density of railway in terms of km per square land area of the state, China is ranked in the 50th place.

As mentioned above, China's transport infrastructures is under developed with more dependent on railway and the advantages of road and waterway transport have not been brought into full play. With development of market orienting economic system there are more and more demand for road transport, which is the most convenient and door-to-door transport mode. In recent years governments at all levels attached more importance to road construction particularly the expressway construction.

(2) Transport efficiency

According to the sampling survey made in 1995, the loading factor of the trucks in China is only 64%, i.e. almost halfway empty running, if taking into account of overload phenomenon. China is not rich in natural resources. In 1993, 27.23 million tons of oil (including crude oil, gasoline, and diesel) were imported from abroad. By

estimation, potential savings of fuel consumption, about 2.4 million tons annually, can be expected if the loading factor is raised up to 70%, based on the fuel consumption level of 34.3 *l*/1000ton-km in 1995, annual freight volume of 500 billion ton-km, fuel consumption reducing rate of 267 million *l* every 1% improvement of loading factor. The other reasons for the low efficiency of the transport are outdated vehicles, low speed, small capacity, high fuel consumption etc.. To bring into full play of the advantages of expressway many vehicles need to be replaced with new ones.

(3) Transport can not adapt to the fast development of the economy

Insufficient transport infrastructure and low efficiency of transport industry have negative impact on the national economy mainly in the following ways.

A. Lack of accessibility for remote and poverty areas

There are still many places not accessible by road, which is one of the major reasons for remote and poverty areas unable to get rid of poverty.

B. Low efficiency in transport industry means high transport cost for the general public a direct impact on improvement of people's living standard

Transport cost is one of the basic items of people's daily life included in the cost of traveling and household commodities. Road transport cost was increased from CNY391.92/1000ton-km in 1994 to CNY 530/1000ton-km, 35% up, during the same period, the price index of the urban and rural area commodity market increased by 14.6%, of which quite a part is due to the increase of transport cost.

C. Serious congestion of urban traffic with impacts on both environment and people's living standard

By the end of 1996, population in China reached 12,23.89 million, of which 359.5 million are living in urban area, accounting for 29.4% of the total. Along with the economic development, industrialization and urbanization are inevitable trend. The people's living standard is improving continuously with more private cars entering into ordinary households. The growth of vehicle population in the urban areas is far greater than that of the road capacity, which makes some of the urban areas have to impose some constrains on the vehicular traffic, such as Beijing and Shanghai, only even or odd numbered vehicles being allowed on road on even or odd days. Even under such circumstances traffic congestion is still very serious, with negative impact on both environment and the people's living standard. If China follows the same pattern of the industrialization as some countries did more people will move to urban area from the countryside on the one hand and more people with high income will move to the suburban areas on the other, which will have impact not only on the suburban traffic but also on the whole road network.

As mentioned above, lack of transport infrastructure is the fundamental problem for China, which will have to be solved first in the coming future.

It can be expected that in the coming 20 years, China will be still in its construction development stage, with the fastest development speed in the world. According to the "Ninth Five-year" plan and the development program for the year of

2010, China will accomplish a major national trunk road system with total mileage of 35,000km including a total of 12 routes (five longitudinal and seven lateral routes across the country), major waterway, major ports and road passenger and freight terminals. The major national trunk roads are all high grade road. Based on the urban area situation, a development strategy of giving priority to public transport will be implemented for urban areas. Great achievements were achieved in road construction in 1997, with 1,313km of expressway built. If the development trend is kept on, the target of the "Ninth Five-year" plan will be materialized ahead of time.

The target of railway infrastructure construction from 1996 to 2000 are : building new railway more than 6,000 km and double tracking railway 3,000 km, new electriaztion railway more than 4,000 km. To the end of 2000, the total business mileage will be more than 68,000 km, railway fright turnover volume will be 1,530 billion ton-km and passenger turnover volume 470 billion passenger-km.

In China the aviation is one of the rapid development transportation model. More and more peoples will select airplane in their long-distance travel. From 1996 to 2000, China will build Beijing, Guangzhou and Shanghai new airports, as well as province capital and tour city airports. To 2000, aviation passenger volume is estimate to 100 million person-time.

2. Intelligent transport system, a new field of transportation R&D

From beginning of 1990's, many developed and developing countries enter on R&D of Intelligent Transport System (ITS). Intelligent Transportation System is a revolution in transportation, especially in roadway transportation field, which fully utilize electronic technology, information technology and communication technology to intelligenlize transportation system so as to enhance traffic safety and transportation efficiency .In road transportation field, Intelligent Transportation System transit various road traffic information and road service information, processed after traffic management information center to road user(driver, resident, transport corporation, etc.), administrator(traffic manager, road maintainer and toll collector, etc.) and related management department through wire and wireless network such as telecommunication, satellite, television, broadcast and telephone. It links traffic manager, road user, vehicle, road and other related service facilities to intelligenlize transportation. With the rapid development of ITS, China is facing the decision-making between alternative solution for meeting the sharply increasing transportation demand. According to us research in ITS, when ITS is used the main changes and effects on transportation are as follows:

With the growing up of high-grade highway system in the relatively economic developed regions, to realize informatic traffic control through advanced traffic detection/communication will improve regional mobility and promote the use of infrastructures. For example, in Beijing area several urban access expressways have been built and they will be further connected with a ring expressway. It is expected that the capacity of these infrastructures, which were built with huge investments, could be copensated among each other through an integrated traffic information service system. The traffic pressure on the roads would also be eased and region mobility improved. Similar requirements are believed to exist in the provinces along the south-east coast,

such as Guangdong.

Traffic accident is a remarkable problem in China. Although the vehicle ownership in 1995 is only the sixth of that in Japan, and eighteenth of that in USA, the fatality rate is 20-30 times as high as those in developed countries. According to the statistics of the Ministry of Public Security, from 1991 to 1995 the total road traffic accidents was 1.26 millions with 310 thousands fatality and 5.0 billion RMB yuan economic loss . Again it is obviously that such serious accidents can hardly be reduced in a short term only by improving the infrastructure, while efficient traffic management and advanced vehicle safety technology should be introduced.

Another important aspect in meeting traffic demands is the rational, efficient, safe, rapid,and punctual transport service. However, compared with the road infrastructure construction, the transport service is even more backward in this country. The nation-wide pivotal transportation terminals are still under planning. While the development of transport service system directly bears on the high-grade highway system and advanced vehicle equipment, it is the determinant for further enhancement of road transportation.

Environmental impacts of transportation increase have been greatly concerned by the society. ITS technology shall help cut the increase in transport demand while improving the efficiency, in order to mitigate adverse impacts on the environment.

As a revolution of transportation technology, ITS is also expected to have significant effects on the transportation administrative structure, especially the management system of road infrastructure. ITS originated from traffic control, transport operation and road management, but it is quite different from these individual systems, as we believe in : 1) ITS emphasis on the optimization of system function; 2) ITS emphasis on the utilization of information, especially the collection, exchange and share of information; 3) ITS needs enhanced functions of communication and supervision. These differences qualitatively change the transportation and stimulate the growing of a new industry.

ITS provides China with a new solution to transportation in addition to infrastructure construction. System development requirements should be considered to make choice between different solutions. The infrastructure construction should consider the possibilities of ITS applications; while ITS should support the infrastructure management and lead to a better use of the infrastructure.

3. ITS work in the near future and possible cooperation with the outside world

According to the actual situation of the research and development of ITS both at home and abroad, ITS covers wide range of technology, almost including all the aspects of telecommunications, information and electronics technology, which provides a great application market for high and new technology. It has, however, to be point out that though many technology and equipment may be used in ITS, it does not mean that ITS can be materialized simply by technology and equipment introduction and importation from abroad. The R&D and application of ITS is a huge system engineering. It is very important that government participating and organizing. That is why China is prepared to organize an ITS Management Commission, with participants from different departments in China including the Ministry of Communications (Ministry of

Transportation), the Ministry of Machinery Industry, The Ministry of Railway, The Ministry of Public Security, the State Technical Supervision Bureau, etc., for further systematic research and development of ITS in China. The overall development program includes the development strategy for ITS to be used in road, railway, waterway and air transport in China, formulation of standards, personnel training, organization of joint research work for key ITS technology and pilot demonstration engineering work. An ITS research center has been established in the Research Institute of Highway of the Ministry of Communications. In addition to the research and development of some applied ITS technology and equipment the research center will mainly engage in the ITS development strategy work in terms of system engineering, to provide theoretical basis for implementation of ITS development program for the high grade road system in China.

The Chinese government is now actively organize the research, development, application and international exchange of ITS. Table 3 shows the ITS international exchange organized by government.

Table 3 The International Exchange on ITS Organized By Government

Date	Content	Organized by
Oct. of 1995	Attend 2nd International Congress on ITS	MOC
Oct. of 1996	China-Japan ITS Seminar and Demonstration	MOC
Jan. of 1997	Government Delegation Visit EC and ERTICO	SSTC
Feb. of 1997	Government Delegation Visit US and Canada	MOC
Apr. of 1997	International Proseminar on ITS, Beijing 97'	MOEI
June of 1997	Sino-Euro ITS Seminar	SSTC
Oct. of 1997	Attend 3rd International Congress on ITS	MOC
Nov. of 1997	International Seminar on Water, environment, Traffic and Continue Development	MO Cons.

MOC: Ministry of Communications

SSTC: State Science & Technology Commission

MOEI: Ministry of Electronic Industry

MO Cons.: Ministry of Construction

A China and European Commission cooperative demonstration project of Beijing Ring road reconstruction was established. Further international cooperation is expected including the cooperation with the United States, Japan and other countries. The followings are the major work which are and will be underway in China and for which possible international cooperation may be carried out.

(1) To formulate standard for ITS development

Since ITS is a very large system with many products to be involved from different departments and enterprises, necessary standards and specifications should be set up before hand. At the moment organized by the Ministry of Communications research and development of a series of traffic engineering standards have started, meanwhile the work for ISO/TC204 commissioned by the State Technical Supervision Bureau has also started with participants from the Ministry of Communications. At present the non-stop electronic toll collection (ETC) system has been in use. Relevant standards for the ETC system will be worked out under the leadership of the State Science and Technology

Commission. To standardize information transmission for the ITS to improve efficiency, the research and development work in this aspect has been extended to the dedicated short range communications (DSRC).

(2) Reconstruct and perfect the urban traffic management system

The urban traffic management system in China has become one of the major issue concerned about by the local governments. Due to the high growth rate of urban traffic arising from fast economic development and improvement of people's living standard, the urban road and the traffic management system can not adapt to the actual situation. In addition, the urban traffic in China is characteristic of mixed traffic with motor vehicles, bicycles and pedestrians and with outdated management style. So it is a very urgent task to improve the urban traffic management system, which includes two kinds of work, firstly, to make full of the existing road system to accommodate the traffic efficiently by strengthening the traffic management system with necessary video and telecommunication traffic monitoring and control technology, combined with simple and low cost information system such as radio broadcast and television information system; secondly, more road infrastructure facilities will have to be built, which is one of the important task for the government, since the urban in China is still in developing stage; but overall planning of land use for urban development should be taken into account with enough room for future ITS development.

(3) To develop public transport system

The urban public transport development not only needs proper urban transport policy and well developed road system, but also needs application of advanced management system and equipment with efficient operation and maintenance technology, such as computerized dispatch and monitoring system. Intercity high speed, safe, and comfortable passenger transport service is developing along the high grade road. There are potentials for application of advanced high technology, such as GPS, communication, computerized ticket booking system, etc., for the intercity passenger transport, to improve the transport efficiency and the service quality.

(4) Traffic safety and accident prevention system

There are applied technology for traffic safety and accident prevention system to be developed and applied, such as vehicle crash warning, vehicle safe spacing warning and control system; drink and driving warning, drowsy driving warning; vehicle accident warning, incident response and first-aid system; etc..

(5) Advanced logistics system

The development of high grade road system combined with advanced computer technology, EDI, GPS, freight tracking, and freight and fleet management system provide opportunity for development of advanced logistics system in China, to form high speed, safe, and efficient freight transport and management service for the public.

(6) Traffic surveillance and control, toll collection

The traffic surveillance and control and toll collection are important aspects of ITS. By the end of 1997, the expressway built in China reached over 4,735km, and the high grade road reached over 19,000km. However, only less than half of these roads were provided with relative sound management and service system for road safety, telecommunication, traffic surveillance and control system. All expressway and most of

high grade road install various toll collection system. Due to such reasons as inadequate management and uncompleted road network, there are great potentials for further development. Now, a national project of Electronic Toll Collection (ETC) is going to begin. More than 10 province join the project.

(7) Traffic information service

Traffic information service for the public is a very important part of ITS. The air transport system in China has already established a national internet ticket booking system; the similar system is being established in the railway transport system. The Chinese government has started its economic information network development, in which transport information service is one of the important composition. The information system will provide service for ticket booking, travel planning, accommodation booking, freight transport, and traffic guidance, etc..

Conclusion

ITS is developing rapidly in industrialized countries. For China more efforts are still needed to develop and improve infrastructure facilities in the next 10 ~ 20 years, with road transport development mainly depending on more investment in road infrastructure facilities. Development of ITS, however, is a common development trend in transport field all over the world. The challenges China is faced with are more or less different from those for the industrialized countries, and coordinated development of road infrastructure facility with ITS is needed to improve transport efficiency and safety and to reduce negative impact on environment. Overall planning and coordination are essential for the road network development and ITS, taking into account of and in consistent with middle and long term use and urban development program. ITS may be developed and applied earlier in some areas with satisfied conditions. A modern road transport system will be established on the basis of sound road infrastructure facilities and good management and operation system.

Questions and Answers

Comment: From Chairman
Just to start the ball rolling, I would like to ask for some more clarification about the shift of the role of government in infrastructure. This is a worldwide phenomenon, of course, and in Australia, it is very clear. My own interest is privatization, and the relative role of a few things –one is globalization and competitiveness, and a priori, of course, is efficiency, and the other is fiscal deficit losing on the part of the government, which I suppose is an important consideration. How important were these two relatively in the decision go privatization?

Comment: From Prof. Hooper:
Well, let me give the example of selling our airports. I believe that the driving force there is that Australia has a debt problem. The government would like to reduce its accumulated debt, and selling the airports allows the government to do that, and then of course frees it up to pursue other policies. So, I think that there is a very pragmatic theme underlying some of the government's approaches to privatization, but there also is an efficiency side of it, and we shouldn't lose sight of that. To give you an example of the airports, personally, on theoretical grounds, I'm opposed to airport privatization. Certainly in a situation like Australia where there is such big distances between the airports that each one has degree of monopoly, I would be concerned about somebody getting control of an airport and raising their airport charges, and the airlines paying very large landing fees up to some very large point. I think that they could exploit that situation, so normally you would try to protect the public and industry from that monopoly power. So, on those grounds I'm opposed to it, but then when you see what happens with the private sector operating airports, I get involved in advising airports on traffic forecasting. First of all, what the new airport owners are asking is not what the forecast is for next year; they want to know how many of those people will be males and females, what age groups will they be, what nationalities will they be, because these things matter in the way that they approach the airport development. Suddenly, there is a different mentality about the marketing of the airport and about its future development. The private sector does bring that in, and this is one of the limits that you have. How do you trade off the reduction in competition or competition concerns against some of the things that the private sector is very good at doing? In Australia, the presumption has been more, "Let us have competition; let us not worry too much about some of the competitive issues." I think that at some stage those competitive issues will come back to haunt us, and policy has got to be dynamic and keep moving forward. But right now we're enjoying benefits as a result of going down this path. And New Zealand has done even better. I mentioned, I think, that New Zealand has achieved much more than Australia even.

Question: To Prof. Hooper
I want to ask one question about the domestic airliners who connect between cities in Australia. In your explanation, it seemed more international.

Reply:
We deregulated the domestic airline industry in 1990, and this came after 45 years of a policy to 45 years of a policy that protected the market for two carriers. What happened was that we had a number of airlines that wanted to start up. One was successful, and it lasted one year, but it failed financially. I believe that it failed financially largely because of bad strategy. It chose the wrong type of aircraft, it didn't have a computer reservation system, it didn't have yield management system, and I think these things are fundamental if you are going to survive in the airline business. We had another airline that started subsequently, and it too failed, and I again believe that it was because of faulty strategy. But the fact is that the Australian market is very much concentrated between a small number of cities, it's very difficult to break in, and we're left with the same two airlines that we had before. But there's not much concern about that particular issue because there seems to be enough to get some competition going, and if fares are lower, there are more discount fares, the airlines compete in market share. The biggest problem has been the domestic and the international, and I think that is true not just for Australia; it is true for Korea, it is true Japan, it is true for Indonesia, it is true for the Philippines. When you deregulate, and then you have one that is much bigger internationally, and you integrate the domestic and the international, you destabilize the situation. Qantas, which was equal in the domestic market before, is now dominant, and Anzed was very much weakened, and this is part of the reason why Anzed's owners wanted to sell out, and Air New Zealand has come in to fill the investment gap. But then, the next stage of this is that Singapore Airlines also wants to invest in Anzed Airlines, and there's the star alliance, and the story goes on.
We live in a dynamic, competitive world, and I don't think the policy-making process is over. I think we have to watch sensitively about the issues, but in a domestic market, nobody is complaining. They just want to make sure that Anzed Airlines doesn't fail as well.

Question: To Dr. Ozaki
I am Chakraborty from India. It is a unique example which has just been cited. We found that private investment was made in the beginning, and the government stepped in later. I want to know what prompted the private industries come in for such investment. Also, it was mentioned that Dr. Ozeki planned for electrification of the 10,000 kilometers. My second question is, who supported it, was it the private industries or the government?

Reply:
In answer to your first question, the Meiji government at that time didn't have enough money; it was so poor. Also, there were two wars that Japan had to fight, the first one being with China, and the second with Russia. It was from that painful realization that at the time public coffers were not adequate, and also the railway system was a military installation. From that point, the government realized that since it didn't have money at the time, it would have to take over the railway industry, and then welcome as much money as could be available. So, what the government did was pay money by the sector, and bought the railway industry.
Mr. Seki realized at the time that Japan was defeated in the war, and he considered it a mission to improve the railway industry in Japan. However, at that time he was only at the very young age of 36, and realizing that he had no political clout or any connections with politicians at the time, he garnered support in this undertaking from a colleague, an expert in electrical engineering by the name of Nishimura who sympathized with him.

Question: To Dr. Ozeki
I'm from China, and my name is Xiao Jing Wong. In 1995, the Japanese government announced its information-society-pushing plan. In this plan, we noticed that transport information works focused on road transportation. Could you give me some brief introduction about your information works on railway in Japan?

Reply:
There were nine railway corporations and there was what you call Japan Telecom Corporation, which was involved in the information industry. JR, Japan Railways, had one system for information, and it also had another separate system for its own operation.
Japanese National Railways was divided into six passenger railroads, one freight company, one communication company, and one information system company. So, altogether it was nine companies.

Question: To Mr. Jusman
I am from the Department of Science and Technology, the Philippines. Certainly Indonesia has made commendable efforts and progress in their space industry. However, I have two questions if you will allow it. The first question is, what prompted Indonesia to embark into this aerospace industry? Second is, what preparations did it make to realize its goal?

Reply:
When the founding fathers of the Republic of Indonesia made the Independence Day of Indonesia, they already sent the young engineers into two fields, the ship industry and the aerospace industry. In 1959, at that time, they already sent young high school students to learn about aeronautics and to learn about the ship industry. In 1964, fortunately, they were already in the full phase of sending the people in these two fields, and this under a presidential decree. At this time in Indonesia, there was no growth and there was no economic reason to do that. Why? Because, in Indonesia, there are 17,000 islands in remote areas, so the only bridge to integrate those islands at that time was the ship and the airplane. Then, in 1964, one year before the end of what we call the Sukarno era, there were already joint ventures under which we would build aircraft industries, so they built the aircraft industries. In fact, the IPDN is using the airports facility to increase the level. Then, Professor Habibie got ships from the government to Germany and went back to Indonesia to do his mission to build aircraft industry. When they built the airliners for the first time, it was also interesting that the first airliners, DC3s, were bought by the people of Achang, a small area in the east. They collected all of their gold and all of their money to give to the first president to buy one DC3. So, the necessity to build and to enter into the airlines industry was always there.
Your second question was, what was the preparation. The first preparation was that we already sent young engineers to learn technology from Europe, from Holland, and from Germany. In the second phase, they sent people to Russia, to Czechoslovakia, and to all the east bloc to learn about aeronautics and ships. Then, in the fifth generation, at that phase, in 1965, they started to send people to the United States. In fact, our flight task person graduated from MIT in the aerospace industry. So, there is a preparation for that. The second preparation is that we also developed the capability of the skill method by helping training centers for the technique on the level of polytechnic in a high school dedicated to aeronautics. So, they maintained the skill

method for the mechanical background and electrical background to make wire, and things like that. Then, in 1969, in the university of technique, Bandun Institute of Technology, from which I graduated, there was a field in aeronautics to learn about the designs and also the production. The third part of the preparation was the air force becoming something like a driving force to make an acquisition of the technology by having the training center. In fact, they reported for the first time a small-scale industry with four-seaters and also agricultural airplanes. So, there was a lot of preparation. If we come from '59 until '85, there has been almost 30 years for preparation for that.

Question: To Mr. Jusman
I'm from the Philippines. What components do you manufacture locally, and what components do you import? In your development process, what industries did you find necessary to develop, especially in the manufacturing and the service industries?

Reply:
With this aircraft, all components were imported. We only made it under license, and then made flight pass to deliver. In this area, we already made a component of an autowing, and then all the tail parts. For the fuselage, we divided this one to Indonesia, but the nose and the center section were in CASA. This wing is all high-level intensive content, so it is repetitive joint wing. And then, the tail section of the vertical tail also came from CASA. So, 50% was made in there. But all the electronic parts were imported. For example, the flight deck arrangement, cockpit, and also the landing gear –all the high-precision, high-content technology—was imported. In this airplane, all of the components of the airplane's structural components are made locally, but only the components of the electronics and also the propellers, the moving parts, were imported. Before, there was no design, and this is the design we sent to 100 people through CASA, so all the design drawing, engineering, and laboratory fabrication was done in Madrid. But , all the design is done in Indonesia. We developed the infrastructure for design engineering centers like computer-aided designs and integrated facilities, and we have done all our own laboratories. But because there is big hours to produce this, we need almost 12,000 hours –big drawings of all of the components. In the two years in the big session, there weren't enough engineers to draw those drawings, so in the two-year period from 1992 to 1994, we acquired some experts to make drawings in Indonesia. There were 200 engineers from all over the world, from Britain, the US, Japan, and other areas, and now there are still 10 engineers staying there. But, in that case, what we did is put the engineers in, for example for computer-aided design, to make a tooling, to make a surface. So, we acquired one group of five people from Rockwell to come to Indonesia, surrounded them with 30 young engineers, and then they made a drawing, and then, after that, we reduced that group from five people to three people, and then to two, until all of the technology was already acquired. But the lesson that we learned was that we cannot take that responsibility alone, because in the airplane industry, there is a standard that we have to fulfill. Sometimes you cannot pass the standard because there are so many reasons. If you go to the Federal Aviation Agency from the United States, always they say there is no systematic rationale, there is no discipline, or something like that. Therefore, it seems that we cannot reduce it 100% and then acquire by our people. Maybe in this area, in the airplane industry, I think there is a place for all nations working together; no one nation can handle it alone. That was our lesson.

Question: To Dr. Wang
I'm wondering how old the vehicles are in China. I haven't been to China yet. So, how will they ask for high pay with the old vehicles?

Reply:
In China, we now have more than 10 million vehicles, but in most of our big cities, we have serious traffic congestion. So we need to put in more infrastructure, but as I said, the speed of infrastructure development is very low. So, the Chinese government thinks that we can use some new technology to improve the management of the traffic and the infrastructure. We raise the efficiency of the use of the infrastructure. Another aspect is that traffic efficiency and the transportation efficiency in China are now very low. I can give you an example. According to a survey, in 1995, the loading factor of the trucks in China was only 64%. So, the Chinese government wants information technology to improve this situation. If the loading factor is raised to 70% based on the fuel composition level in 1995, with an annual freight volume of 500 billion tons, fuel consumption would be reduced by 267 million liters. If we improve 1% of the loading rate, we can reduce 267 million liters, so we want to use information communication technology to improve this situation. Now, in China, most of the truck drivers don't know where the freight is. They send the freight to this city, and then return to their own cities without freight.

Question: To Dr. Wang
So that means that you have to retrofit the old vehicles with beacon system and the computer system. You say in your statement here that your rate of accidents is very high. That means that it has something to do with the driver, apart from the vehicle itself.

Reply:
Yes, that's very important. Now, in big cities in China, we have some laws, and the drivers have to attend a school, and every year they have to study the traffic law.

Comment:
And maybe it also has to do with the traffic enforcer. This is also our problem here. So, I just hope that those factors will not affect much the ITS system. Human activities like those of the driver and the traffic enforcer will have a big influence on the success of your ITS.

Question: To Dr. Wang
Kawasaki from Japan. Thank you very much for your fair presentation of your challenging project, ITS. I have one question. At this moment, to what extent do you image the coverage of the ITS to be? My question arises from a point which is quite difficult to solve. There are quite a lot of alternatives to choose from among the three major traffic policies –surface, including railways and roads, air, and the sea. Certainly, ITS may provide some of the answers to solve those traffic mixtures.

Reply:
You are right, but in China, now we consider the ITS to cover roadway and railway operations.

But now China is in the stage of building its infrastructure, so we are selecting some projects which we think are important to improve the efficiency of our strategy development.

Question: To Dr. Wang
May I ask a question? China is in the throes of tremendous road construction, I should mention. What is the role of the foreign private sector in the construction of these new roads?

Reply:
In China, the government policy is that work can broaden investment in China to build infrastructure. In highways, the government has a system whereby if you invest in this road, you can establish a management corporation --you can toll it, and you have the right of management.

Question: To Dr. Wang
Just connected with experiences describing previous papers, what is the policy of China with respect to aviation? For example, we talked about aviation in Australia, and now in Indonesia. I'm interested in how China views the development of its aviation industry.

Reply:
In China, the government plans to build more airports in the big cities. In China, three departments control the transportation. The Ministry of Communications is only in charge of roadway and waterway transportation. For railway, we have the Ministry of Railway, and for aviation transportation, we have an aviation bureau. So I don't think I can answer your question.

Chairman:
Now we have time for questions related to all the papers or the papers previously presented, or comments or questions. So, the floor is now open for discussion of every topic as a whole, and also issues raised by these papers or previous papers on transportation and economic development.
Just for starters, may I ask a question of the presenter from Australia, Dr. Hooper? How did you manage the cross-subsidy problem in the privatization stage? For example, in the Philippines, we have left it very clearly. We opened up aviation to private investors, but private investors invariably went to the more interested routes, and what happened is that all the bigger corporations that were serving non-lucrative routes became blind-sided, and they decided, "We're not going to go into that anymore as well. Let's play it fair." What happened in Australia in this matter?

Comment: From Prof. Hooper:
Well, basically, it wasn't a problem any more in Australia when we deregulated. We did have cross subsidization in Australia. It was very similar in the United States as well, that on the long routes, they cross subsidized people traveling on the shorter routes. There were some services to rural areas that weren't profitable. Mainly they were unprofitable because we used the wrong type of aircraft on those routes; we tried to use the larger jets, when in fact the sort of aircraft that Indonesia is looking at developing as a regional aircraft is more appropriately sized. In the lead-up to deregulation, the airlines had been rationalizing their services. There were some political problems with this, because communities don't like to see that their air services are

downgraded; they like to see larger aircraft. For remote communities it's like a lifeline: if you see that taken away, then you feel as though something very important has left your life. So, what happened in North America also happened in Australia. When you took the large aircraft away, you had more of the smaller aircraft, so, instead of having two services a day, you might have had four or five. Communities accepted that tradeoff, and we had no problem with the cross subsidy. However, what did happen immediately after the deregulation is that the airline fares came down most on the long routes, for example, between Sydney and Perth, Melbourne and Perth, or to Darwin. And this is exactly what happened in North America, and I think that you will find that would be true throughout the region.

No, to answer your question about China. I can shed a little bit of light on it because I watched what happens in all the countries in the region. I'm not an expert on China --I have a colleague who is in a much better place to look at that-- but as I understand it, in China, there has been a cross subsidy in the form that foreigners pay one rate for travel on domestic airline services, and resident Chinese pay a lower rate. Now, I'm aware that in Nepal there is a similar type of cross subsidy between foreigners and residents. In China, they have just taken away this cross subsidy. It is related to attempts by China to [get] into the World Trade Organization. So, the airlines are now grappling with that problems with the situation in the Chinese economy. They are trying to rationalize the airline services in China, because like in all the countries in this region, they have had tremendous growth in the market, and the difficulty has been in coping with that. Private sector airlines are filling the void, but you go through a stage where some are successful and some are not, you need to rationalize, and this is happening in China right now. I could go on with that, but basically, I think China is going through a process of rationalizing industry, trying to consolidate the airlines into more viable units. And the cross subsidy was not a great problem for Australia when we deregulated; there was not great backlash in the community. We have one exception, and I think it is relevant to mention. We had one island state –whereas you have thousands—and Tasmania is very concerned because you cannot drive car across, you must go on a ferry or you must fly. There has been subsidy, a specific subsidy paid to the airlines to keep the airline fares down. So, you can come up with mechanisms to deal with this if necessary.

Comment: From a Philippine

Let me share with you our experience here. We privatized the airline industry, and many private airlines came into the picture, and of course the last crash was part of a private group. I go to an island called Bahol, and we are served by the Philippine airlines from Cebu, and that is one of the routes that became questioned after the deregulation because it wasn't very profitable, and so we stood to lose. Fortunately for us, at the same time, the shipping industry was deregulated. That particular shipping route from Cebu to Bahol used to take six hours, but after the deregulation, the introduction of small speed boats, some of them hovercrafts like in Hong Kong, the travel time went down to one-an-a-half hours. So, the population did not feel the reduction in flights because they decided to just use the shipping. In this case, the whole deregulation philosophy affected the outcome, and the political economy did not arise as a problem.

Comment: From Prof. Hooper

I think we do have to remember that in the United States deregulation, they have an excellent

highway system, and they have a very strong inner-city coach industry, so if small communities did lose their airline services, there was a safety net below that. In many of the countries in this region, that is not always the case, so I think we do need to have mechanisms that protect communities if we take the step of deregulation. I personally do not like cross subsidies because you submerge something in a system, and all sorts of inefficiency begins to creep into the way you do things over time. The Australian example was that you use large aircraft where you should use smaller aircraft. In India, I think that this is the problem with the current regulation, which forces the airlines to use the larger aircraft going into communities who are better off with 35- to 70-seater aircraft –everybody would have a better service. I think cross-subsidy leads to these sorts of irrational commercial decisions, but you must have a safety net. In most of the countries in this region, surface transport is very poor or simply doesn't exist because of waterway development, or whatever, and we do need to come up with mechanisms to deal with this.

Comment: From Dr. Chakraborty
This is not a question; it is only a suggestion I am putting forward. I am Chakraborty from India. I was very impressed with the presentation made by Dr. Jusman of Indonesia. I am very happy that they are going with the 50-seater passenger aircraft program. Now, a few comments on points he mentioned during his presentation. I found that some of the tests like fatigue tests, etc., are not being carried out in Indonesia, but that they are taking the help of the United States or advanced countries. Now this is a seminar for extension of economic partnership in the Asia-Pacific region. I would like to tell Dr. Jusman that India is also venturing into a passenger aircraft program, and in India we have excellent fatigue test facilities. Apart from that, we also have many facilities, wind tunnel facilities, tower testing facilities, etc. We must cooperate in the Asia-Pacific region so that we are not overly dependent on the West. This is only a suggestion that I'm putting forward.

Question: To Dr. Ozaki
Thank you very much, Mr. Chakraborty. I would like to pick up on some issues that we raised in the Japanese railways case. As was earlier pointed out, the private sector came in first, probably for purposes of simply profit, and then the government came in and nationalized the transportation services. This is very much in contrast to what happened to the other activities in Japan. As you see, Japan had model factories in shipbuilding, textiles, etc., which the government went into for demonstration purposes. Then, after a while, the government turned around and sold them at essentially basement prices. And some of these model factories became big conglomerates, which is quite interesting. What is the motivation behind the big difference in the attitude towards transportation here (which, for example, does not exist for shipbuilding)?

Reply:
This relates to a thing of the past which covers the time of my grandfathers. I don't really know what actually happened at that time, but maybe I could just tell you what I imagine to be the case. We have to remember that the Meiji government during the Meiji Era had this plan for the short-term installation of transportation. This relates to the background of Japanese history during the Tokugawa Period, when the government was closed to foreign influx, and transportation was heavily regulated and limited to horseback and other traditional forms. From

the realization that transportation modes had to be improved, the Meiji government had to embark on projects to install transportation on a short-term basis, to make transportation more convenient in keeping with the changes in the times. I'm amazed also at how the private sector at the time had adequate resources. What would be a rather fair assessment of the situation would be that during the Tokugawa Period, the landed farmers of the time had to pitch in, not really on orders of the government, but probably on suggestions of the government, in order that this would be used as investment.

Question: To Dr. Ozaki
I would like to ask this question to Mr. Ozeki about a point he emphasized in his paper. It is indeed amazing that the young generation, those people ranging from 30 to 40 years old, helped a lot in contributing to the development of the railways in Japan. In a country like Japan, a country with a strong social hierarchy where seniority plays a very important role, especially in major decisions in society, how could so much trust be placed in young people towards the development of one of the most important transportation systems in the country?

Reply:
The Meiji government at that time valued the creation of the transport system and the railway system, however, they also equally valued education. And as early as the fifth year in the Meiji Era, a university was created, and the graduates were valued as those who would take up the cudgels in society as a privilege for serving the people. So, with the university education that some were able to undertake, the bright ones found their niche in society, since people then thought that students who had graduated from university had somehow penetrated or destroyed the hierarchy, so to speak. There was a notion among the people at the time that a person who had graduated from the university was there to serve the greater interests of the people. And then, secondly, it was widely known among the people that there were equal opportunities for education, that it was free for all, but also that it was a difficult task to enter the university.

Chairman:
Thank you very much for that. That particular question was quite interesting for me as well. So, society was able to transcend its hierarchical order when it came to expertise, knowledge, and skill. That is an interesting aspect of the Japanese society.
We are backed up in our schedule now. It's 4:10, and we are now supposed to start the next phase of our workshop, the closing session. May I call upon the chairpersons and rapporteurs to give their summaries of the presentations. Thank you very much.

Closing Session

Questions and Answers

Dr. Murata:

His collaborative work will be shown to you through the proceedings. He has recorded most of the questions and answers, together with the content of the presentations. At the end of our session, we briefly summarized the presentations. In my following summary, I won't repeat the same thing again, because I expect your memories to be fresh. Looking forward to the 21st century, we discussed two types of society here: one is the sustainable society, and the other one is network society. The stable energy supply or the efficient use of energy was associated with environmental issues pertaining to the sustainable society, but it also was partially related with the network society. Through the six presentations and questions and answers, we recognized the important aspects in solving those issues. One is the identification of global issues; we have to share the global issues. Then, we have to think of regional issues, as presented by the geothermal power supply in the Philippines, and the stable power supply presented by Mr. Kobayashi of Japan. But in there, we have some contradictory factors. We have to have economical growth. That is a way to control the population, too. In order to make it real, we have to back up the objective with sound installation of infrastructure and discuss here the information system, multimedia system, as well as transportation system. Today, we didn't have a chance to talk about those infrastructures for society that we need for economic growth. At the same time, we need sustainable growth for the coming generations, the long-term view, which may not be on the same lines, but sometimes contradictory.

So far, among other suggestions, the importance of human aspects, cultural aspects, the need for philosophy, lifestyle, etc., was presented. So, we need to identify and locate the issue. For example, through the seminar lectures, we have to debate and communicate well over different cultures. But we also need guideline concepts --the framework for today and framework for the future. Then, we need the understanding of the importance of the social system, which has been sort of a boundary within which technology has been seeking the solution. Because the boundary is moving, the condition of the technology is now changing. The social system is important, and social acceptance criteria is important. The six presenters pointed out the importance of human resources, a world-eye view, because we tend to specialize in one area as specialist. A so-called high-tech person may know only one portion of a total issue. We realize the importance of leadership, the need for leaders in addition to specialists. Also, we tend to forget that we have to have ideas along with the time, history, culture, system, and future view that accompanies the time scale. Finally, we need patience: we can't solve everything within the time we are living. The final view graph that I'll just show you is the lessons that we learned from the presentations, questions, and discussions here. Everybody here will agree that we have regional conditions. For example, for the power supply system, we have several options. Mr. Kobayashi mentioned that we had the best mix for stability, and also the best mix for economical reasons. So, we say that we have regional solutions, but we have to have the following conditions. We have to have a long term view to obtain the best regional solution, we have to have strategy, we have to have networking which will be explained in more detail, and then, we have to have competition and the competitive technology to survive. To back up those, as I said, we have to have a philosophy, we have to have a spirit, a leadership, and education

evaluation. Finally, we have to have an evaluation system to encourage people to challenge the unknown world. One thing that we haven't touched on today much is the productivity of resources. So far, in mass production, mass consumption, and mass waste, we utilize the productivity concept of labor, and the productivity of capital. Universally, we have to agree that that is the definition of productivity, but we do not have the definition for the productivity of resources, because of numerous parameters, because of hidden characteristics of resources. But now it is time for us to bring up those issues and present standard ideas and concepts upon which we base our judgments.
So far, as a summary, I would like to mention one thing: the importance of judgment, depending on which the management will be selected.
Thank you. That is my summary. I hope that you can add to what I said, because I am afraid that I have missed something important. Thank you.

Chairman:
Thank you very much, Dr. Murata. Does anyone have anything to add to Dr. Murata's comments? Professor Concepcion?

Summary: By Prof. Concepcion
I will just focus on the highlights of the papers and the short discussion that follow. Let me apologize beforehand for any inadequacies in coverage and understanding of some of the points made by the various speakers.
Before opening the floor for questions, comments, suggestions, and/or recommendations, the chairperson, Mr. Kawasaki, outlined structured change and its features, which included five items: creation of the project concept, initiator of the project, management of the project, carrier of the project, and financial source of the project. The chair also noted that three presentations traced 1) the historical development of Malaysia's Multimedia Super Corridor, MSC for short; 2) the Japanese telecom network digitalization; and 3) Singapore's High-Speed Test Bed project, or HSTB. Common to all three was the emphasis laid on human resource development and R&D to facilitate project implementation greatly. In addition, effective partnership between government and private industry is a necessary ingredient for success.
MSC success depends very much on the availability of knowledge workers in Malaysia. To address this challenge, the government of Malaysia has taken a number of initiatives. First, MSC-status companies are allowed to bring in their knowledge workers without any restrictions, and they also provide in-house training to their employees. Second, the enrollment of students in publicly funded universities has greatly increased with a target of 20% of the 19- to 20-year-olds enrolled in institutions of higher learning by the year 2000. Third, the privilege of MSC status will be extended to institutions of higher education with the aim of encouraging further investment on information technology, IT for short, and multimedia education. Fourth, there is an ongoing effort to attract overseas Malaysians to serve their country. Long-term sustainability requires a pool of R&D activities in both public and private sectors; that is, funding schemes are in place to help nurture 'technopreuners,' and create a vibrant R&D culture within the MSC. The digitalization in Japan brought about high network quality and performance, standards in open network architecture, new network services, and cost reduction for maintenance and downsizing of equipment. Building the human infrastructure involves identifying the key technologies, giving first-hand experience to the best and brightest engineers

and manufacturers, and further assignment by individual aptitudes. The Asian Multimedia Forum, AMF for short, is a cooperative project involving 19 founding organizations in eight countries. It is expected that the AMF will contribute not only to the building of a coherent multimedia infrastructure for the Asian region, but also to helping future Asian leaders to have a wider view necessary for the harmonious development of regional infrastructure across national boundaries.

In 1994, broadband technology and its applications were being experimented on in small laboratory projects by splintered academic research groups in Singapore. Today, through a determined push by key government agencies and private sector companies, the world's first nationwide broadband infrastructure has been successfully installed and put into operation in this city state. In response to subscribers' demands, applications are being rapidly added, and additional infrastructure such as satellite links are being planned to complement terrestrial or submarine lines. However, deploying applications alone will not suffice. New broadband technology and products have to be nurtured and test-bedded. Present capabilities and skills have to be upgraded to meet broadband-era needs. The fourth presentation dealt with the networking society of the 21st century, characterized as involving anyone, anytime, anywhere, any information, and any format. In shaping tomorrow's network society, free communication technologies –that is optical fibers, satellites, and short-hole radio—are expected to play complementary roles. The network society can be expected to evoke changes in education, work culture, the environment, and health. This society is dependent on the growth of the information technology industry, which will call for extensive retraining of professionals and continuous updating of their knowledge. Therefore, strong education and training programs in both formal and informal education sectors need to be instituted. Virtual reality will be the ultimate evolution of a network society, however, the presenter felt that the role of virtual reality should be limited to training human beings to handle hazardous operations. During the discussion, someone asked whether China was included in the AMF. Dr. Kano replied that members were mainly private organizations, but that any organization is free to collaborate with the AMF. Hong Kong is one of the founding organizations of the AMF, and since the changeover from British to Chinese hands last July, one can consider China to be represented in the AMF. One of the Chinese participants volunteered the information that China has already established and SNT network with the European Union, and is considering cooperate activities with Japan. As to the network society, Dr. Hooper stated that while it may be more productive to work at home, there was a tendency to put in longer hours. There also seemed to be a step back toward rendering [piece] work. It was also disproved that pollution would decrease with less travel in a network society because one's desire to come into contact with a fellow human would increase commuting. In response to inquiry on how much has been spent on R&D in Singapore, Mr. Wu replied that of the 3.5 million Singapore dollars requested, 3.2 million had been expended, mainly for seed funding of relatively small projects. Dr. Kano agreed with Prof. Vishwanathan's concern about virtual reality, however, he felt that virtual reality should not deprive one of physical contact. He mentioned that in the drive towards high technology, the danger laid in wanting to replace humans with technology. He cited the increase of robots for hazardous operations. Dr. Kano also supported Professor Vishwanathan's point on the coexistence with nature, and added an example to the two that were cited by Professor Vishwanathan on the use of fiberoptics to light a high-rise building in Japan. Prof. Vishwanathan mentioned that he had come across in his readings a white paper on Japan's

telecom policy which highlighted human aspects, particularly in the telecom policies dealing with women and the handicapped. Dr. Kano proposed classification to the list given by the chairperson, and he proposed that technology and human beings be added.
Another question that came up was, in the MSC, what was the critical mass needed for takeoff. Do all companies need to be collected in one place? In reply, Dr. Yap stated that the response of local companies had been most encouraging, leading to a good mix of local and foreign companies. The momentum is being carried forward, but he could not really say whether the critical mass had been reached. In any case, the government of Malaysia had not exerted pressure on MSC-status companies to locate themselves in Cyberjaya, but had provided a two-year grace period for them to relocate to this area. I did not put them in the order that they were given in the discussion, but I wanted to make them more coherent by rearranging. Thank you very much.

Chairman:
Thank you very much, Prof. Concepcion. After we have finished our summaries, perhaps we can receive some general comments or questions. So, could I ask Dr. Sigua to give his summary?

Summary: By Dr. Sigua
Thank you very much. I would like to briefly summarize what has transpired. I think that Session III, being the last session, will probably be fresh in your minds. Anyway, if you look at the papers presented, there were four, and basically they deal either directly or indirectly with the role of transportation in economic development. I said indirectly because, for example, in the paper by Mr. Jusman from Indonesia, I think the actual intention in the paper is to present the role of air transport in alleviating poverty in Indonesia, but I realize that he changed the presentation by focusing more on the history of the aerospace industry in Indonesia. Of course, the paper from China presented by Mr. Wang focused on the impacts of economic development in China, and it discussed a number of solutions, both infrastructure-related, and some innovative schemes to alleviate the traffic congestion in urban areas in China.
I will just summarize briefly the presentation by Prof. Hooper. It focused on the role of air transport in the economic development in Australia. Australia has been considered as a case study in this paper, considering that the nation is heavily dependent on its air transport services to maintain links with the rest of the world. From Dr. Hooper's words, an airport should be considered an integral part of the economic structure of the country. Australia has undertaken a number of reforms in the transport sector to cope with the increasingly competitive global economy, and most of these are in the privatization of the transportation sectors. The experience of Australia has shown the readiness of the private sector to finance and operate transport infrastructure services in that country, and it was also recognized that economic regulation is difficult to maintain in these dynamic markets. Prof. Hooper also discussed the role of air transport with regard to the competitiveness of cities in this era of globalization. Some examples were cited, not only for the Australian experience, but the experience of other countries, where air transport has a major impact on vocational decisions. Also, Professor Hooper stressed the importance of human resource development as infrastructure development grows, and also as the demand for air travel continues in the Asian-Pacific region.
In Session II, in the paper by Dr. Ozeki, he gave us a glimpse of the Japanese national railways

over a period of more than a hundred years, and he emphasized the role of the young generation, who made great contributions towards the development of the railway industry in Japan. It is recognized that Japan was quite behind in introducing railroads compared to other countries, but Japan built railroads vigorously with strong support from the private sector. Dr. Ozeki discussed the development of the Japanese railway in four stages, and through these stages, he commended the roles of young experts in a number of decisive actions, from manufacturing locomotives locally, electrification, construction of the Shinkansen or bullet trains, and privatization of the national railway. It goes on to show that major change in the transportation system of any country can take place only when the people concerned with transportation posses innovative minds and the passion and knowledge to turn the situation around --in Japan, this happened in the Meiji Era-- and these are actually characteristics of young, talented people. Considering the experience of Dr. Ozeki now, I'm sure that he has contributed a lot in the development of the Japanese railway.

Mr. Jusman presented the historical transformation of the Indonesian aerospace industry, which we call PTIPTN, from 1976 to what it is now. So far, it has undergone three phases. He stressed the importance of the step-by-step process towards the present capability of Indonesia in manufacturing aircraft. He discussed the industry's capability in testing as well as its capability in terms of technical manpower. The last paper by Mr. Wong, Xiao Jing stressed that China is undeniably one of the fastest developing countries in the world, considering the impressive GDP of about 9% in recent years. However, it is recognized that for the fullest support of this economic development, transport infrastructure should likewise be developed. Although a number of projects have been planned, Mr. Wong stressed that transport infrastructure alone cannot cope without demand brought about economic development, and he also therefore looks at other solutions which we call innovative ones to ease up traffic congestion in built up areas in China. He stressed the application of the Intelligent Transport System, which depends largely on telecom technology. Some of the potential applications of ITS mentioned are the electronic toll collection system, or ETC --which I believe is being used now in China-- and applications for traffic management systems, public transport systems, traffic safety, advanced logistics systems, traffic surveillance and control systems, and traffic information service. Presently China is pushing on a number of projects related to ITS, and the country has been seriously looking at ITS work since 1995 by investing a lot in international exchange and institutionalization of R&D organization related to ITS. There were a number of questions, and if we go back to the open discussion part of the session, a number of questions were raised on privatization, both for Professor Hooper and for Mr. Ozeki, related to air transport and railroad industries. Some questions were raised also on the situation of the domestic airlines, because Prof. Hooper focused more on international operations. And some questions also on subsidy problems on non-lucrative routes were raised.

On the presentation by Mr. Jusman, there was a suggestion made by a participant from India regarding the availability of some testing facilities in the country which could help Indonesia, since both countries are within the Asian Pacific. With regards to ITS, there were some concerns raised on the effectiveness of the proposed system considering the situation in China –for example, the vehicle age, the high accident rates which could be attributed driver errors, and of course the behavior of the enforcers –which could effect in some way or another the success of the ITS. There was also a question by Mr. Ozeki on the extent of ITS application for China

considering that there are a number of alternatives. If we still include the different modes of transport, then definitely you will be having a large matrix of applications of ITS.

Chairman:
Thank you very much, Dr. Sigua, for your very comprehensive summary of the three sessions from each rapporteur. Does anyone have any additional comments; especially the chairperson? Kawasaki-san, please.

Comment: From Mr. Kawasaki:
Maybe the following address is a little bit real, so I'd say, some further consideration. But, I am very interested in the title of this symposium. We used the name ***Technology Management for an Extension of Economic Partnership,*** but through the three sessions, I felt strongly, for several reasons, that 'partnership' had quite a dominant meaning. I would like to point out two items over these three sessions. First is the current trend of so-called globalization. We picked up the topics Energy and Environment, the Information Society, and also transportation and traffic issues. By definition, those are strongly related to globalization. On the other hand, however, those items are also quite strongly linked with native cultures, regional conditions, regional resources, climate, and local situations. Each paper suggested local solutions aiming at some degree of globalization. I think that was quite an interesting position. Therefore, any process has the sum of international aspects of each project to conduct or persuade the goal. So, the word 'partnership' is quite important. Maybe 'partnership' is a little different from 'cooperation.' I'm not a native English speaker, but when I hear the word, I feel that all members of a partnership must share the burdens and the profits. It's quite an interesting point of view. Also, this partnership maybe extended to a global partnership. Thank you very much.

Comment: From Dr. Fabella
Just a short comment. Looking at the four country papers, I realized one thing that I'd like to share with you. Australia, Japan, and perhaps to a certain extent China make it a goal of infrastructure policy to provide an adequate backbone for economic growth. On the other hand, Indonesia is a bit different. Providing an economic backbone for economic growth does not need a country to produce the rolling stock. I think Australia has done very well with its infrastructure without having the capacity to produce the rolling stock. I think that in Japan, the first impetus towards infrastructure was really provision for facilitating infrastructure for growth and for defense. Indonesia is a bit different in that the transportation policy tries to shoot both things at once. Once is the provision of infrastructure for economic growth, and at the same time, the provision for capacity building for rolling stock. The Indonesian experience is bold, but I'm afraid that it is also a bit risky, in that, in the interest of the provision for the capacity to build the rolling stock, the first goal might be sacrificed. What I'm saying is that the first goal could be pursued without the second, and in the pursuit of the second, the first goal could be enhanced or sacrificed. This is true of all infant industry experience, anyway. Either they became very successful like Pohang and were able to serve the long-term economic growth of the economy, or they simply debilitated the other side of the picture.
That's I wanted to share with you. Thank you.

Chairman:
Thank you very much, Dr. Fabella. Are there any other comments? Please make them general comments; not necessarily directed towards Session III. Dr. Hooper?

Comment: From Prof. Hooper:
I'd just like to offer one response to the economic partnership theme. In the paper that I provided, there was more there than I was able to cover in my address, and there certainly was one contribution that works along the theme that you've raised. Within APEC, the APEC transport ministers raised for their transport working group the concept of an APEC center for research, development, and education in transport. This has been pursued by the transport working group, and I have discussed that in the paper. At the present time, the idea that is being looked at is the development of the network. Transport research, development, and education ranges across such a diverse set of activities, from aerospace through to driver training. To arrive at some sense of every possibility is simply not feasible, but the idea of creating a framework for a network to develop is being is examined, and I urge you all to read that part of my paper, and to see how that might fit into some of your plans. I certainly see a lot of potential for that.

Chairman: Thank you very much, Dr. Hooper. Okay. I thank all the audience for your very hot discussions and very great interest in these seminars.

Closing Address

Dr. Moriya Uchida
Vice President, Japan Federation of Engineering Societies

At the close of this seminar, I would just like to make a few remarks.

The currency crisis that started last year in Thailand spread rapidly to Indonesia, Hong Kong, Malaysia, and Korea, and for some time now, the Japanese money market has also been in confusion. The collapse of two big financial companies in the last part of 1997—Hokkaido Takushoku Bank, which was one of the large city banks, and Yamaichi Security Company, which was one of the four leading security companies in Japan—sent shock waves through the whole country.

In the wake of these traumatic events, Japanese companies have two options: one is to improve their international competitiveness; the other is to move out of areas in which they are relatively weak and concentrate their management effort on areas in which they are strong. Since late last year, action along these lines has become widespread in all Japanese industries.

The economies of many countries in Asia are experiencing severe stagnation. At this time we need to reconsider some fundamental questions, such as: "What are the essential elements of a nation's power?" and "What kind of capability and environment is needed to stimulate growth in order to overcome economic recession?"

I think that revitalization of the economies of Asia must be based on two factors: human assets, and the socio-economic environment. We must, therefore, restructure the socio-economic system in the Asia-Pacific region to be more appropriate for the new world order, as was suggested earlier in this seminar.

I would like to emphasize a couple of points.

1. The advanced information technology society and response to a consumer-led economy.

Thanks to the advance of communications technology, any new scientific or engineering invention or discovery is communicated to the entire world instantaneously. It is now nearly impossible for any country to keep monopolistic control of any piece of information. In any advanced industrialized country, national final consumption accounts for

approximately 60 percent of gross domestic product (GDP). When investment in the facilities and equipment which supply this level of consumption are included, the figure rises to about 80 percent. This means that the prime mover of economic activity is consumption by people who seek a better standard of living.

What is important, therefore, in the management of science and technology is the ability to grasp quickly the needs of consumers for new products, to conduct research and development (R&D) that directly reflects these needs, and to establish intellectual property and de facto standards.

2. Policies to produce well-trained scientists and engineers.

Scientific activity gives humans the wisdom to understand nature. Engineering activity is a manifestation of the ability to apply scientific knowledge to society's needs. The furthering of knowledge is dependent on basic research, and is the function of universities. Engineering competence, on the other hand, underpins industry. Having technological capability that is unique to an individual corporation (or in which it has a comparative advantage) is an essential element of its international competitiveness.

Consequently, successful R&D, whether conducted in industry or in academia, can be achieved only if there are highly competent human resources and the best possible environment for research or business creation for them to work in.

National governments must adopt policies to create well-trained scientists and engineers. The higher education system in any country or region reflects the history of its development, and for this reason it will not be easy to standardize higher education systems internationally, as each has deep roots in the ethnicity and culture of its country or region.

At the same time, the globalization of the world's economies has raised the question of how the qualifications of engineers who have trained or gained experience in different places may be certified internationally. This question has also been raised at APEC. It deserves future examination as one of the issues of R&D management in the Asia-Pacific region.

Conclusion

In regard to the management of science and technology that is designed to promote an extension of economic partnership in the Asia-Pacific region, the following points deserve

attention.

1. It is very important to understand the fact that in this period of mega economic competition, corporations pick and choose countries and regions for their business operations. A national government must implement comprehensive policies for technological innovation that consolidate social, industrial, and economic policies with science and technology policies, and that boost the international competitiveness of industry, thereby improving the standard of living of its people and at the same time assisting the economic growth of the region.

2. Industry must promote research and development in ways which directly tie marketing to R&D, and capitalize on unique technological capacities in order to respond to a consumer-led economy. In taking the results of research and development to commercialization, corporations must build strong international competitiveness by consolidating all management resources, including out-sourcing.

3. Universities should be Centers of Excellence in the creation of knowledge, aiming to be the best in the world in specific fields, and should also aim to produce competent workers.

4. Technological innovation and management can be promoted by establishing strategic fields in response to industrial needs, by building the infrastructure necessary for economic growth and to meet the demands of the society, and by fostering a consensus among academia, government, and industry about the intrinsic value of science and technology, which represent intellectual capital for the people of a nation.

5. Today, intellectual property has come to be regarded as a component of infrastructure. It should be noted that the governments of some advanced countries have begun to provide research funds as an investment for improving social and economic infrastructure that will raise the standard of living of their peoples.

6. The success of economic growth hinges on human resource. Nations and corporations may prosper or decline, depending on how well they educate or train their people and how skillfully they create an environment which is conductive to the formation of intellectual assets, as well as on what effective strategic management policies they adopt that enable them to use such intellectual assets to develop viable commercial products.

In the last session, Dr. Fabella and Dr. Sigua mentioned their interest in the contribution young Japanese engineers made to the industrialization of Japan in Meiji Era and why they were able to play an active role in this process. I would like to explain briefly.

The change from the feudal system of the Tokugawa period to the modernized system of the Meiji era brought about a social revolution in Japan. The feudal administration of the Tokugawa clan that had lasted for three hundred years was destroyed. However, the leaders of the new regime were samurai of low position, many of whom had been involved in their local region in activities such as improving food production technology, building roads and bridges, controlling rivers, and improving agricultural productivity among farmers. When the Western nations forced Japan to open up, these young samurai were ambitious for Japan to become strong and catch up with the West.

Mr. Yozo Yamao, one of these young, hopeful samurai, who became the first president of the Japan Federation of Engineering Societies, went to England and learned shipbuilding technology at Glasgow University. This university was well known because James Watt, who was one of the initiators of the Industrial Revolution, worked there.

After his return to Japan, Yamao established the Ministry of Industry, the most important role of which was setting up a school to train engineers, a technical college for engineers that was the beginning of the Engineering Department of Tokyo University. He invited English teachers who promoted a new educational program that combined advanced knowledge with actual work on-site in factories. This was instrumental in producing young engineers who were able to make a significant contribution to the rapid industrialization of Japan.

In addition, the Japanese government built ironworks in Yokosuka and Nagasaki for ship-building, where R&D facilities were included in the plants. Not only were advanced technologies introduced, but they were absorbed and improved, and workers were trained with the intention that they would develop original technologies themselves.

Another important factor was the introduction of the industrial property system.

Mr. Korekiyo Takahashi, who was later Prime Minister, was given the mission of creating a patent system for Japan. He went abroad to study, and learned that craftsmanship was most important for industrialization, and that establishing a system to protect industrial intellectual property would encourage the development of industry.

An American friend sent me a paper published in 1900, which describes Mr. Takahashi's experiences in the United States.

The Director of the Patent and Trademark office asked him "Why do you study the patent system in United States?" He said, "I hope Japan will be a great nation like Western

countries in the future. But in Europe I did not find out the secret of success. The secret I found in the United States; it is the patent system."

After Takahashi returned to Japan, he established an industrial property system, creating a special Japanese-style utility model law, which encouraged the formation of small businesses based on craftsmanship.

These efforts by Japan were the secret of Japan's success.

This two-day seminar has been very meaningful, as these issues were debated from various angles. I hope that our discussions will contribute to reviving the economic vitality of the Asia-Pacific region.

Finally, I would like to express my deep appreciation for everyone's contribution to the success of our meeting.

Thank you again, all of you.

Program

The 3rd Asia-Pacific Research and Development Management Seminar

Science and Technology Management
for an Extension of Economic Partnership in the Asia-Pacific Region

February 16, 1998

09:00 - 10:00 Registration

10:00 - 11:50 Opening Ceremony

Master of Ceremony : Atty. Imelda D. Rodriguez, Assistant Secretary, DOST, *Philippines*

1. Welcome Address:

   Dr. Estrella F. Alabastro, Undersecretary, Department of Science and Technology, *Philippines*

2. Inaugural Address :

   Mr. Masahiro Kawasaki, Special Adviser, Japan Science and Technology Corporation, *Japan*

3. Special Lecture:

   Dr. Jose A. Magpantay, Professor, Faculty Affiliate, Technology Management Center, *Philippines*

4. Keynote Speech :

   Dr. Moriya Uchida, Vice President, Federation of Engineering Societies, *Japan*

========== *Lunch (11:50 - 13:20)* ==========

13:20 - 17:10 Session I Stable Energy Resources and the Environment

Chairperson: Mr. T. Murata, Executive Advisor, Nippon Steel Corporation, *Japan*

Rapporteur : Dr. Wilfredo I. Jose, Professor, University of the Philippines

1. Supply of Electrical Energy in Japan

   Mr. Osamu Kobayashi, Advisor, The Tokyo Electric Power Company, *Japan*

2. Research Collaboration among POSCO, POSTECH and RIST (Pohang Research Tripod) in the area of Environmental Catalytic Technology

   Dr. In-sik Nam, Director/Professor, School of Environmental Engineering, Pohang University of Science and Technology, *Korea*

3. Philippine National Oil Company-Energy Development Corporation: One of the World's Biggest Geothermal Steamfield Developer

   Mr. Serafin E. Garcia, Manager, Exploration Development and Resource Development, PNOC-Energy Development Corporation, *Philippines*

========== *Tea Break (14:50 - 15:10)* ==========

4. Energy, Environment and the Recent Trend of Automobile's R&D in Japan

   Dr. Yasuo Nakajima, Professor, Musashi Institute of Technology, *Japan*

5. Photovoltaic Application in the 8th National Social and Economic Development Plan of Thailand (1997-2001)

   Dr. Wattanapong Rakwichian, Associate Professor/Director, Solar Energy Research and Training Center, Naresuan University, *Thailand*

6. R&D Management for Improving Existing Radwaste Treatment Systems and Problems in Technology Transfer

   Mr. Kosei Watanabe, Special Consultant, Japan Manned Space Systems Corporation, *Japan*

7. Questions & Answers

18:00 - 19:00 Reception [Hyatt Regency Manila]

February 17, 1998

09:00 - 11:50 Session II Information and Society

Chairperson: Mr. M. Kawasaki, Special Adviser, JST, *Japan*

Rapporteur : Dr. Mercedes B. Concepcion, Professor Emeritus, University of the Philippines

1. Multimedia Super Corridor: Transforming Malaysia's Economic Development

   Dr. Yap Chee Sing, Senior Manager, Technology Policy & Research, Multimedia Development Corporation, *Malaysia*

2. Telecom Network Digitalization - How it is done in Japan -

   Dr. Sadahiko Kano, Senior Vice President, NTT, Deputy Senior Executive Manager, R&D Headquarters, *Japan*

3. Evolving New Information Society: An Indian Perception

   Prof. T. Vishwanathan, Director, Indian National Scientific Documentation Centre, *India*

========== *Tea Break (10:30 - 10:50)* ==========

4. SingaREN - A Case Study on Government-Industry Partnership in Technology-Push Strategy

   Mr. Steven W P Wu, Manager (Executive Director's Office), National Science and Technology Board, *Singapore*

5. Questions & Answers

========== *Lunch (11:50 - 13:20)* ==========

13:20 - 16:10 Session III Transportation and Economic Development

Chairperson: Dr. Raul V. Fabella, Professor, University of the Philippines

Rapporteur : Dr. Ricardo G. Sigua, Director, University of the Philippines

1. Transportation and Economic development

   Dr. Paul Hooper, Associate Professor, Institute of Transport Studies, the University of Sydney, *Australia*

2. Learning from the History of the Japanese National Railways

   Mr. Masanori Ozeki, Senior Advisor, Railway Technical Research Institute, *Japan*

3. 20 Years Experience of PT IPTN: Integration of Technology, Human Resource and Economic Development in Emerging Country

   Mr. Jusman Syafii Djamal, Executive Vice President, P.T. IPTN

   - Indonesian Aerospace Industry, *Indonesia*

========== *Tea Break (14:50 - 15:10)* ==========

4. China Economic, Transport and ITS

   Mr. Xiao-jing Wang, Deputy Director, Research Institute of Highway,

   the Ministry of Communications, *P.R.China*

5. Questions & Answers

16:10 - 17:30 Closing Session

1. Summing-Up

   Rapporteurs and Chairpersons

2. Closing Address:

   Dr. Moriya Uchida, Vice President, Federation of Engineering Societies, *Japan*

February 18, 1998

09:00 - 13:00 Study Tour

Programme of the 3rd Asia-Pacific R&D Management Seminar - February 1998, Philippines -

Date	From	To	#	Subject of Presentation	Country	Name and Position of Speaker
Feb. 16				Opening Session		
	10:00	10:05	1	Welcome Address	Philippines	Dr. Estrella F. Alabastro, Undersecretary, Department of Science and Technology
	10:05	10:10	2	Inaugural Address	Japan	Mr. Masahiro Kawasaki, Special Adviser, Japan Science and Technology Corporation
	10:10	11:00	3	Special Lecture	Philippines	Dr. Jose A. Magpantay, Technology Management Center
	11:00	11:50	4	Keynote Speech	Japan	Dr. Moriya Uchida, Vice President, Federation of Engineering Societies, Japan
	11:50	13:20		Lunch		
				Session I Stable Energy Resources and the Environment		
	13:20	13:50	1	Supply of Electrical Energy in Japan	Japan	Mr. Osamu Kobayashi, Advisor, The Tokyo Electric Power Company
	13:50	14:20	2	Research Collaboration among POSCO, POSTECH and RIST (Pohang Research Tripod) in the area of Environmental Catalytic Technology	Korea	Dr. In-sik Nam, Director/Professor, School of Environmental Engineering, Pohang University of Science and Technology
	14:20	14:50	3	Philippine National Oil Company-Energy Development Corporation: One of the World's Biggest Geothermal Steamfield Developer	Philippines	Mr. Serafin E. Garcia, Manager, Exploration Development and Resource Development, PNOC-Energy Development Corporation
	14:50	15:10		Tea Break		
	15:10	15:40	4	Energy, Environment and the Recent Trend of Automobile's R&D in Japan	Japan	Dr. Yasuo Nakajima, Professor, Musashi Institute of Technology
	15:40	16:10	5	Photovoltaic Application in the 8th National Social and Economic Development Plan of Thailand (1997-2001)	Thailand	Dr. Wattanapong Rakwichian, Associate Professor/Director, Solar Energy Research and Training Center, Naresuan University
	16:10	16:40	6	R&D Management for Improving Existing Radwaste Treatment Systems and Problems in Technology Transfer	Japan	Mr. Kosei Watanabe, Special Consultant, Japan Manned Space Systems Corporation
	16:40	17:10		Question & Answer		
Feb. 17				Session II Information and Society		
	9:00	9:30	1	Multimedia Super Corridor: Transforming Malaysia's Economic Development	Malaysia	Dr. Yap Chee Sing, Senior Manager, Technology Policy & Research, Multimedia Development Corporation Sdn. Bhd.
	9:30	10:00	2	Telecom Network Digitalization - How it is done in Japan -	Japan	Dr. Sadahiko Kano, Senior Vice President, NTT / Deputy Senior Executive Manager, R&D Headquarters
	10:00	10:30	3	Evolving New Information Society: An Indian Perception	India	Prof. T. Vishwanathan, Director, Indian National Scientific Documentation Centre
	10:30	10:50		Tea Break		
	10:50	11:20	4	SingaREN - A Case Study on Government-Industry Partnership in Technology-Push Strategy	Singapore	Mr. Steven W P Wu, Manager (Executive Director's Office), National Science and Technology Board
	11:20	11:50		Question & Answer		
	11:50	13:20		Lunch		
				Session III Transportation and Economic Development		
	13:20	13:50	1	Transportation and Economic Development	Australia	Dr. Paul Hooper, Associate Professor, Institute of Transport Studies, the University of Sydney
	13:50	14:20	2	Learning from the History of the Japanese National Railways	Japan	Mr. Masanori Ozeki, Senior Advisor, Railway Technical Research Institute
	14:20	14:50	3	20 Years Experience of PT IPTN: Integration of Technology, Human Resource and Economic Development in Emerging Country	Indonesia	Mr. Jusman Syafii Djamal, Executive Vice President, P.T. IPTN - Indonesian Aerospace Industry
	14:50	15:10		Tea Break		
	15:10	15:40	4	China Economic, Transport and ITS	China	Mr. Wang Xiao-jing, Deputy Director, Research Institute of Highway, the Ministry of Communications, P.R.China
	15:40	16:10		Question & Answer		
				Closing Session		
	16:10	17:20	1	Summing Up		
	17:20	17:30	2	Closing Address	Japan	Dr. Moriya Uchida, Vice President, Federation of Engineering Societies, Japan
Feb. 18	9:00	13:00		Study Tour (Half-day)		

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