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ANNIVERSARY
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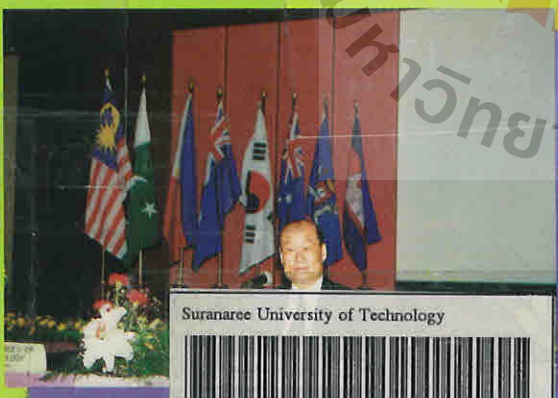
SURANAREE UNIVERSITY OF TECHNOLOGY

INTERNATIONAL COLLOQUIUM ON UNIVERSITY-INDUSTRY-GOVERNMENT COOPERATION IN QUALITY ENGINEERING AND TECHNOLOGY EDUCATION FOR SOUTHEAST ASIA IN THE 21ST CENTURY

SPEECHES AND CONTRIBUTED PAPERS



SURASAMMANAKHAN HALL
SURANAREE UNIVERSITY OF TECHNOLOGY
NAKHONRATCHASIMA, THAILAND
27 - 28 JULY 1995

FOREWORD

It is with pleasure that Suranaree University of Technology organized the "Colloquium on University-Industry-Government in Quality Engineering and Technology Education of Southeast Asia in the 21st Century" in connection with its Fifth Founding Anniversary Celebration on 27 July 1995.

The Colloquium addressed three institutions that will play key role in steering Southeast Asia into a technologically self sufficient region by the first decade of the 21st Century-the University, the Industry and the Government. Its aim was to provide a forum for engineering educators and managers of engineering-based industries as well as representatives of relevant government ministries to share experiences and to gain insight into issues confronting engineering education. It allowed as well discussion of future aspirations as well as paradigms or strategies of linking and matching engineering education to the dynamic requirements of industries and governments.

The Colloquium could not have been possible without the kind and generous assistance of SEAMEO RIHED and UNESCO-UNISPAR. SUT highly appreciated the participation of distinguished speakers especially Prof. Dr. Sipphanondha Ketudat, Chairman, the National Economic and Social Development Board, Thailand, for delivering the keynote address. It was also a great honour for SUT to have presidents, rectors and vice chancellors of 48 universities from 12 countries and deans of schools of engineering attending this colloquium.

Prof Dr. Wicht Srisa - an
Rector, Suranaree University
of Technology

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Colloquium Program

COLLOQUIUM

26 July Wednesday..................

19:10 Arrival of Overseas Participants at Nakhon Ratchasima Airport, TG062
20:00 Check in at Surasammanakhan
20:30 Buffet Dinner at Surasammanakhan

27 July Thursday

Venue: Surasammanakhan Hall
07:00 Breakfast for guests staying at Surasammanakhan
08:00 Registration of Participants
09:00 Participation in the SUT Fifth Anniversary Celebration
10:30 Campus Tour: leaving from Surasammanakhan
12:00 Buffet Lunch
Venue: National Pavilion
13:30 Opening Ceremony
Venue: Surasammanakhan Hall
M.C.: Mr. Robert Burgess, Chair, School of English

"Colloquium on University-Industry-Government Cooperation in Quality Engineering and Technology Education for Southeast Asia in the 21st Century"

Welcome Address:
Prof. Dr. Wichit Srisa-an
Rector, SUT

Remarks:
Dr. Tong-In Wongsothorn
Director, SEAMEO RIHED

Message:
Dr. A. Badran
Assistant Director General for Science, UNESCO, Paris

Message:
Dr. Adrianus Mooy
ESCAP Undersecretary General

Keynote Address:
Prof. Dr. Sipphanondha Ketudat,
Chairman, The National Economic and Social Development Board, Thailand
"Paradigms of University-Industry-Government Cooperation in Quality Engineering and Technology Education for Southeast Asia in the 21st Century"

15:00 Coffee Break
15:30 Panel Presentation and Open Forum
"State of the Art of Engineering Education in Southeast Asia and Future Requirements"

CHAIR:
Assoc. Prof. Dr. Kasem Prabriputaloong,
Dean, Institute of Resources Technology, SUT

RAPPORTEUR:
Dr. Arjuna Chaiyasena,
Institute of Science, SUT

MALAYSIA:
Prof. Dr. Elias B. Salleh
Director, Innovation and Consultancy Unit, Universiti Teknologi

PHILIPPINES:
Prof. Dr. Ruben Garcia,
Former Dean, College of Engineering, University of the Philippines

THAILAND:
Asst. Prof. Dr. Tavee Lertpanyavit,
Dean, Institute of Industrial Technology, SUT

GRADUATE PROGRAM:
Dr. Alastair North,
President, Asian Institute of Technology

16:30 Keynote Paper Presentation

CHAIR:
Assoc. Prof. Dr. Sam-arng Srinilta,
Vice Rector for Administrative Affairs, SUT

RAPPORTEUR:
Dr. Utai Meekum,
Institute of Resources Technology, SUT

"Role of Government in Quality Technology and Engineering Education"
Assoc. Prof. Dr. Vanchai Sirichana
Deputy Permanent Secretary, Ministry of University Affairs

"Role and Policies of Government in Encouraging Technology R & D"
Mr. Dov Geva
First Secretary, Office of the Commercial Attache, Embassy of Israel, Bangkok

18:30 Dinner
Venue: Surasammanakhan

28 July Friday

07:00 Breakfast for guests staying at Surasammanakhan

09:00 **Colloquium Part II**
Panel Presentation and Open Forum

CHAIR:
Prof. Dr. Ronald R. Goforth,
Institute of Industrial Technology, SUT

RAPPORTEUR:
Asst. Prof. Dr. Sarawut Sujitjorn,
Institute of Industrial Technology, SUT

"University-Industry Partnerships: Experiences, Needs, Issues, Challenges and Strategies"

"University-Industry Linkages: New Paradigms to Enhance Human Resource Development"
Dr. Peter Brimble,
President, The Brooker Group Ltd., and
Assoc. Prof. Dr. Chatri Sripaipan,
Faculty of Engineering, Chulalongkorn University, Thailand

"University-Industry Partnership: Vietnam Experience"
Dr. Banh Tien Long,
Vice Rector, Hanoi University of Technology, Vietnam

"Science and Technology in India and University-Industry Relationship"
Prof. Dr. P.N. Srivastava,
Nuclear Science Center, Jawaharlal Nehru University, India

10:30 Coffee Break

11:00 (Panel Discussion and Open Forum, Continued)

"Engineering Education in England: Linkage with Industry"
Prof. John Roberts,
Kingston University, London, United Kingdom

UNESCO UNISPAR Programme
Mr. Y. Aoshima,
Officer-in-Charge of the UNISPAR, UNESCO, Paris, France

11:40 Closing Remarks
Prof. Dr. Wichit Srisa-an, SUT Rector

12:00 Buffet Lunch at Surasammanakhan

p.m. Departure of Participants

List of Chairs/ Rapporteurs/Speakers

SPEAKERS

CHAIR: Assoc. Prof. Dr. Kasem Prabriputaloong
Dean, Institute of Resources Technology, SUT

RAPPORTEUR:
Dr. Arjuna Chaiyasena,
Institute of Science, SUT

SPEAKER: Prof. Dr. Elias B. Salleh
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Universiti Teknologi, Malaysia
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Prof. John Roberts,
Kingston University, London, United Kingdom
Mr. Y. Aoshima,
Officer-in-Charge of the UNISPAR, UNESCO
Paris, France

Speech/Address/Message

PROF. DR. WICHIT SRISA-AN
SPEECH OF THE RECTOR FOR THE OPENING OF THE COLLOQUIUM

Prof. Dr. Sippanondha Ketudat, Chairman, the National Economic and Social Development Board, Thailand

Dr. Tong-In Wongsothorn, Director SEAMEO RIHED

Mr. Aoshima, Officer-in-Charge UNESCO, UNISPAR, Paris

Distinguished Participants and Guests; Ladies and Gentlemen;

Firstly, on behalf of the Royal Government of Thailand, the Ministry of University Affairs and Suranaree University of Technology, it is indeed my distinct pleasure and honour to welcome the distinguished speakers, participants and guests to this Colloquium on University-Industry-Government Cooperation in Quality Engineering and Technology Education for Southeast Asia in the 21st Century.

Five years ago on this day, the 27th of July, His Majesty the King signed the Royal Bill before the Parliament in its 1989th session establishing Suranaree University of Technology, named after Tao Suranaree, the historical heroine of Nakhon Ratchasima.

To mark its Fifth Founding Anniversary, Suranaree University considered 1995 as its International Year for a number of good reasons. This academic year, SUT launched the first of its International Program with courses taught in English for the degree of Mechanical Engineering in collaboration with the Canadian Universities of Technology Consortium, specifically with the University of Waterloo. To implement this program and additional programs in the future, SUT has now 17 foreign professors and lecturers to complement the Thai staff who can lecture equally well in English. The University has also elevated the Administrative Office for International Relations to a Center for International Affairs or CIA with its own Director and staff.

During this week of celebration, Suranaree University of Technology is organizing and sponsoring three international events. Firstly, SUT hosted on 25 - 26 July the Third Governing Board Meeting of SEAMEO RIHED, participated not only by representative of Institutes of Higher Education and Ministries of University Affairs from the nine SEAMEO member countries, but also by affiliated institutions like the UNESCO, ASAIHL and IAU. Secondly, tomorrow, SUT will host the Founding Conference of the Association of Universities of Asia and the Pacific of which among the 135 universities that have expressed desire in joining the Association, 67 will be personally represented by their presidents, rectors, vice chancellors or high administrative officals during the signing of the Memorandum of Agreement and the maiden Foundation Conference.

The third international event is this Colloquium with distinguished speakers not only from Southeast Asia but also from India, Israel, the United Kingdom and UNESCO, Paris.

The climax of the International Year is the hosting by SUT of Worldtech 95 from 4 November to 16 December-an international fair in agricultural and other modern technologies. We hope you could participate again in this big event.

Ladies and Gentlemen,

In common with other Thai universities, SUT has a mandate for the production of high quality graduates for research and development, for academic services to society and for cultural preservation and promotion. SUT is however unique in that its focus is on engineering and technology higher education. Although SUT already has the highest number of Engineering students in Thailand, it still cannot meet the demands for skilled technological manpower of the country. Even if consortia between universities can be formed and programs of student and faculty exchanges as well as collaborative research can be established, it is not enough to bring about high quality engineering and technology education in the country. There is a need to bring two other institutions in this cooperative endeavor-namely the industries, which will be employing most of the graduates and the government for their supportive policies. It is also not sufficient to have this cooperation at the national level, it must extend beyond political and geographical boundaries in this present age of internationalization or globalization.

SUT is therefore very pleased that our distinguished speakers and participants have honoured our invitation to make this Colloquium a truly international one. We hope that this colloquium could serve as a forum for academic, industrial and governmental leaders and experts from participating countries to start the process of continuous quality improvement of engineering and technology education in Southeast Asia to meet the ever growing and varied demands of the next century.

SUT is eagerly looking forward to the new ideas, paradigms and strategies to be presented by the speakers and to the suggestions that would come from the participants during the open forum. To all the speakers and participants and for all the efforts and enthusiasm, SUT is most appreciative and grateful.

This Colloquium is also being co-sponsored by SEAMEO RIHED as part of their series of regional conferences on the Improvement of Engineering Education in SEAMEO member countries and by the UNESCO University-Industry-Science Partnership Program or UNESCO UNISPAR in Paris. We would like to thank them for their financial and technical support.

Once again I wish you all fruitful and successful deliberations and I hope your stay with us though short would be most enjoyable and happy that you would want to visit us again specially during the Worldtech 95.

Thank you.

OPENING CEREMONY ON 27 JULY 1995
MESSAGE SENT BY DR. A. BADRAN ASSISTANT DIRECTOR-GENERAL FOR SCIENCE, UNESCO

Mr. Chairman
Distinguished Guests, Ladies and Gentlemen

I am honoured to send a message to the Colloquium on University-Industry-Goverment Cooperation in Quality Engineering and Technology Education in Southeast Asia for the 21st Century and to welcome you on behalf of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and of its Director-General, Federico Mayor, and to wish you full success in this scientific and technological meeting jointly organized by Suranaree University of Technology and UNESCO.

Technology-led industrialization has become a main issue in Third World countries and eastern and central Europe. When the issue of industrialization is raised, another United Nations specialized agency, the United Nations Industrial Development Organization (UNIDO), may look at this issue from industry's point of view. UNESCO's reaction is to ask "How can academic contribute?" Industrialization of a country will not take place without human resources development and technology transfer. A university has three functions: education, research and services. However, in developing countries engineering universities do not participate sufficiently in the process of industrialization of their country. UNESCO believes that university-industry co-operation can be a valuable strategy in the process of industrialization of developing countries.

Indeed, the challenge to Engineering Education at the turn of the century is great and intriguing. Engineering Education has to develop quickly in terms of equality and diversity to respond to new emerging needs of the industry and the society at large. It has to adapt itself to the vast changes which are taking place in the fast technological development of the South East Asian countries. We are entering a new revolution of industrialization which is based mainly on Brain-Capital and this is where Engineering Education becomes crucial in the preparation by the engineering human capital for economic and social development.

The years 2000+ envisage the following five areas of technology to be fast moving in the competitive open-market economy:

- Informatics, communication,
- Microelectronics,
- Optics,
- Genetic engineering,
- New materials based on atomization, moleculerization and polymerization.

Engineering education in terms of quality and specialization has to address these issues in depth.

I am happy, on behalf of UNESCO, to congratulate the initiative taken by the Center for International Affairs of Suranaree University of Technology to organize this regional conference on the topic of university-industry co-operation. I would like to also thank all institutions, private companies and individuals who have contributed to the organization of this conference and wish your meeting every success.

MESSAGE

FROM

ADRIANUS MOOY

UNDER-SECRETARY-GENERAL
OF THE UNITED NATIONS
AND
EXECUTIVE SECRETARY
OF ECONOMIC AND SOCIAL COMMISSION FOR
ASIA AND THE PACIFIC

TO

The Colloquium on University-Industry-Government Cooperation in Quality Engineering and Technology Education for Southeast Asia in the 21st Century

27-28 July 1995
Nakhon Ratchasima, Thailand

Excellencies,
Distinguished Participants,
Ladies and Gentlemen,

It gives me great pleasure to convey my warm greetings and best wishes to the distinguished participants at the Colloquium on University-Industry-Government Cooperation in Quality Engineering and Technology Education for Southeast Asia in the 21st Century which has been convened in Nakhon Ratchasima, Thailand, on the occasion of the Fifth Founding Anniversary of the Suranaree University of Technology.

The Asia-Pacific region not only spans the largest of the continents, it also contains the great majority of humanity. The region should be justly proud to have persons who are heirs to a number of ancient civilizations with different cultures and traditions. Despite the talk about dynamic growth impulses, many of the countries are at varying stages of development and some 500 to 600 million people continue to live in abject poverty. Within this context, the responses to meeting the challenges of quality engineering and technology education into the next century will undoubtedly differ considerably among the peoples and countries. In spite of this, a certain commonality of interests and a sense of underlying unity, strengthened by shared values and experience is prevalent.

The various economic reforms and liberalization measures adopted by many developing countries in the region have provided opportunities for higher economic growth in general and trade expansion and industrial development in particular. These measures resulting in increased integration of economic activities at the global, regional and subregional levels have led to fierce competition both in domestic and in international markets.

For the developing countries of the region, this creates major challenges centering around the imperative to make the transition, in the shortest possible time, to a stage of industrial and technological development that would ensure increased productivity of resources and sustained improvement in the living standards of the people. This task is neither easy nor likely to be realized within a short span of time. Therefore, the developing economies of the region need to pursue development strategies anchored in rapid industrialization and flexible industrial restructuring, keeping those challenges in perspective and working out the critical and important elements for their successful implementation.

This distinguished gathering is no doubt well aware that tecnological progress is the key difference between dynamic, industrializing societies and those mired in traditional modes of production. Everybody here is unavoidably aware of the technology gap between developing and developed Asia and the Pacific and between Asia and the Pacific and the developed world. That gap is widening between and among the different groups especially since the advent of new technologies, increasingly sophisticated and increasingly difficult to master without specialist skills and qualifications. Yet we do heve examples of countries and economies in the region that have created a solid base of education at all levels and for acquiring skills for the use of technology. These are the NIEs in which more than a fifth of the government budget is allocated to education which is the key to human resources development whether it is formal or informal, adult education, technical or on-the-job training.

I am sure we can all agree that overall technological upgradation and the move towards adoption of new and emerging technologies, is a sine qua non for continuously improving product quality, efficiencies and competitiveness. However, the developing countries of the region need to prepare themselves for such a situation through the generation and development of human resources especially for the adaptation and utilization of new and emerging technologies. One of the most forceful lessons of the decades of successful economic development is that economies investing wisely in human resources development have succeeded in achieving an accelerated pace of industrial growth, improvements in technological capability, competitiveness and overall social progress. In particular, investments in literacy and skill formation have very high social as well as economic returns. Furthermore, as a result of rapid technological progress, a systematic approach to human resources development, especially in key managerial and technical areas is essential. The linking of human resources development with core requirements in industrial and technological areas, especially research and development, the technological upgradation of existing units, consultancy services, entrepreneurship promotion and standardization and quality control has become a necessity for retaining the competitive edge and sustaining and strengthening economic achievements. In the rapidly changing global economic environment, human resources development programmes are under pressure to become more flexible, cost-effective, and attuned to the priorities of economic development.

From the foregoing, you will all agree with me, I am sure, that the mere allocation of the resources for human resource development will not necessarily change the situation. Investments in education should be linked to gainful employment. Vocational and technical training cannot be irrelevant to current and prospective employment conditions. In other words, the education received in an environment steeped in rapid social, economic and technological changes should ensure not only creativity and flexibility but also adaptation to changing employment opportunities over an individual's life time. National skills development programmes should therefore adopt a new approach with an emphasis placed on a greater integration of technology with development, e.g. linkages between agriculture and industry as well as the service sector to develop suitable complementarities. The slower growing economies can learn from the experience of the rapidly developing countries.

Increased attention must be brought to bear on the planning and organization of such programmes to ensure that the national response in human resources demands is coherent and coordinated. Human resources development programmes therefore have to become more outward-looking and demand-driven in order to establish clear linkages between formal education, vocational training and the needs of the private sector. Important organizational changes would therefore be needed in both public and private sector training facilities to increase their flexibility and responsiveness to the technological challenges and the demands of the global markets. The tasks of human resources development for sustainable development is large and multidimensional.

The universities and research institutions cannot do much on their own. Necessary support must be provided by the private sector and government to assist them undertake basic and applied research as well as effect a meaningful change in their curricula and skill development programmes. Even though expenditures of less than one per cent of the GNP have been demonstrated to have no significant impact on economic development many developing countries of the region still spend below that figure, while in the industrialized countries about 2 to 2.5 per cent of their GNP is spent. With such figures, it is difficult to accurately discern the future trends. Even so, no matter how formidable the obstacles, developing countries of the region must rise to the challenge. A possible move in the right direction is for government in cooperation with industry to work out a strategy to provide attractive domestic research and other opportunities to encourage engineers, scientists and technicians working abroad to return and those at home to stay and contribute to the development of their countries.

We can glean from above that the magnitude and scope of tasks in quickly building up the needed human resources is often beyond the limited resources of many developing countries of the region, particularly the least developed, island developing and the market-oriented transitional economies. At the same time many economies within the region have built up significant capacities and capabilities in the area of education and training. As these countries further strengthen and consolidate their human resources development capability and infrastructure they could provide available skills development sources and resources for the region as a whole.

I am pleased to note that the Colloquium will provide a forum for educators, governments and the production sectors to discuss the state of the art of engineering and technology education and identify cooperative measures to meet the need in human resources in the 21st century. The task before you is a challenging one. It calls for a concerted efforts to reorient policies and strategies in line with rapid changes occurring in the region and beyond.

I wish you every success in your deliberations.

KEYNOTE ADDRESS

PARADIGMS OF UNIVERSITY-INDUSTRY-GOVERNMENT COOPERATION IN QUALITY ENGINEERING AND TECHNOLOGY EDUCATION FOR SOUTHEAST ASIA IN THE TWENTY-FIRST CENTURY

BY

PROFESSOR DR. SIPPANONDHA KETUDAT CHAIRMAN,
NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT BOARD
ROYAL THAI GOVERNMENT

Colloquium on University-Industry-Government Cooperation in Quality Engineering and Technology Education for Southeast Asia in the Twenty-First Century
and
Founding Conference of the Association of Universities of Asia and the Pacific (AUAP)

Suranaree University of Technology
Nakhon Ratchasima, Thailand
27 July 1995

PARADIGMS OF UNIVERSITY-INDUSTRY-GOVERNMENT COOPERATION IN QUALITY ENGINEERING AND TECHNOLOGY EDUCATION FOR SOUTHEAST ASIA IN THE TWENTY-FIRST CENTURY

Mr. Rector of Suranaree University of Technology Professor Dr. Wichit Srisa-an;
Mr. Director of the Southeast Asia Regional Center for Higher Education and Development, Dr. Tong-In Wongsothorn;
Mr. Assistant Director General for Science of UNESCO, Dr. A Badran;
Distinguished Participants;
Ladies and Gentlemen;

May I, first of all, express my deep appreciation to the organizers for inviting me to deliver a keynote address to this distinguished gathering. I feel deeply honored since the meeting of the next two days signifies a conjunction of three important events.

Firstly, we are here to celebrate the fifth founding anniversary of SUT, the first public university of Thailand operating with full autonomy. Congratulations SUT, for spearheading the innovative management of Thai public higher education.

Secondly, the timing of the Colloquium on the subject of University-Industry-Government Cooperation in Quality Engineering and Technology Education for Southeast Asia in the Twenty-first Century is most appropriate for the reason that the Twenty-first century will be the century of growth and prosperity of Asia and the Pacific. Thanks to the organizers for their foresight and best wishes for your success.

Thirdly, and consequently, the founding of the Association of Universities of Asia and the Pacific is most appropriate and timely. Best wishes too for success and potential achievements of the AUAP.

Let me now dwell on the subject of "Paradigms of Univesity-Industry-Government Cooperation in Quality Engineering and Technology Education for Southeast Asia in the Twenty-first Century by discussing three interrelated major points.

1. Evolution of the Concept of a University

First, let us take a quick look at the roles of a university. A university is a social institution created and nurtured by the surrounding society that supports it. It is similar to a living organism in which the nutrients nourish the organism. Both universities and organisms are by no means passive bodies depending on the mercy of the environment. Their interactions are coupled in multidimensional directions. Master teachers during the "Takasila" university, a couple of thousand years ago, had as much influence on feudal states as the states upon them.

The same was true with the University of Bologna and the surrounding societies. The impact of the "modern model", the University of Berlin as envisaged by Wilhelm von Humboldt, the Prussian Minister of Education, to pursue excellence in teaching and research was copied, transplanted and adapted to suit various modern cities around the world over the past two centuries. In this way, science and technology progressed at a fast pace and permeated all European societies.

As centers of progress and wealth moved from the congested European region of the vast of North America, the concept of land grant colleges emerged; this was just over a century ago. That concept *emphasized the combining of research,* teaching and services where teaching and research were not confined to within the fence of the university area, but were extended to provide services to those within the state boundaries and beyond.

After the second World War, when many new universities were established by newly independent nations and states, the concept of national unity through the promotion of cultural heritage was added to the existing three major functions of a university, those of teaching, research and services.

Furthermore, over the past few decades of the bipolar geo-political environment, a cooperative element among universities and countries of similar ideologies has influenced the roles of the university. This quick tour-de-france evolution of the university, I hope, serves as a lesson to our vision for the future direction of the university and its interactions with the surrounding society.

The question is whether the "teaching-research-services-cultural heritage promotion" university will be able to service the future globalized and seemingly borderless and competitive world. In particular, as Asia, with Southeast Asia leading, will be the center of growth for the Twenty-first Century, in what direction should Southeast Asian universities be heading? This is the second part of my address.

2. Globalization and Dynamism of the Southeast and East Asian Region

Let me begin my second part with the globalization and the dynamism of the Southeast and East Asian region.

Globalization and dynamism bring new challenges for universities. Globalization, as we understand it today, has evolved over a decade, but after succession of events starting with the destruction of the Berlin Wall in late 1989, the disintegration of the Soviet Union, the United Nations Conference on the Environment and Development (UNCED) - often termed the "Earth Summit", the conclusion of the Uruguay Round of the General Agreement on Tariffs and Trade (GATT), the birth of the World Trade Organization (WTO), and the United Nations Conference on Social Development-or the "Social Summit", the bipolar geo-political world has truly shifted towards a monopolar geo-economic globalized "borderless" world, where goods and services flow across national borders.

Viewing the world over the last few decades of this century from another entirely different dimension, we recognize that the integration of computer and telecommunications technologies, arising from the science of microelectronics and quantum physics, has played a pivotal role in our lives. The collection of massive amounts of data, the processing, the retrieval, the distribution and the multimodal presentation to people at all levels have been utilized for varying purposes in all sectors of the economy and society. This so-called "Information Technology (IT)" **has been, is** and **will be,** the main driving force that shapes our way of life, in a manner much more significant than the forces of the agricultural and industrial revolutions. The IT will make the world "virtually borderless". The IT will be the driving force of the economy and the society in the Twenty-first Century.

Let us look at the Southeast and East Asian region. The region as a whole is quite distinctive. There is a natural division of labor and complementarity: a healthy combination of ageold civilizations, youthful dynamism, entrepreneurial and pioneering spirit, an abundance of natural resources, a rich manpower base with vitality and economies that are vibrant and moving ever forward. Japan assumed the lead in the 50s and 60s soon after the second World War, followed by the four Asian Tigers: Hong Kong, Korea, Singapore and Taiwan in the 70s and 80s. Coming up in the 90s and the first decade of the Twenty-first Century are Thailand, Malaysia, Indonesia, the Philippines and coastal China. Double digit economic growth rates are not uncommon. What is common are average growths of around 6-7 percent over the past decade.

In the past decades, the East Asian nations have led from liberal policies with a strong export orientation. The region's share of world trade has been rising steadily and so has intra-regional trade. This economic dynamism is closely intertwined with political developments. The trend after the ending of the cold war has stimulated resolution and settlement of conflicts in East Asia. The restructuring of centrally planned economies to market oriented regimes has quickened the process of the bilateral and regional economic cooperation.

Looking towards the year 2000 and beyond, one must conclude that the geo-political and geo-economic prospects in this part of the world look peaceful and bright. The economic policies as laid out by the nations of this region will further stimulate the growth and dynamism of the Southeast and East Asian region.

The growth of the economy was achieved mainly by the use of overseas capital, land, cheap labor and abundant natural resouces. Furthermore the countries of the region have experienced a significant shift in the structure of production from agriculture toward industry. The remarkable economic performance has been brought about by high growth in the export sector of the "borderless" world, investment and tourism.

The macroeconomic success is borne not without cost. The price is social ills and environmental degradation. Comparative advantage of the past in abundant natural resources and low wage human resources will no longer be sustainable particularly with the higly competitive globalized society.

The above mentioned argument points to the needs of more qualified scientists, engineers and highly skilled technologists to keep the region moving forward. Most importantly the need is for the kind of technologists who are sensitive to social consequences and the environment.

Knowledge and skills of the people properly inculcated and planned will be the key to the future. The wise utilization of knowledge, particularly technology in harmony with the environment will pave the way toward sustainable development.

3. University-Industry-Government Cooperation

The foregoing discussion brings me to the third and last point. I shall begin by asking a few basic questions.

- Who can begin to tackle the problems of the lack of and the ever rising number needed of qualified scientists, engineers and technologists that are sensitive to social and environmental issues, and at the same time have both competitive and cooperative allegiance in the globalized world?
- Can a government or an industrial firm solve the problem of the environment alone?
- Can the old style "teaching-research-services-cultural heritage promotion" university tackle these issues?

Let me attempt to answer these questions.

A university, by tradition, is conservative and fairly static, barely able to cope with a rapidly rising demand on training. A university professor tends to teach and carry out research at his or her own pace. Furthermore, unless there are extra resources from outside, a university is likely to coast following the usual way of carrying out business. Also university research problems and the associated reward system tend to be academic in nature.

On the problem of the environment, there tend to be opposite ways of viewing issues-community, government and industry. A neutral unbiased professional institution, such as a university, can perform the task as a mediator. Similarly, a university can facilitate a way to acceptable solutions to solve conflicts between government authorities and local communities.

The brief foregoing argument indicates that neither the conservative university, nor industry, nor government alone can arrive at solutions to face the challenges of globalization, rapidly changing borderless world and dynamic viability of the Southeast Asian region. There have been cases where cooperation of university, industry and government sheds some light on a way forward for those willing to take up the challenge. I shall outline four key strategies, concepts and conditions that pave a way to table these issues.

3.1 Strategy to Shortcut Sequential Research, Development, Engineering and Technology to Concurrent Teamwork Action

In the past research was carried out at a university. The results were published. Research and development were then taken over by an industrial research laboratory while conceptual and detailed engineering were performed in industrial firms. Teaching at academic and professional levels was, and still is, the role of a university while pre-service training was, and still is, organized by industry.

Can we short-cut this relay race by concerted concurrent action?

The answer is yes. It was done during the Second World War at the end known as Radiation Laboratory of Harvard-M.I.T., the "Pile" at the University of Chicago. Those were the days when the American university-industry-government cooperation was at its peak in order to solve specific targeted problems. Successive cooperation such as "Silicon Valley" cooperation between university and industry has been somewhat different but useful in laying the ground work for microelectronic technology, the precursor of the Information Technology. This type of model has been transplanted and adapted to many parts of the world. SUT and many universities in Southeast Asia are persuing it.

Making a comparison with competitive sports, Daniel F. Burton Jr., the President of the Council on Competitiveness, said that instead of sequential relays we must play basketball. This sport exemplifies the concerted team effort of continuous exchanges of the ball among the basketball players. In a similar fashion continuously exchanging ideas and outcomes among research, development, engineering, manufacturing, marketing and teaching, as needed by university-industry-government, would shorten relays, lead to concerted actions and to achieving the goal. A true team effort will require an unbroken succesive exchange of ideas and efforts among all the team members from the three groups.

In this concept, the university, industry and government should not only have cross board memberships at the policy level, but at the research, development, implementation, engineering, teaching and training level as well.

In my view, this is the most fundamental strategic concept which can lead Southeast Asian universities towards national self sufficiency, raising the level of competitiveness and continuous growth in technological development.

3.2 Strategy Focusing on Technology in Harmony with the Environment

The phenomenal growth of the Southeast Asian economies were achieved mainly by both inter-and intra-regional trade and export at the expense of and with the deterioration of the environment.

Environmental appreciation, conservation and efficient utilization of natural and energy resources, and fair sharing of resources among government, community and industry are the main keys to sustainable development in Southeast Asia. The concern for sustainable development is not only limited to national boundaries but affects the international circle as well, as demonstrated by the "Earth Summit".

In addition, the issue of harmony between people and the environment is felt throughout the global community. The "Green Export" standards are now under discussion in many arenas. The worldwide dialogue on ISO 14000 is an example of the future standards for all our exports. The export of goods and services in the future industrial and post-industrial era will have to satisfy both the ISO 9000 and ISO 14000 standards.

Pressured by these three forces on the balance of economic and environment domestically, the ever stringent export requirements bilaterally and by trading blocs, and the international agenda on sustainable development, cooperation of industry, government and university is absolutely necessary. We recognize that the environmental predicament and its problems are multidimensional-technical, social, legal to name but a few. To prevent the problems up front, increasing research and development on new environmentally friendly processes is required. Engineers and technologists will have to be sensitive and open to these issues. Industry and university could work together in solving industrial pollution. Step-by-step or properly phased environmental regulations desired by the three parties-government, industry and university-could be worked out. These are some of the urgent goals of the tripartite cooperation. Revamping the scientific and engineering curricula to include the appreciation of society and the environment is a must. In order to further enhance the backgroud of graduates with global perspective, a third foreign language, preferably that of a neighboring country, in addition to one's own language and English should be included.

3.3 Strategy for National Self Sufficiency of Quality Science Engineering and Technology Education

In all rapidly growing economies, there are not enough qualified scientists, engineers and technologists. Fewer and fewer of the best wish to teach in our universities or to work in government service. Therefore, specific measures such as employment of capable expatriates and expert neighboring immigrants to augment university teachers and researchers will be necessary. But such measures and also encouragement of reverse brain-drain to bring back former nationals, need strong support of the government in revamping immigration laws regulations and practices

Industry also has a role to play, for example, in providing modern laboratories and equipment as well as utilizing, thereby subsidizing, the expertise of university faculty, including the brain-drain returnees and expatriates as consultants. Encouragement should be given to the high quality post-graduate education at selected Southeast Asian institutions which have been established with the cooperation of overseas universities. Furthermore, quality engineering and technology education can not be realized if it is not supported by the high quality basic sciences: physics, chemistry, biology and mathematics.

Interactive satellite communication for education should be supported and used. In this way an outstanding teacher-researcher at one university or a famous industrial entrepreneur can teach and interact with thousands of students around the world. Such programs have been utilized by SUT and the National Technological University of the USA.

These are some introductory remarks on the strategy for increasing self-sufficiency of quality science, engineering and technology education.

3.4 Strategy for Management of Quality Science, Engineering and Technology Education

The three main above mentioned strategies will not be and can not be implemented unless there is renovation or reengineering of the management of the traditional university. Reengineering is not just a very fashionable concept, but it is a team work information-for-all process which will make possible the survival of the university in the Information Era. Management must awaken to the importance of a broad based understanding of the university goals, policies and of a total integrated system in support of quality education and research. Relationships among universities, as exemplified by the establishment of AUAP, among university faculty, among engineers/scientists and university staff and teachers and especially among the whole university community must be fostered and cultivated to bring quality. Furthermore, reengineering and continuous total quality management will provide students with a real living example of management skills necessary to strengthen global competence of the graduates. Reengineering the management of the traditional university is the only way forward towards the goal of quality education of the whole scientist engineer and technologist and, hence, to an increased quality of life for all the nation.

4. Conclusion

In conclusion, there are three major institutional players in quality science, engineering and technology education, namely, the university, government and industry. Any single institution alone can not fulfill the dynamic and balanced and sustainable development to face the challenge of the seemingly borderless world of the Twenty-first Century. The cooperation of university, industry and government is required if we are to provide quality science, engineering and technology education.

The paradigms are to shortcut sequential research, development, engineering, manufacturing, marketing and teaching to insure a concerted interactive effort of teamwork focusing on technology in harmony with society and the environment. The goal is focused on national self sufficiency in qualified manpower while mindful of social and environmental issues. Revamping and reengineering the management of the traditional university will lead the way forward toward the goal of an increased quality of life and a society in harmony with the environment.

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BIODATA
Dr.Sippanondha Ketudat

Education

1953	B.S. in Applied Physics, University of California at Los Angeles
1954	A.M. in Physics, Harvard University
1957	Ph.D. in Physics, Harvard University
1976	Diploma, National Defense College
1982	Diploma, (Hons.), Royal Thai Air Force Staff College
1982	Ed.D. (Hons.), Silapakorn University
1987	Ed.D (Hons.), Prince of Songkla University
1992	Eng.D. (Hons.), King Mongkut's Institute of Technology, Thonburi
1992	D. Agr. Tech. (Hons.), Maejo Institute of Agricultural Technology
1994	D. Sc. (Hons.), King Mongkut's Institute of Technology, Lat Krabang

Brief Biography

Dr. Sippanondha Ketudat, a former Minister of Education and a former Minister of Industry of Thailand, founding President of the National Petrochemical Corporation Ltd., is at present Chairman of the National Economic and Social Development Board, Chairman of the Executive Committee of the National Research Council of Thailand, Chairman of the Policy Board, Thailand Research Fund, Chairman of the newly established Commission on Thailand's Education in the Era of Globalization supported by the Thai Farmers Bank, and Professor Emeritus of Physics, Chulalongkorn University. He also serves as Chairman of the Council, Chiengmai University and Council member of five Thai Universities and a former Council Member of the United Nations University. Dr. Sippanondha is a member of the National Education Commission, the Thailand Development Research Institute and other national institutes and organizations.

Dr. Sippanondha was trained as a nuclear physicist, with a Ph.D. from Harvard. He has had a wide career ranging from service in academics, government, politics, industry, and business.

During the 70's and 80's he played a major role in shaping education reform in Thailand. During the same period he served as consultant to the World Bank, UNESCO and education-related foundations. He is engaged in industrialization especially petrochemical, oil and gas industries. Presently he is playing a major role in giving research grants, reorienting Thai education and formulating the Eighth National Economic and Social Development Plan (1997-2001).

August 15, 1995

Papers

NOTES ON : STATUS OF ENGINEERING EDUCATION IN MALAYSIA - ITS FEATURES AND CHALLENGES

by

Professor Elias Salleh, Ph.D.
Universiti Teknologi Malaysia

1.0 CURRENT STATUS

1.1 CURRENT DEVELOPMENT IN MALAYSIA IS GUIDED BY VISION 2020 :
- Fully-developed and industrialised nation by the year 2020.
  (Estimated population of 35 million)

1.2 CURRENT RATIO OF ENGINEERS TO POPULATION IS 1.5 : 1000 (19 million population)
- Need to raise ratio to at least 5 : 1000 by the year 2020 (Australia : 5.6; Germany : 8.9; USA : 7.3)

1.3 ESTIMATED NEED FOR ENGINEERS:
By the year 2000 - 56,600
By the year 2020 - 175,000

1.4 CURRENT BREAKDOWN OF ENGINEERING DISCIPLINES (approximate percentages) :

Civil / Structural	- 45%
Electrical	- 23%
Mechanical	- 22%
Chemical	- 3%
Others	- 7%

1.5 Professional engineering preoccupation has been focused on the CONSTRUCTION AND BUILDING INDUSTRY, hence the high percentage of civil engineering stock (more than 40%).

1.6 ENGINEERING EDUCATION PROVIDERS:
- Universities (UM, UKM, USM, UPM, UUM, UIA, UNIMAS, UMS)
- MARA Institute of Technology
- TAR College
- Private Colleges + Twinning Programmes
- Polytechnics
- Institutes of Industrial Training
- MARA Skills Training Institute
- Private Institutes / Colleges

1.7 CAPACITY OF LOCAL INSTITUTIONS -Table 1

1.8 LACK OF LOCAL CANDIDATES FOR GRADUATE STUDIES.

1.9 GENERALLY LACK OF SKILLED MANPOWER

2.0 NEW INITIATIVES / CHALLENGES:

2.1 With Vision 2020, the MANUFACTURING SECTOR has been identified as the engine of growth; therefore a shift of emphasis for related engineering disciplines :

e.g. Computer and Control
Industrial Engineering
Mechatronics
Microelectronics

2.2 RE-STRUCTURING OF MINISTRY OF EDUCATION

2.3 CORPORATIZATION OF GOVERNMENT-FUNDED UNIVERSITIES
- Cost-effective management
- Competitiveness

2.4 MASSIFICATION OF HIGHER EDUCATION:
- Establishment of Private Universities
- Establishment of branch campuses of Foreign Universities

2.5 DEMOCRATIZATION OF HIGHER EDUCATION:
- Entry Requirement (broad-based)
- Mature students (working experience)
- Distance Learning Programmes
- Medium of instruction (Malay + English)
- Cross - disciplinary approach

2.6 CONTINUING PROFESSIONAL DEVELOPMENT PROGRAMMES

2.7 HANDS-ON APPROACH (e.g. Industrial Centres)

2.8 INCREASE IN RESEARCH FUNDING

2.9 EMPHASIS ON TECHNICAL SKILLS TRAINING (hi-tech) :
- Fast-track skills training
- Skills up-grading
- Skills up-dating
- Multi-skills approach

Table 1 : Capacity of Local Institutions to Meet the Demand for Selected Engineering and Technical Occupation (1990 - 2000)

Occupation	Stock 1990	Manpower 2000	Local Supply (1991 - 2000) Public	Private
Engineers:	26,500	56,600	21,000	-
Civil	11,100	19,500	3,700	-
Electrical/Electronic	6,200	14,600	4,200	-
Mechanical	5,200	10,800	4,000	-
Chemical	800	2,000	900	-
Others	3,200	9,700	8,200	-
Engineering Assistants:	72,400	195,300	84,070	20,900
Civil	27,100	58,500	20,400	600
Electrical/Electronic	32,300	75,900	21,200	8,800
Mechanical	6,400	32,400	11,600	9,600
Chemical	600	6,000	570	-
Others	6,000	22,500	30,300	1,900

Source : Second Outline Perspective Plan (1991-2000) Government of Malaysia

BIODATA
Prof. Dr. Elias B. Salleh

DATE OF BIRTH: 8 June 1948

PLACE OF BIRTH: Malaysia

EDUCATION: Malaysia, United Kingdom, Australia

QUALIFICATIONS:
Diploma in Architecture
Masters in Building Science
Ph.D. in Energy and Environment

EMPLOYMENT:
Universiti Teknologi Malaysia, since 1973
- Head, Department of Architecture (1977)
- Deputy Dean, Faculty of Built Environment (1980-1983)
- Dean, Faculty of Built Environment (1983-1985)
- Deputy Dean, Research Consultancy Unit (1991-1993)
- Director, Bureau of Innovation & Consultancy (1993-Present)
- Director, Technovation Park UTM (1995-Present)

OTHERS:
* Board Member
  Board of Architects Malaysia
  (1990-Present)
* Chairman, MINDS (Johor Branch)
  (Malaysian Inventors and Designers Society)

SPECIAL INTEREST: Environmental Design

STATE OF ENGINEERING EDUCATION IN THE PHILIPPINES

by

Prof. Ruben A Garcia, Ph. D.

I. Introduction

The Republic of the Philippines is an archipelago consisting of over 7,100 islands with a total land area of about 300,000 sq. km. Its population of about 67 million is growing at an average rate of 2.3% per year. Located in the tropics, the Philippines has a variety of climate. Temperature differences are slight on the lowlands but altitudinal variations are marked. The literacy rate is 93.5%

The Schoolyear (SY) starts in June with the first semester ending in October. Second semester starts in November and ends in March. Summer term falls in April-May.

There are 50 State Colleges and Universities (SCUs) and 138 private schools offering Bachelors degree (BS) in Engineering. A few have Masters degree (MS) and only one offers a Doctoral degree (Ph.D.) program. The estimated total enrollment in SY 1991-92 is 220,000 and the number of graduates during that school year is about 28,000.

Table 1 shows the BS enrollment data and the corresponding number of graduates from 1882 to 1992. There has been a gradual increase in enrollment and in the number of graduates during the first half of that decade but this trend changed in the second half although there has been a significant jump in the last year (1991-92).

Table 1. Engineering Enrollment Data (BS only)

School Year	Total Enrollment	Total Graduates
1982-83	195,932	19,423
1983-84	209,302	21,875
1984-85	213,413	23,326
1985-86	220,870	25,215
1986-87	214,246	24,997
1987-88	215,639	26,479
1988-89	207,859	24,834
1989-90	192,893	22,994
1990-91	155,249	27,839
1991-92	220,348	

Not shown in the table is the percentage of students enrolled in the private schools compared to the SCUs. In the early 80's, 79% of engineering students were enrolled in private schools. This percentage gradually decreased year after year to 83% in 1991-92. This was due to the fact that during these decade there was a moratorium on the opening of new engineering programs in private schools but more and more SCUs were established and have opened new engineering programs. The corresponding percentage of graduates in the private schools had likewise decreased from about 93% in 1982 to about 82% of the total number of graduates.

The enrollment and number of graduates per year of graduate students (MS and Ph.D.) are still very minimal compared to the BS. In 1991-92 for example, there were 860 enrollees in the Masters programs which were offered by some 22 schools. Only 13 Ph.D. students were enrolled in that year at the College of Engineering of the University of the Philippines (UPCE), the only school in the country which offered a Ph.D. program in engineering. The corresponding number of graduates during that school year were 35 MS and 2 PhDs only.

II. Brief History

In 1820, a four-year Nautical program was offered where students were taught hydrology, meteorology, navigation and pilotage in addition to basic mathematics and physics. By 1903, there were on record 108 civil engineers and surveyors. In 1939, there were already over 5,000 engineers in the country and in the 1990s, the graduates per year averaged about 25,000. In 1992, about 22,000 took the various professional board examinations in engineering but only about one third of them passed, although there was a very wide range of percentage passing ranging from near 0% to near 100%.

III. The Engineering Educational System

The structure of higher education in the Philippines is currently undergoing a drastic change. Last year, 1994, the **Commission on Higher Education (CHED)** was created by law **(R.A. 7722).** Its creation was the result of a very intensive study conducted by the Congressional Commission on Education (EDCOM) on the state of education in the country. The new law placed both public and private institutions of higher education under the coverage of the CHED and no longer under the Department of Education, Culture and Sports (DECS). CHED is independent and separate from DECS and is attached to the Office of the President of the Republic for administrative purposes only.

CHED's mission is stated as follows: "Higher Education shall be geared towards the pursuit of a better quality of life for all Filipinos by emphasizing the formation of those skills and knowledge necessary to make the individual a productive member of society and accelerate the development of high-level professionals who will search after new knowledge, instruct the young and provide leadership in the various fields required by a dynamic and self-sustaining economy. Higher education shall likewise be used to harness the productive capacity of the country's human resource base towards international competitiveness".

It is mandated to (1) promote quality education; (2) take appropriate steps to ensure that education shall be accessible to all; and (3) ensure and protect academic freedom for the continuing intellectual growth, the advancement of learning and research, the development of responsible and effective leadership, the education of high-level and middle-level professionals, and enrichment of historical and cultural heritage.

The CHED has the following objectives: (1) To provide a general education program that will promote in every individual a sense of national identity, cultural consciousness, moral integrity and professional idealism, (2) To advance knowledge through research work, and apply the new knowledge for improving the quality of human life and responding effectively to changing societal needs and conditions, (3) To develop and maintain the integrity of the professions or disciplines that will provide leadership for the nation, (4) To encourage all higher educational institutions to exemplify through their physical and natural surroundings the dignity and beauty of, as well as their pride in, the intellectual and scholarly life, and (5) To offer affordable quality higher education and to ensure that the same is accessible to all.

The CHED shall, among others, formulate and recommend development plans, policies, priorities, and programs on higher education and research; recommend to the executive and legislative branches, priorities and grants on higher education and research; set minimum standards for program and institutions of higher learning recommended by panels of experts in the field and subject, monitor and evaluate the performance of programs and institutions of higher learning for appropriate incentives as well as the imposition of sanctions such as, but not limited to, diminution or withdrawal of subsidy, program termination or school closure.

CHED does not limit academic freedom of Colleges and Universities nor does it abridge curricular freedom of an individual educational institution, except of course when required curriculum units are either mandated by law or the professional subjects required by the professional licensure boards.

To assist the CHED in setting standards and in program and institution monitoring & evaluation, Technical Panels in various areas of specialization / disciplines are organized. The Technical Panel for Engineering, Architecture and Maritime Education (TPEAME) is the technical panel concerned with engineering education. Before the creation of the CHED, the predecessor of TPEAME had long been in existence under the then Bureau of Higher Education, DECS. It started as TPEE (TP for Engineering Education), and later became TPEAE to include Architecture.

IV. Features of the Engineering Programs

For admission to the BS programs, at least ten (10) years of formal schooling is required. The ten years consists of six (6) years of elementary and four (4) years of high school (secondary) education. Some private schools require an additional year in the elementary level, making it seven (7) years. Most engineering schools emphasize above-normal ratings in English, Mathematics and Physics or other Natural Sciences. Academic programs in engineering require five (5) years of study consisting of two (2) semesters (18 weeks each) or three (3) terms (14 weeks each) per year. Summer sessions are six (6) weeks long.

The set of policies and standard was last amended in 1989 (DECS Order No. 102, s. 1989). It embodied the revised principles and guidelines for the establishment and operation of engineering programs. Each engineering school, in order to align its programs to the goals and missions of the institution and the nation and to make engineering education responsive to the growing demands for manpower in the business and industrial world, should have the built-in mechanisms for a continuous self-assessment of its instructional, research and extension service capabilities and program thrusts, and the necessary flexibility and adaptability to improve its internal operation and curricular programs to meet the diverse needs of the students, the community and the nations.

This set of policies covers the different aspects of engineering education, including faculty, school administration, library, curricular and laboratory requirements.

BS programs in Aeronautical, Ceramic, Chemical, Civil, Computer, Electrical, Electronics & Communication, Industrial, Geodetic, Mechanical, Metallurgical, Mining, and Sanitary Engineering are offered by the 188 colleges and universities throughout the country. These engineering programs require a total minimum credit units ranging from 177 (Chemical Engg) to 204 (Aeronautical Engg). A credit unit consists of one (1) hour of lecture or three (3) hours of laboratory work/week for one semester.

Table 2 shows the minimum curricular requirements set by DECS for the various programs in engineering. Schools may include additional courses but grand total of 210 credit units should not be exceeded.

The minimum requirements for a degree-granting program is defined in terms of the aggregation of a set of core courses and their corresponding minimum credit units and minimum credit units for electives. The function of the core courses is to ensure that the graduates will have the necessary foundation in all fields of specialization. On the other hand the electives afford the school to build areas of specialization or distinctive mark of competence of its graduates.

Table 2. Curricular Requirements

BS Degree Programs	A	B	C	D	E	Total Tech Courses	Non-Tech Courses *	Grand Total (Min)
Aero	21	16	32	82	3	154	50	204
Chemical	21	25	24	51	6	127	50	177
Civil	21	19	31	57	6	134	50	184
Computer	24	19	24	66	6	139	50	189
Electrical	24	16	24	59	6	129	50	179
Electronics & Comm	24	16	24	64	6	134	50	184
Industrial	21	16	24	61	6	128	50	178
Mechanical	21	16	31	63	6	137	50	187
Met'gical	21	26	24	55	6	132	50	182
Mining	21	26	21	57	6	131	50	181
Sanitary	21	19	31	71	6	148	50	198

Legend:
A - Mathematics
B - Physical Sciences
C - Basic Engineering Sciences
D - Professional & Allied Courses
E - Technical Electives

* Non-Technical Courses consists of
F - Languages, Humanities & Social Sciences - 36 units
B - Miscellany (PE, CMT) - 14 units
Sub-total - 50 units

Aside from the program and institutional monitoring and evaluation by the TPEAME, a system of accreditation is in place and operational. In 1977, the three (3) existing accrediting agencies namely (1) ACSC-AA (Association of Christian Schools and Colleges-Accrediting Agency, (2) PAASCU (Philippine Accrediting Association of Schools, Colleges and Universities) and (3) PACU-COA (Philippine Association of Colleges and Universities-Commission on Accreditation) were federated into the Federation of Accrediting Agencies of the Philippines (FAAP) through the initiative of the Funds for Assistance to Private Education (FAPE). Benefits granted to schools with accredited programs include partial or full administrative deregulation and curricular autonomy or deregulation. Lately, the idea of Peer Evaluation Process (PEP) is being discussed and is gathering acceptance. Here, the procedure or system through which schools are evaluated is not done by DECS (now CHED) but by a group of peers coming from the academe, industry, Professional Regulatory Commission, professional organizations, practicing engineers and other concerned agencies from the government.

The U.P.-Manufacturing Linkage Program (UP-MLP) which started and was institutionalized in 1985, serves as a model for other engineering schools to follow in institutionalizing their linkage with industry. This program, although not required by DECS or CHED at present, is worth replicating in all the other engineering schools. As a matter of fact, most of the best schools have now established and formalized their linkages with industry.

Among the activities that this linkage program do are the following: (a) Summer internship program where selected students undertake actual and real-life work with a company, (b) Integrated lecture-plant visit course which is an elective course with credit units, using company engineers as lecturers and their lectures are re-inforced with actual plant visits, (C) Faculty projects/consultancy with industry during summer, (d) Periodic lecture-seminars conducted by engineers and executives in industry. No doubt, these activities of the linkage program proved to be beneficial not only to the students but also to the faculty as well as the participating companies.

V. Some Issues & Problems

There exists a wide range of quality of graduates among the 188 schools offering engineering programs. While these schools turn out so many graduates per year, only a small fraction eventually land jobs as engineers. The rest may find themselves working as technicians or even jobs not requiring engineering skills for that matter. Well-established companies often do not bother or waste their time looking for new graduates form just any school. Usually, they recruit from graduates of reputable engineering schools. Another indicator of the wide disparity in the quality of graduates is the results of the professional board examinations. In the last few years, the national average for percentage passing in the board examinations is very low at 37%. Data gathered by the TPEAME shows that only very few schools have percentages of passing above 80%. The percentage passing of graduates from majority of the schools are near or below the national average.

The current state of engineering education is still one where the government has to set the policies and standards for the schools and their programs. It sees to it that they are being implemented and followed through regular monitoring and evaluation. Sanctions, such as warning, non-renewal of permit, withdrawal of recognition status, or compulsary phasing out of programs are given to those that do not satisfy the policies and minimum standards. There is particularly true for the engineering schools which produce low quality graduates.

Poor quality of graduates may be traced to a number of causes, such as, unqualified and overworked faculty members, inadequate physical facilities particularly the laboratories and libraries.

Another issue is the apparent mismatch of graduates and what the industry needs in terms of majors fields or specializations, and the expectations of industry from a new graduate. It is therefore important for the academe and industry to strengthen their linkage so that problems such as this one could be threshed out.

Faculty recruitment, retention and development seems to be a common issue among engineering schools. Salaries and benefits from schools can hardly match the lucrative financial packages from industry, thus good, young, faculty members with great potentials are lured away from the academe. Many schools do not have attractive faculty retention and development programs.

There is an extreme lack of R&D culture especially in the private schools. This is brought about initially by the fact that very few or none of their faculty members have advanced degrees (Masters and Doctoral) and therefore are not research-oriented. Another factor is the utter lack of R&D funds either from the school, research agencies or from the industry itself.

Engineering faculty members are seldom trained as teachers. Most of them do their teaching by just get feeling or by just following or imitating the techniques used by ones favorite teacher. There is a need for school administrators to address this problem and provide opportunities for their faculty members to become more effective teachers.

VI. Vision and Future Challenges

The creation of the CHED is a big step in the direction for rationalizing higher education in the country. We can now hope to have a truly integrated and concentrated approach and not just a smorgasbord of half-solutions.

The TPEAME of CHED will be playing a key role in the development of a strong and responsive engineering education system. TPEAME looks forward 25 years in the future where schools will be World-Class in both undergraduate and graduate programs, *Self-Regulating* where there will be practically no government intervention and where they will be developing and upgrading their curricula and laboratories according to their needs and not just following a list by some overseer, utilizing *Information Technology* in classroom instruction, research, community outreach and even in the administration of their schools, with close Industrial or Economic ties, and-Financially Stable, some of which would be accorded World Class status. This is the vision of TPEAME, a dream that will propel and guide the engineering sector in the next two decades.

The strategic plan of TPEAME shall bridge the current realities to the TPEAME vision of world-class engineering, architecture and maritime education system by the year 2020.

Long-Term Plan. The long-term plan shall ensure smooth and unhampered development towards the vision. It shall likewise account for market reactions, periodic re-focusing of intermediate targets, and constant consultations with stakeholders. The strategy is for a participatory type, market driven education system.

* **Market-Oriented** - among theimportant task is the institutionalization of a information system necessary to make market information available to the players. This would include, among others, technical, economic and system information.

* **Participatory** - an education process to condition the market to play according to natural laws shall be initiated. Moreover, a system of seasonally consulting the various stakeholders in order to attune academic programs to market needs. The players have to have the right attitude to survive in a new system.

Short-Term Plan. The short-term plan agenda shall set the foundation necessary to sustain the long-term-plan. The main strategy is to review/evaluate existing engineering, architecture and maritime education programs, and review/ revise existing curricular guidelines and minimum laboratory requirements for the same cluster of programs.

VII. Concluding Remarks

The TPEAME vision can only be realized if the main players or stakeholders in Engineering Education get their acts together. Recent events show that the academe, industry and the government are convinced that engineering education plays an important role the country's efforts towards NIChood.

Both the Executive and Legislative branches of the government have given priority status to manpower development in the scientific and technical field. Senate President Edgardo J. Angara, in a very recent speech, said among other things, "we must improve the quality and extent of our scientific and technological education by inversting more public money and private interest in it and we must raise the incentives and rewards for our scientifically and technologically-trained pepole. He said that the Senate now devotes a large part of its time both to remake basic education and to ensure that our young people keep up with the new science and technology. Last year, aside from passing RA 7722 (creation of CHED), the senate also passed into law the "Dual Training System Act of 1994" which was patterned after the German model that combines in-plant training and in-school training. Another bill passed is the Science and Technology Scholarship Act, which created college scholarships in science and technology for more than 3,200 young men and women who choose to study science, mathematics, and engineering.

Another bill being discussed in the lower house is the Macro-Plan for Engineering. As a strategy for upgrading engineering education it uses the "flagship" approach where a school that excels in a particular engineering program will be provided with government assistance to further develop that program with the corresponding obligation to help other schools offering the same program, in terms of facilities, equipment, manpower and technical assistance.

One of the important components of the Department of Science and Technology's (DOST's) Manpower Development Program is the Engineering & Science Education Project (ESEP). This project is composed of different components, engineering being one of them. The general objectives are (a) to uplift the quality of engineering education in both undergraduate and graduate levels; (b) to raise the level and quality of local research and development activities; and (C) to promote a workable linkage between the industry, academe and R&D sectors.

Specific objectives are to support the development of engineering MS and Ph.D. programs in selected flagship schools; to provied engineering MS and Ph.D. scholarship grants to faculty members of Engineering schools and personnel of R&D institutes; to provide grants for training of engineers of R&D institutes and industrial companies; and to support the upgrading of laboratory facilites of the Engineering Manpower Development Project (EMDP) network member schools.

In other words, the stage is now set for the implementation and ultimate realization of the TPEAME's vision.

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BIODATA
Ruben A. Garcia

Ruben A. Garcia was born in the Philippines. He is married to Fe M. Casillan with whom they raised 5 children who are all professionals now.

Professor Garcia obtained his BS Mechanical Engineering, MS, and Ph.D. degrees from the University of Philippines (1954), Stanford University (1957), and University of Minnesota (1971) respectively.

He started his teaching career by joining the faculty of the College of Engineering, University of the Philippines as an Instructor. He occupied administrative positions as Department Chairman (1964-66 ; 1972-85) and various chairmanships of college, as well as university-wide and national committees. He served as Dean of the U.P. College of Engineering from 1985 to 1991.

His research studies covered a range of topics, among which are: Production and Utilization of Coco Gas for Mechanical Power, School Science Equipment Development; Gasifier Monitoring Profect in the Philippines; Feasibility Study of a Technology Park in the Diliman Science Community: Urban Energy Consumption and Air Pollution in Three Major Philippine Cities, etc.

Professor Garcia was responsible in initiating and in implementing the Masters and Ph.D. programs in Energy Engineering at the University of the Philippines. This is the first engineering doctoral program in the Philippines. He did the pioneering work towards the establishment of a Technology Park in U.P. Diliman with a feasibility study and by selling the idea to the university administration and to the Department of Science and Technology. When he was chairman (1988-91) of the Technical Panel for Engineering Education (TPEE), minimum requirements for engineering schools were updated and the schools were monitored and their programs were evaluated regularly.

He actively participated as resource person/lecturer/course director in many engineering seminars on continuing education courses for practicing engineers and engineering faculty members from 1975 to the present. He served as Ph.D. dissertation and MS Thesis adviser to a number of graduate students aside from being a member of Dissertation/Thesis and Comprehensive Examination panels.

Among the honors and awards he received are: Elected member of Phi Kappa Phi Honor Society, UP-Stanford Fellow, ICA-NEC Fellow, Ford Foundation Scholar, Certificate of Appreciation from the Philippine Society of Mechanical Engineers for "Distinguished Contribution in Advancing the Technology of Mechanical Engineering" Achievement award from the National Research Council of the Philippines in "Industrial Research and Engineering Education, Professorial Chair Holder-DCCD Professor of Refrigeration.

POST-GRADUATE ENGINEERING EDUCATION IN SOUTHEAST ASIA

BY

ALASTAIR M. NORTH
PRESIDENT, ASIAN INSTITUTE OF TECHNOLOGY

27-28 July 1995

CONTENTS

POST-GRADUATE ENGINEERING EDUCATION IN SOUTHEAST ASIA

by

Alastair M. North
President, Asian Institute of Technology

1 . INTRODUCTION

I interpret the obligation of a discussion panelist as being to provide an outline of the topic under discussion, while injecting a number of stimuli of a debatable (or even highly controversial) nature. Consequently, I do not attempt to give a precise and detailed review of all post-graduate engineering education in Southeast Asian countries either by national statistics or subject by subject. Instead, I remark on the quality and quantity of postgraduate programs, venturing a comparison with developed countries and a personal view on the relevance and effectiveness of these in the current regional scene.

2 . REGION-WIDE HETEROGENEITY

Looking across SE Asia one can see a complete spectrum of national systems ranging from that in which both quality and quantity match human resource planning needs to those in which such programs are effectively non-existent. In between lie intermediate cases where programs exist but are lacking in both quality and quantity (as measured by graduate output), or are good in parts but with certain deficiencies in either quality (by comparison with the developed world) or in matching output to national needs.

Jumping straight in to the sensitivities of national pride, I rank the post graduate Masters (Table 1) and Doctoral (Table 2) programs of the 6 ASEAN and 3 INDOCHINESE PENINSULA countries on this 4 point scale.

3 . QUANTITATIVE CONSIDERATIONS

Excellence and absence are hardly debatable issues, so what about the country programs in the middle? I have talked about quantity and quality. Quantity, too, is hardly an exciting subject for debate. Manpower planning statistics proliferate for all the countries in these middle groups, and all show a need for skilled degree engineers and technologists greater than the university (or technological institute) throughout.

While talking about human resource needs at post graduate level, we should be clear on two most important points. First, post-graduate programs are NO MORE important to a nation than first degree, vocational, secondary and primary education. Deficiency in ANY sector diminishes the whole. Of course, post graduate qualification require longer study and involve mastery of more difficult cognitive skills, so that possessors are fewer in number and may command higher "market force" salaries. However, any "academic snobbery" that drifts a national system to orient its resources to this sector at the cost of, for example, vocational training is running a severe risk. Do I see this in countries like Thailand?

Secondly, we should be clear what sort of functions second degree engineers and technologists will be expected to perform in society (Table 3). Only then can we analyze whether or not the curricula involved are suitable or otherwise.

4 . QUALITY ASSESSMENT

So now we come to the exciting part. Just how good are regional programs? What are their strengths (Tables 4 and 5) and what are their weaknesses (Tables 6 and 7).

Straight away we come to the dilemma. Should we (almost vocationally) orient ourselves towards local issues regardless of how "academic" they may or may not seem in the developed countries, or should we try and match the academic "pushing back the frontiers of knowledge" that wins Noble prizes in developed countries? My personal view is towards the former in masters programs, and towards a 50% compromise in doctoral programs i.e. trying to find issues which relate to local problems but which require high academic input for their solution. It is, of course, much easier to reach an answer to this question in engineering than in pure science.

Therefore, in Tables 4 to 7 I suggest some strong points of some programs I have seen, as well as some clear points of weakness.

Since criticism is always much more of a stimulant than praise, let me extract from these tables one or two deliberately pointed questions. For example, to what extent should a masters or a doctoral program prepare its graduates to communicate with the world society of fellow engineers, either by INTERNET or any other organ? Do programs delivered mainly (or totally) in the national language fail to meet this objective, and if so, how serious is it?

Second, how important is the existence of a stimulating academic environment in which OTHER FACULTY AND STUDENT GROUPS work day and night at, talk all the time about, their subject? Do the teaching faculty of national universities meet this "test" of dedication and application?

Third, is the availability of equipment, field practice, industrial "internship" adequate for the students to meet objectives of competence and confidence, as for the programs to have respectability in the eyes of developed-country peers?

Fourth, most tasks in technology, and increasingly in engineering, are interdisciplinary in nature. How well can Civil Engineers understand the materials they handle, Electrical Engineers understand the environmental impact of energy generation, distribution and use, Mechanical Engineers understand the energy technologies that drive their machines? Do our post-graduate programs reflect the rigid subject compartmentalization of classical undergraduate Departments and Faculties?

These, and more, we should ask ourselves at this seminar and as we construct our curricula for the future.

5 . CONTINUING EDUCATION

Post graduate education should not consider only Masters and Doctoral degrees. We must include post-experience professional upgrading through short course and other continuing education endeavors.

All over the region programs in management are springing up like mushrooms in the forest after rain. But in engineering, in new technologies, where are they? With three words I rest my case. Where are they?

6 . CONCLUSION

In my view no country in the world should be satisfied with its post graduate engineering program. Everywhere is some deficiency, large or small, but perceived when we focus on the technologies of the future, national needs in the future, and the different level of development of the countries in the future. It is pointless for us here, in SE Asia, to try and establish in each country an Oxbridge or a Boston-Massachusetts axis in the immediate future. Instead we must consider at each stage what is required in a step by step growth (in quality and quantity) and endeavor to take each step with dedicated attention to national and academic objectives.

I believe we can do it.

AMN/pk
24 July 1995

MASTERS DEGREE ENGINEERING PROGRAMS IN SE ASIA	
Developed to meet most national needs	Singapore
Moderately developed, but inadequate for national needs	Thailand, Malaysia
Somewhat vestigial	Brunei, Philippines, Indonesia, Vietnam
Non-existent	Cambodia, Laos

DOCTORAL DEGREE ENGINEERING PROGRAMS IN SE ASIA	
Quality and quantity adequate	Singapore
Some programs starting up	Thailand, Malaysia
Quality questionable	Philippines, Indonesia
No meaningful effort	Brunei, Cambodia, Laos, Vietnam

LEVEL	QUALIFICATION	EMPLOYMENT
1. School	School Certificate	Low skill level, but literate
2. Vocational	Vocational Diploma	Skilled Technician
3. University	First Degree	Junior Management/Use of Technology Entry to Professions
4. University	Higher Degree	Senior Management Control of Technology

Some Strengths of Regional Masters Programs

Good curricula within subject boundaries

Well qualified teaching staff

Often good equipment

Some Strengths of Regional Doctoral Programs

Can address topics of regional relevance

Carefully evaluated by both regional and external assessors

Student supervision often more dedicated than in the west

Some Weaknesses of Regional Masters Programs

Language

Inadequate attention to problem solving skills

Poor interdisciplinary coverage

New technologies not sufficiently addressed

Dedication of teaching faculty and wider stimulating academic environment sometimes deficient

Some Weaknesses of Regional Doctoral Programs

Equipment inadequate for "cutting edge" research

Academic environment not intensely stimulating

Literature coverage outdated and inadequate

Critical thought and higher cognitive inputs often poor

Familiarity with "cutting edge" research in the west often inadequate

BIODATA
Dr. Alastair M. North

PRESIDENT : Asian Institute of Technology (AIT)
1983 - Date

EDUCATION :

B.Sc. (Hons)	1954	Chemistry
Ph. D.	1957	Physical Chemistry
D. Sc.	1964	Polymer Chemistry

All Aberdeen University, U.K.

HONOURS :
Officer Order Of The British Empire (U.K.)
Commandeur De L'ordre Des Palmes Academique (FRANCE)
Commandeur In The Order Of King Leopold II (BELGIUM)
Commandeur In The Royal Order Of Ghorkas (NEPAL)

CAREER :
Lecturer In Physical Chemistry
University Of Liverpool 1958-1967
Professor Of Physical Chemistry
University Of Strathclyde 1967-1983

RESEARCH SPECIALIZATIONS : Chemistry and Physics of Plastics and Rubbers.

EDUCATION EXPERIENCE :
1) University Planning and Development
2) Scottish National Science Curriculum Development

STATE OF THE ART OF ENGINEERING EDUCATION IN SOUTHEAST ASIA AND FUTURE REQUIREMENTS

ENGINEERING EDUCATION IN THAILAND

BY

DR. TAVEE LERTPANYAVIT
DEAN, INSTITUTE OF INDUSTRIAL TECHNOLOGY
SURANAREE UNIVERSITY OF TECHNOLOGY

Summary

The paper gives an overview on the development of engineering education and practices in Thailand. It provides an account of the educational system, structure and curriculum of engineering education, the problem of short supply of engineers Thailand is facing and measures to solve it. The paper finally reviews the Long range higher education plan and examines the quality of engineers to engineers to serve the future needs.

BIODATA
Tavee Lertpanyavit

EDUCATION :

* B.Eng. (Hons) Chulalongkorn University, Banghole 1961
* Dr. Ing. University of Rome, 1967

PRESENT POSITION :

Dean, Institute of Industrial Technology; Suranaree University of Technology (1992-Present)

PAST APPOINTMENT :

* Acting Vice Rector for Administrative Affairs, SUT (1993-1994)
* Acting Vice Rector for Academic Affairs, SUT (1991-1993)
* Dean, Faculty of Engineering, Chulalongkorn University (1983-1991)
* Head, Department of Mechanical Engineering, Chulalongkorn University (1979-1983)
* Member, Council of Private Institutions of Higher Education, Ministry of University Affairs (1992-Present)
* Member, National Committee for Industrial Products Standards, Ministry of Industry (1992-Present)
* Member, National Research Council Engineering and Industrial Research, (1995-Present)
* Secretary to the Minister, Ministry of Science, Technology and Environment

PROFESSIONAL AFFILIATIONS :

* Fellow, the Engineering Institute of Thailand (EIT)
* Registered Professional Engineer, Board, of Professional Engineers
* Secretary General, the Engineering Institute of Thailand under H.M. the King's Patronage (1992-1993)
* Member, Board of Professional Engineers, Ministry of Interior (1986-1989)
* Member, American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE)
* Associate Member, International Institute of Refrigeration (IIR), Paris

Address
on
Role of Government in Quality Technology and Engineering Education
by

Associate Professor Dr. Vanchai Sirichana
Deputy Permanent Secretary for University Affairs

at the Colloquium on University-Industry-Government Cooperation in Quality Engineering and Technology Education for Southeast Asia in the 21st Century
at Suranaree University of Technology
27 July 1995

Rector of Suranaree University of Technology,
(Prof. Dr. Wichit Srisa-an)
Distinguished Speakers and Participants
Ladies and Gentlemen,

It is a great honour for me to be here on this very special occasion and has an opportunity to express some ideas about quality education. In particular, I am personally interested and have been involved in the qualitative improvement of technology and engineering education for a period of time.

Distinguished participants, ladies and gentlemen, the past century has been great leap of development of Thai educational system, starting from teaching-learning in temples, the oldest educational institutions to the establishment of schools and setting up of institutions of higher learning some 80 years ago. It could be stated that since then, Thailand has entered the era of systematic science and technology education development.

The production of middle to high level manpower has always fallen into the responsibility of higher education institutions under the supervision and support of the government. It was in 1962 when the First National Economic and Social Development Plan was drawn up to clearly determine directions of administration and national development. Integral into the Plan was education component which has turned to be one of the most important policies in all the subsequent National Plans.

Thailand's determination to utilize science and technology as a crucial means to national development has been made much clearer during the Fifth National Economic and Social Development Plan and has stayed significant in the Sixth and now Seventh National Plans. Looking at the implementation level, the government's policy has been well translated and witnessed. At the beginning of the Fifth Plan, there existed only 7 faculties of science and 4 faculties of engineering as compared to the present with 21 faculties of science and 16 faculties of engineering in the public universities.

The turning point that marked evident developmental process for science and technology was when Thailand's economic growth skyrocketted into two digits and continued to rise from the years 1988 to 1991. Such a rapid economic boom has led to the greater demand for manpower in various fields especially in technology and engineering which are the core group for industrial development. The government has responded to the needs by intensifying students' enrolment and by increasing science and engineering study programs. Furthermore, the private sector has been urged to take a more active role in producing manpower in this specific area as well.

Tracing back to the development, it could be seen that the first stage of science and engineering attended primarily to cope with the rising demand. Qualitative aspect was looked into following the existing *processes. The more the economy* and industrial technology grow, the higher the quality of scientists and engineers is required. The thirst for highly qualified manpower is even greater when Thailand enters the world community. The prevailing driving forces combined have served as accelerators for provision of quality and world standard science and engineering education.

The government's serious enthusiasm in pushing forward development in science and engineering education has stayed on for more than 10 years. While encouraging universities to increase their instructional effectiveness, it has also rendered continuous support by prioritizing these two areas as highly important, accelerating the production and escalating the quality of instruction. Some actions taken are as follows :

1. Strengthening human resource development by allocating scholarships for lecturers to pursue their master's and doctoral degrees to enhance the quality of teaching. This has allowed 400 lecturers to upgrade their levels of qualifications in the period of within 5 years.

2. Providing grants and fellowships for well-qualified lecturers to further enrich their knowledge and widen their perspectives from relevant institutions abroad.

3. Procurement of modern laboratory equipment for the faculties of science and engineering to enhance effectiveness of teaching and learning process. In 1994, the government in addition to the annual budget allocated, requested higher education institutions to study their requirements for modern laboratories and equipment. It turned out that the estimations reached as high as US$ 560 million. The government subsequently negotiated with the World Bank for a loan to support this project. The World Bank agrees to grant a US$ 160 million loan within the period of three years. This effort has demonstrated the government's seriousness to fulfil the national requirements for science and engineering personnel.

4. Promoting the quality assurance system of higher education. Mechanisms and systematic ways of insuring the quality will be created by the Ministry of University Affairs to upgrade education to meet with the world standard. During the initial period, the Ministry has urged universities/colleges to set up their internal auditing, monitoring and evaluation systems before expanding into full-fledged program of quality assurance system to the higher education institutions in the country.

The underlying principle of quality assurance takes similar form of that in the developed countries, that is to place high importance on academic freedom, autonomy while maintaining accountability of the system employed so as to allow for tangible and transparent inspection and appraisal.

In addition, professional associations and societies are encouraged to have a vital role in curricular development, improvement of instruction and quality assurance.

5. Encouraging universities/colleges to set up their science parks in order to bring about closer cooperation between higher education institutions and the private sector particularly on R & D.

The governments have made every possible effort to ensure the quality of technology and engineering education by granting greater autonomy to institutions for increased flexibility of implementation. The role of the government has also been adjusted to function as the supporter and driving force for development, taking such actions as budget allocation, and systems development to facilitate joint operation tasks. Accordingly, policy directions have placed on the five dimension of emphases which are :

1. Efficiency, aiming to increase the efficiency of external and internal management of the institutions

2. Equity, focusing on the provision of equal educational opportunities to all

3. Excellence, looking into the high quality of overall academic development

4. Internationalization, aiming to enhance institutions, academics and students to meet with international standard

5. Privatization, giving high priority to involve the private sector in the provision of higher education

However to realize the favorable outcomes of quality higher education translated from the stated policies, close and continued cooperation of all concerned, be they the public sector or professional associations, is crucial. Are we all aware of this enormous task and ready for the actual joint actions?

T h a n k y o u

ROLES AND POLICIES OF GOVERNMENT IN ENCOURAGING TECHNOLOGY R&D

BY

DOV GEVA

FIRST SECRETARY, OFFICE OF THE COMMERCIAL ATTACHE
EMBASSY OF ISRAEL, BANGKOK

27-28 July 1995

WHAT IS EDUCATION ON INDUSTRY?

* Education on industry is education for **values** - work, responsibility, precision, openness to criticism, professionalism, and a constant quest for quality.

* Education on industry is teaching team work and interpersonal communication, for working relations between supplier and client, between partners and business competitors, in a cosmopolitan atmosphere.

* Education on industry **develops thinking skills** - creative thinking, inventive thinking, logical thinking, critical thinking and problem solving abilities.

* Education on industry **teaches learning skills**- the ability to acquire basic knowledge, to build on existing knowledge and to access new sources of information.

* Education on industry **connects the student to real life** situations, through this interdisciplinary and intradisciplinary field. It means intertwining thinking, values and knowledge, based on the content of the industrial world, along with learning the "rules of the Game" - competition, money, and commitment to the market and the customer.

* Education on industry **teaches entrepreneurship** - taking the initiative to develop new products and marketing strategies, to identify problems and find original solutions for them. Entrepreneurship leads to higher quality and greater efficiency in an improved world.

* **Education on industry teaches how to successfully confront the challenges of the 21st century.**

"THINK INDUSTRY" EDUCATIONAL PROGRAM ON INDUSTRY AND ITS VALUES

The AICR has developed a broad scope educational program intended to teach Israeli students of all ages the concepts of industry, industrial entrepreneurship and industrial and business thinking.

TARGET POPULATION:

All School children in the educational system, gifted youngsters as well as students with learning difficulties and socially alienated youth.

THE PROJECT INCLUDES THE FOLLOWING:

* Six curricula for schools, Grades 1 - 12.
* Courses for the development of thinking skills and industrial entrepreneurship.
* A program for encouraging technological thinking for students aged 13 - 15 (Junior high school).
* A series of lectures given by industrialists and businessmen.
* Activities promoting quality, and quality of the environment.
* Problem solving workshops.
* Nation wide annual Young Inventors Competition.
* Nation wide competition for best written work about an industry related subject.
* Educational video movies about industry, enterpreneurship and business.
* Simulation games intended to develop creative thinking skills and teach the full process of industrial product development.
* Structured workshops for in-service teachers and young instructors training.
* Effective presentation workshops for teachers and industrialists.

The program is modular and flexible, enabling every school to adapt the various parts of the curricula to its needs and goals.

"THINK INDUSTRY" A POTENTIALLY INTERNATIONAL EDUCATIONAL PROGRAM

The AICR has developed seven curricula, intended to transmit the values of industry to all students in Israel. The curricula have been developed as a joint project with the Ministry of Education and selceted universities.

The curricula are desinged for students in grades 1 - 12 in all types of schools in the educational system, and in informal study frameworks as well, from the bright to the weak and the underprivileged.

The project teaches the general principles of industry and entrepreneurship, and is not restricted to the specific needs of any country or geographic region.

All the curricula will be translated into Arabic, and made available to the Arab sector in Israel and to all the educational systems in neighboring Arab countries as well, as of September 1995.

To this end, the AICR has established a special section which will adapt the curricula to the needs of the Arab sector. The sector will translate the curricula, train school teachers, "draft" volunteer industrialists and business men and women from the Arab sector who will share their knowledge and experience with students, and implement the curricula in the schools.

"THINK INDUSTRY" - THE CURRICULA

A. "THINK INDUSTRY" FOR ELEMENTARY SCHOOL

1. A Written Work about an Industry-Related Subject

A program intended to develop independent study skills within the scope of industrial contents, for grades 3 - 6

The program, which is presented in a teacher's guideline kit, enables a single student or a group to perform a variety of industry-related activities, such as the study of materials and production processes, research of markets and of consumer behavior, and development of creative thinking. The student uses the skills and knowledge he or she has acquired to prepare a written work about an industry related subject.

2. "Technology of Materials and Processes"

This is a chapter from the Ministry of Education's "Technology studies" curriculum, designed for grades 1 - 6

The chapter is comprised of 9 units, which study the basic components of industry - raw materials, the manufacturing process and the product, with emphasis on the use of industrial products in the student's immediate environment.
The chapter deals with topics like paper, print, textile, plastics, and packaging.

3. "From Machine to Industry"

A curriculum within the framework of "Science in the Technologic Society", developed in conjunction with the Center for Teaching of Sciences of Tel Aviv University, for grades 5 - 6.

This 30 hour curriculum presents industry in a whole-system perspective, from the birth of an idea to selling the final product.

B. "THINK INDUSTRY" FOR JUNIOR HIGH SCHOOL

4. "Economy and Industry in the Modern Age"

A 90 hour modular curriculum, for grades 7 - 9.

The program includes three units :
Unit A - Introduction to industry
Unit B - The industrial system in operation
Unit C - Industry in the modern age

The aim of the curriculum is to introduce the industrial system and show its role in the comprehensive economic system.

5. Encouraging Technological Thinking

A 30 hour curriculum, designed for grades 8 - 9, whose goal is to introduce the student to the world of industry from the point of view of multi faceted and challenging technology, and motivate him to plan his future in the field of advanced technology.

6. "THINK INDUSTRY" FOR HIGH SCHOOL

"Industrial Thinking and Entrepreneurship"

A curriculum for the understanding of industrial thinking, for grades 10 - 12.

The curriculum focuses on experiencing entrepreneurial simulations within the world of industry, while using various thinking tools. Industry-related problem solving leads the student to a personal project, organized as a business plan.

The curriculum includes topics such as entrepreneurship, marketing, business planning, information sources available to the industrial entrepreneur, industrial design, plant financial management, quality, computers in industry, and problem solving in industry.

Course for Developing Thinking Skills and Industrial Entrepreneurship

For grades 5 - 9

A series of modular sessions adjusted by the students age, class scholastic level and availability of time (12 - 60 hours, divided to 2 - 3 hour sessions). These sessions, taught by AICR-trained instructors, introduce the students to the various stages of industrial production, starting with an idea, through the development of a prototype, all the way to marketing and sales. The students experience problem solving and decision making, through use of inventive and creative thinking techniques. This activity can be structured as student creation of an industrial product, through development, financing, marketing, advertizing and sales.

ISRAEL

FACTS & FIGURES 1994

Figures refer to Millions of U.S.$ unless otherwise stated.

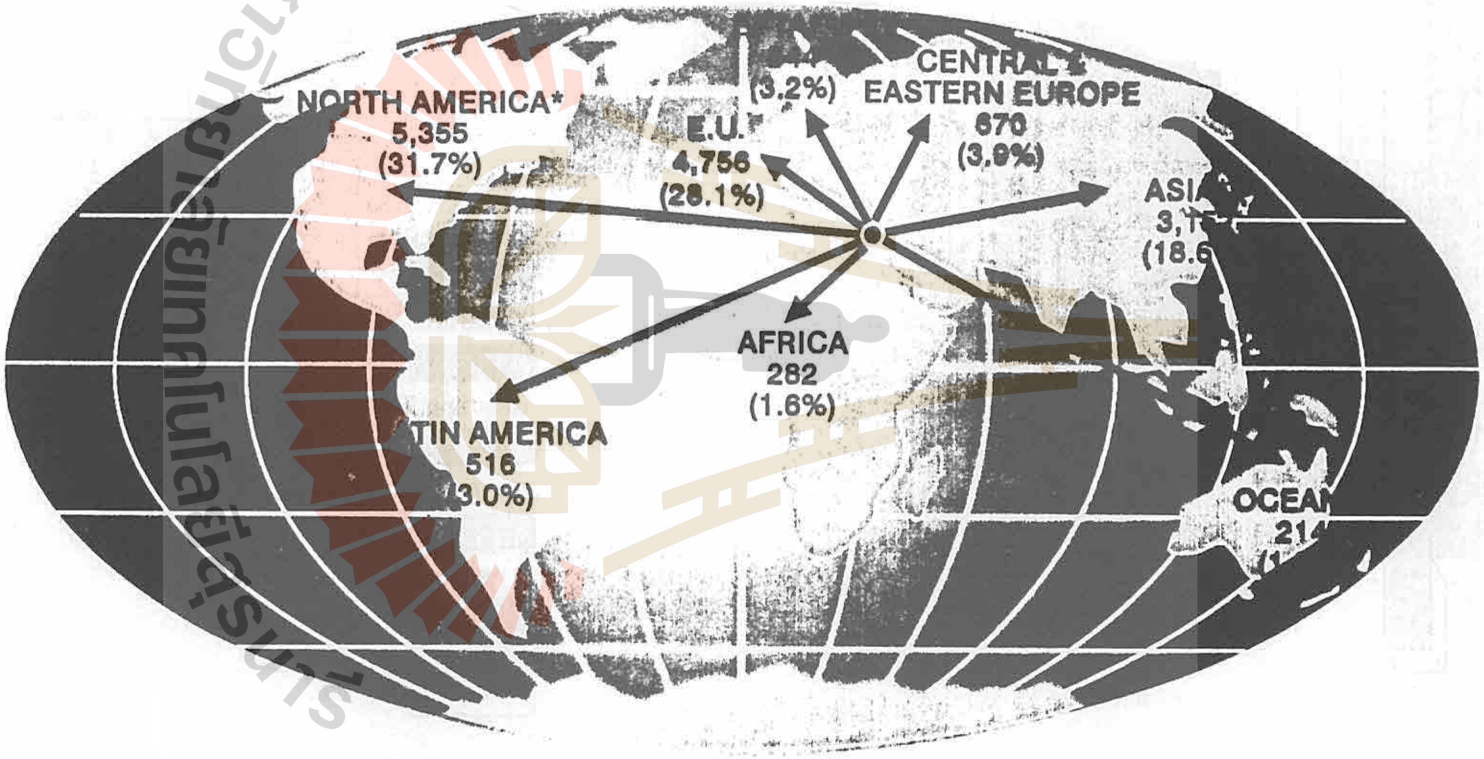
GROSS DOMESTIC PRODUCT (GDP)	73,944
BUSINESS SECTOR PRODUCT	49,600
GDP PER CAPITA (U.S.$)	13,728
INVESTMENT IN FIXED CAPITAL	16,932
IMPORTS OF GOODS (NET)	23,444
EXPORTS OF GOODS (NET)	15,929
INDUSTRIAL EXPORTS	14,915
IMPORTS OF GOODS AND SERVICES*	34,534
EXPORTS OF GOODS AND SERVICES*	23,386
IMPORT SURPLUS (of Goods And Services)*	11,148
EXTERNAL DEBT (NET)**	11,740
POPULATION-AVERAGE (Thousands)	5,390
EMPLOYMENT (Thousands)	1,871
UNEMPLOYMENT RATE (%)	7.8
INFLATION RATE (CPI-%)	14.5

All Figures are estimates.
* Balance of Payments Definition
** As of End of September'94

ISRAEL'S EXPORTS OF GOODS, 1994

(MILLIONS OF U.S.$)

TOTAL EXPORT - 16,884****



Unclassified - 1,395 (8.2%)

* 1. N. America Including : U.S.A. and Canada

2. Export to U.S.A. 5,250.2

** Including Asian Republics of former U.S.S.R.

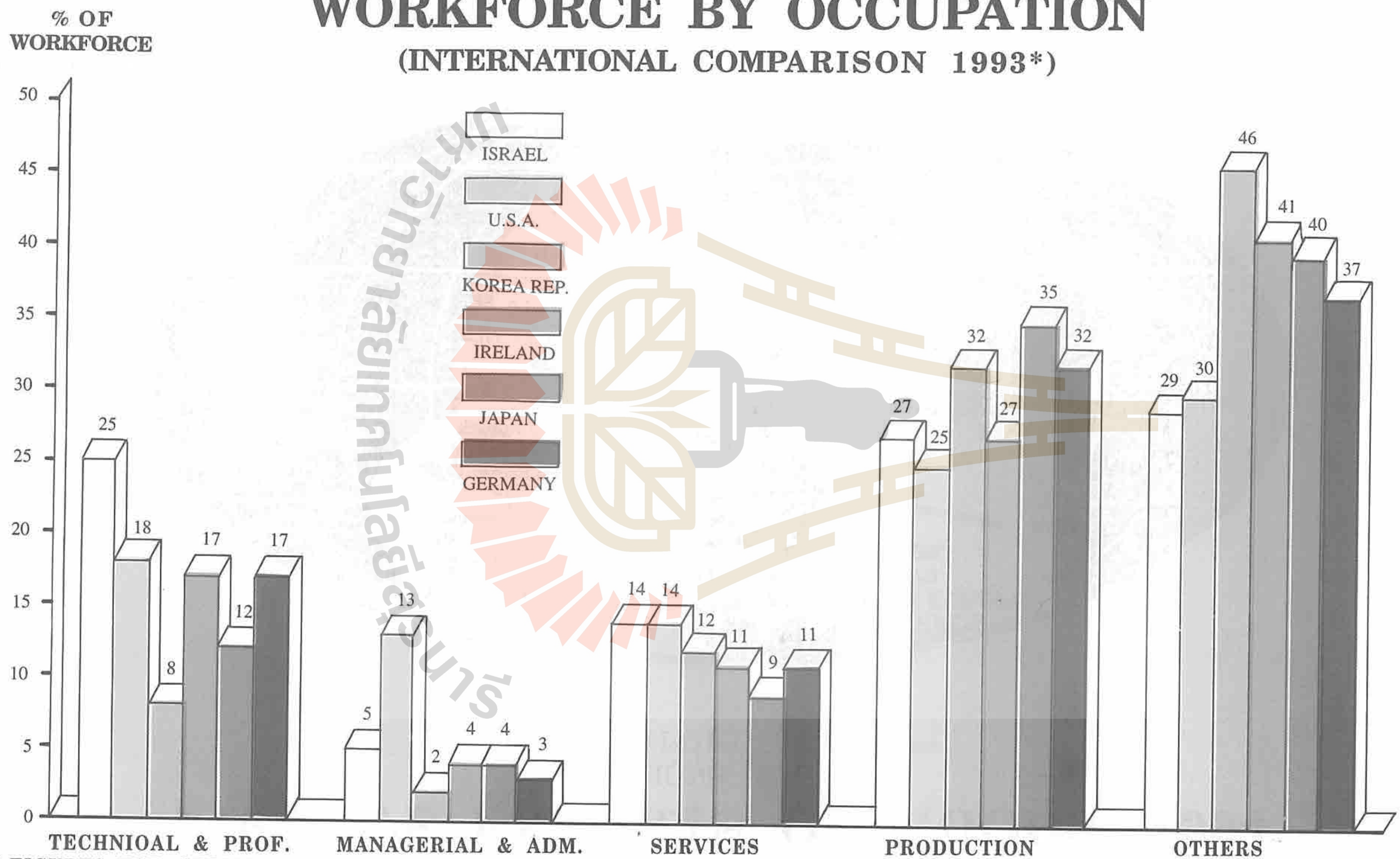
*** Figures for 1994 Including export to Austria, Sweden and Finland

**** Before Reduction of returned goods

SOURCE: C.B.S. Foreign Trade Department

WORKFORCE BY OCCUPATION

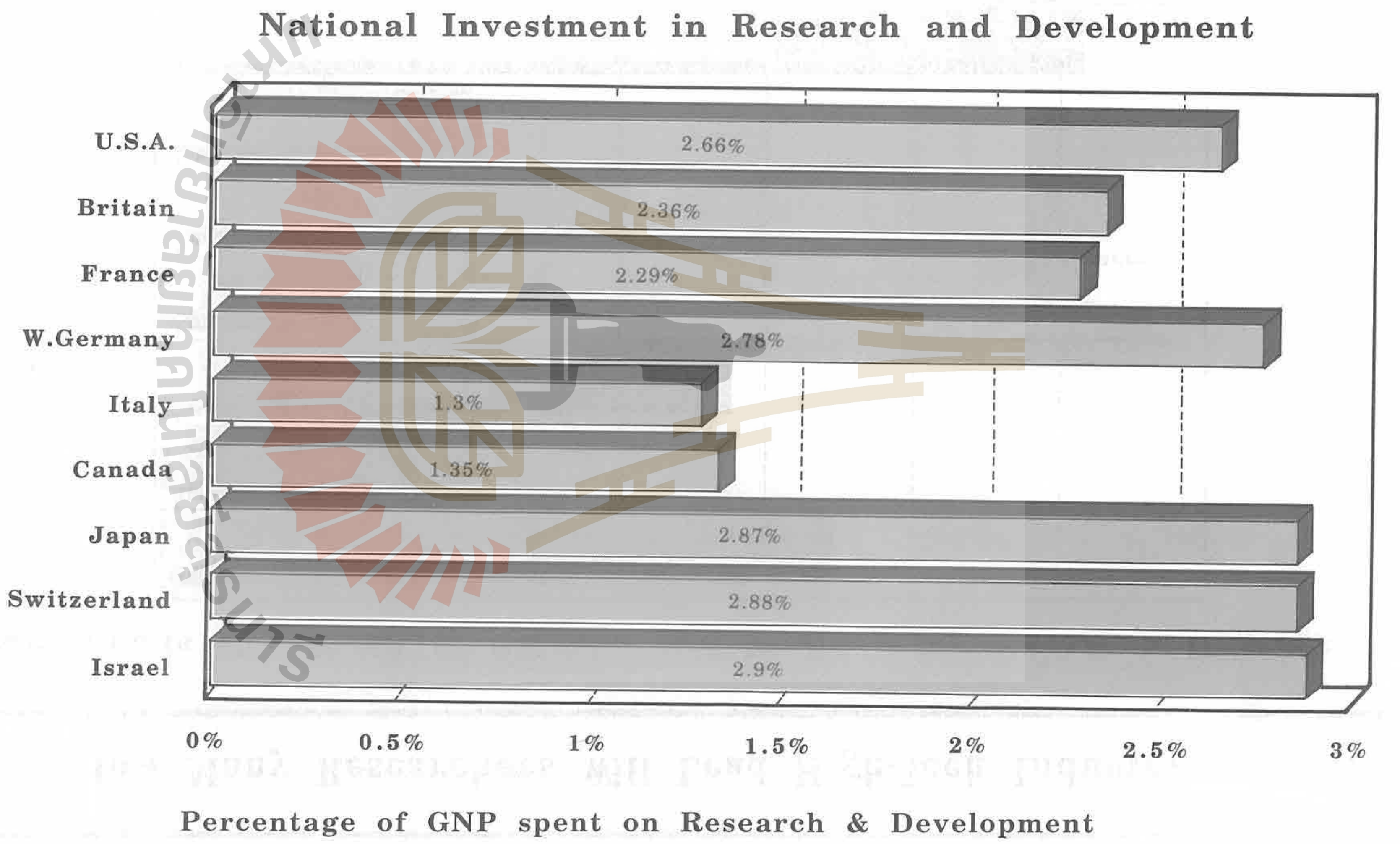
(INTERNATIONAL COMPARISON 1993*)



* FIGURES FOR GERMANY-1991

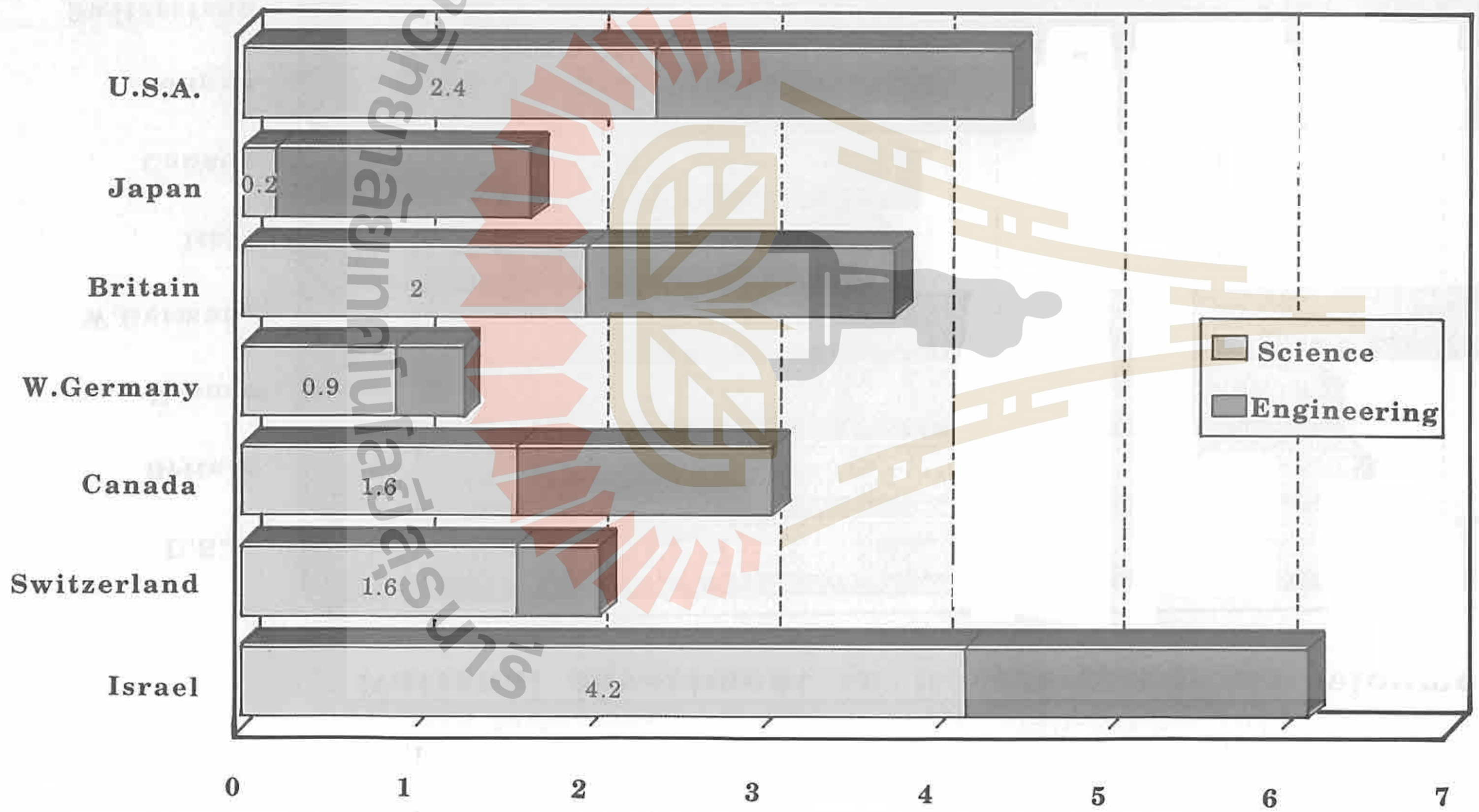
SOURCE: International Labour Organization Yearbook

How much do Countries Invest in the Future of their Industry?



How Many Researchers Will Lead High-Tech Industry?

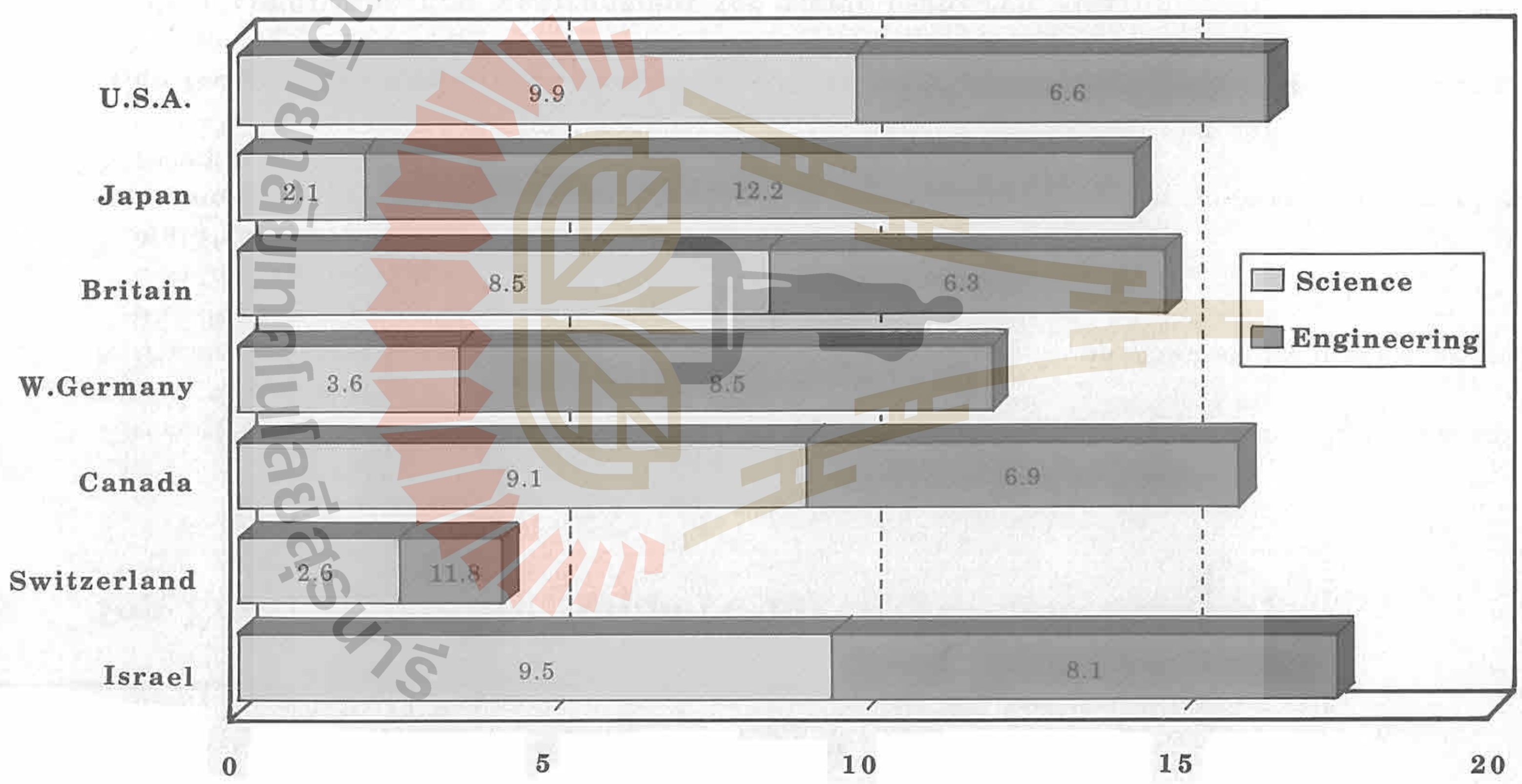
Israel Leads the World in Science and Engineering Researcn Degrees



Advanced degrees in Science and Engineering per 10,000 People in Working Population

How Many Young People are Available to High-Tech Industry?

Israel Leads the World in Basic Science and Engineering Education



First Degrees in Science and Engineering per 10,000 people in Working Population

Universities and Research Institutions

Top-Level Academic Support for High-Tech Industry

* Internationally recognized universities and research institutions provide high-tech industry all of the following:
  * Highly educated and trained graduates and postgrads in mathematics, computer science, physics and all other scientific and business fields
  * Consulting services
  * Mainframe computers and laboratories
  * A constant stream of innovations and inventions suitable for commercial development
  * Proven experience in commercialization of high technology

* High-technology 'incubators' associated with universities or regional development authorities offer :
  * Ideal conditions and environment for small high-tech startups
  * High level of scientific and technological cross-fertilization between multi-disciplinary teams
  * Low-cost centralized management services
  * High level of leverage from government incentive financing

Top-Level Research and Development Manpower

High-Tech Industry Depends on the Best Brains

* Israel has the most highly qualified scientific and technological manpower in the world:
  * The highest concentration of science and engineering graduates and research degrees (M.Sc., Ph.D., D.Sc.)
  * The highest productivity of original scientific research, as measured by scientific publications
  * The highest level of new patent applications
  * A high level of international experience, including studies at leading universities and work in top research institutions and R&D companies

* Israeli R&D staff are trained and experienced in finding practical solutions to real-world problems at low cost

Fortune 500 Companies Working in Israel (1)

The Biggest and Best U.S. Companies Take Advantage of Israeli Knowhow

* IBM (4) -$65.1 bn
  * Scientific Research Center; Purchasing Organization & international marketing for Israeli hardware & software manufacturers
* Boeing (12) - $30.2 bn
  * Sub-contracts aircraft assemblies
* McDonnell Douglas (23) -$17.5 bn
  * Subcontracts aircraft assemblies
* Hewlett Packard (24) -$16.4 bn
  * Software development and adaptation for international markets
* Digital Equipment Corp. (27) - $14.0 bn
  * VLSI hardware & software design centre
* International Paper (31) - $13.6 bn
  * Partner in Scitex (pre-press graphic computers & imaging systems)
* Motorola (32) - $13.3 bn
  * Product R&D; manufacturing center
* Sara Lee (33) - $13.3 bn
  * Partner in Delta Galil (fashions & textiles)

Numbers in brackets show place in Fortune 500 ratings, 1993; sales figures are for 1992

Fortune 500 Companies in Israel (2)

The Biggest and Best U.S. Companies Take Advantage of Israeli Knowhow

- * Martin Marietta (92) - $6.0 bn)
  - * Joint Venture agreement with BVR avionics
- * Intel (93) - $5.9 bn
  - * Product R&D; Microprocessor manufacturing
- * Microsoft (Services 64) - $1.9 bn [1991 figures]
  - * Software development center; licencing of OEM software from Israeli developers
- * National Semiconductors (243) - $ 1.7 bn
  - * Electronics design centre; joint ownership of manufacturing facility
- * McCormick (275) - $1.5 bn
  - * Marketing of Israeli agricultural products
- * Pioneer High-Bred (Services 99) - $1.1 bn [1991 figures]
  - * Agricultural R&D; international marketing of Israeli seedstock
- * Vishay Intertechnologies (455) -$664 mn
  - * R&D centre; manufacturing facilities

Numbers in brackets indicate place in Fortune 500 ratings, 1993; sales figures are for 1992

Major Issues in Training for Work
in the
Era of Uncertainty

Complexity of New Technologie

Rapid changes of:

- Technologie~
- Markets
- Ways and concepts of production
- Fast replacement of equipment

Needs for:

- High investments in personnel and equipment
- Continuous upgrade of workers
- Training support for all personnel

Israel at a Glance

Statistical Data

Total population:	5.4 M
Number of students K-12:	1.5 M
Number of teachers:	70.000
Number of schools:	2.800

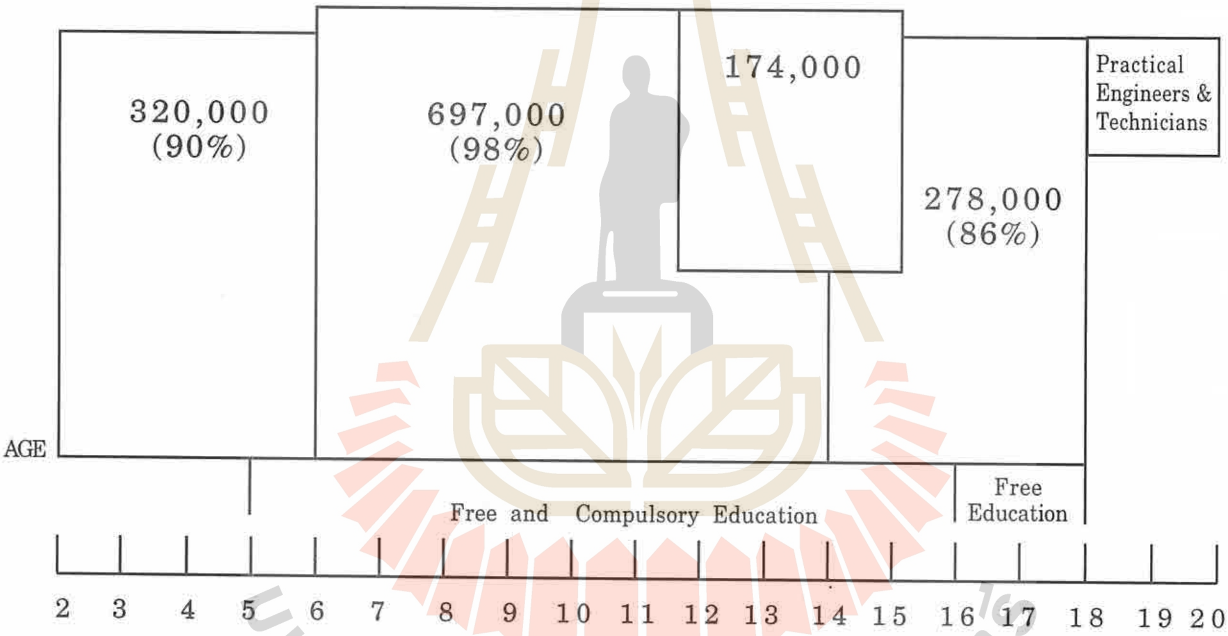
Industry 1994

Production:	$ 28.billion
Export:	$ billion
GNP per Capita:	$ 12.000

STRUCTURE OF THE EDUCATION SYSTEM, 1994

Source : Ministry of Education, Culture and Sport

Pre-Primary Education	Primary Education	Secondary Education	
Kindergarten and Nursery School (ages 2-6)	Primary School (grades 1-8)	Lower Secondary Schools (grades 7-9)	Upper Secondary Schools (grades 9-12)



MINISTRY OF EDUCATION,
CULTURE AND SPORTS

Responsibilities:

- Curriculum
- Equipment
- Evaluation
- Certifications
- Financing

Diagram 1 shows the structure of the education system in Israel:

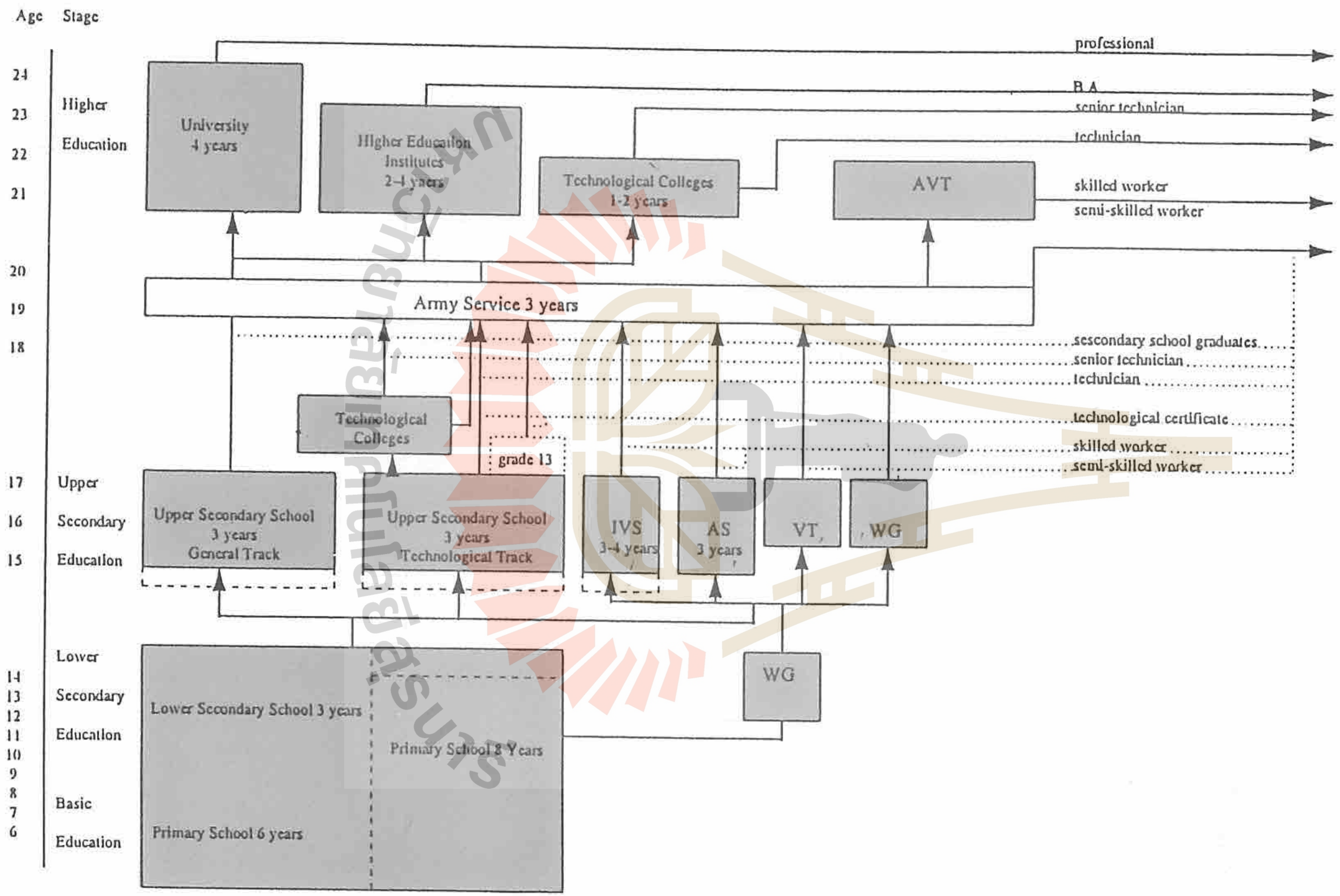


Diagram 1; The Education System of the State of Israel

"Think Industry"

Training for Life

Objectives

1. To acquaint youngsters with the technical environment of modern life and prepare them to successfully confront XXI century challenges.

2. To show the students the challenges of modern industry and to improve the image of industry as compared to other professional activities.

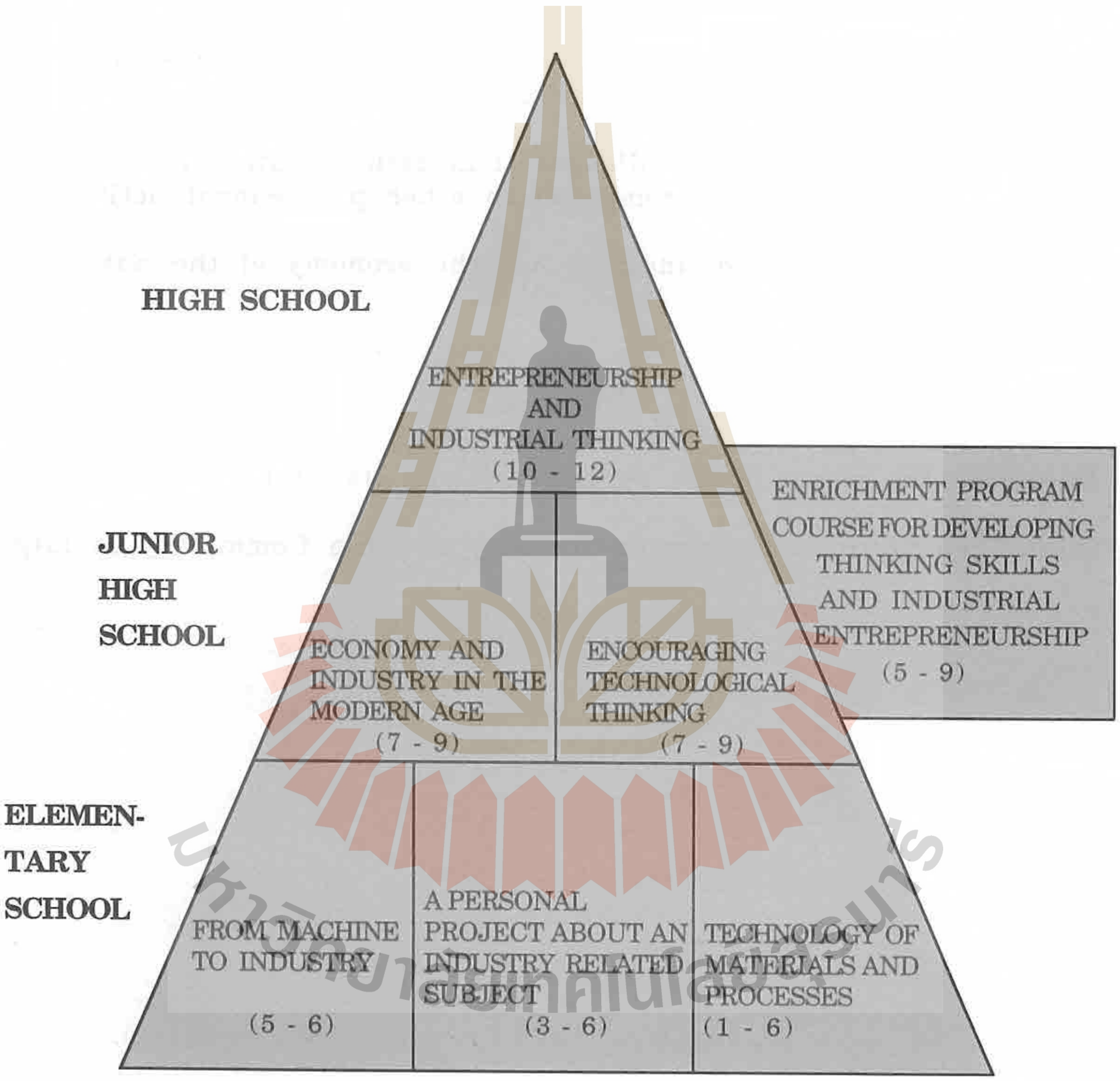
3. Stress the importance of industry for the economy of the nation.

Means

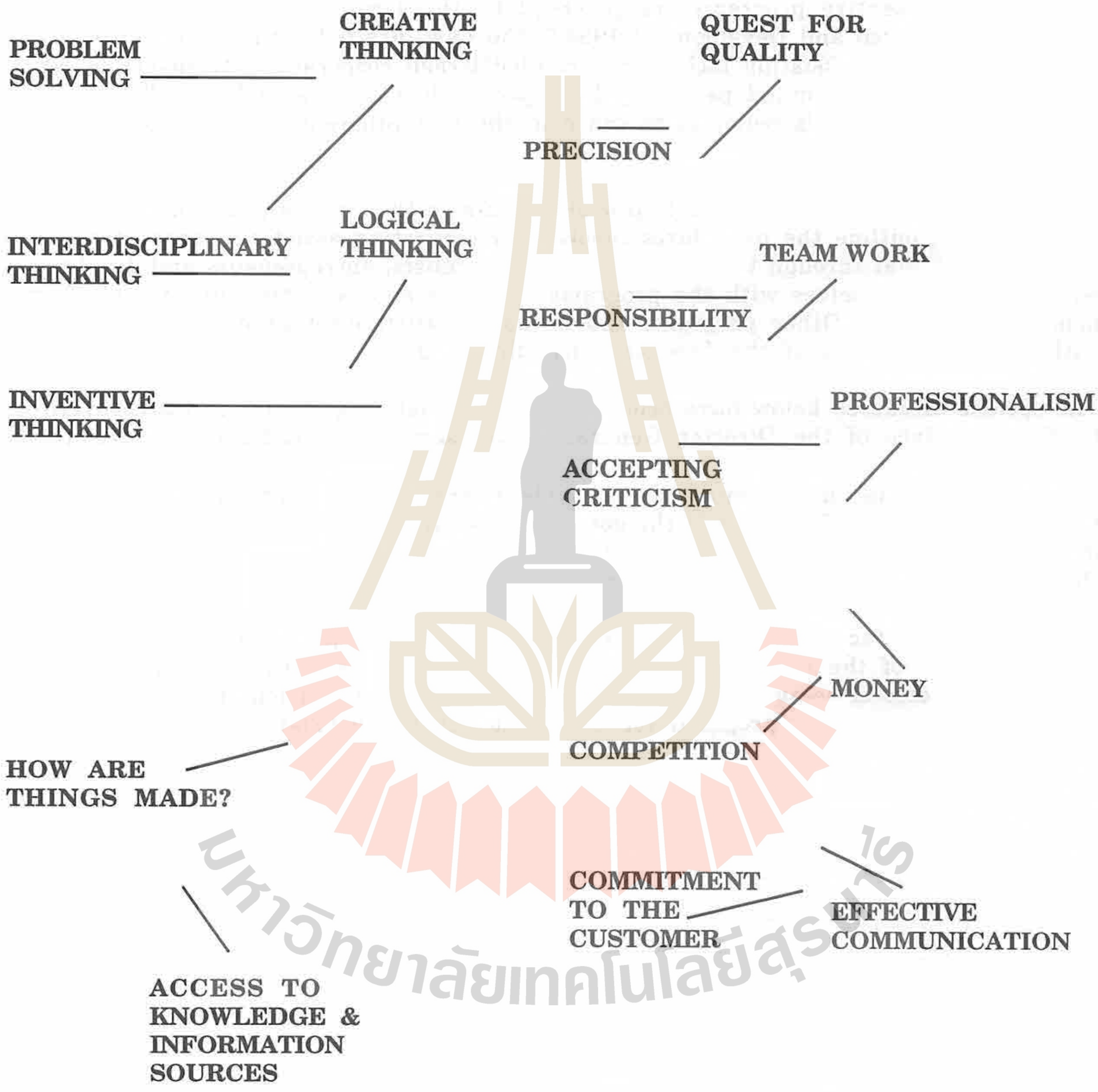
* Educating the young people on Industry and its values

* Strengthening the ties between Industry and the Community at large

"THINK INDUSTRY"
THE CURRICULA



THE VALUES OF INDUSTRY



INTRODUCTION

The Office of the Chief Scientist (OCS) of the Ministry of Industry and Trade if responsible for implementing government policy regarding support and encouragement of industrial research and development.

Support and incentive programs are governed by the "Law for the Encouragement of Industrial Research and Development-1984," (the Law) drafted for the express purpose of encouraging and assisting technology oriented Israeli corporations to invest in R&D projects that are based on independently developed products and technologies. The purpose behind the government's policy is to share in the risk inherent in industrial research and development.

The purpose of this publication is to provide details on the various grant and assistance programs and outline the procedures involved in requesting assistance under the Law. It is our hope that through this publication, industrialists, entrepreneurs and developers will acquaint themselves with the programs available and be better able to select the most suitable ones. Other programs and forms of assistance that do not fall strictly within the framework of the Law are also discussed.

The options discussed below have been enacted by Israel's legislature and are governed by the directives of the Director General of the Ministry of Industry and Trade.

Also included in this publication are the principle recommendations of the Public Committee formed to reexamine the Law and the government's overall policy regarding government incentives for industrial R&D. The Committee was assigned this task in order to ensure that policy continued to be in line with changing economic and business realities.

The Committee's recommendations regarding programs and options that are not within the framework of the Law have already been instituted. The other recommendations are in the process of being implemented, and are undergoing revisions regarding royalty payments. All are being prepared for submission to the legislature.

GRANT OPTIONS UNDER THE LAW FOR THE ENCOURAGEMENT OF INDUSTRIAL RESEARCH AND DEVELOPMENT - 1984

R&D PROJECT

Grant
Grant totaling 50% of the total approved R&D expenditures.

Terms and Conditions
An approved R&D program lasting one or more years, the result of which will lead to the manufacture of a new product or a significant improvement in an existing product. The development may also lead to a new process or a significant improvement in an existing process.

Royalties
When the project reaches the stage of sales, annual royalties of 2% of revenues derived from the product or process developed will be repaid to the State Treasury, up to the total amount of the original grant linked to the $US.

Regarding proposed changes to the terms of royalty requirements, please refer to page 61.

R&D PROJECT IN A START-UP COMPANY

Grant
Grant totaling 66% of the total approved R&D expenditures, up to a ceiling of the NIS equivalent of US $150,000* per fiscal year, and 50% of R&D expenditures above that sum.

Terms and Conditions
For the purposes of the Law, a start-up company is any company for which the proposed R&D program is its first and only activity. The company shall have no other sources of finacing except for the capital provided by the developers themselves. The R&D program, as well as the start-up company status, must be approved by the Research Committee.

*A proposed change in the Law recommends this ceiling to be the NIS equivalent of US $250,000 per year for the first two years.

Royalities
As detailed on page 61.

R&D PROJECT CONDUCTED IN A TOWN LOCATED IN DEVELOPMENT AREA A

Grant
Grant totaling 60% of the total approved R&D expenditures.

Terms and Conditions
- The approval process is identical to that of the standard R&D program.
- For the purposes of the Law, Development Area A is an area designated as such in the "Law for the Encouragement of Capital Investment - 1959." All the researchers and professionals employed in the project must also live in Development Area A.

Royalties
As detailed on page 61.

R&D PROJECT FOR DEVELOPMENT OF COMPUTER SOFTWARE*

Grant
Grant totaling 50% of the total approved R&D expenditures during the first year, 30% during the following years of development.

*A proposed change in the Law recommends that the terms of the software sector be changed to be the same as in other sectors. Therefore the percentage would be 50% during all the years of development.

Terms and Conditions
The R&D plan must be approved by the Research Committee, for the exclusive development of computer software.

Royalties
Royalties to be paid in the amount of 3% of the revenues derived from the sale of the software, up to 150% of the original grant, linked to the $US. (Upon ratification of the Law's amendment, this will be adjusted to 100% of the original grant).

R&D PROJECT TO IMPROVE AN EXISTING PRODUCT

Grant
Grant totaling 30% of the total approved R&D expenditures.

Terms and Conditions

- The R&D plan must be approved by the Research Committee.

- The product being improved was originally developed with the assistanc of government aid.*

Royalties
As detailed on page 61.

*A proposed change in the Law recommends that a grant of 30% be given for any existing civilian product, irregardless of whether it was developed with the assistance of gevernment aid. Defense-related products will be entitled to grants of 20%.

GENERIC R&D PROJECT FOR THE DEVELOPMENT OF TECHNOLOGICAL INFRASTRUCTURE

The Magnet program supports the development of generic, pre-competitive technology, with grants awarded to consortia of industries in the relevant technological area and academic research institutions, cooperating in the development of generic technologies.

Assistance is also granted to support the development of advanced technologies in industry via industrial and user associations.

Grant
Grant totaling 66% of the R&D expenditures, approved by the Magnet Committee of the Office of the Chief Scientist. No royalty payments are required.

Terms and Conditions

- The project must be dedicated to the development of vital generic technologies, for which no alternative funding source from abroad is available.

- Unless stated otherwise by the MAGNET Committee, the project must be carried out by a consortium of industrial concerns, together with an lsraeli academic or research institution that specializes in the area of technology under development.

- The consortium shall cooperate fully in the management and direction of the development program.

- This program entails no royalty repayments.

For further information regarding the generic R&D program, please contact:

Dr. llan Kuziatin
29 Hamered St., Tel Aviv 50364
Telephone: 972-3-510-0010

ASSISTANCE DURING THE TRANSITION PERIOD FROM R&D TO MANUFACTURING AND MARKETING (B-SITE STAGE)

This program is intended for companies that have completed the R&D stage, and wish to either develop prototypes to be displayed or introduced to potential customers abroad, or to operate pilot installations, such as industrial chemical pilot plants, in order to produce samples. This stage allows the *project must be as follows:*

at least 50% - the initiator

at least 10% - the employees

20% - outside investors

up to 20% - the incubator

Royalties
As detailed on page 61.

ASSISTANCE IN ESTABLISHING INDUSTRIAL INCUBATORS

This program is designed to provide assistance to companies with the experience and resources to support business development in technological fields, where such initiatives can benefit form the existing infrastructure, as well as the financial and managerial backing these companies can provide.

Grant
A grant of 66% of approved R&D expenditures, up to a ceiling of US $300,000. for a period of up to two years. After the two year period, all the standard grants and programs under the Law will apply.

Terms and Conditions
- The formation of a joint framework for initiators, mainly new immigrants, and established business concerns of one of the following types:

  1. An Israeli industrial entity, experienced in R&D an annual sales volume of at least US $s million.

  2. Commercial companies experienced in R&D with owners equity in excess of u.s. 7.5 m$.
- At the stage where this joint framework receives government aid, the initiators of the project will have an equity interest of at least 26%.

Royalties
As detailed on page 61.

ASSISTANCE FOR R&D PROJECTS CARRIED OUT AS SUBCONTRACTORS

This program is designed to assist Israeli corporations in carrying out civilian R&D as subcontractors for customers abroad. These projects are intended to increase employment opportunities in Israel and to foster international cooperation. The intended result of cooperation of this sort is to make it easier for these companies to penetrate, at a later stage, the same markets with their own products.

This program is being operated on a trial basis until the end of 1994.

Grant
A grant of 20% of approved expenditures outlined in the subcontractor agreement.

Terms and Conditions
- The R&D plan must be approved by the Research Committee.

- The Israeli concerns performing he subcontracting must not be affiliated with the foreign companies that have contracted their services, unless otherwise stated by the Research Committee. The Israeli companies performing the subcontracting must be industrial concerns, whose annual sales volume does not exceed US $100 million.

- The R&D project that is subcontracted must be a new project for the Israeli company: an addition to its other activities and product lines.

- A minimum of 70% of the project's cost, including overhead, must be labor.

- The duration of the project must not exceed 30 months.

- Projects for the development of military products and applications are not eligible.

- This program has no royality repayment.

ASSISTANCE FOR PRE-INDUSTRIAL PROJECTS WITHIN THE FRAMEWORK OF ACADEMIC INSTITUTIONS

Grant

A grant of 50% of the approved R&D expenditures for opening the pre-industrial project file, not to exceed US $50,000.

Terms and Conditions

The approval of the Financial Aid Committee of the Office of the Chief Scientist, contingent upon industry providing at least 10% of the financing.

ASSISTANCE IN ABSORBING NEW IMMIGRANTSCIENTISTSINRESEARCH INSTITUTIONS SERVING ISRAELI INDUSTRY

Grant

Grants to finance the employment contracts of new immigrant scientists in research institutions for a limited time period.

Terms and Conditions

- Integrating and absorbing new immigrant scientists in vital fields of research that are particularly relevant to Israeli industry.
- The costs of employing the new immigrant scientist, including fixed costs and social benefits, may not exceed the maximum amount, which will be adjusted periodically.
- The R&D program must be approved by the Chief Scientist.
- This program has no repalty repongment.

ASSISTANCE IN MARKET RESEARCH AND FEASIBILITY STUDIES FOR INDUSTRIAL RESEARCH AND DEVELOPMENT

Grant

A grant of 50% of the total amount approved to conduct a feasibility study, up to a maximum of US $25,000 if the study is conducted on one continent, US $30,000 if the study is conducted on two or more continents.

Terms and Conditions

- A preliminary study regarding the marketing potential of the project, prior to having invested large sums in either research or manufacturing. The preliminary report must consider the technological, marketing and economic aspects of the project and will be relevant for all of the grant options.
- The initiative for carrying out the feasibility study may come from the company developing the new product or from the Research Committee.
- This option is intended for new or young companies, as well as meduim sized companies who wish to investigate areas of research and development that are not in their particular area of expertise.
- The feasibility studies will be carried out by outside consultants who have proven experience in marketing feasibility studies, and who have been approved by the Office of the Chief Scientist.
- The feasibility study must be completed within a period of 6 months.
- Approval for the study must be given by the Research Committee, provided that the recommended consulting firms have no ownership interest or financial connections with the project owners.

BIODATA
Mr. Dov Geva

1991 Graduated in Political Science from Tel Aviv University.
Joined the Ministry of Industry and Trade and, in charged of the Economic relation between Israel - South and Southeast Asia.

1994 After getting Masters degree in public administration, he was posted as commercial attache in Bangkok, Thailand

ABSTRACT
UNIVERSITY-INDUSTRY LINKAGES NEW PARADIGMS TO ENHANCE HUMAN RESOURCE DEVELOPMENT

BY
PETER BRIMBLE, THE BROOKER GROUP LTD.
AND
CHATRI SRIPAIPAN, CHULALONGKORN UNIVERSTIY
JULY, 1995

The global economy is experiencing unprecedented change, competition, and integration. Southeast Asia, as an emerging growth pole of the region and the world, will increasingly face the challenges of keeping up with developments in the global marketplace or risk falling behind in the race towards the 21st century. The region as a whole must seek innovative solutions and take advantage of the growing web of communications and information exchange that will shape the market place of the next century.

Amidst the rapid change, the role of universities in the process of economic and social development must be reappraised. University, as the traditional providers of knowledge to society, must now go beyond tradition and intensify levels of collaboration with the productive sector. Four key global trends in higher education will drive this process: popularization, liberalization, internationalization, and modernization.

The paper marks a case that university-industry linkages (UILs), as a non-traditional loop in the interactive relationship between the users and suppliers of manpower, will play a critical role in enhancing the entire manpower system. An analytical framework is developed to examine UILs that clearly distinguishes between the activities undertaken and the mechanism through which the activities are delivered. The importance of the core functions and missions of universities are explicitly considered in this framework.

The paper then draws a number of key lessons from international experience, both with regard to UIL activities and mechanisms. It introduces the concept of a "knowledge park" to consider a range of various UIL mechanisms that can serve as a window for society into the know ledge resources of higher education institutions.

Following a brief summary of the Thai experience to date with UILs, the paper concludes with a look towards the future-identifying some key areas in which UILs may be expected to play a critical role. These include: supporting human resource development and the evolution of the higher education system; supporting science and technology development and sustaining international competitiveness; supporting regional integration; growing synergistically with advances in information technology and new related teaching methods; and supporting the growth and modernization of university systems and networks.

UNIVERSITY-INDUSTRY LINKAGES NEW PARADIGMS TO ENHANCE HUMAN RESOURCE DEVELOPMENT [1/]

BY

PETER BRIMBLE, THE BROOKER GROUP LTD.

AND

CHATRI SRIPAIPAN, CHULALONGKORN UNIVERSITY

Paper Prepared for the

Colloquium on University-Industry_ Government Cooperation in Quality Engineering and Technology Education for Southeast Asia in the 21st century

Suranaree University of Technology
Nakhon Ratchasima, Thailand

July 28, 1995

1/ This paper draws from materials presented in a series of research papers recently prepared by The Brooker Group under a technical assistance project for the Asian Development Bank on behalf of the Ministry of the University Affairs - entitled *The Higher Education Development Project in Thailand.* While the paper represents only the opinions of the authors and not those of the ADB and the MUA, the authors gratefully acknowledge permission from the ADB to use the materials for this paper. Useful comments made by participants in the Colloquium held at Suranaree University of Technology are also acknowledged.

1. Background and Structure

The global economy is experiencing unprecedented change, competition, and integration. Southeast Asia, as an emerging growth pole of the region and the world, will increasingly face the challenges of keeping up with development in the global marketplace or risk falling behind in the race towards the 21st century. The region as a whole must seek innovative solutions and take advantage of the growing web of communications and information exchange that will shape the market place of the next century.

Amidst the rapid change, the role of universities in the process of economic and social development must be reappraised. Universities, as the traditional providers of knowledge to society, must now go beyond tradition and intensify levels of collaboration with the productive sector. Four key global trends in higher education will drive this process: popularization, liberalization, internationalization, and modernization.

The paper makes a case that university-industry linkages (UILs), as a non-traditional loop in the interactive relationship between the users and suppliers of manpower, will play a critical role in enhancing the entire manpower system. An analytical framework is developed to examine UILs that clearly distinguishes between the activities undertaken and the mechanisms through which the activities are delivered. The importance of the core functions and missions of universities are explicitly considered in this framework.

The paper then draws a number of key lessons from international experience, both with regard to UIL activities and mechanisms. It introduces the concept of a "knowledge park" to consider a range of various UIL mechanisms that can serve as a window for society into the knowledge resources of higher education institutions.

Following a brief summary of the Thai experience to date with UILs, the paper concludes with a look towards the future -identifying key areas in which UILs may be expected to play a critical role. These include: supporting human resource development and the evolution of the higher education system; supporting science and technology development and sustaining international competitiveness; supporting regional integration; growing synergistically with advances in information technology and related teaching methods; and supporting the growth and modernization of university systems and networks.

2. Global Education Trends

The role of UIL in revolutionizing the education sector must be considered in light of an analysis of global trends in the higher education sector. This paper considers four main concepts which are increasingly common to higher education institutions worldwide-popularization, liberalization, internationalization and modernization[2/].Each of these major global trends incorporates elements related to greater collaboration between universities and the productive sector.

Popularization

This first concept is based on the premise that university education should be designed, dilivered and funded in such a way as to enable all those who are involved to benefit. This concept leads in three clear directions - equity of access, lifelong learning and relevance to individual, local and national needs. Common means that are used to induce a positive response to follow such directions are financial schemes such as student loan funding, "on-the-job" training programs and distance learning methods of delivery.

With equity of access comes the concept of diversification. Students entering higher education can come from all walks of life, diverse in terms of culture, age, and income. A large portion of them may want to study part-time or study from a distance. Therefore, a university will increasingly need to make important decisions on how to allocate resources between its traditional, full-time students, and the rapidly growing numbers of "other students"

2/ This section builds on insights gleaned from many sources, but particularly World Bank (1994) and UNESCO (1995)

Liberalization

Traditionally the extent of government involvement in higher education has far exceeded what is economically efficient. Meanwhile increasing pressures for change are stimulating a reappraisal of the extent, objectives and modalities of government intervention in higher education to ensure a more efficient and effective use of resources.

Successful implementation of reforms have been shown to depend on a more liberal form of governance which emphasizes the following directions:

- encouraging greater differentiation of institutions:
- development of private institutions;
- redefining the role of the government in higher education;
- reliance on incentives and market oriented instruments to implement policies;
- increased management autonomy for public institutions;
- increasing reliance on new financial sources.

With regard to the financing element, many argue that funds should be raised through training, research and consultancy contracts with both the public and private sectors. Although there is vigorous debate on these matters (see below), there is no doubt that establishing closer links with the productive sectors opens up more opportunities to generate incomes for university, as well as ensuring the relevancy of programs.

Internationalization

The growing internationalization of higher education is predominantly a reflection of the emerging global nature of learning and research. This universality is being reinforced strongly by myriad factors such as increased economic and political integration, the growing need for intercultural understanding, advances in telecommunications, growth in international links in education, and worldwide economic competition.

This internationalization leads in the direction of universal knowledge and a greater awareness of cross-cultural issues. Means used to meet this universality of higher learning are student/staff fellowships, regional and international research linkages and the growth of cooperative mechanisms for international recognition of courses and qualifications.

The increasing establishment of international teaching and research linkages will ensure that the common missions of universities worldwide endure and evolve as well as enhancing quality. In economies with lesser developed education structures, international linkages and networks with better established universities and university systems can greatly speed up the upgrading process of the higher education sector and enhance efforts to gain acceptance in the international scene.

Modernization

While "relevance" is presently considered most in terms of the role of higher education as a system and of each of its institutions towards society, in the years to come "relevance" will perhaps best be expressed through the variety of academic services it offers to society. This interpretation of "relevance" entails the search for "modern" solutions and leads in directions that require the development of "knowledge modules", multi-disciplinary and inter-disciplinary learning methodologies, increased significance of linkages between higher education and the work place, strengthening of the research function and, most prominently, an enhanced relevance and quality for the whole teaching/learning process.

Common means to attain this "relevance" utilize such measures as information technology, distance learning and video-conferencing, establishment of flexible modular courses based on a system of credits, as well as increased allocation of funding for postgraduate courses to strength the teaching and research elements of all levels of higher education.

Perhaps the most influential modern technology that will affect education in years to come is information technology (IT). In distance education, it frees the students from having to be in the same place at the same time as others for the same subject, while preserving the privilege of two way communications with the teacher, the classmates, as well as other knowledge seekers. In classrooms, teachers shift from being lecturers to being facilitators (or "discovery guides"), showing students how to learn from the world's storehouses of knowledge [3]. A distinguished scientist at Apple Computer and an expert on educational Technology believes that it may take 10 years or more likely 20 before the technology is widespread [4]. However, the basic elements of the technology are already available for all to benefit from.

3. A Macroeconomic Perspective

A macroeconomic perspective on UILs is illustrated in Exhibit 1, which lays out an interdisciplinary framework of the various elements of the higher education system [5].

The two key players are seen to be the **suppliers,** namely the public and private universities and related higher education institutions, and the **users** of higher level S&T manpower and related outputs, namely the productive sector.

On the supply side, universities are seen to be facing a number of pressures, ranging from global developments in the role of higher education and the increasing internationalization of knowledge to persistent domestic manpower shortages and increasing coercion from the fiscal authorities to become financially more self-sufficient.

It should be noted that the supply side itself also generates a demand for higher level manpower for both teaching and research activities.

On the demand side, the productive sector is also facing severe pressures, ranging also from global concerns, such as increasingly rapid technological change and growing competition and integration, to domestic factors such as higher domestic resource costs and infrastructure constraints.

Faced with these pressures, which most would agree have been greatly intensifying in the past decade or so, both sides in the manpower arena must look carefully at the whole system. The dynamics of the system can essentially be characterized as a continuous interaction process between the two key players, where the need for greater interaction is driven by the intensity of the external pressures and the extent to which the various players are responsive to each other.

Exhibit 1 depicts the interactions between the two players in two loops: the traditional and the non-traditional. Non-traditional in this sense is not meant to imply that such interactions have never taken place, simply that they have not yet been generally seen as a major channel of communication.

The traditional loop essentially involves the supply of manpower to the productive sector, the functioning of the labor markets, and the transmission of short, medium, and long term signals back to the university system from the labor market.

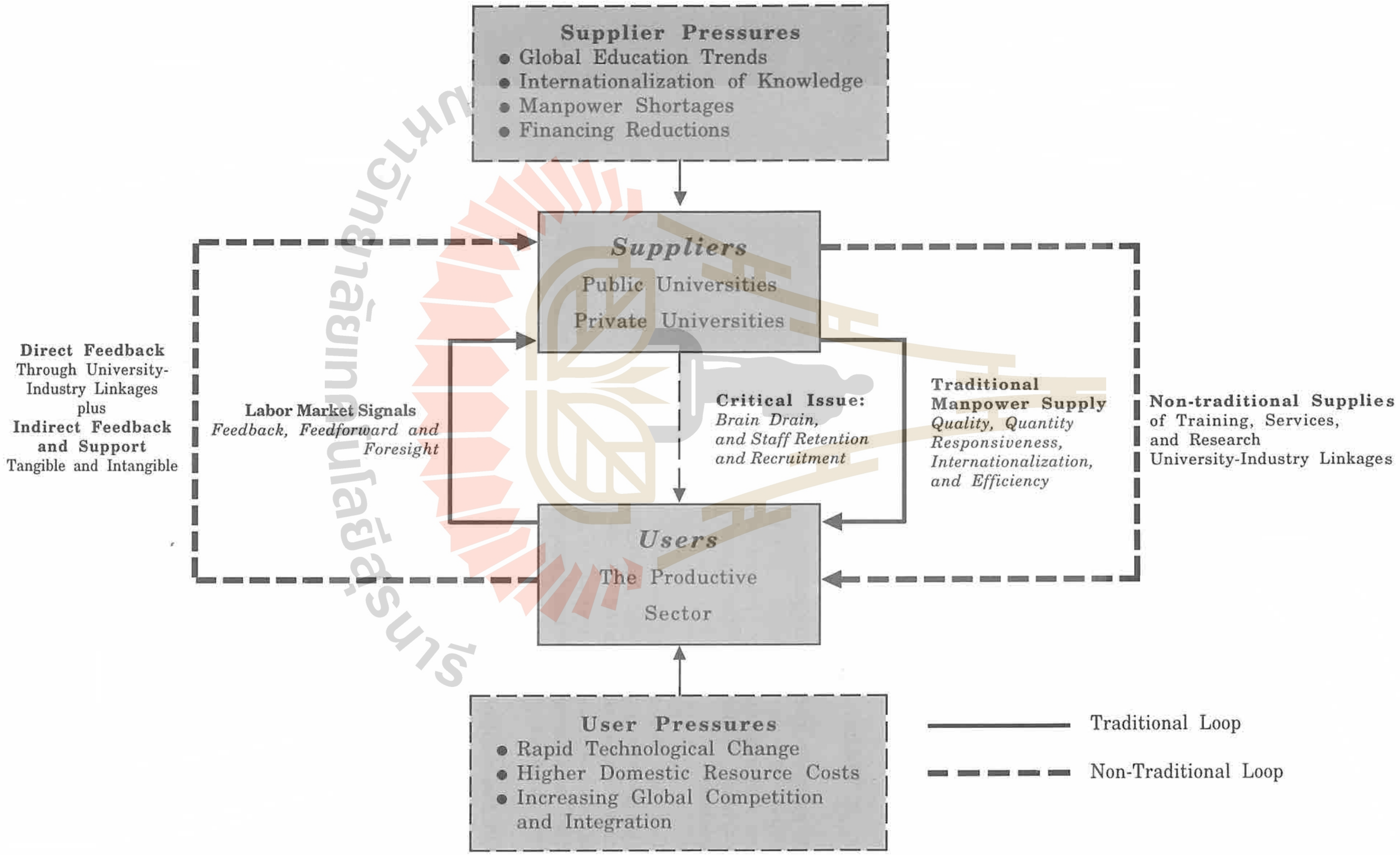
---

[3] Aristotle is reputed to have said that the main function of a teacher should not be to teach, but to show students how to learn. This bears some remarkable similarity to the characterization of a lecturer presented here.

[4] Quoted in a special issue of Time magazine in May, 1995 devoted to the potential of cyberspace.

[5] This framework draws on Sripaipan and Brimble (1991).

Exhibit 1: University-Industry Linkages: A Macroeconomic Perspective



The non-traditional loop involves the interactions between universities and the productive sector that involve cooperation beyond the basic supply and use of human resources in the traditional mode. These interactions are termed university-industry linkages, and essentially include cooperative activities between the universities and the private sector in the areas of training, research, and services. The non-traditional loop also includes direct feedback from the university-industry linkages as well as other indirect feedback and support activities, both in a tangible and an intangible form [6].

The pressures on both universities and the productive sector are mounting and creating singificant incentives to explore closer collaboration.

From the university perspective, UILs can enhance ability to raise incremental incomes to compensate for decreasing government budgets. Closer links with the private sector can also provide access to a set of diversified skill resources and facilities and contribute to the relevance of teaching and research activities carried out in the university sector.

From the productive sector perspective, UILs are one means of strengthening production capabilities, moving up the value-added tree, and maintaining competitiveness in the face of lower-cost competition from newly emerging countries. UILs can expand the access of private companies to cost-effective knowledge-based resources & facilities and play an important role in retaining and upgrading staff as well as obtaining top-quality new staff.

4. A Conceptual Framework - Activities and Mechanisms

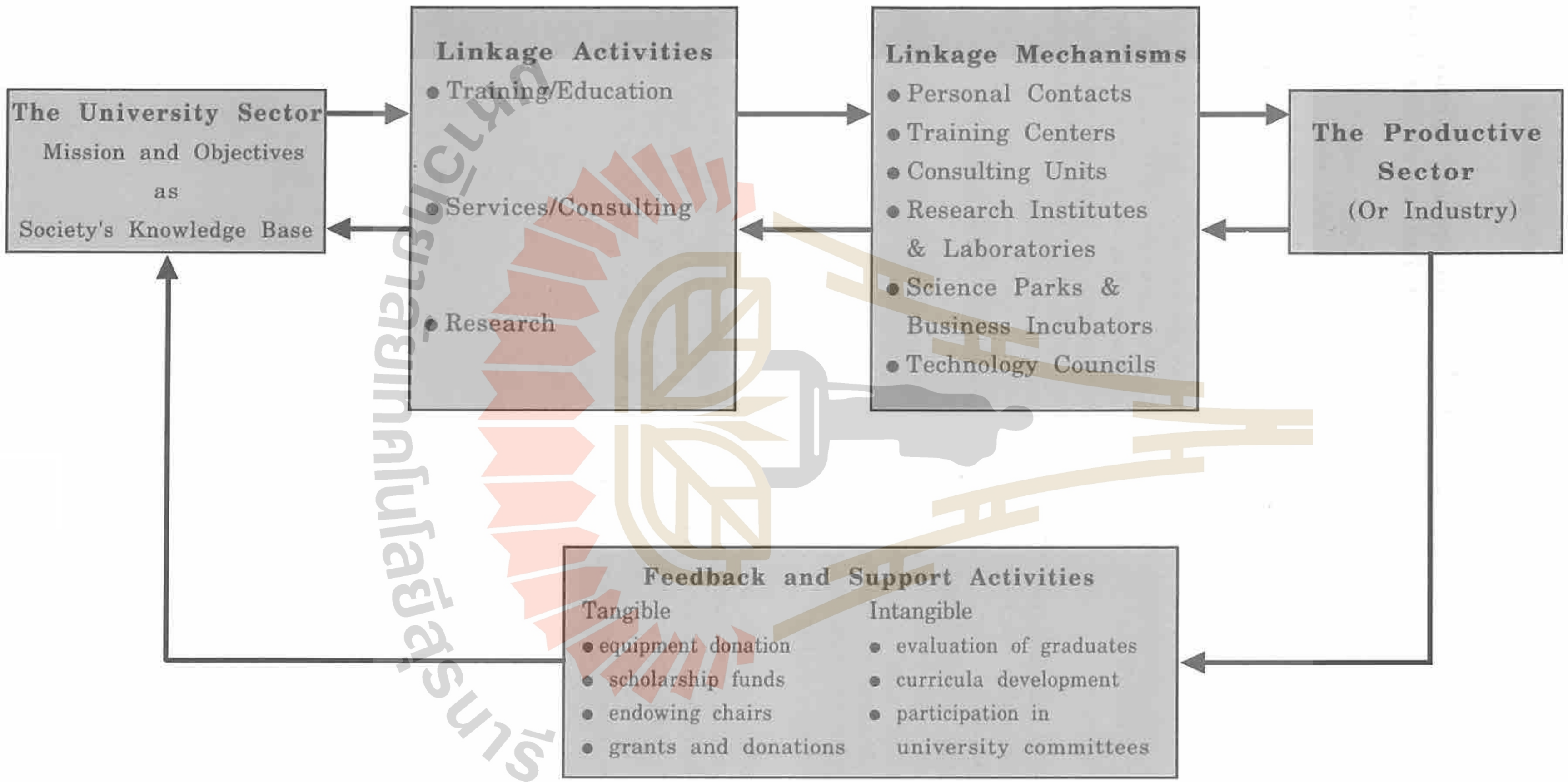
A conceptual framework for analyzing UILs has been developed and is shown in Exhibit 2. A clear distinction is made between the type of linkage activity being undertaken and the mechanism through which that UIL is implemented. This allows for a conceptual differentiation to be made between the types of linkage activities a university may decide to encourage or to develop and the mechanism (s) through which it actually delivers the various services to the productive sector.

Linkage Activities

Three groups of such activities or modalities can be identified, corresponding to the three broad missions of the university sector: training and education related activities; the provision of services and other consulting activities; and research-related activities. Exhibit 3 provides a detailed listing of the types of linkage activities that have been observed throughout the world, classified according to the three broad modality groups.

[6] These activities are described in more detail in the following section.

Exhibit 2: University-Industry Linkages: Activities and Mechanisms



In general, the development of UILs has recently taken a much stronger focus on the support of entrepreneurs[7]. This is fully consistent with the needs of companies to strengthen entrepreneurship to face increasng competitiveness in global markets.

Linkage Mechanisms

Traditionally, the principal mechanism through which a transfer of university resources to the productive sector would take place was personal contacts.

More formal mechanisms that have proliferated primarily in the developed countries can be broadly grouped as follows:

- training centers, such as entrepreneurship teaching facilities, cooperative education centers, and small business training centers;
- Consulting units, such as consulting practice plans, industry liaison offices, and industrial outreach programs;
- research laboratories/institutes, cooperative research centers, and interdisciplinary research institutes;
- science parks and incubators, generally but not necessarily with greater physical space and additional facilities than the other mechanisms; and
- technology councils, which carry out primarily policy and coordination functions between universities, the government, and the productive sector.

It should be emphasized that all of the above mechanisms, with the exception of personal contacts, can involve a range of levels of institutionalization and of physical needs. Increasingly, they can be developed to some degree as a "virtual" mechanism, using existing resources in the case of teaching, or using new information technologies and telecommunications facilities to network the required resources together without the need for an actual physical base beyond a simple computer terminal. Indeed, advances in information technology are revolutionizing the way in which we live. The impact of the IT revolution on the nature, extent, and potential of linkages involving the university sector in general [8], and UILs in particular, are great.

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[7] Baba (1988) makes this point very clear for the United States where she identified most new linkages types as having as their specific focus the support of entrepreneurs.

[8] While the present paper focuses on university-industry linkages in particular, other university-related linkages that need to be enhanced and which will be facilitated by IT include: linkages between departments and faculties within a university; linkages between universities within the country; linkages between the university system in the country with institutions from abroad; and linkages between universities and other public sector agencies within the country. Indeed, the development of these linkages will facilitate the development of UILs as well.

Exhibit 3
Modalities of University-Industry Linkages

Modality Group	Type of Linkage Activity	Description of Linkage Activity
1. Training/ Education	Cooperative Education	Involving students spending a singificant portion of their academic program in private companies
	Industrial Training (continuing education)	In the application of new technologies such as CNC machine tools
	Small Business Training	Addressing issues of concern to small or nascent entrepreneurs
	Entrepreneurship Training	Similar to small business training with a stronger focus on current issues with regard to entrepreneurship
	Visiting Lectureships	Formal arrangements where private companies support staff to participate in teaching activities
2. Services/ Consulting	Industrial Extension Services	Including testing, calibration, repair services, production trouble-shooting, simple design modifications
	Technology Brokerage/Licensing	Assistance in obtaining or licensing technologies either from the university or from a third party
	Business Consulting/Services	From business schools, or through research parks, science parks, incubators
	Direct or Indirect Investments	Through equity investments and venture capital schemes
	Coordination of Technology-Related Issues	Through such inter-organization entities as regional technology councils
3. Research	Research Consulting	Contractual research carried out for a private company with specified terms
	Joint or Cooperative Research Projects	Often carried out in dedicated laboratories, centers, or institutes
	Partnership Contract	Long-term arrangement between university and company to build up research/education facilities
	Personnel Interchange or Industrial Fellowships	On a regular or long-term basis
	Shared Equipment or Facilities	On a regular or long-term basis

Note: This list of modalities does not include purely gifts or donations (such as equipment donations, endowment contributions, financing professorial chairs, etc,) to universities which may well be very good ways of improving relationships between a company and a university and may improve teaching and research.

Source: Derived primarily from Baba (1985) and (1988). Modified by the authors.

Feedback and Support Activities

The last group of cooperative measures identified in Exhibit 2 are not considered to be UILs as such, but as tangible or intangible activities that strengthen the relationships between universities and the private sector. They generally involve a one-way flow of information or resources form the productive sector to the universities.

These activities essentially constitute either feedback such as evaluations of graduates, development and improvement of curricula, and participation in university committees or support activities such as donations, endowments, grants, and so on, which may or may not connect with linkage activities.

UILs and the Core Mission and Objectives of the University

A key question that has been raised in the literature concerns the extent to which UILs threaten the core mission and objectives of the university system-especially as they relate to basic research, knowledge creation, and academic integrity [9]. This concern is the basis for attempts to "peripheralize" or "institutionalize" the linkage mechanisms, and to create a "protective boundary" around the core functions.

There must be recognition that some elements of a university's basic mission must be protected due to great externalities, long time horizons for decisions, and financial market weaknesses in the education area [10].

However, the need to allocate continued budgets and to create mechanisms and structures for UILs that protect some elements of the core from the undue influence of private sector goals and objectives should not be simply an excuse to insulate the core from outside

influences; to lead the core disciplines to stagnate in face of rapidly changing global and national business and academic environments.

A balance must be struck that allows the university's core to retain its key characteristics and maintain its function as society's knowledge base while at the same time permitting appropriate flexibility in the core mission to respond in a dynamic manner to changing conditions. And carefully structured UIL mechanisms and procedures can greatly assist the university to reach this goal.

Formal Versus Informal Linkages

In general, the distinction between formal and informal linkages depends on the extent to which there exists a contractual relationship between the enterprized and the university (as opposed to only between the individual academic and the firm) and on the time frame over which activities are being carried out. For example, the sponsoring of employees by industry to attend short courses in university does not constitute a formal linkage, but agreeing to send a number of employees to attend the same courses regularly for a longer period of time can be claimed as a formal linkage. Similarly, inviting a lecturer to teach in a factory is not a formal linkage even though he or she may have obtained formal permission from the university. It becomes a formal linkage when the factory has an agreement with the university covering the respective service and the remuneration flows into the university or a university-related mechanism.

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[9] Baba (1985) considers this in some detail and the discussion below builds on her analysis. She presents an Appendix which lays out a partial listing of university core characteristics. They include such elements as: (1) faculty constitute a community of scholars dedicated to the preservation and expansion of knowledge; (2) faculty have academic freedom to teach and discover knowledge in their field of choosing; (3) faculty participate in the governance of their institution; (4) universities are politically independent and have some degree of autonomy within the nation-state; (5) universities perform some services in support of local community interests, but these clearly are viewed as secondary to the knowledge related functions. Some additional characteristics listed are related to teaching, appointment, and promotion systems.

[10] From UNESCO (1994): "...public support to higher education remains essential to ensure its educational, social and institutional mission."; From World Bank (1994): "...there are clear economic justifications for continued state support of higher education."

5. Activities-Lessons from International Experience [11]

A consideration of numerous international experiences in developing UILs yields a number of key issues that must be considered:

Technology visioning and audit. A country needs to consider its likely future technological strengths and opportunities, and the role which the higher education sector can play in the development of these key technologies.

The need for a development plan. An idea to establish a pilot program to develop UILs prior to embarking on a more ambitious larger-scale program. The pilot might be restricted to:

- specific technologies/academic departments;
- specific degree programs (e.g. masters programs); or
- specific universities which would provide good demonstrator projects.

The need for an ownership plan. Linkage programs need to be owned by many constituencies including:

- government;
- scheme managers;
- senior management in universities;
- industry.

It is therefore of the greatest importance that there be a clear contract for all parties, which indicates how each constituency will benefit and the contribution which it must make in order to ensure that the benefits are realized.

The need for a funding plan. In order to facilitate the development of UILs, there will be a need to consider a variety of modes of funding.

In terms of the critical success factors with regard to the establishment of UILs, the following stand out:

- The commitment and involvement of top management and representatives from all the stake-holders.
- The assignment of appropriate linkage program managers, i.e. those with some experience with industry and a flair for dealing with the private sector.
- Linkage programs must be based on entrepreneurial foundations, of university staff and of private industry, with a well thought-out development plan.
- Linkage programs should relate to the core functions and resources of univesities and ideally involve elements of more than one activity; e.g. research with training.
- Linkage programs should focus clearly on building credibility with the private sector and acceptance from the university side (i.e. they must not be seen as a threat to the university's basic nission). This can often be achieved by developing specific and limited linkages that demonstrate success to all sides[12]

6. Mechanisms - Towards the "Knowledge Park" [13]

As a mechanism which has received much publicity, the concept of a "science park" differs greatly from country to country.

Accordingly, a focus of this paper is to develop and promote the concept of "knowledge park" to be applied in the East Asian regional context as an activity which:

- is conducted in a circumscribed geographic area. In some cases, the "park" may be a separate tract of land. In others, it may be contained within an existing campus, either contiguously or on scattered parcels within the campus;
- is intended to link knowledge workers and knowledge infrastructure with industry. In most cases, the knowledge workers and infrastructure are provided by universities. But increasingly knowledge workers may be government or private sector employees, as well as university faculty who may be brought into the parks;
- improves technology. That can occur by facilitating the creation of new products or processes, or by helping to improve existing products and processes. That is done by linking industry to facilities, information, and expertise they otherwise would not use.

11/ This section draws on work by Colin Biggs of Segal Quince Wicksteed

12/ There is also a significant cultural element in the acceptance of UILs. A culture must be created that is conducive to such activities, and this may differ from society to society. UILs must be culturally sensitive.

13/ This section draws on work by Michael Luger of the University of North Carolina.

What constitutes "knowledge activity" is not always easy to identify with precision. Such activities are often defined as those which lead to "knowledge output", including new or improved ideas, products, or processes. These can in turn be measured in terms of scientific or technical reports, academic publications, and patents. However, activities that now are not knowledge enhancing in this manner (i.e. basic training for workers) may lead to knowledge creation later. It is important to keep in mind the dynamic nature of industry linkages. What one agent (say a technical institute) provides to industry today may establish credibility for further linkages later, and raise the technological level of the client to a point where universities and government S&T organizations can offer services to increase knowledge production.

The following attributes have been seen to lead to knowledge park success in the west:

- appropriateness-realistic given the needs of the regional economy and the resources of the university;
- commitment-supported with patience and funding resources; and
- well managed-with entrepreneurial leadership and good organization.

One additional factor that is critical, especially in light of developments in information technology, is the need to down-play the real estate element of park development-focussing more on enhancing the interface between the university's knowledge resources and the productive sector and on the real value of proximity to the university.

7. The Thai Experience

At the conceptual level, the basic finding was that, while all players in the S&T higher education arena recognize the potential of UILs, the levels of understanding and vision of the true potential of such linkages are not great. Most UILs that were identified were not very substantial and represented short term training or ad-hoc use of consulting or research services rather than longer-term, more extensive relationships. The range of activities and mechanisms remains rather limited; considerable scope exists for developing both the nature and depth of activities and the institutional sophistication of mechanisms.

In sum, the development of long-term, formal UILs in Thailand is at an early stage.

Although not yet a reality, the concept of"science parks" in Thailand has been well developed. However, the plans have often been overly ambitious and unrealistic. The first two parks are likely to be non-university parks developed by the National Science and Technology Development Agency and the Thailand Institute for Scientific and Technological Research. In all cases, however, the exact nature and structure of the initiatives and the detailed scope of activities to be carried out through the "knowledge park" remain to be finalized.

Given their relative novelty in the Thai context, the development of UILs faces a number of constraints: ingrained attitudes and skepticism from both universities and industry (a significant "credibility gap"); bureaucratic regulations and attitudes that continue to influence the university sector in a number of areas; continuing tendencies for academics to pursue private sector work through personal contracts; weaknesses in the intellectual property rights system; lack of adequate channels for communication; and the existence of goals that are unrealistic and not achievable at this time.

Lastly, in terms of feedback and other support activities: the support mentality in Thai culture for educational institutions is not will entrenched, partly due to extremely low tax benefits for those who carry out charitable activities; and mechanisms to involve the private sector in activities such as curriculum development remain weak.

While the situation and the pressures are changing very rapidly, the above findings on the "credibility gap" remain true to a large extent. However, although it is clearly still early days for UILs in Thailand, the conditions are ripe for rapid growth.

8. A Look Towards the Future

How will enhanced collaboration between universities and the productive sector play a role in a vision for the future? This section attempts to identify some critical areas where UILs could be expected to contribute significantly.

Supporting Human Resource Development. UILs, through creating closer communications and interactions between universities and the private sector, can enhance the relevance of human resource development activities, broaden the scope of such activities, and increase the volume of financial resources available for human resource development.

Promoting Science and Technology Development. UILs can play a role in accelerating the deepening of S&T capacity in three key areas: *technical manpower,* through enhancing relevance of courses, upgrading manpower, and supporting more efficient use of both university and industry resources; *S&T infrastructure,* through increasing the supply of technical services and results of public sector R&D to the private sector; and *technological capability,* through sharing resources, embarking on mutually beneficial cooperative research and technology transfer endeavors, and solving technical problems in industry .

Closer linkages can also shorten the time frames of product and process development by permitting the various stages of technology commercialization-basic research, applied research, pilot production, and commercial production-to be carried out concurrently rather than consecutively.

Accelerating Regional Integration. Economic cooperation between countries is becoming critical in this age of increasing global integration. And in the complex web of networks and interrelationships that will characterize the world of the 21st century, UILs can play a key role in solving technical problems and enhancing global efficiency through information sharing. The exchange of knowledge and ideas through growing networks of universities and productive sector agents offers channels and mechanisms for economic cooperation that are less politically sensitive than other forms of economic cooperation, such as trade or investment cooperation. It also offers an unprecedented opportunity for universities to play a critical role in promoting and supporting regional economic dynamism.

Increasing Synergy with Information Technology. UILs by growing synergistically with advances in information technology (IT) and new related teaching methods, can greatly enhance the effectiveness with which IT can sustain the international competitiveness of the productive sector. Universities can work closely with the productive sector to ensure that strengthened IT facilities and information resources are used to the maximum effect. And the closer communications links that will be made possible by the increasing application of IT will also greatly enhance the growth of closer relationships between the universities and the private sector and facilitate the evolution of UIL activities and mechanisms.

Enhancing Evolution and Modernization of University. Through all these developments, stronger UILs will offer considerable support to the evolution and modernization of university systems and networks.

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BIODATA
Peter Brimble and Chatri Sripaipan

Peter Brimble. Dr. Brimble is the President of The Brooker Group Ltd., one of Thailand's foremost business and policy research consulting operations. He is an economics graduate from the London School of Economics, Georgetown University, the University of Sussex, and Johns Hopkins University. His Ph.D. thesis examined the productivity performance of Thai manufacturing firms.

A British national, Dr.Brimble has worked as an industrial policy analyst at the World Bank, a visiting professor at Thammasat University, a partner in SEAMICO Ltd., and an advisor to many sections of the Thai government. In the past 10 years, he has carried out extensive research on industrial and technological development issues in Thailand and the region-working for various agencies, including the International Finance Corporation, the Asian Development Bank, the Harvard Institute for International Development, the United Nations, and the Thai Board of Investment. He has served as advisor to a number of private companies and senior Thai policy makers, interpreting the impacts of industrial development and related policies on private business.

Dr. Brimble presently serves as team leader on a major Asian Development Bank project looking at the science and technology higher education sector in Thailand, focusing in particular on ways to enhance linkages between universities and the productive sector. He has also been actively seeking to promote cooperation between university in the Greater Mekong Subregion as a means to accelerate economic cooperation and social development.

Chatri Sripaipan. Dr. Chatri Sripaipan is an Associate Professor in the Department of Electrical Engineering of Chulalongkorn University, where he is presently serving as Head of the Department. He received his education in electrical engineering at the bachelor's and master's levels in Australia and completed his Ph.D. in the United States in 1976 after a short teaching stint.

Since 1980, he became more and more involved in policy research work, particularly in electronics and engineering industries and issues relating to science and technology. Between 1986 to 1989, he served as the first Director of Chula Unisearch--The consultancy arm of Chulalongkorn University. After that he took up the position of Program Director of the Science and Technology Development Program at the Thailand Development Research Institute, where he conducted policy research on many issues including science and technology policy, industrial policy, S&T manpower, etc. In September 1993 he returned to his present position at the University.

Building on his long-time interest in promoting collaboration between universities and the productive sector, Dr. Chatri recently carried out research for the Asian Development Bank on university-industry linkages as part of a major research profect focusing on science and technology higher education in Thailand.

HANOI UNIVERSITY OF TECHNOLOGY
Dal Co Viet Road - Hanoi - Vietnam; Phone (84.4) 692033, 692200FAX: (84.4) 692006

From : Dr.Sc. Banh Tien Long
Vice-Rector for Research
and Post graduate training

REPORT SUMMARY

In this report the writer has briefly introduced the Hanoi University of Technology with some details as follows : potential teaching staff, graduates trained over the last 40 years, present number of students including undergraduate (long - term, short term); in - service and post graduate training, the fields offered by HUT and its orientations on the furtherance of science and development towards the year 2000.

Secondly, the report has focused on the University - Industry partnership, i.e. the link between HUT and production units recorded here by the number of students doing their practical work at the manufactures and enterprises, undergraduate theses, scholarships offered by production units, job recommendation after graduating, participation of students in scientific and research activities such as workshops, conferences, project implementation and business contract implementation related to industry.

Furthermore, the report has reviewed the problems in linkage between universities and industry, e.g. imbalance between outdated equipment and facilities of University and modern assembly lines of industry; disproportionate share of students enrolling among different fields limited financial support for students' practical work at production units; trend of concentration of graduates at the urban areas; training programmes have not met the demand of industry.

The report has provided a panoramic picture of the University - Industry partnership in Vietnam.

HANOI UNIVERSITY OF TECHNOLOGY
Dal Co Viet Road - Hanoi - Vietnam; Phone (84.4) 692033, 692200FAX: (84.4) 692006

University - Industry Partnership Vietnam Experience

Dr. Sc. Banh Tien Long, Vice-Rector for Scientific Research and Technology Transfer, Hanoi University of Technology, Hanoi Vietnam

Dear Sir / Madam,

On behalf of Hanoi University of Technology, I would like to express great thanks to you for inviting us to attend the conference on 'Colloquium on University-Industry-Government Cooperation in Quality Engineering and Technology Education on Southeast Asia for the 21st Century'. Let me present here some information about our university and 'University-Industry Partnership' in Vietnam

I. HANOI UNIVERSITY OF TECHNOLOGY

HUT was established in 1956 and will celebrate its 40th anniversary on 15 October 1996. As one of the most important technical universities of Vietnam, HUT has a good number of staff members, many of them are assistant doctors, doctors, associate professors and professors trained in foreign countries. After 40 year from its establishment, hundreds of Masters, assistant Doctors as well as over 30,000 students have been trained at HUT. At present, approximately 17,000 students are following various courses, training high technicians, engineers, post graduates, in-service training in the fields of electronic and information technology, telecommunication, mechanical engineering, electricity, energy, metallurgy, biotechnology, environmental technology, textile engineering, business management.....Besides, many Scientific-Research Projects in technology of information, materials, biology, environment, automatization, techniques applied in agriculture...are being conducted. Though suffering from a shortage of governmental training budget, good training quality at HUT is still highly regarded by industrial organizations throughout the country, Moreover, many of the universities in Vietnam which used to be part of HUT are now still receiving help from staff members of HUT as a Government University.

II. UNIVERSITY-INDUSTRY PARTNERSHIP

1. Progress

* Most students in universities of different fields such as medicine, techniques, economics...are sent to suitable places for practical training before graduation. Practical training fees are paid by universities themselves.

* Many subjects are taught by specialists from factories and industries. Practical demands of scientific research as well as technological transfer and application must be ensured in graduation projects. There is participation of producer's representatives in all graduation ceremonies.

* Examining committees are chosen at University level and Ministry level and scientific conferences are held yearly with participation of representatives from industrial producers.

* Many producers and institutes provide scholarship for bright students assuring that they work for them after graduation.

* Today, students are conscious of gaining good knowledge on informatics and foreign languages for finding future jobs.

* A 'Students with Science' week is organized annually. About 1/3 of students take part in scientific projects applied to researches and industrial manufacture including profitable ones. Over 100 scien-

tific projects and programs conducted annually at HUT are worth VND 4 billion.

* Teachers and students play an important role in carrying out contracts signed between universities and industrial producers for manufacturing products and equipment. Every year, approximately 200 contracts are signed with total value of VND 26 billion (in the year 1994) which is 3 times as much as supported fund of Government for training annually. These activities have improved real income of staff members and students as well as equipment for training.

* The issue of Vietnamese renovation policy, investment of foreign companies and modern production require staff members of good qualification. As a result, priority has been given to post graduate training.

* Universities are responsible for designing projects and feasibility studies as well as evaluating technical quality of major industrial plants such as North-South 500 kv electrical line, hydroelectric plant.....

2. Limitation

However, the gap between training and reality as well as university and industry is a big challenge to Vietnam for cooperation with South East Asian countries and the rest of the world.

* Due to limited financial resources, training equipment in universities is not in conformity with market economy requirement of modernized and advanced technology. Training quality in Vietnam, as a result, does not meet the demand of society's practical need.

* Due to influence of working opportunity and unsatisfied salary of Government most of students register for training courses in electronic, informatics, food engineering and business management whereas the number of students following training courses in mechanical engineering, metallurgy and chemistry is reduced considerably though still badly needed in industrial factories. Besieds, graduated students only want to work in big cities and industrial centres while no available opportunities are provided for them to find right jobs. These lead to unequal proportion in training in put, out put and staff distribution as well as a big challenge in process of industrialization and modernization of the country (for example: every year, chemical, metallurgical, mechanical manufacturing industries need about 400-500 engineers and it is increasing in the future, but at this time every year only 50-70 students in those fields are graduated from HUT.)

* In comparison with equipment of many industrial bases and private ones, those of universities for training and doing researches are too backward.

* Though facing many difficulties, univesities have to meet all the costs for training students, Masters and Doctors without any contribution from industrial organizations.

* Training curriculum in universities do not really meet the demand of modern industry and multi-sector economy. In order to help Vietnamese universities merge with others in South East Asia and the whole world, the linkage requires not only best teachers but necessary equipment and documentation.

* Those mentioned above are only main features of "University-Industry Partnership" of Vietnamese universities in general and of HUT in particular. Other universities will have their own features. I however, hope that through provided information, you can have an overall view on our status.

We would like to expand cooperation with other universities in South East Asia and the rest of the world in training, scientific research, training-industry partnership, Government policy for such partnership as well as science and technology development. We sincerely hope that our cooperation will get better in the future.

Thank you very much. We look forward to meeting you at HUT.

SCIENCE AND TECHNOLOGY IN INDIA
&
UNIVERSITY-INDUSTRY RELATIONSHIP

P.N.Srivastava
Nuclear Science Centre, J.N.U. Campus, New Delhi, India

When India got its freedom in 1947, we had only a few obsolete textile mills and sugar factories in the name of technology and produced almost nothing of what the country needed. Today almost every basic requirement of country is produced indigenously.

In 1947, with regard to technical education, we had 38 institutions at degree level with an intake of 2,940 students and 53 institutions at diploma level with an intake of 3,670 students. As compared to that of today, there are 372 technical institutions at degree level and 958 institutions at diploma level with an intake of 88,930 and 152,554 respectively. These include regular engineering colleges, polytechnics, Indian Institutes of Technology, Regional Colleges of Engineering and other institutions.

With regards to science and technology, the Indian Parliament has adopted a number of very important basic policy documents. The Science Policy Resolution of 1958 states that "The key to national prosperity, apart from the spirit of the people, lies, in the modern age, in the effective combination of three factors, technology, raw materials and capital, of which the first is perhaps the most important, since the creation and adopting new scientific techniques can, in fact, make up for a deficiency in natural resources, and reduces the demand on capital. But technology can grow out of the study of science and is applications".

This was followed by the Technology Policy Statement in 1983 which laid stress on "self-reliance" and stipulated that "technology acquisition from outside shall not be at the expense of national interest. Indigenous initiative must receive due recognition and support".

The new Industrial Policy announced in 1991 emphasises on "self-reliance and development of domestic technology through investment in R&D. 'Self-reliance' here implies the ability of Indian industries to pay for inputs through its own foreign exchange earnings". In a major shift from the policy on public sector, it specifies that "Public sector will continue to play a pivotal role in technology development and building of manufacturing capabilities in areas which are crucial in the long-term development of the economy and where private sector investment is inadequate".

There are two levels for the management of Indian technical education. The All India Council of Technical Education is basically responsible for planned and coordinated development of technical education, promotion of qualitative improvement and regulation and maintenance of norms and standards. The University Grants Commission also plays some role since it finances 32 University departments dealing with higher education in engineering. At the second level, most of the state governments have their own Directorate of Technical Education. However, the academic control of state level engineering colleges rests in universities to which they are affiliated.

For technological development, a strong science and technology base is required. In a highly competitive market innovation, adaptation and upgradation of technology is very essential and for this University-Industry interaction is very necessary. This, however, has been unfortunately weak in India as yet. The Government of India has shown its deep concern. The Human Resource Development Ministry of the government has very recently set up synergy groups comprising of representatives from each field for strong links between government, educational institutions and the industry.

BIODATA
Professor P.N. Srivastava

Professor P.N. Srivastava received his education in the University of Allahabad from where he received his M.Sc. and D.Phil. Degrees. He did his post-doctoral and advanced research work in Dalhousie University, Canada; Yale University, USA; National Institute of Radiological Sciences, Japan; Christie Hospital & Holt Radium Institute, UK; Italian Atomic Energy Agency, Casaccia; etc. He held Visiting Professorship in U.S.A., Germany and Japan.

Professor Srivastava held faculty positions in the University of Allahabad, University of Rajasthan, Jaipur and Jawaharlal Nehru University, New Delhi. He was Pro Vice-Chancellor and Vice-Chancellor (1982-1987), Jawaharlal Nehru University, New Delhi. He was Member of the Planning Commission (status: Minister of State), Government of India, New Delhi, from 1987 to 1990.

Professor Srivastava has been elected Fellow of many national and intenational academies such as National Academy of Sciences of India; Indian National Science Academy; National Academy of Medical Sciences, India, Royal Microscopical Society, U.K.; Linnean Society, U.K. and Foreign Member of the New York Academy of Sciences, U.S.A.

Among the many awards that Professor Srivastava has received, mention may be made of the Federation of India Chamber of Commerce and Industry Award (1984); Institute of Oriental Philosophy Award, Japan (1986); Aryabhata Medal of Indian National Science Acadmy (1989); J.C. Bose Award (1990) of the University Grants Commission; K.N.Bahl Gold Medal (1990) of Indian Society of Biosciences; Atma Ram Award (1992) of Ministry of Human Resource Development; Royal Foundation Award (1994) and Japanese Academy of Medical Sciences Medal (1994).

Of the major honours received by Professor Srivastava include Professor Emeritus for Life, Jawaharlal Nehru University, New Delhi; President Section of Zoology, Indian Science Congress (1977); President Section of Biological Sciences (1978), National Academy of Sciences: General President, Indian Science Congress (1993-94); President, Indian Society of Development Biology (1979-81); Founder President Indian Society of Radiation Biology (1989-91); General Secretary (1982-87) and President International Council of Scientific Development, Heidelberg, Germany; Member, Executive Council, International Union of Biological Sciences (IUBS), Paris (1988-91); Chairman, National Commission of IUBS, India (1991-94); Member, Committee for the Formulation of National Policy of Education, Government of India, (1985-86) and its plan of Action (1986 and 1992); Member of the Expert Group for the establishment of Nuclear Science Centre, New Delhi; All India Council of Technical Education, New Delhi and Indira Gandhi National Open University, New Delhi.

ENGINEERING EDUCATION IN THE UK: LINKAGE WITH INDUSTRY

BY

Eur Ing Professor John Roberts, BSc(Eng) PhD C.Eng, FIStructE, FICE, FIMgt, FRSA, MICT
Dean of Technology, Kingston University

Abstract

In this paper Professor Roberts explains how links with industry can be used to enhance the learning experience of students and develop both the staff and resources available for course delivery. He explains the various contributions which people from industry can be expected to make, including:

- the provision of supervised work experience
- appointment as Visiting Professor
- Participation in Group Design Projects
- acting as industry mentor
- contributing to industrial advisory committees
- teaching on a part-time or fractional contract basis
- contributing to postgraduate activities such as short courses and MScs

The paper also points out the contribution which can be made to the research and consultancy activities of the Faculty which can develop both the academic staff and physical resources. Attention is also paid to the development of industry contacts through the Alumni of the Faculty.

Introduction

It is essential for education and industry to work together. Universities need to be clear and up to date about the needs of industry and be prepared to adapt courses to keep them relevant. A specific challenge to education is to extend the assessment process to cover transferable skills, that are of interest to employers, rather than limit the process to assessment of academic ability. Employers, for their part, need to recognise the aims of universities and to maintain involvement in the education process.

This paper highlights some of the ways in which the UK Engineering industry interfaces with universities and helps to ensure that Engineering education is kept relevant and up to date.

Supervised Work Experience

Supervised work experience is used within sandwich courses to provide undergraduates with periods of employment in an industry relevant to their degree programme. Historically two types of sandwich course have been run in the UK, the "thin sandwich" in which students spent two separate six month periods in industry, and the "thick sandwich" in which the students spend a full year in industry. Predominantly it is the "thick sandwich" approach that is currently implemented in the UK.

The basis of successful periods of student placement must be a clear understanding by both the employer and student of what is expected by each party. Most universities would provide the employer with a guidance document spelling out what is expected of them and what a student can be expected to contribute. Students working in industry need to be visited by tutors during the placement and have contact numbers where help, if required, can be obtained for the University.

Students benefit enormously from their period in industry which normally results in enhanced motivation and commitment to their subject. A salary is paid to the students which helps to finance the completion of their studies. Very often an employer will decide to employ students they have seen during an industrial training period once they have succesfully completed their undergraduate studies.

Many UK students are therefore happy to follow the Sandwich and recognise three main incentives:

- the better employment prospects that are offered to sandwich students
- the prospect of a real income rather than a student grant
- the ability to apply knowledge and skills to real situations

Experience has also shown that students who have completed a year in industry return to university with greater maturity and confidence. In most cases they are more highly motivated because they now see the relevance of subjects.

Industry Mentors

A variation on industrial contact practised by some universities in the UK is the appointment of industry mentors. Each student is appointed a mentor in industry, often for the duration of the course. The mentor is expected to remain in contact with the student, provide general help and encouragement, and arrange opportunities for site visits etc. Potentially this is a very powerful interface with industry but presents major logistical problems when there are large numbers of students on a particular course. Increasingly, industry is also reluctant to dedicate the time of professional staff to an activity which does not help their business in the short term.

The approach is more easily applied to postgraduate courses on which the number of students is generally lower and the relationship can focus around a project which can be seen to benefit the employer directly.

Industrial Advisory Committees

Liaison with industry takes a high priority in many Schools of Engineering. Regular discussions take place between the Advisory Committee and the respective school. It is important to constitute the membership of such a committee so that is represents all segments of the industry which the course serves. Local needs must also be properly considered with key figures from local industry contributing.

Information can be exchanged on a range of activities including the development of new courses and activities. Informal discussion is facilitated by members showing particular interest in certain topics and relating to members of the academic staff on a one to basis.

Through such interchange the University department becomes more aware of industries' requirements and is better able to prepare the next cohort of students for employment.

Alumni

The establishment of a strong Alumni group associated with a course can provide powerful support for the subsequent development of the course. By definition past graduates have a direct interest in their college and can see how their learning experience has equipped them for the particular branch of the profession they have joined. Regular contact with Alumni can therefore be part of a continual process of updating course content to reflect the needs of industry.

A variation on this approach can occur with postgraduate courses where a clearly identifiable group of employers can send a number of employees on a course over a period of years. This employer group can provide a valuable input into the meeds of a course and can help to update and contribute to subsequent delivery.

Visiting Professors

Visiting Professors are often appointed to support Engineering departments. Invariably such appointments are offered to very senior figures from industry who have demonstrated exceptional skills and competence in their area of expertise. Typical roles for a Visiting Professor in the UK might include:

- giving a high profile professional lecture to a specially invited audience
- contributing individual specialist lectures within the normal teaching of the academic department
- acting as an assessor and critic for special design activities or other innovative exercises
- supervising Group Design exercises in which students make a prolonged contribution in a specialist role
- facilitation site visits and special initiatives

Teaching

Experienced individuals working in industry can provide a valuable resource to supplement the teaching offered by full time academic staff and compliment and extend the range of skills available in a department. There are a number of ways of involving people from industry in teaching:

- as a guest lecturer on a selected topic on a one off basis
- to teach a programmed block of a course
- to make a regular contribution to teaching on a fractional or part-time basis
- as a Supervisor for a project or specific task
- by contributing and assessing Group Design exercises

Group Design Projects

Group Design Projects provide an excellent opportunity for industry to influence the education of undergraduates. The purpose of such projects is to provide opportunities for students to work in a design team just as they would in industry. Each student is assigned a specific role or function within the design team to which they are assigned. Industry can help by:

- defining the project brief for the exercise
- providing staff to act as consultants to the design teams
- assessing the outcomes including listening to presentations etc

Projects of this type are often difficult to assess but are vital if students are to understand the dynamics of working as a team.

Accreditation

Professional accreditation is an important aspect of Engineering courses in the United Kingdom. The Engineering Council provides the over-arching framework for accreditation which is then delegated to the Professional Institutions for implementation. Both the Engineering Council and the Professional Institutions are representative of industry which therefore has a very direct input into the academic standards and subject coverage expected of Chartered Engineers.

Each engineering department in the UK is visited by an accreditation party of academics and industry representatives every five years and receives a detailed report commenting on the strengths and weaknesses of the department. Where an appropriate standard is not maintained by a department professional accreditation can be withdrawn.

Validation

It is common in UK Universities to hold a validation event for new courses and when courses are reviewed-typically at five year intervals. The purpose of a validation event is to ensure that a course team has addressed all relevant issues in developing or reviewing a course and that the course is educationally sound and meets the needs of industry.

In preparing for the validation event the course team would be expected to consult with industry regarding the content and industrial relevance of a course and incorporate the feedback within the review *documentation.* The validation panel would include representatives from industry who would further question and investigate the course proposal.

Research

In the UK research in universities has to be focused to meet the needs of industry. An academic is unlikely to receive a research grant from a funding council unless at least 25% of the cost of the project is met by industry . This approach is intended to ensure that the academic has a customer for the work. Other initiatives, such as the Technology Foresight Programme, are intended to ensure the UK research is conducted in support of the National Economy.

A variation on Technology transfer from universities into industry is the 'Teaching Company Scheme' which in the UK is funded by the funding council and the Department of Trade and Industry.

In this scheme money is made available to assist with funding a good graduate to work typically 80% of the time in industry and 20% in the university on a specific project involving technology transfer from the university to the particular industry. The result is a powerful partnership which benefits the industry by the application of new technology to the solving of a particular problem and the University by providing a "real" challenge to which the academic staff can apply their knowledge and skills.

Consultancy

Few commercial organisations in the UK now retain large Research and Development organisations, preferring to buy in specialist support when required. This approach provides opportunities for academic staff to provide specialist consultancy support to industry which assists industry in meeting its objectives and keeps academics up to date and provides case studies that can be fed into the teaching programme.

Short Courses

Short courses are an important interface between the academic community and industry. Traditionally, industry looked to universities as centres of excellence to which staff were sent on courses but increasingly industry in the UK prefers to "buy in " expertise from the univesity to contribute to in house courses. The best and most successful short courses are often a blend of contributions from both Academia and Industry.

Summary

In the UK there are a number of routed by which the views of industry influence and change activities in univesities. By and large the relationship is a symbiotic one and both parties benefit. There are, however, dangers that both sides must recognise, In particular, as technology develops, there is a continual need to update and include new material into already crowded courses. It is often much easier to identify what needs to be added than to specify what can be left out. Industry is also prone to specify the person they need now rather than have a vision, which the univesity must have, of the person they will need in the future.

The general conclusion must be that in the UK the best examples of good practice show the very positive benefits that can accrue from a close and open relationship between Industry and Universities.

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BIODATA

Eur Ing Professor John Roberts

BSc (Eng), Ph.D. C.Eng, FIStructE, FICE, FIMgt, FRSA, MICT.

Professor Roberts spent the first 19 years of his career working in research and development with the Cement and Concrete Association and the British Cement Association before taking up an appointment on the 1st July 1988 as Mowlem Professor and Head of the School of Civil Engineering at Kingston University. It March 1992 he was appointed Acting Dean of the Faculty of Technology and was subsequently appointed Dean on 1 January 1993. The Faculty has a complement of 163 academic, technical and administrative staff and some 2400 students. It comprises of four schools, namely, Civil Engineering, Mechanical, Aeronautical and Production Engineering, Computing and Electronic Systems Engineering and Information Systems. The Faculty of Technology generates a total income approaching £10M and as such is the largest income generator in the University.

Professor Roberts has extensive experience of work on British Standards and Codes of Practice and was a contractor in the production of a draft Code of Practice sponsored by the Property Services Agency. (BS5628 Part 2). Additional representational work has included sitting on project steering committees for bodies such as CIRIA, liaising with government bodies, BMP, NHBC, BEC, and with industry. He has been very much involved in European activities including Eurocodes, CEN, ISO, RILEM, and CIB. Recent representational roles include the following.

Chairman, ICE Eurocode 6 Working Party
Chairman, CEN TC125/WG1/TG4
Chairman, CAB 11/6
Chairman, CIB W67 Working Party on High Thermal Insulation
Chairman, B519/1
Member, B525
Member, BDB 2
UK expert on ISO TC 179
Member, RILEM LUM 76
Leader of UK delegation to CEN TC250/SC6 (Eurocode 6)
Member, CIRIA Project Steering Committee RP354
Member, NCBMP Technical, Commercial and Legislative Committee
Honourary Auditor of Thames Valley Branch of the ISE
Council member of BMS and Chairman of Meetings Committee
Member, Joint Board of Moderators
Council member of the Engineering Professors Council
Member of the ISE Education Task Group
Chairman of the Association of the Heads of Civil Engineering
Chairman KU Civil Engineering Alumni Association

He is the co-author of four books and over 50 papers and articles. In 1976 he was awarded the Henry Adams Bronze Medal by the Institution of Structural Engineers.

COLLOQUIUM ON UNIVERSITY-GOVERNMENT COOPERATION IN QUALITY ENGINEERING AND TECHNOLOGY EDUCATION FOR SOUTHEAST ASIA IN THE 21ST CENTURY

At Suranaree University of Technology

27 and 28 July 1995

UNESCO UNISPAR PROGRAMME

UNIVERSITY-INDUSTRY-SCIENCE PARTNERSHIP

UNESCO UNISPAR PROGRAMME

by Dr. Y. Aoshima
Officer-in-Charge of the UNESCO UNISPAR Programme
Engineering and Technology Division
Science Sector, UNESCO

I. Introduction

UNISPAR is the abbreviation of University-Industry-Science Partnership. In today's world, people discuss many issues relating to technology-led industrialization, human resources development, sustainable development, environmentally sound technology, environmental preservation, technical co-operation among developing countries, technology, transfer, energy, etc. How should UNESCO (United Nations Educational, Scientific and Cultural Organization) respond to the needs of the world? Technology-led industrialization has become a main issue in Third World countries as well as eastern and central Europe. When the issue of industrialization is raised, another United Nations specialize agency, the United Nations Industrial Development Organization (UNIDO), may look at this issue from industry's point of view. UNESCO's reaction is to ask "How can academia contribute?" Industrialization of a country will not take place without human resources development and technology transfer. UNESCO believes that university co-operation can be a valuable strategy in the process of industrialization of developing countries. A university has three functions: education, research and services. However, in developing countries engineering universities do not participate sufficiently in the process of industrialization of their country. UNESCO's effort should be aimed at encouraging local universities to be more involved in the process of industrialization and at attracting industry towards co-operation among universities, in dustryand research institutes.

The 27th Session of the General Conference of UNESCO in 1993 approved the UNISPAR (University-Industry-Science Partnership) Programme. All UNESCO Engineering Science activities related to co-operation among universities, industry and research institutes have now been grouped under the umbrella of the UNISPAR Programme. This aims at promoting international co-operation in networking and in information dissemination and in promoting within UNESCO Member states identification and implementation of joint projects between university-industry at national, regional and international levels. The main objectives of the UNISPAR Programme are the following:

1. Adaptation of university engineering education to industrial needs.
2. Promotion of partnerships between universities and industry for the retraining of practicing engineers (continuing engineering education).
3. Identification of effective ways and means of improving the transfer of research results to industry.
4. Assistance to UNESCO Member States in creating or strengthening effective university-industry-science co-operation.

UNESCO and UNIDO have recently agreed to take joint action in the promotion of human resources development and technology transfer and in the enhancement of co-operation between science and industry in development countries.

II. Strategies of the UNISPAR Programme

There are three strategies of the UNISPAR Progrmme. These are; (1) organization of conference; (2) establishment of UNISPAR working groups in various countries and (3) development of database.

(1) Conferences on University-Industry Co-operation

In the past, UNESCO organized a series of International Congress of Engineering Deans and Industry Leaders. The first symposium was held in Ohio in 1989, followed by the second international symposium in Paris in 1991. The Third International Congress was jointly organized by UNESCO and the International Union of Technical Associations and Organizations (UAIT) in June 1993 at UNESCO House in Paris. The congress attracted 296 representatives of engineering universities/colleges, industry, research institutes and engineering associations/federations from 53 developing countries.

UNESCO encourages and promoted regional conferences on the topic of university-industry interaction. In fact, at Puebla in Mexico "Second Mexican International Conference of Dean of Engineering and Industry Leaders" was organized in February 1994. In Cairo, "The First International Conference on University-Industry Interaction" was held in March 1994. In Belgium, "The East-West European Seminar: Technology Transfer from University to Industry" was held in May 1994. In Poland, "The National Polish Conference of Engineering Deans and Industry Leaders" was held in September 1994. In Italy, 'the Seminar on New Possibilities for Co-operation among Industries, Public Research Centers and Universities: Joint Ventures for Research and Development" was held in November 1994. In India, 'the International Conference on Engineering Education - An Indian Perspective" was held in November 1994. In Mexico, "Mexican, Central American and the Caribbean Conference of Deans of Engineering and Industry Leaders" was held in February 1995. Similar conferences are under preparation in Vietnam and in Australia in July 1995, in Trinidad and Tobago in September 1995 and E1 Salvador in November 1995 as well as in Vietnam, Papua New Guinea, Poland, Iran and Turkey in 1996.

UNESCO is organizing, with UNIDO, the International Union of Technical Associations and Organizations (UATI) and the world Federation of Engineering Organizations (WFEOO, the World congress of Engineering Education and Industry Leaders at UNESCO House on 2 - 5 July 1996 within the framework of the commemoration of the 50th anniversary of UNESCO. The Congress will summarise the results of national and regional conferences and discuss on-going projects and the identification of new ones rather than conceptual discussions.

(2) UNISPAR Working Groups

To organize conference is one thing, but to ensure follow-up action is another thing. Conferences are like fireworks and people may easily forget the issues of the discussion once the conferences have terminated. For this reason, UNESCO encourages the organizer of the conference to establish a UNISPAR regional working group as a permanent body in order to ensure the implementation of the recommendations of the conference.

UNESCO is establishing through UNESCO Regional Office UNISPAR's regional working groups in various regions. University people and industry managers will be the members of these regional working groups and will identify and implement their national and regional university-industry joint projects. The first UNISPAR regional working group has been established in Egypt and the second and third are being set-up in Mexico and India. The regional working group in Egypt is financially supported by three big industry in Cairo and backstopped by the Egyptian Syndicate of Engineering and UNESCO Regional Office and they have selected "Total Quality Management" as the first pilot project for university-industry joint project. UNESCO encourages these regional working groups to establish industry sponsored UNESCO chairs.

(3) Exchange of Information

UNESCO is establishing a database "Congress Participants Directory". The database will not be printed as a so-called periodical directory (i.e. in paper form) but will be retrievable by any user through a communication network, such as INTERNET. The congress participants could contact each other without passing through UNESCO. The database will be, in the future, expanded to include persons who have not participated in the Congress but nevertheless wish to participate in the activities of the UNISPAR. The second database will be "Activities of UNISPAR Regional Working Groups and Scope of Work of terminated, on-going, and future projects".

III. The International Fund for Technological development of Africa

On the occasion of the Symposium of

Science and Technology in Africa held in Nairobi, 14-15 February 1994, UNESCO launched the first Workd Science Report of the Organization with the Director-General announced the creation of the International Funds for the Technological Development of Africa. UNESCO has made a contribution of US$1 million to this Fund for the implementation of scientific and technological projects that have immediate relevance to the African industrial development. These projects would constitute the African component of the UNISPAR Programme. A donor's conference was held at Arusha in Tanzania in December 1994 and 9 university-industry joint projects were approved as the first year project, which are;

1. Avocado Oil Extraction and Avocado Seedcake Project in Kenya
2. Accelerated Promotion of Biogas Technology in Zimbabwe
3. Gum Technology for the Preservation of Cassava in Ghana
4. Bioassay Directed Evaluation of Traditional Medicinal Plants of Zimbabwe Potential for Commercialization
5. Pilot Scale Commercial Extraction of Celluloses for Certain Agricultural Wastes in Nigeria
6. Utilization of Sisal Waste for the Producation of Chemical Feed Stocks in Tanzania
7. Development of Rural Areas through Export of Natural Products in Ghana
8. Transformation of Tomato to various Derivatives in Togo
9. Development of Pentadiplandra Brazzeana in Cameroon

IV. UNESCO Model: University Twinning-Industry-sponsored UNESCO Chairs

The last two decades have seen a domino phenomenon of industrialization in Asia and the Pacific region. Japanese foreign direct investment (FDI) stimulated the Asian Newly Industrializing Economies (NIEs), which in turn are now investing their capital in other countries in the region. Asia and the Pacific has encouraged foreign direct investment more than any other developing region and this has brought to the host contries increase opportunities for the greater particpation of firms from developed and newly industrialized economies as well as new technology.

UNESCO UNITWIN Programme and its associated UNESCO Chairs Scheme aims at strengthening inter-university co-operation with particular emphasis on support for higher education and science in developing countries. The key objective of the plan is the development of a spirit of solidarity, based on twinning, networking and other linking arrangements, among universities throughout the world, It is aimed at making full use of North-South and East-West co-operation, especially along the North-South axis. UNITWIN will support (i) existing higher education network, (ii) management and academic staff development, (iii) university and scientific libraries, (iv) higher-level distance education and (v) the UNESCO Chairs Scheme. UNESCO Chairs are professorships established by UNESCO in conjunction with other institutions or funding agencies. So-called UNESCO Professors are eminent specialists in higher education and science and help, mainly in developing countries, to ensure the transfer of knowledge via their teaching and research. UNESCO Chairs are considered as complementary to fellowships in terms of human resources development and technology transfer and becoming note-worthy because of their cost efficiency and wider impact.

The UNESCO Model for promotion of university-industry co-operation in developing countries is an industry-sponsored UNESCO Chair supported by UNITWIN. On the basis of university twinning between technical universities in industrialized developing countries, UNESCO encouraged to establish a UNESCO Chair at a university in developing country. The chair will be financed by foreign industry and backstopped by the university in industrialized country.

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List of Participants

SPEAKERS

No	Country	Institute	Position	Title/Name
1	France	UNESCO	Assistant Director General for Science	Dr.A. Badran
2	Thailand	Asian Institute of Technology	President	Dr.Alastair M. North
3	Philippines	University of the Philippines	Former Dean, College of Engineering	Prof.Dr. Ruben Garcia
4	Vietnam	Hanoi University of Technology	Vice Rector for Research	Dr.Banh Tien Long
5	India	Nuclear Science Center	Former Vice-Chancellor	Prof.Emeritus P.N. Srivastava
6	England	Kingston University	Dean, Faculty of Technology	Prof.John Roberts
7	Thailand	The National Economic and Social Development Board	Chairman	Prof.Dr.Sipphanondha Ketudat
8	Thailand	Ministry of University Affairs	Deputy Permanent Secretary, MUA	Assoc.Prof.Dr.Vanchai Sirichana
9	Thailand	The Brooker Group Ltd.	President	Dr.Peter Brimble
10	Thailand	Chulalongkorn University	Faculty of Engineering	Dr.Chatri Sripaipan
11	France	UNISPAR, UNESCO	Officer-In-Charge	Mr.Y.Aoshima
12	Malaysia	Universiti Teknologi Malaysia	Deputy Vice-Chancellor (Development)	Prof.Dr.Elias B.Hj. Salleh
13	Thailand	Embassy of Israel	First Secretary, Commercial Affairs	Mr.Geva Dov
14	Thailand	SEAMEO RIHED	Director	Dr.Tong-In Wongsothorn
15	Thailand	Suranaree University of Technology	Dean, Institute of Industrial Technology	Asst.Prof.Dr.Tavee Lertpanyavit
16	Thailand	United Nations		Dr.Fedorov

Colloquium Participants

No	Country	Institute	Position	Title/Name
1	Indonesia	Tarumanagara Univ.	Lecturer	Ir.MM Surya Rudy
2	Indonesia	Tarumanagara Univ.	Dean, Faculty of Engineering	Dipl.Ing Tjahjadi Eduard
3	Indonesia	TELKOM School of Engineering	Chairman	Dr.Taufik Hasan
4	Indonesia	TELKOM School of Engineering	Vice Chairman for Student Affairs	Mr.Soewono
5	Philippines	Ateneo De Manila Univ.	Instructor	Mr.James Bernaro Simpas
6	Philippines	Ateneo De Manila Univ.		Prof.Dr.Fabian M.Dayrit
7	Philippines	Wesleyan Univ.-Philippines	Member,Board of Trustees	Ms.Mariano Liz
8	Philippines	Wesleyan Univ.-Philippines	Asst.Prof. III	Prof.Cleto Nelya
9	Philippines	Bulacan State Univ.	President	Dr.Pimentel Rosario
10	Philippines	Technological Institute of the Philippines	MCF President	Dr.Quirino Antonio
11	Thailand	Assumption Univ.	Associate Dean	Dr.Win Tin
12	Thailand	Assumption Univ.	Instructor	Miss Rungsri Wongvitavas
13	Thailand	Chulalongkorn Univ.	Director,Petroleum and Petro-	Prof.Somchai Osuwan
			chemical College	
14	Thailand	Dhurakijpundit Univ.	Acting Head, School of Industrial	Mr.Suphalatchai Vorarat
			Engineering	
15	Thailand	Dhurakijpundit Univ.	Dean, Faculty of Engineering	Dr.Archaamphon Khumphanondha
16	Thailand	Electricity Generating Authority of	Engineer Level 9	Mrs.Champasak Uruyos
		Thailand		
17	Thailand	Electricity Generating Authority of	Engineer Level 7	Miss Pathnee Bumbudsanpharoke

Colloquium Participants

No	Country	Institute	Position	Title/Name
		Thailand		
18	Thailand	Indonesian Embassy	Attache for Education	Dr.Suwarslh Madya
			and Culture	
19	Thailand	King Mongkut's Institute of Technology	Lecturer	Mr.Attason Soontornchati
20	Thailand	King Mongkut's Institute of Technology	Lecturer	Mr.Ming Lokitsangtong
21	Thailand	Prince of Songkla Univ.	Dean, Faculty of Engineering	Asst.Prof.Dr.Surapon Araykul
22	Thailand	Rajamangala Institute of Technology,	Asst.Director of Bachelor's degree	Mr.Amarit Surasit
		Northern Campus	studies	
23	Thailand	Siam Univ.	Vice President for Research,Dean	Prof.Dr.Smith Kampempool
			of Engineering Faculty	
24	Thailand	Sripatum Univ.	Head of Mechanical Engineering	Dr.Bundit Limmeechokchai
			Department	
25	Thailand	Telephone Organization of Thailand		Miss Phanapas Chitaphu
26	Thailand	Telephone Organization of Thaialnd	Instructor 8	Mr.Aram Leorak-O-Ran
27	Thailand	Telephone Organization of Thailand	Senior Manager	Mrs.Sudaporn Vimolseth
28	Thailand	Telephone Organization of Thailand	Human Resources Officer	Mrs.Isara Fongsaran
29	Thailand	Thammasat Univ., Faculty of Engineering	JICA Expert at Faculty of	Mr.Keiji Higa
		(JICA Project Office)	Engineering	
30	Thailand	Thammasat Univ., Faculty of Engineering	JICA Expert at Faculty of	Dr.Hiroo Niyama
		(JICAProject Office)	Engineering	

Colloquium Participants

No	Country	Institute	Position	Title/Name
31	Thailand	Thammasat Univ.,Faculty of Engineering	JICA Expert at Faculty of	Dr.Yutaka Yoshitani
		(JICA Project Office)	Engineering	
32	Thailand	The Siam Cement Co.,Ltd.	Engineering	Mr.Wittawat Nilasena
33	Thailand	The Univ. of the Thai Chamber of	Dean,Faculty of Engineering	Dr. Djakkrit Puranasamriddhi
		Commerce		
34	Thailand	Rajamongkol Pathumthanee		Nakawiwat Kanokphol
35	Thailand	Rajabhat Institute Phranakorn		Asst.Prof.Wichai Vanpetch
36	Thailand	Rajaphat Kanchanaburi Institute	Instructor Program Technology	Paiyon Mongkarotai

SEAMEO RIHED

No.	Country	Institute	Position	Title/Name
1	Brunei Darussala	Universiti Brunei Darussalam	Vice-Chancellor	Dato Abu Bakar Apeng
2	Cambodia	Ministry of Education, Youth and Sport	Director, Dept.of Higher Education	Mr.Pich Sophoan
3	France	International Association of Universities (IAU)	Secretary-General	Dr.Franz Eberhard
4	Lao	Ministry of Education	Deputy Director, Dept. of Vocational Technical	Mr.Thammarath Nakhavith
			Higher Education	
5	Malaysia	Ministry of Education	Principal Asst.Secretary, Higher Education Division	Ms.Mimi Ismail
6	Malaysia	Ministry of Education	Deputy Secretary General 1	Nuraizah Binti Abdul Hammid
7	Philippines	Commission on Higher Education	Commissioner	Dr.Mona D.Valisno
8	Singapore	National University of Singapore	Dean,Faculty of Arts&Social Sciences	Assoc.Prof.Ernest C.T.Chew
9	Thailand	Ministry of University Affairs	Director,Bureau of Private Higher Education	Dr.Chantavit Sujatanond
10	Thailand	ASAIHL	President	Dr.Ninnat Olanvoravut
11	Thailand	Ministry of Education	External Relations Officer	Mr.Churairat Songboonnum
12	Thailand	SEAMEO RIHED	Director	Dr.Tong-In Wongsothorn
13	Thailand	SEAMEO RIHED	M.I.S. Officer	Mr.Andrew Lamb
14	Thailand	SEAMEO RIHED	Assistant Administrative	Ms.Chutima Chamnanwetchakit
15	Thailand	SEAMEO RIHED	Executive Secretary	Ms.Fonthong Puangsawat
16	Thailand	SEAMEO RIHED	Data Entry Officer	Mrs.Sompit Sangkatip
17	Thailand	SEAMES	Director	Dr.Ashanbin Clu Mat
18	Thailand	SEAMES	Deputy Director	Dr.Padoongchart Suwanawongse
19	Thailand	SEAMES	Asst. Director (Finance)	Ms.Prapaporn Agamanon
20	Vietnam	Ministry of Education and Training	Director,Dept. of Higher Education	Lam Quang Thiep
21	Thailand	UNESCO	Programme Specialist	Prof.Dr.Wang Yibing

COLLOQUIUM PARTICIPANTS
(AUAP MEMBERS)

No.	Country	Institute	Position	Title/Name
1	Australia	Australian Vice-Chancellors Committee	Director, International Relation	Dr. John Scutt
2	Australia	Deakin University	Director, for the Vice-Chancellor	Prof. Lindsay D. Mackay
3	Australia	Edith Cowan University	Dean, Faculty of Science, Technology & Engineering	Prof.John Renner
4	Australia	James Cook University of North Queensland	Head, Department of History & Politics	Prof. Keet Kennedy
5	Australia	The University of Sydney	Vice-Chancellor and Principal	Prof. Donald McNicol
6	Australia	University of Melbourne	Deputy Vice-Chancellor (Academic)	Prof. Schedvin Carl Boris
7	Australia	University of Technology, Sydney	Vice-Chancellor and President	Prof. R.D. Guthrie
8	Australia	University of Wollongong	Pro-Vice-Chancellor (Research & International)	Prof. W. J. Lovegrove
9	China	Wuhan University of Hydraulic and Electric Engineering	President	Prof.Gong Xunjie
10	China	Yunnan University	Deputy Director of Personnel Division	Mr. Ma Jie
11	China	Yunnan University	Director of Personnel Division	Mr. You Qingzhang
12	China	Yunnan University		Prof. Jian Yinlian
13	China	Guizhou University	President	Prof. Zhu Kai-Cheng
14	China	Guizhou University	Vice-President	Prof. Zhang Geng-Guang
15	China	Guizhou University	Director of Foreign Affairs Depart	Prof.Mao Jian-Lin
16	Hong Kong	The University of Hong Kong	Pro-Vice-Chancellor and Acting Vice-Chancellor	Prof. W.I.R. Davies
17	India	Cochin University of Science and Technology	Vice-Chancellor	Dr.Kenoth Govindan Adiyodi
18	India	Gujarat Vidyapith	Vice-Chancellor	Prof. Ramlal Parikh
19	India	Indira Gandhi National Open University	Pro-Vice-Chancellor	Prof. Janardan Jha
20	India	Panjab University	Vice-Chancellor	Prof. T.N. Kapoor
21	India	University of Delhi	Vice-Chancellor	Prof. V.R. Mehta
22	Indonesia	Airlangga University	Rector	Prof. Dr. Bambang Rahino

COLLOQUIUM PARTICIPANTS
(AUAP MEMBERS)

No.	Country	Institute	Position	Title/Name
23	Indonesia	Brawijaya Universitas (University Brawijaya)	Vice Rector for Planning Development and Cooperation	Dr. Bambang Guritno
24	Indonesia	Trisakti University	Dean, Faculty of Mineral Technology	Ir. N.St. Nusjirwan Sutan-Assin
25	Indonesia	Trisakti University	Vice Rector for Academic Affairs	Ir. R. Karmawan Semiawan
26	Indonesia	Trisakti University	Rector	Prof.Dr.R. Moedanton Moertedjo
27	Indonesia	University of Indonesia	Rector	Prof. Dr. Mohammad Kamil Tadjudin
28	Indonesia	TELKOM School of Engineering	Chairman	Dr. Taufik Hasan
29	Indonesia	TELKOM School of Engineering	Vice Chairman in Student Affairs	Soe Wono
30	Japan	Hannan University	Professor	Prof. Mizoi Takashi
31	Korea	Seoul City University	Dean of Engineering	Dr. Myong-Jin Yu
32	Korea	Seoul City University	Staff of Planning & Research	Mr. Chan-Doo Park
33	Korea	Seoul City University	Director of Planning & Research	Dr. Sang-Bae Kim
34	Macau VIA Hong Kong	Universidade de Macau (University of Macau)	Dean, Faculty of Science and Technology	Prof.Martins Rui
35	Macau VIA Hong Kong	Universidade de Macau (University of Macau)	Rector	Prof. Mario Mascimento Forreira
36	Malaysia	Universiti Pertanian Malaysia	Dean, Faculty of Engineering	Prof. Dato Dr. Abang AlliAbang Abdullah
37	New Zealand	University of Otago	Head, International Office	Mrs. Gill Parata
38	New Zealand	University of Otago	Deputy Vice-Chancellor (Research & International	Dr. Ian O. Smith
39	Philippines	Angeles University Foundation	President	Dr. Emmanuel Angeles
40	Philippines	Adamson University	Executive Vice President	Rev. Vargas Francisco
41	Philippines	Benquet State University	President	Dr. Cipriano C. Consolacion
42	Philippines	Bulacan University	President	Rosario Pimentel
43	Philippines	Centro Escolar University	Executive Vice President	Dr. Maria Ayuyao
44	Philippines	De La Salle University	Executive Vice President	Dr. Carmelita Quebengco

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(AUAP MEMBERS)

No.	Country	Institute	Position	Title/Name
45	Philippines	Don Mariano Marcos Memorial State University	President	Dr. Corpus Manuel
46	Philippines	Gregrorio Araneta University Foundation	President	Dr. Manuel D. Punzal
47	Philippines	Holy Angel University	Registrar	Ms. Basco Corazon
48	Philippines	Holy Angel University	Dean, College of Engineering	Engr. Ruby Henson
49	Philippines	Manuel S. Enverga	Vice President	Dr. Jaime M. Buzar
50	Philippines	San Sebastian College-Recoletos	President	Rev. Fr. Victor Lluch
51	Philippines	Southwestern University	President	Dr. Alicia P.Cabatingan
52	Philippines	St. Paul University	OIC-Director, SPU Research and Development	Dr. Carmelo M. Callueng
53	Philippines	University of Cebu	Exec. Vice President	Dr. Erlinda P. Barcelo
54	Philippines	University of Negros Occidental-Recoletos	President	Rev.Fr. Constantino Real
55	Philippines	University of Northern Philippines	Vice President for Academic Affairs	Dr. Pacita B. Antiporda
56	Philippines	University of Northern Philippines	President	Dr. Dorotea Campos-Filart
57	Philippines	University of San Jose-Recoletos	President	Rev.Fr. Emeterio Bunao
58	Philippines	Wesleyan University-Philippines	President	Atty. Emmanuel G. Cleto
59	Philippines	West Visayas State University	President	Dr. Bernabe B. Cocjin
60	Philippines	Western Mindanao State University	President	Dr. Erdulfo B. Fernando
61	Thailand	Bangkok University	Assistant to the President for Planning and Development	Asst. Prof. Laksana Satawedin
62	Thailand	Chiang Mai University	Vice President, Research & Foriegn Relation	Assosc. Prof. Luechai Chulasai
63	Thailand	Chulalongkorn University	Dean, Faculty of Engineering	Dr. Narong Yoothanom
64	Thailand	Chulalongkorn University	President	Prof. Charas Suwanwela
65	Thailand	Huachiew Chalermprakiet University	Vice-President	Dr. Tongroj Onchan
66	Thailand	National Institute of Development Administration (NIDA)	President	Dr. Anumongkol Sirivedhin

COLLOQUIUM PARTICIPANTS
(AUAP MEMBERS)

No.	Country	Institute	Position	Title/Name
67	Thailand	Payap University	President	Dr. Amnoay Tapingkae
68	Thailand	Siam University	President	Dr. Pornchai Mongkhonvanit
69	Thailand	Suranaree University of Technology	Rector	Prof. Dr. Wichit Srisa-an
70	Thailand	National Technological University	Executive Director	Mrs. Doris Wibunsin
71	Thailand	UN (ESCAP)	Associate Social Affairs Office	Miss Tanaka Hiroko
72	Thailand	Walailak University		Mr.Rugchart Owasith
73	Thailand	Walailak University	Lecturer	Dr. Opas Tantithakura
74	Vietnam	University of Dalat	Dean of Faculty of Sciences and Technology	Dr. Xuan Trung Mai
75	Vietnam	University of Dalat	Vice-Rector	Dr. Huu Duc Nguyen
76	Vietnam	Vietnam Natinal University,Hanoi	President	Prof. Ngnyen Van Dao
77	Vietnam	Vietnam National University, Hanoi	Director, International Relations Department	Dr. Vu Ngoc Tu
78	Vietnam	Hanoi University of Technology	Vice Rector	Dr. Banh Tien Long

SUT PARTICIPANTS

No.	Position/Institute	Title/Name
1	Dean,Institute of Medicine	Prof.Dr.Vithoon Osathanon
2	Dean,Institute of Science	Assoc.Prof.Dr.Vutthi Bhanthumnavin
3	Dean,Institute of Social Technology	Assoc.Prof.Krich Suebsonthi
4	Lecturer,Institute of Agricultural Technology	Prof.Dr.Paisan Laosuwan
5	Lecturer,Institute of Agricultural Technology	Asst.Prof.Dr.Sunthorn Karnjanathavee
6	Lecturer,Institute of Agricultural Technology	Dr.Andrew L.Kohnhorst
7	Lecturer,Institute of Agricultural Technology	Miss Samorn Kwanthong
8	Lecturer,Institute of Agricultural Technology	Dr.Thawatchai Teekhachunhatien
9	Lecturer,Institute of Agricultural Technology	Dr.Marina Ketudat-Cairns
10	Lecturer,Institute of Agricultural Technology	Asst.Prof.Wittawat Yomjinda
11	Lecturer,Institute of Agricultural Technology	Dr.Neung Teaumroong
12	Lecturer,Institute of Agricultural Technology	Asst.Prof.Dr.Kanok-orn Intarapichet
13	Lecturer,Institute of Agricultural Technology	Dr.Bunchorn Likitdecharote
14	Lecturer,Institute of Agricultural Technology	Dr.Yuwadee Manakasem
15	Lecturer,Institute of Industrial Technology	Miss Pornsiri Chonggol
16	Lecturer,Institute of Industrial Technology	Dr.Veerachai Manophichetwattana
17	Lecturer,Institute of Industrial Technology	Assoc.Prof.Dr.Vorapot Khompis
18	Lecturer,Institute of Industrial Technology	Asst.Prof.Suyut Satayaprakorb
19	Lecturer,Institute of Industrial Technology	Asst.Prof.Dr.Sarawut Sujitjorn
20	Lecturer,Institute of Industrial Technology	Prof.Dr.Ron Goforth
21	Lecturer,Institute of Industrial Technology	Dr.Kontorn Chamniprasart
22	Lecturer,Institute of Industrial Technology	Assoc.Prof.Dr.Amnat Apichatwallop
23	Lecturer,Institute of Industrial Technology	Dr.Thanongsak Bisarnsin
24	Lecturer,Institute of Resources Technology	Dr.Guntima Polprasert
25	Lecturer,Institute of Resources Technology	Dr.Noppadol Kongsricharoern
26	Lecturer,Institute of Science	Dr.Sureeluk Rodthong
27	Lecturer,Institute of Science	Asst.Prof.Dr.Praphasri Assawakul
28	Lecturer,Institute of Science	Asst.Prof.Dr.Punnee Wara-Aswapati
29	Lecturer,Institute of Science	Dr.James R.Ketudat-Cairns
30	Lecturer,Institute of Science	Asst.Prof.Dr.Sittichok Saengsoda

SUT PARTICIPANTS

No.	Position/Institute	Title/Name
31	Lecturer,Institute of Science	Assoc.Prof.Dr.Krissana Sakarik
32	Lecturer,Institute of Science	Assoc.Prof.Dr.Thasanee Sukosol
33	Lecturer,Institute of Science	Dr.Santi Sakdarat
34	Lecturer,Institute of Science	Asst.Prof.Dr.Tritaporn Choosri
35	Lecturer,Institute of Science	Assoc.Prof.Dr.Annop Vara-assavaphati
36	Lecturer,Institute of Science	Assoc.Prof.Dr.Suwan Tangmanee
37	Lecturer,Institute of Science	Dr.Manu Omakupt
38	Lecturer,Institute of Science	Dr.Arjuna Chaiyasena
39	Lecturer,Institute of Science	Assoc.Prof.Dr.Phunsuk Sriyotha
40	Lecturer,Institute of Social Technology	Dr.Theerawit Phinyonattakarn
41	Lecturer,Institute of Social Technology	Miss Busaya Buranasin
42	Lecturer,Institute of Social Technology	Miss Kwankamon Klinsrisuk
43	Lecturer,Institute of Social Technology	Assoc.Prof.Dr.Charnchai Indhrapravadhi
44	Lecturer,Institute of Social Technology	Ms.Jiraporn Sangarun
45	Lecturer,Institute of Social Technology	Asst.Prof.Ladda Grote
46	Lecturer,Institute of Social Technology	Dr.Charlene Clements
47	Lecturer,Institute of Social Technology	Mr.Peter Hilton
48	Lecturer,Institute of Social Technology	Ms.Wilaiporn Iaprasert
49	Lecturer,Institute of Social Technology	Assoc.Prof.Dr.Prapavadee Suebsonthi
50	Staff,Center for Computer Services	Mr.Bruce Strong
51	Director, Center for International Affairs	Prof. Dr. Ruben C. Umaly

Evaluation

Questionnaire Evaluation for Colloquium

(1) How did the Colloquium get to you?

- Personal contact	6
- Post	15
- E-mail internet	1
- TV ads.	0
- other	2
newspaper	1
	25

(2) How did you travel to seminar site from Bangkok?

- Coach	1
- Train	1
- Air	15
- Private car	6
- other	-
	23

(3) How did you find your travel?

- Excellent	4
- Good	17
- Fairly good	1
- so so	1
- Never do it again	-
	23

(4) If you have to come to join the seminar at SUT again, which sort of transportation you would use?

- Coach	-
- Train	-
- Air	18
- Private car	5
- other	-
	23

(5) How much travelling information did you get from the organiser beforehand?

- Very well	1
- More than enough	5
- Just enough	8
- Not enough	3
- none	5
	22

(6) How well of the seminar registration procedures?

- Excellent	7
- Good	10
- Fairly good	1
- Just all right	2
- Must improve	2
	22

(7) How much appropriate of the seminar hall used for this meeting?

- Excellent	8
- Very good	10
- Good	4
- Just about right	1
- Not appropriate	-
	23

(8) Facilities in the seminar hall

8.1 Air conditioning

- Too cool	5
- Cool	4
- Very comfortable	14
- Warm	-
- Too warm	-
	23

8.2 Audio visual

- Excellent	7
- Very good	7
- Good	5
- Fairly good	3
- Hardly hear/see	1
	23

8.3 Lighting

- Excellent	7
- Very good	10
- Good	3
- Fairly good	2
- Could be better	1
	23

8.4 Presentation Equipment

- Excellent	7
- Very good	6
- Good	4
- Fairly good	3
- Could be better	3
	23

(9) How did the time used for each of session?

- Suitable	9
- Too long	1
- Too short	5
- Just OK	8
- Could be better	-
	23

(10) How do the discussion topics appropriate to the title of the seminar?

- Absolutely	1
- Quite well	14
- Fairly good	8
- Just about	-
- Not at all	-
	23

(11) Qualification of the speakers

- Excellent	2
- Very good	11
- Good	8
- Fairly good	2
- Could be better	-
	23

(12) What did you expect to have at the receptions?

- Typical Thai food	7
- Traditional local food	7
- Mixed cuisine	12
- European food	1
- other - non pork food	1
- diet food	1
	29

(13) For food only

13.1 Quality

- Excellent	4
- Very good	11
- Good	7
- Fairly good	1
- Could be better	1
	23

13.2 Quantity

- Excellent	3
- Very good	10
- Good	8
- Fairly good	1
- Could be better	-
	22

13.3 Services

- Excellent	4
- Very good	7
- Good	6
- Fairly good	3
- Could be better	2
	22

(14) Other comments :

- Air conditioning in bed roooms - too cold and difficult to adjust.	1
- For Colloquium activity, the organization committee can prepare direct international telephone.	1
- Thanks.	1
- International phone/fax communication inadequate.	1
- Early distribution of hand-outs preferred for pre-reading.	1
- Speaker should have used audio-visual aids to hold the attention of the audience. Lectures that are read all the way become boring and puts audience to sleep.	1
- Members of the Organization Committee and the SUT Hotel Staff were friendly and accommodating.	1
- Speakers must be notified beforehand of the time limit for paper presentation so that they do not rattle off their report due to time constraints.	1
- The paper of each speaker should be distributed after the session or on the last day due to the short time used for each session.	1
- Secretariat should see to it that all participants have copy of the papers presented.	1
- Documents should be more provided.	1
- Questions by writing should be included with the oral questions.	1
- The long queue for each meal (except breakfast) is somewhat frustration, it should have been estimated the number of participants and time needed by each to fill the plate! Otherwise the proportion and facilities are excellent.	1
- Hand-outs from other speakers could have been provided.	1