TECHNOLOGY AND EXPORT COMPETITIVENESS

Society for the Advancement of
Technology Management in the Philippines

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AND
EXPORT COMPETITIVENESS

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Organized in October 1996, the Society for the Advancement of Technology Management in the Philippines (SATMP) is a tripartite alliance of leaders in the government, industry, academe, who are committed to accelerating the technological development of the nation. In pursuit of this goal, SATMP shall:

- Act as an information resource center on new technologies, products and processess;
- Advocate policies that give priority to the development of human resource, science and technology;
- Support the commercialization of indigenous technologies and local adaptation of imported technologies;
- Initiate research cooperative ventures with the industry, goverment and academe as partners;
- Sponsor national and local forum to promote technology management; and
- Link with various local and international science and technology organizations.

The present membership of SATMP comprises of more than 100 individuals and 18 institutions, affiliated to industry, academe, and government.

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Preface

A major factor that accounts for the success of developed countries and the Asian Tiger economies is an effective management of science and technology in tandem with sound fiscal, monetary and competition policies. In the case of post-war Japan, a national innovation system that undertakes technology assessment, selection and forecasts, reverse engineering and incremental innovations, was instrumental in attaining long-term goals of improving quality in products and processes. The government nurtured corporations to achieve competitive advantage through incentives, financial and technical support, and worldwide marketing intelligence services. Korea, for her part, laid a wager on large, diversified and hierarchical chaebols, sheltered by a strong and interventionist state. Taiwan's strategy was to develop small and medium enterprises (SMEs) so that the major manufacturers can rely on them for parts and intermediate inputs.

A common feature of the development strategies in these countries is the high priority given to R&D by both private and government sectors, with the former determining the market focus and the latter providing stimuli by means of incentives and infrastructure. Competitive intelligence was used as a tool to develop products, processes and markets. The educational systems were geared towards providing the scientists, engineers and technical manpower required by the expanding industries. The investments in technology, i.e., accumulation of hardware (machinery and equipment) and software (methods, processes, systems, etc.), resulted in significant improvements in labor productivity and product quality. These developments helped define niches, expanded markets and, in turn, provided feedback mechanisms for further improvements and innovations.

Against this background, the Policy Forum on Managing Technology for Export Competitiveness explores the development challenges and options for the Philippine government and business. The imperatives are made more critical in the face of tightening competition in the global market and increasing pressure from various multilateral agencies for developing countries to open their protected markets.

This compendium contains papers presented during the Policy Forum, held on the 3rd June 1999 in Makati City, Philippines, and organized by the Society for the Advancement of Technology Management in the Philippines (SATMP) and the Philippine Exporters' Confederation (PhilExport), through the support of the United States Agency for International Development (USAID). There were five main papers presented: *Technology Management for Exporters* by Meneleo J. Carlos Jr.; *Technology Management and Export Competitiveness: Lessons from Korea and Taiwan* by Roger Posadas; *Securing Global Competitiveness through Accelerated*

Quality Improvement by Nestor O. Raneses; *Some Proposals towards Improving Efficiencies in Technology Transfer and Adaptation Process in the Philippines* by Serafin D. Talisayon; and *TRIPS Y2K: Managing Intellectual Property Rights in the Third Millennium* by Ma. Rowena R. Gonzales.

The compendium also includes the *Conference Overview* presented by SATMP Chairman Magdaleno B. Albarracin Jr., and the *Keynote Address* delivered by Congressman Leandro B. Verceles Jr., Vice-Chairman of the Committee on Science and Technology of the House of Representatives. Albarracin notes that the rigors of global competition are forcing local industries to face new market challenges which include: increasing rate of innovation, widening application of new technologies, shorter life cycles, diminishing role for unskilled labor, and constant changes in the organization of production. Critical to a firm's survival in the global market is its ability to manage technology. Verceles suggests that the government consider shifting its promotion from resource-based goods to knowledge-based services. He points out that the country has the resources that can be honed to develop comparative advantage in IT-based goods and services. But domestic technological activity in this area is sparse, hence the need for the government to stimulate it.

In his exposition, Carlos discusses the rapid changes in consumer demand and how technology can be made to respond to these changes. He highlights the importance of managing technology as an economic resource, of promoting a technology-oriented culture in the country, and of adapting technology to the demands of the consumer. Carlos notes that successful companies are those adept at selecting technology and not necessarily those that create them; and that time-to-market factor is critical to competitiveness. He calls on the private sector to invest more in R&D, and for the State to open government laboratories for collaborative research.

Posadas reviews the development experiences of Korea and Taiwan from where he culls some lessons on technology management that may be relevant to the Philippines. He elucidates on the major features of the export-led development strategies that transformed these countries into economic tigers. He places importance on the close linkages forged between the government, industry and academe, as he claims that such linkages facilitated the growth of industrial clusters — instrumental to the rapid industrial development of these two economies.

Talisayon tackles the issue of technology transfer from what he calls a "market" instead of a public policy perspective. He focuses on the motivations of technology buyers and the options available to them so they can obtain the technology they need at the most efficient manner. He notes the basic problem is that many local inventors produce technologies that do not address market demand or the requirements of technology users. Hence the challenge is to bridge the gap between what the market needs and what local technology producers generate. Towards this end, he proposes: (a) the establishment of a technology market or clearinghouse; (b) the enactment of legislation on business incubators; and (c) local adaptation of the Swedish Inventschool Model.

Raneses' paper on product quality stresses the importance of developing local standards that are aligned to global standards. He examines the strategic options for improving product quality: superior product and package designs, world class manufacturing technologies and services,

including cycle time and delivery performances, total quality management, alignment to world class product and quality system standards, benchmarking of best practices, and improvement and acquisition of new technology. But there are institutional barriers to improving product quality. To address these concerns, he recommends: (a) obtaining international accreditation of testing laboratories through ISO, IEC, and other foreign accreditation standards; (b) proliferating "best practices" to exporters; (c) "incentivizing" the cost of getting new technology; (d) removing protectionism and exposing mature industries to competition; and (e) setting up a clearinghouse of standards for manufacturers.

On the issue of Intellectual Property Rights (IPR), Gonzales raises alarm on the lack of preparedness of the country for the 1 January 2000 deadline when the Philippines has to abide by the WTO agreement on the protection of IPR. She forewarns local users of foreign creations on possible legal complaints from foreign holders of IPR and the forthcoming US Super 301 Review early next year. At the same time, she urges the government to undertake extensive information campaign on the possible impact of the IPR agreement to local users.

In a rejoinder paper, *Refocusing IPR Regimes in Developing Countries*, Adelardo Ables and Ma. Felisa Batacan relate the issues of reforming IPR regimes with concerns to generate investments and trade. They stress that as the country strives to comply with international treaties and agreements on IPR protection, it should, at the same time, ensure that adequate protection is accorded to locally produced intellectual property. They also point out a number of institutional problems that hamper the enforcement of IPR in the country.

Indeed there are critical institutional problems that have to be addressed so that the private sector can better utilize technology to attain market competitiveness. However, as the contributions in this compendium clarify, much of the work has to be done by the private sector. But given their limited resources, there is a need for greater collaboration with the government and academe to draw in more resources and help them overcome the technological constraints that weaken their competitive position.

SATMP and PhilExport believe that bringing together various sectors in a forum to discuss issues and exchange views on possible approaches to solve the problem, is a step in this direction.

ABOUT THE AUTHORS

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Ma. Rowena Gonzales is a Senior Researcher at the Institute of International Legal Studies, University of the Philippines Law Center. She is one of the Philippines' leading authorities on the subject of intellectual property rights, and has acted as editor for the World Bulletin's January-June 1996 and May-August 1997 issues regarding IPR matters.

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Ma. Felisa H. Batacan is a policy researcher for the Economic Intelligence and Investigation Bureau under the Department of Finance. She was a former investigative journalist for ABS-CBN's 'Assignment' and won the grand prize for the English novel in the 1999 Palanca Memorial Awards for Literature.

Overview of

The Policy Forum on Managing Technology for Export Competitiveness

Magdaleno B. Albarracin, Jr.

The Society for the Advancement of Technology Management in the Philippines (SATMP), the Philippine Exporters Confederation (PhilExport) and the United States Agency for International Development (USAID) are privileged to host the Policy Forum on Managing Technology for Export Competitiveness.

This forum is a venue for ventilating ideas on how best to harness technology as a strategic economic resource. It has well been recognized that the key resource in attaining competitiveness in the global marketplace is technology. The rigors of competition are compelling firms to faithfully commit to applications of new technology, to new ways of managing production, and to new approaches to understanding the market.

Competitiveness ceases to be a function mainly of price. Quality, delivery time, services and capacity to adapt rapidly to user needs have increasingly become crucial in capturing markets. Indeed the link between cheap labor and export competitiveness has weakened.

Those who have been exposed to the rigors of global competition know too well that the real market challenges come from the increasing rate of innovation, widening application of new technologies, shorter life cyces, diminishing role for unskilled labor, and constant changes in the organizational paradigm of production, among others. It is how well a firm adapts and responds to these challenges that will determine its survival in the marketplace. To these daunting challenges, the appropriate response is effective management of technology.

As most technology advocates, SATMP believes that it is high time for the Philippines to strive to compete in more sophisticated industry segments, where value-added is generally higher, but where also the productivity requirements are more rigorous. To succeed, however, we need to create an economic environment that is open, flexible and conducive to innovation.

It is of course not the intention of this forum to develop a national technology development paradigm, that would be a tall order requiring a series of consultations. Our goal is relatively modest: to build a working base of strategies and policy proposals that can be brought to the attention of decision- and policymakers.

In developing such a base, we can debate on the approaches and strategies that best suit our present condition. Surely, there is a wide range of development models to choose from. Some may opt for incremental change in existing structure; others may choose radical institutional and policy change. In the end, however, we need to draw up some consensus if only for the public and private sectors to get their acts together.

The urgency of forming some consensus, at least in the direction that we want to take as a nation, stems from the realization that many of our neighbors have long ago bypassed us in technological development. New forms of technological cooperation are evolving even among competing firms. New modalities of competitive cooperation are thus evolving. Process niche-ing is becoming a byword of our neighbors and competitors, and yet, we have not even developed roots in product niche-ing.

It is our firm belief that in the final analysis, global competition will favor those who have learned to manage technology well. The likely survivors in the global marketplace are:

- Those who correctly recognize the needs of the market and develop product or process technologies that address such needs;

- Those who can perform a proficient technology foresight or forecast and direct resources to such technological path;

- Those who can devote resources to R&D and use them efficiently and effectively;

- Those who can conduct technology intelligence and have the information for faster dissemination than their neighbors-competitors;

- Those who can build on and perform incremental innovations to existing products or processes in order to exploit unrecognized demand and deliver products to the market before obsolescence and competitors set in; and

- Those who can muster the resources of the state, industry and academe in a symbiotic resource cooperation.

This forum brings together leading technology advocates, industry leaders and key government personalities. Cognizant of the imperatives of global competition, the goal is to identify key technological concerns that bear heavily on the capacity of local producers to compete. We will attempt to identify these issues and to draw up a list of policy options to address them. We hope that these could serve as inputs in rethinking policy directions and in crafting new strategies.

Technology Management for Export Competitiveness: How About Knowledge-Based Products?

Keynote Address

Leandro B. Verceles, Jr.

I am honored to be part of this select group of some of the best minds and key movers of the country in business, government and the academe.

This forum is a recognition of the growing impact of technology and the imperative of exploiting it to promote the national development agenda.

The increasing influence of technology in our export markets cannot be ignored, and this is why our efforts to formulate a technology management framework is laudable and deserves fullest consideration .

You may have observed that presently, technology management in relation to trade does not figure too prominently in our country's development agenda. The Philippine Medium Term Development Plan of the Estrada Administration, for instance, puts emphasis on agriculture as key to promoting our country's global competitiveness. There is merit to this. But let me go on. Aside from this, pre-identified potential sources of incremental growth in exports, according to the Philippine Export Development Plan from 1991 to 2001, are dominated by resource-based products and industrial manufactures. To cite some figures, agricultural resource-based products constitute about US$1.3 billion or 4.5% of the total US$29.5 billion Philippine Export Market. Food-based agricultural products constitute another US$1.2 billion, or 4.3%, of our export market.

In a country of 76 million people by the year 2000 with 40% of the national workforce in the farms, it is but logical that our economic policies focus on agriculture- at least from the standpoint of livelihood, employment and food security. After all, we cannot simply let our people starve. But, whether due to inherent limitations, miscalculated policies, uncontrollable world events, protectionist policies, or furies of nature, agriculture has not produced much economic value-added, nor the value of our agriculture export products been stable.

Other resource-based products, while giving short and medium-term revenue to the country, are slowly stripping the Filipino nation of its patrimony. Together with heavy industries, we are left with the "environmental trash" in terms of soil erosion, deforestation, air and water pollution and other wastes.

Our local market is also small, not enough to maintain economies of scale needed for successful world class industrial ventures. In fact, to rely on the export market may be a daunting challenge considering the enormous costs of shipping industrial goods to the bigger markets abroad. This simply does not make Filipino products very competitive abroad. Our problems could be exacerbated upon the implementation of the GATT-WTO agreements. Do we have the competitive niches to survive in the new economy?

I believe we need to undergo a reality check, reexamine our strengths and weaknesses as a nation, and if found imperative, change gears and consider a two-pronged strategy approach to exports development -- one that is not solely agriculture or resource-based, but rather, one that is also anchored on technology butressed by a strong knowledge-based services sector.

This shift in emphasis will rely on our gradually increasing comparative edge in information technology, as contrasted with our basic dependence on agriculture, from which Filipinos are still deriving low and unstable incomes; or in natural resources that are easily depleted; or, moreover, in big industries that are highly capital-intensive.

Dr. Craig Barrett, Chief Executive of Intel, was right when he observed that "natural resources and labor rates are no longer the only factors needed for a country to remain competitive. One must have the knowledge that can be put to use to create new products."

A high value-added service economy, sustained by a strong information technology program, will open new trade opportunities. And we have all the people we need to be tapped: 60 percent of our population working outside of the farms, the non-agricultural sector. Moreover, our people have relatively good English skills that are required for I.T. work.

The demand abroad is staggering. Electronic commerce, or e-commerce, for instance, is estimated to become an annual trillion dollar industry worldwide by the year 2003. In the Asia-Pacific region alone, there will be a US $200 billion I.T. market per year. Relate this to our 1998 total export revenue of only US$29.5 billion, equivalent to 14.8 percent of the potential regional I.T. market.

To pump-prime e-commerce, a potential export winner for the country, I recently filed House Bill 7104, which serves as a counterpart measure of a similar bill filed in the Senate. Clearly, this will be as challenging as the recent Y2K measure that we also authored, and which was recently signed into law.

Tough issues on e-commerce will have to be resolved. There is the problem of security of transactions, digital signatures, satisfaction of the notarial legal requirement of personal presence before the notary of the affiant and witnesses under a state of own volution and free will. How do you comply with this if you are transacting online and you do not get to meet face to face with the affirming authority? And then there is the issue of admissibility and weight of electronic evidence, and the probative value of electronic documents. Most likely, we will have to reengineer our rules on evidence, our commercial laws, our laws on sales and the notarial law, among others.

The forthcoming convergence of telecommunications, information technology and the media in the world arena will also bring more opportunities as countries, by sheer necessity, will now have to be more liberal with their municipal laws if they are to promote cross border commerce. New international agreements like the GATT-WTO are also creating new trade paradigms. Moreover, nation states are now merging into one global village that is rooted on

ubiquitous electronic networks and driven by a new set of economic rules - the rules of a connected world manifested by the Internet.

Indeed, the active participation by Filipinos in the future global economy would not be far-fetched given a sound technology policy framework that encompasses a national agenda toward developing a knowledge-based service export industry. We will have to create a regime where the intellectual property rights of Filipinos as well as those of other countries in relation to I.T. are truly respected and protected. This is needed if e-commerce is to thrive.

Bringing about this change, however, would require strong advocacy support, particularly from the private sector. A recent study has shown, in fact, that while technology policies are important, technological progress in East Asia must be led mostly by the private sector. David Osborn and Ted Gaebler in their thesis *Reinventing Government* argue that the government should only steer and let the private sector do the rowing in bringing about economic progress.

As a tripartite group, the Society for the Advancement of Technology Management in the Philippines could very well take up this challenge to advocate a change in focus in trade and export development to one that recognizes the huge potential of knowledge-based enterprises.

Various publications have also emphasized the importance of indigenous sources of technological capability, which could initially start with simple innovations and graduate to consequent masteries in research and design.

In the Philippines, semi-conductor and electronics offer some potential. In 1998, exports of these products constitute US$19.8 billion, or 67 percent of the total value of Philippine exports. But at present, there is only assembly activity in these sectors, with very limited knowledge input.

For the medium-term, offshore sourcing of knowledge projects offers considerable promise, such as Y2K or millennium bug remediation, web page design, computer graphics, testing of hardware and software applications, and software programming.

In the long-term, Filipino industries can engage in software design and research. Alongside these initiatives, however, our telecommunications and information infrastructure must be improved. Without such facilities, our economy will surely fail in the new information century.

The directions mentioned thus far would lack the necessary teeth if not backed up by financial resources through allocations in the national budget. The shift to an export development strategy must be reflected in the government's budget for technology promotion and development vis-a-vis other appropriation items .

In 1998, P931.1 million of the government budget was allocated to technological research and development. This represents merely 0.3% of GNP that is far below the minimum prescribed level of R&D expenditure by UNESCO. UNESCO prescribes 1.0% of GNP. In comparison, industrialized countries are allocating as much as 3 to 5% of their GNP to scientific research and development. The UNESCO minimum standard is meant for developing countries like the Philippines, which is necessary to prevent stymied economic growth. Economist Robert Shaw claims that technology has been responsible through the ages for 80% of economic growth.

This representation has filed a bill in Congress requiring the government to allocate a minimum of two percent of the total GNP for scientific and technological research and development. This will hopefully generate for R&D some P18.6 billion per annum. Even at 1% of GNP, the minimum requirement under UNESCO, the allocation will increase to P9.3 billion- still a respectable amount, not just for I.T. but for all of technologies.

With sound policy environment, necessary infrastructure, and technology management efforts firmly in place, I believe we can elevate our knowledge-based industries, and information technology most especially, to a higher level as a primary export development strategy for the country.

Technology Management for Exporters

Meneleo J. Carlos, Jr.

Today's technology is market-driven. There is no stronger force for technology development and application than exports, where competition is most severe. As the year 2002 approaches, the distinction between domestic and export markets will increasingly become irrelevant, as global competition will be right in our markets. Business managers, especially exporters, should therefore learn to manage technology as an economic resource, just as they manage human, capital, and material resources to fulfill the social and economic objectives of their organizations.

Socio-economic progress and the well being of our people have always been foremost among the objectives and concerns of our leaders and policy makers. To the extent that science and technology are perceived to be essential elements for national development, they have received much attention from our leaders. Our people generally associate economic progress with the more advanced countries where the goods and services are products of modern technology and this is how they perceive the importance of modern technology. Travel and trade liberalization have exposed us to more of these modern goods and services. But it is mainly at the level of "awareness" rather than "know-how" that we appreciate the value of science and technology. Therefore, in spite of our interest and concern, there has been very limited success in providing more technology inputs to goods and services that we produce that would make us more globally competitive.

Shortly before the Science and Technology Coordinating Council[1] of the Philippines was organized, former president Corazon C. Aquino inquired why science and technology had not been made to bear beneficial impact on the Philippine society and economy. The answer to this query may have been provided by the late Senator Diokno years ago. In response to the probe on why limited funds were budgeted for S&T, Senator Diokno asked: "Would you still vote me into office if I were to spend your money in projects with long gestation period and with relatively little to show for it?" Such are the perceptions of many of our leaders and policy makers, and many businessmen share the same view. Science and technology must therefore be made to show more positive social and economic benefits quickly.

Today's technology is market-driven. The imperative to export is perhaps the strongest driving force for technology development and application, especially as competition in the world market intensifies. The country's ability to continuously generate and adopt innovations is the key to competitiveness. Indeed, necessity is the mother of invention and innovations. Where the academician is mandated to "publish or perish", the exporter is required to innovate and be

competitive, or close shop. As we approach year 2002, the distinction between domestic and export markets will increasingly become irrelevant, as global competition will be right in our markets. Already, our local customers are becoming more discriminating and more demanding of performance—beginning with the industrial customers and the households close behind. It is the customer who creates the demand for continuing improvements after being exposed to constant change. This is the nature of the market: there is strong interaction and synergy between the consumer and technology-based product, thus between technology and exports.

A few weeks ago, the National Export Congress presented to President Joseph E. Estrada the Philippine Export Development Plan for 1999-2001. The framework of this plan is the pursuit of global competitiveness, not only by export firms, but also by domestic market-oriented industries and support services. The targets are: (i) to increase the value-added in export industries; (ii) to diversify products and markets; and (iii) to develop a strong local base and domestic linkages that will provide more local value-added to the export industry, with roots in various regions of the country. Increasing value-added is critical for export growth because the global market may not be able to absorb the sheer quantity of goods and services being made available by exporters throughout the world. Our exporters today are competing with an avalanche of cheap goods and they must find niches where they can compete more profitably by exporting higher value products produced with better technology.

This paper will focus on exports and the major factors that affect the competitiveness of Philippine products and services in the global markets. It will show the importance of developing a technology culture in the country. The interaction between technology and the consumer will be illustrated to show how this synergy can create new markets so that we will know how to use these combinations to improve and better apply technologies. Having established these relationships, the paper shall discuss the different aspects of technology management so that technology is applied effectively with an eye towards continuing improvements or sustainability. The policy issues will then be discussed within the context of each technology management activity that needs attention.

TECHNOLOGY AND CONSUMERS

Competitiveness is measured principally by the novelty or innovation, quality, cost, and availability of the goods or services. Each of these factors can be substantially improved by the application of the appropriate technology whether in the product itself or in the process to manufacture it. All of these are measured by their "value to the customer" and require a very good understanding of the customers' needs and preferences. There are many measures of quality depending on the customer, but there are some intrinsic measures like usefulness, durability, weight, size, comfort, etc. taken in the context of today's living conditions where time and space are becoming tighter and tighter.

When the Japanese became leaders in miniaturization, they confidently shifted from the production of commodity plastic to engineering plastics. This enabled them to make TV sets thinner, lighter in weight, stronger in structure, and with better and larger screen so that they can be mounted on the wall to fit a smaller house. They understood the need of TV customers well and put their engineers to task in this direction.

A more mundane technique in determining people's wants is commonly used by a fashion designer to determine the style of clothes to endorse in the next season. The designer would spend considerable time, say in the sidewalk cafés of Rome, Paris, London, New York, and Tokyo, to observe what people wear and how they wear their clothes. And the designer would invariably be able to pick out those styles that would become popular. This is because the people themselves are good sources of ideas as they express their preferences in the way they would wear their clothes and accessories. This is true not only in the fashion world but even in almost all facets of daily living. The essential element is to observe what people want or need, and to translate these into technology requirements that scientists and engineers can interpret.

CHEMTECH has an interesting article by Roger Miller in the November 1998 issue. It begins by suggesting that for "new product development, look to customers for ideas." Miller adds: "The majority of our benchmarked industrial product companies cited customers, not creativity, as the most commonly used and most important source of ideas. Nurturing an ongoing dialogue between technologists and customers appears to be a popular route to a successful product". He also reported that "research and engineering was the second most popular source of new-product ideas", which is the traditional supply-side approach especially when an organization has a strong technically-oriented group of scientists and engineers.

The debate between those who favor the demand-pull approach over the supply-side approach continues. In this regard, technology can also stimulate demand when a technology-oriented market exists. One interesting conclusion of Miller is that majority of the benchmarked companies did not consider "creativity" a major element of industrial new product development. It is good for our scientists and engineers to observe and communicate more closely with the customer to determine what he prefers, and only thereafter determine what, where and how to apply their technology for innovation.

In some cases, technology is the market driver, particularly when many users become familiar with the basis for the product applications so that they are able to innovate on these. Users love to innovate and improve their tools. One of the best examples is the Internet, which was originally used by the civilian population mainly to send e-mail. People are now applying the system to electronic commerce, delivery of recordings and software, undertaking researches and finding numerous sources of information and data, etc. In the field of communications, the Internet is now being used to conduct video conversations much more inexpensively. The area of commercial broadcasting is already being investigated. Like the amateur radio enthusiasts of many years ago, the freedom to apply the new technology led to many developments that added to the storehouse of knowledge and applications. There is a free computer operating system now available in the Internet called Linux that is beginning to attract many users and applications mainly because it is freely available. These types of technology are readily applied even by the numerous small firms, with their specialized knowledge and niche markets, so that the chances that there will be improvements are greatly enhanced by the sheer numbers of users involved.

It is important to recognize the value of the domestic market and why it is important to ensure its technological development. In Japan, many products are tested in the domestic market before being exported. In this case, to ensure that the products have adequately passed the market test, the quality awareness of domestic consumers have to be raised. There is no doubt that the Sony Walkman that invaded the world markets was first successfully test-marketed in Japan before it was launched as a global product. Since then the concept has been copied by many other electronic outfits, although Sony has maintained their lead by means of continuous product improvement.

Another case in point is China. Having to prepare for entry into the global market, China embarked on a program, called "Spark", that spreads the use of science and technology in rural areas. Spark invigorated the rural economy, and more importantly, raised the technological consciousness of the rural population. In fact, the program initiated 5,353 field demonstration-oriented projects and trained almost 4 million technicians and managerial people.[2] Another massive undertaking in China was the "Torch Program" for the urban areas, which aimed to make full use of China's strength in science and technology, and developed a large number of high tech products that were technology-intensive, high value-added and of short cycle, gradually bringing out products that were competitive in the global market. Again the concept was to familiarize the people with the new technologies so that they will not only benefit from their application, but also become sources of ideas and innovations. It is essential that a significant proportion of the population becomes technology-oriented so that innovations or ideas for product improvements can emanate from them. Relevant to this point is the attempt made by Department of Science and Technology (DOST) to disseminate the use of a rapid composting technique among farmers, but it did not catch on due to the farmers' unfamiliarity with technology and insufficient field extension support. The lack of widespread appropriate technology in raising prawns had almost decimated a formerly US$250 million export industry because of diseases. However, the DOST has been more successful in its urban projects, one of which is the Internet backbone. In a short period of four years since the backbone was laid out, over 120 private Internet service providers have emerged.

By exporting, producers are exposed to the wants and needs of the global market, and to a wide range of ideas. Multimedia also brings the world to our homes. Our overseas workers have become intimate with many devices that the modern world has come to regard as essentials. The Internet allows even small outfits to communicate with foreign suppliers and customers as though they were the giant firms of a few years ago. Indeed, the Internet is evolving to be a great equalizer of information and market opportunities, enabling firms to go global like the multinationals. All these sources of ideas and information on market needs are potential drivers of technology development and application. It is not enough to depend on our present buyers for market information, because we must be able to anticipate how the markets will evolve, hence the need to study all these ideas.

Recently, significant value is being created from the application of information technology (IT) on existing products, i.e., by "adding intelligence" on the products to enhance their usefulness. For example, we are now applying information technology in cars by installing microprocessors as satellite navigation devices. Where these were formerly limited to boats and airplanes, the IT-based navigation systems allow the driver to get to his destination quickly. And with added intelligence, the system can perhaps be even used to avoid traffic jams in the future. More products are said to have intelligent components that enhance the services that they provide, and therefore are considered by the customers to be more valuable. Thus the current trend in product development is the use of information technology to add value on traditional products.

Another example is a simple outdoor lamp which can be converted, at not too significant cost, into a security device by equipping it with a motion detector. With this, the buyer is no longer looking at a traditional lamp but at a security device which will provide him confidence and comfort when he goes to sleep, while saving him the cost of having to keep his outdoor light on all night. If we now add some IT features, the residents can even be away and still make it appear that they are in the house by programming the lamp to simulate human intervention.

One may then see the synergy that exists between technology and the consumer especially when the latter is technology-familiar. The result is a mutual reinforcement of

technology and exports for hi-tech products — one that provides a strong demand for technology application, and justifies the investments needed for commercial development.

Having defined the environment where technology and exports are mutually reinforcing, we shall now address the issues that can help bring this about.

S&T, GOVERNMENT AND PRIVATE SECTOR PARTICIPATION

To industrialize rapidly and remain competitive, an economic development policy and agenda must be clearly defined in order to focus complementary science and technology policies and programs. Japan promoted a strategy of importing technology that she needed to help rebuild and modernize her war-shattered industries. The Ministry of International Trade and Industry implemented this strategy to make her a very strong competitor in the world markets. Korea and China also followed similar paths to jump-start their industrialization. Both countries disseminated new technologies in the rural areas that led to the improvement of agricultural practices, while modernizing their industries in the urban areas. They created institutions to support or implement these programs, and finally they developed endogenous capabilities to assess and transfer technologies from abroad that would provide them a lead over other competing economies.

We must distinguish between science and technology, and probe the budget that is allocated to their promotion. Science is the study of nature and the knowledge of facts and laws based on observations arranged in an orderly system. The sciences include the branches of knowledge like biology, chemistry, physics, astronomy, sociology etc. Technology, on the other hand, is a body of knowledge concerning the application of these sciences like in agriculture and engineering. Technology relates more to the production of goods and services, while sciences relate to the study and organization of knowledge.

DOST Secretary Filemon Uriarte Jr. compared the S&T budget of the Philippines with those of Singapore and Malaysia as follows:

	S&T % of GDP	**Technology % of S&T**	**Technology % of GDP**
Singapore	1.18	67.0	0.79
Malaysia	0.37	49.7	0.18
Philippines	0.22	19.6	0.04

From these, we find that compared to neighboring countries, the Philippines allocate a smaller proportion, i.e., 0.04%, of a much smaller GDP, on technology development and application. It is not surprising therefore that the impact of S&T on the economy is not sufficiently felt. Clearly, we have to allocate more to technology development and application to support product and process innovations for competitiveness and economic returns.

There is added reason for this. Citing the 1998 World Competitiveness Report, former DOST Secretary Dr. Ceferino Follosco noted that the country's rank dropped from 31st to 32nd, out of 46 participating countries.

The use of government facilities to undertake contract research or development work for the private sector on a proprietary basis would promote technology development tremendously because there are no laboratories in the country that offer such services. There are however many DOST agencies and institutes that can undertake contract research and development work if allowed. Otherwise the private sector or the academe can undertake the work in conjunction with the government-funded laboratories.

For the surface coating industry, the private sector and government contributed funds that were spent on generic research. One finds similar mode of collaboration between the private sector and government in developed countries, where significant amount has been budgeted for R&D in the energy, agriculture, health, defense, or electronic sectors. Collaboration among the private firms is feasible for generic research that benefits all. For proprietary research, however, there is a need for private contract research laboratories which the country does not have.

At present, the DOST is eliciting the participation of the private sector in making decisions regarding the allocation of grants-in-aid to research projects. The private sector has majority representation in the five DOST Governing Councils for R&D, namely: in Advanced Science and Technology, Agriculture, Industry and Energy, Health, and Marine and Aquatic Resources. These councils award research grants. While recent guidelines on awarding grants emphasize the criteria of commercial-orientation, majority of proposals still come from research scientists rather than commercial users. In anticipation of larger budget required for technology development and commercial application, there should be a larger allocation of the DOST budget to these councils.

One of the major problems is the very limited spending of the private sector on R&D; there is hardly any fundamental research being undertaken. We believe that the private sector spends about 10 to 15% of the local R&D effort. This has to be qualified because there are many payments made by the private sector for manufacturing licenses, know-how and engineering or some form of technology transfer, which could otherwise have gone to fund local development work. There is no doubt that globalization will require the private sector to spend more for R&D and innovations. In the area of basic research, the private sector is still hesitant in participating, mainly because of their limited resources and also the uncertainty of obtaining favorable results. Where technology development is not speculative and of proven economic value, private investments will support studies for innovation. In this direction, government can induce the private sector to spend more by providing matching grants that will supplement the limited budget presently allocated. Other ways of inducing the private sector expenditure would be to allow them to use or rent, on a limited time basis, some of the government laboratories or facilities since laboratory facilities needed for research and development are very expensive.

The government and some academic institutions have set up Technology Business Incubators for the purpose of encouraging the private sector to commercialize research findings. These have met limited success for a number of reasons:

- The gaps between available technology and semi-commercial application are often too wide for the available resources to bridge. One must recognize that the resources needed to translate research into commercial activity are often much more than the funding of the research

project. This is the reason we feel the budget for technology development must be substantially increased.

■ There is no sufficient competition for space in the TBI's, hence no urgency to induce the tenants to graduate from incubation and attain commercial status. In Singapore, there is so much competition for space as there are many more applicants than available spaces. As a result, only the persistent and entrepreneurial developers are entertained and, of course, they prove to be successful more often. The proponents must be so market-driven that they are focused and time-bound in their approach to commercial development.

■ The marketing of these TBI's should be directed more towards rapid commercialization and less towards technology development. Offered to exporters with ready markets, the picture may drastically change. Those who wish to engage in technology development should be accommodated in development incubators closer to DOST facilities.

■ The TBI's should be near universities where consultants in all disciplines are available to provide wide support and accelerate results. Other countries provide these disciplines and make other complementary resources available when these are located in larger installations called Technology Parks. Here, the services are not limited to science and technology but include advisers in business, finance, marketing, etc., and with a network of other resources that business developers require; in other words, everything that an entrepreneur would call for. In Mexico, the manager of a technology park is an entrepreneur-developer who networked the talents of the nearby university, some real-estate developers and venture capitalists so that as soon as an incubator shows promising potentials, it has all the other resources ready to assist or take advantage of the new business opportunity.

There is evidently a need for venture capital in the translation from knowledge to practice or commercialization. There are few venture capital enterprises, but experience reveals that very few project proposals have been entertained and the batting average has not been encouraging. There are also R&D loan funds available from the Development Bank of the Philippines' Window III, but we are not aware of any funding being provided to TBI's. The nature of technology development pushes lending rates above normal risks. This is why venture capital is the more popular means employed even in developed countries.

TECHNOLOGY MANAGEMENT

Technology as an economic resource

The most important aspect of technology is that it is an economic resource and undoubtedly, the most enriching of all the economic resources in the world today. The next most important aspect is to recognize that the economic value of technology is time bound by rapid obsolescence and expiring patent protection. As such, business managers should be competent in technology management to be able to manage technology as an economic resource, to be combined effectively with the company's human resources, capital, and materials. The duty of the manager is to lead his team to decide what, why, how, where, and when to apply the technology to their products and processes for best effect.

There is a need to recognize the value of intellectual capital that resides in every competitive organization, and how to harness this capital most effectively. Above all, there is a

need to recognize that this intellectual capital erodes with time, hence the need to nurture it through training and development. Managers who are not familiar with technology can quickly lose the value of this capital and miss the opportunities for technology development in their enterprise.

Intellectual Property Rights

The value of technology as an economic resource is time bound and rests on the system of patents, copyrights, and trademarks which are covered by the intellectual property rights under the World Trade Organization. With the higher technology content of goods and services traded around the world, intellectual property has become increasingly valuable. In fact, William Kingston, in his paper on "Patents and Endogenous Capacity-Building" stated that "no single factor was more important in the transition of Germany from being a poor country at the middle of the nineteenth century to a rich one at the end of it, than the patent system". The monopolistic protection provided by patents "made it possible for German entrepreneurs to invest massively in the new chemical and electrical industries of the time". Even the Japanese then said: "We have looked around to see which are the greatest nations, so that we, too, may become a great nation. We have carefully studied, and have questioned, why is the United States such a great nation? We have made inquiries - and we have discovered that the reason was the existence of patents! Therefore, we too, will have patents".

Another article by Albert, Yoshida and Van Opstal on global patenting trends (Chemtech, February 1999) claims that many experts consider patenting activity to be the best proxy measure available for innovative capacity, and patents filed internationally tend to be more significant than those filed in the home country alone. A country's patenting activity is an indicator of the strength of its research enterprise and technological strengths, both overall and in particular technologies. In fact, the study finds a strong correlation between patenting activity and GDP. Unfortunately, the Philippines, Thailand and Indonesia were not included in the study. It was reported however that for Singapore and Malaysia, there are less than 100 patents per year as of 1996, while the developed countries are patenting several thousand inventions every year.

To enhance the value of our exports, we must strive to safeguard our intellectual property rights by securing patent and copyright protection in our principal export markets. While it is true that in the older system, there have been many violations of patent rights, especially by poorer countries, the present system promises to deliver more protection to owners of the intellectual property. We must strengthen the resources of our patent office and standards so they will assist our local patent holders to secure adequate protection abroad. It should be realized that it costs more to obtain patents abroad, and much more to litigate these when they are attacked. For this reason, local patent rules should apply the same standards as those used abroad so that little else has to be done to register the same patent abroad.

Technology Search and Assessment

A technology management activity that will benefit exports is technology assessment, which includes the search for the most appropriate technology to apply now and in the future. There is so much technology being offered globally today. The competitive game has changed: the advantage now often goes to the companies most adept in choosing technologies, not the companies that create them.[3]

It is worth sending technology missions, apart from marketing missions, in a global search for new technologies. Many developing countries help their exporters to organize and even co-fund such technology missions. In return for this support, members of the mission are required to make a detailed comprehensive report of their findings so that other industry members also benefit from the mission. In many cases, technology is embedded in modern machinery and equipment, or more sophisticated raw materials, where the suppliers are the principal sources of technology and know-how. So even modernization and buying missions are effective ways of obtaining the latest technologies. Other ways of promoting exports and technology are through such activities as attendance at technology fairs, or bringing home some foreign consultants and industry experts.

In fact, the promotion of our inventors and consultants and their networking with counterparts abroad are activities that the industry, government and academe should support. With the ease of communications worldwide, these people who have the ability to transfer know-how very effectively and economically can be the best pollinators of innovation. In major industries in developed countries, one will find a directory of consultants listing their fields of expertise. We should identify our experts, and ensure that the rest of the industry knows how to get in touch with them. There is so much talent in that country that remains underutilized.

Technology assessment is a socio-economic evaluation of the impact and implications of technologies, in particular new technologies. The aim is to introduce, through adequate management, necessary structural and policy adjustments to maximize the opportunities, and to minimize the risks of integrating the country into the global market. Most developing countries make vital economic decisions without being fully conscious of the implications of technologies.[4] Thus, technology assessment must be a joint effort of the private sector, academe and government as the activity is relevant to all sectors.

In most cases, a company's ability to choose technologies wisely has large impact on the performance of the organization in improving its productivity and product quality. Weak technology assimilation can cause delays of several years in developing new products. The production technique adopted must be in harmony with the company's capabilities and its local culture and conditions. The same situation applies to nations. Japanese integrators are less likely to employ cutting-edge technologies; they tend to favor incremental improvements or refinements of technologies with which they are already familiar. Generally, Japanese projects achieved high performance (e.g., faster, smaller, and less expensive integrated circuits) through an evolutionary path, while squeezing more out of relatively mature technological possibilities.[5] This points to the need to consider social, cultural, educational and other non-economic factor in determining the kind of technology to adapt.

The academe should be the major pillar or center for technology assessment. It houses a multitude of disciplines that are necessary to do a thorough job. It has no particular bias that might unduly influence the objective assessment of our strengths and weaknesses in competing in the world market and in adapting certain types of technology. And when the academe maintains its strong linkages with the government and industry, it certainly has all the resources to undertake the critical job at hand.

Another aspect of technology assessment that is vital for the consideration of leading-edge technologies is technology forecasting. It is essential to anticipate and evaluate how the new technologies and their markets are evolving. Our leading exports of electronics and information technology are continuously experiencing massive changes in market demands as these are affected by new technologies or new applications. Being primarily in the assembly-end of the

industry, we will feel the effect of market shifts. Perhaps the developed countries had foreseen the potential market shifts affecting these labor-intensive industries and decided that they would prefer to transfer the risks to the developing countries. Thus it is our risk and our responsibility to ensure that such massive shifts in labor requirements do not lead to major social dislocations by providing alternative employment to our workforce. One possible direction is to involve the labor force in retraining for the production of much higher value-added products with the goal of enabling the workforce to earn sufficiently even with fewer working hours, and fewer products. It is when products become commodities that the danger lies in severe product- value depreciation and massive market shifts. Fortunately for us, our people learn quickly and are easy to train. We should take advantage of the new techno-economic paradigms that have emerged and invest in modern machinery and processes which combine flexibility with information-intensity, and attain high productivity by controlling the energy and material inputs.

Technology Transfer and Application

When the appropriate technology is identified, there must be sufficient freedom for the client to obtain this under terms that are mutually appreciated by the contracting parties. However, while it is recommended that the government allows the contracting parties freedom to negotiate the terms, it is helpful for the Licensing Board or the Board of Investments to guide the local companies by providing them with information about the terms and conditions obtained by others under similar situations. There are many versions of technology transfer arrangements, ranging from one-shot transfers to continuing transfers of know-how during the period of the licensing agreement. The more desirable arrangement is for technology transfer to occur over a certain period of time to allow the client to assimilate the know-how and move forward with innovations thereon. It is not good to be limited by a licensor from innovating upon the know-how because it weakens one's ability or flexibility to compete. As mentioned earlier, patent protection is a very important criterion for valuing know-how, because it provides a limited monopoly to the users.

The evaluation and selection of a licensor or supplier of technology is very critical and preferably done by experienced practitioners. There are laboratories or companies that grant licenses to the technologies that they produce. These companies do not engage in commercialization of technologies but derive their reputation from the success of their licensees. One should be wary dealing with these companies. The best licensors are usually those engaged in commercial activities. This is because the practice of technology through an organization's human resources, physical facilities and financial resources are themselves part of the technology transfer experience that can only be conveyed by someone with that experience.

Before reputable licensors agree to transfer their technology, many of them require that the human resources, organizational structure and operating standards of the prospective licensee are adequate. This recognizes the fact that the more advanced technologies require a certain minimum of organizational discipline from the licensee. This is especially true when the organization seeks to be certified ISO 9000 and ISO 14000. UNIDO provides the following outline for a techno-economic assessment:

- Impact of technology (environment, safety, energy, cost benefit)
- Identification of remedial technologies
- Economic features and impacts of remedial technologies

- Operational and maintenance standards for the plant, as well as safety standards of plant and community

- Quality of management

- Assessment of training requirements of managerial, technical and scientific personnel

- Product quality and competitiveness in relation to optimally functioning similar industries

- Assessment of industrial environment within which the identified remedial technology would operate

- Regulatory and legislative framework

- Institutions affecting operational level of industry

- Basic industrial and financial structures

Foreign direct investments are also good sources of technology, especially for developing countries. There is an increasing pattern of foreign direct investments in the region that the Philippines should aim to attract. The country could be a good investment site given the creativity and manual dexterity of its labor force. However, much is left to be done in providing the other physical infrastructures that the industry and research require.

Timeliness

In an article that appeared recently in The Harvard Business Review, Iansity and West argue that a company's ability to rapidly and efficiently translate its R&D efforts into products that satisfy the market's needs is much more important in attaining competitive strength than the amounts spent on R&D. What they emphasize is that timeliness or speed of commercialization or "time-to-market" is critical to competitiveness. With the rapid turnover of innovations, very often the effective commercial life of a product in a fast-evolving sector like personal computers is probably in the range of 6 to 12 months, whereas only a decade ago, new product development takes two to four years to hit the market.

All the factors of competitiveness are converging in a much shorter time than before. One does not develop novelty first, quality next, cost competitiveness later and capacity last, but all of these must be attained immediately. Much of this is, of course, market-determined. There is hardly a new development that the world does not learn about instantly — thanks to the workings of media and communications. Hence demand can zoom rapidly and fall just as quickly. In this regard, we often hear of flexible manufacturing processes, of distributed information processing, of collaborative research undertakings, and synergy through industry clustering --all geared towards speed, flexibility, and competitiveness in reacting to market changes. All these require improving the speed of doing business and of getting things done through the regulatory agencies and industry support services. In the absence of sufficient local industrial infrastructure, red tape and bureaucratic charges must be eliminated. Parts needed should be available within two days, not weeks, to enable us to compete with our ASEAN neighbors where parts can be delivered within one day.

What this also means is that even as an idea is born, people in industry today are already figuring in their minds how it will develop, what resources may be needed, and how it will be made, and sold, and even how competition is likely to proceed. It is not different from playing basketball or baseball and anticipating how the ball will be handled. The only difference is that the teams are more extensive, the plays are more complex, and the world is the playing field.

CONCLUSION

We can summarize the main points raised in the preceding discussion as follows:

■ Our people are "aware" of the value of technology but do not have the know-how to apply it.

■ Technology is market-driven and ideas are often customer-originated, hence the task of the exporters is to observe.

■ Technology-familiar people are important sources of ideas for hi-value technology applications like the Internet and IT applications, thus we must propagate and popularize technology applications nationwide with massive programs.

■ The competitiveness of a product is measured by its novelty or innovation, quality, cost, availability and more importantly, by its value to consumers.

■ Well-defined industrial and economic policies are essential in designing and focusing supportive S&T policy and programs.

■ Government and private sector must spend more on technology development, in particular:

■ The DOST Councils should allocate a bigger budget for technology and matching grants.

■ The DOST institutes should consider undertaking proprietary contract R&D.

■ Technology Business Incubators or TBI's should focus on commercialization rather than development of technology, enforce tight time targets, and be supported by wide array of services and resources for speed.

■ Businessmen must learn to manage technology as an added economic resource combined with human resources, capital, and materials.

■ Technology has a short competitive life, threatened by obsolescence and protected by patents and copyrights which must be obtained in every major export market with the support of a well-endowed patent office.

■ There are competitive technologies available in the world market, hence the decision to be made is whether to "make or buy".

■ To select the most appropriate technology, it must be widely searched perhaps through technology missions and fairs or inventors and consultants networking with foreign counterparts, and licensed from reliable sources.

■ Forecasting and assessment of technology is important to be able to anticipate its socio-economic impact and implications on our competitive position in the global market. This is best done with industry support, government funding, and led by the academe.

■ Government should guide, not regulate, local companies negotiating licensing terms and conditions.

■ New techno-economic paradigms through modern machines and processes should be adapted for operational flexibility with more information technology, and higher productivity through better control of energy and material inputs.

■ Speed and timeliness are critical factors affecting innovation, thus it is important for organizations, especially the government, to streamline their operations.

Indeed, these are exciting times for technology and exports.

NOTES

1. Science & Technology Coordinating Council was formed by Pres.Corazon C.Aquino with membership from the cabinet, academe and industry. The Council was tasked to coordinate the programs on S&T in all sectors.

2. "China's Science and Technology for Development and International Scientific and Technical Cooperation," Department of International Cooperation, The State Science and Technology Commission, The People's Republic of China, April 1990.

3. Marco Iansiti and Jonathan West, "Technology Integration: Turning Great Research into Great Products", *Harvard Business Review*, May-June 1997.

4. "Report of the Intergovernmental Committee on Science and Technology Development," United Nations General Assembly Official Record: 44th Session, Supplement No.37 (A/44/37), 1989.

5. ditto.

Highlights of the Technology and Exports Open Forum

Competitiveness of Philippine industries. It was pointed out that in the 1998 World Competitiveness Report, the Philippines dropped in the overall ranking from 31st to 32nd, out of 46 reporting countries. US was number 1, and Singapore was number.2. On technology alone, the Philippines was ranked 35th, only better than Thailand in Asia. The ranking is based on 8 factors, some of which had bearing on technology, such as infrastructure, management and people.

Structural inefficiencies. Even in areas where the Philippines is strong in R&D, such as agriculture, there has been tremendous failure in the transfer of R&D results to the farmers. This was primarily because of a weak agricultural extension service and poor entrepreneurial skills of our farmers. The country has various agricultural agencies devoted to various types of commodities—IRRI, NFA, NAFC, NAPHIRE, DA and DAR. Another new cabinet rank agency, the Presidential Adviser for Food Security was recently created under Executive Order 103. Moreover, a new fisheries department is being proposed. Existing structural deficiencies are not being addressed while layers of bureaucracy continue to be added.

Market-oriented technology. Technology development must be market-oriented. Simple and intermediate technology must be promoted simultaneously with high tech ones. High-technologies should be geared for globally competitive industries and the simple technologies for basic and intermediate industries, since a large part of the Philippines' population is in the rural areas. The choice of technology depends on economic factors, price, capital, labor, investment requirements, economic scale, market conditions and technical access.

Prioritization and clustering of various sectors. The issue of selection or prioritization of agro-industrial services and other sectors that are foreseen to have potentials for global competitiveness was discussed with a view to determining how to concentrate resources on agreed priorities. It was noted that Malaysia is trying to make its mark in information technology; the Dutch in transportation, Israel in irrigation. After deciding on priorities, an industrial cluster should be created for each priority sector with such cluster being composed of firms that are related in terms of outputs or technological requirements. A determined effort to improve each segment of the cluster should follow.

The need for a Philippine Technology Plan. As far as policies are concerned, institutions are already in place to recommend and oversee the implementation of policies. The Philippines has the Industry Development Council, the Export Development Council, the Science and Technology Coordinating Committee, the different councils of Department of Science and Technology where both the government and the private sector discuss policies and directions. What needs to be incorporated is the more active participation of the academe in these institutions as an assessor of technology and the inclusion of the civil society as the final end-user of technology. However, it was felt that there is no real technology plan in the country. There are master plans being prepared by the government for some industries, but these master plans focus more on costs of doing business, providing incentives, or attracting investments rather than

developing the technology of basic industries. Technology assessment will help determine the possible impact of technology on society, culture, economy, business and organization.

The need for increased linkage between technology generators and exporters. A representative of the Philippine Nuclear Research Institute pointed out that their agency can offer nuclear techniques and technology to industry, which will increase the quality of products and their competitiveness. About 1/3 of their licensees comes from industries that make use of nuclear gauges that check or increase the quality of their products. But awareness of the availability of such services and facilities for local industries is not widespread. Thus the need for stronger linkages and information dissemination.

Legislative measures. Since funding from government is always a major obstacle to the development of technology, future legislation could allow tax deductibility of donations, grants of private companies to the DOST, to inventors' associations, to RDIs and similar institutions.

Recommendations. Some of the recommendations that were proposed to enhance the contribution of technology to Philippine export growth include: (a) The modernization of the production centers through massive technology transfers; (b) The upgrading the country's R&D capabilities; (c) The development of infrastructure; (d) Institution building and strengthening; (e) Stronger private sector initiatives to upgrade technology towards modernization of products and processes.