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Private Sector Activities on Research and Development

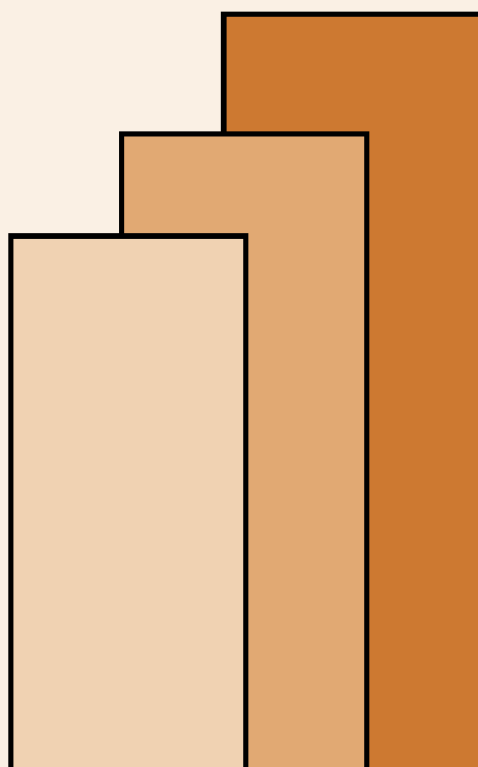
Tristan H. Macapanpan

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**PHILIPPINE INSTITUTE FOR DEVELOPMENT STUDIES
AND THE
DEPARTMENT OF BUDGET AND MANAGEMENT**

**PRIVATE SECTOR ACTIVITIES
ON
RESEARCH AND DEVELOPMENT
(FINAL REPORT)**

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PRIVATE SECTOR RESEARCH AND DEVELOPMENT ACTIVITIES

Tristan Macapanpan

PROLOGUE

This paper was prepared as part of a study of Research and Development Expenditures of the Public and Private Sectors in the Philippines. This report was to be on private sector R&D. On being asked to make the private sector study, the author proposed that instead of focusing solely on R&D, the study be broadened to include all innovation activities. Previous research by the author on acquisition of technology did not reveal any significant pure R&D activity in Philippine industry (Macapanpan,1996 and Macapanpan,1997). Any innovation activity undertaken consisted mainly of purchasing the latest equipment and availing of the technical support of the equipment supplier. Reasons for technology acquisition were to keep up with competitors or to comply with government regulations.

It is within this context that this study concentrates on innovation activities, R&D activity included. To clarify and define these activities, a Note on Innovation is attached as Appendix A.

OVERVIEW

For many years after World War II, the United States lorded it over the rest of the world's industries. It dictated which products were to be offered to the market. The pace of innovation depended on the research and development efforts of American companies. Thus, the major technological breakthroughs in the 30 years after the end of the war, came from America. The past two decades, however, have seen the emergence of other key players in major industries once the turf of U.S. firms. Consider the rise of Japan, South Korea, and Taiwan in the field of consumer electronics, steel,

and automobiles. Philips of the Netherlands is on the cutting edge of consumer electronics innovation.

The rise to eminence of these countries in various technological areas did not come as accidents. The use of R&D to the breadth and depth that was once expected only of American firms was only one vehicle for the success of these countries in challenging American superiority in technology. The strategic management of technology by these countries' firms facilitated the rise of Japan and other Asian countries as economic and technological superpowers. Patalinghug (1996) attributes the recovery and growth of South Korea to the "technological pioneering" practiced by South Korean firms to gain competitive advantage. The Collaborative Manufacturing Agenda (1996) of the National Center for Manufacturing Sciences of the United States emphasized that effective management of technology must become a high priority concern in the United States. Otherwise, as their article succinctly states, the U.S. firms were managing their way to economic decline.

These are but few general indications of the growing importance of the role of technology in the corporate strategy of businesses. As Porter (1985) shows in his analysis of the value chain, everything a firm does involves technology of some sort even if one or more technologies seem to dominate. While technology undoubtedly contributes to a firm's success, how exactly is technology used in the overall strategy of the firm? How is technology and strategy integrated by firms? What forces determine the evolution and substance of a technology strategy? How do firms implement a technology strategy? What are the key issues in implementation?

This paper seeks to examine the various approaches to designing and evolving a technology strategy as an integral part of business strategy. Principally, the ideas of Porter (1985), Dussauge (1992), Noori (1990), and Maidique, et al. (1996) and others will be examined and discussed. A preliminary approach synthesized from the ideas of the above authors will be attempted. This approach will be very helpful in analyzing how the private sector chooses its innovation activities. An attempt will be made to use this

framework and predict what innovation activities Philippine firms will undertake.

Finally, the paper will discuss the results of the survey of a selected sample of Philippine companies to get an overview of the innovation activities and the accompanying use of technology as an integral part of business strategy in the Philippine setting. The results may help point out the directions for technology policy for the Philippines.

Before examining and discussing the approaches to designing and integrating technology strategy into a firm's business strategy, it would be appropriate to have an idea at this point of the Philippine industrial situation. This will serve as the background for analyzing and synthesizing a technology strategy approach for the Philippine situation.

THE PHILIPPINE SITUATION

Patalinghug (1996) discusses the "intensity with which industrial technology is used by firms." He uses measures of productivity to deduce this. Citing Hooley's studies of total factor productivity of Philippine manufacturing from 1956 to 1980, he points the general decline of total factor productivity was attributable to some extent on the absence of research and development in industry during the import-substitution phase of Philippine industrial growth. Citing Morone (1989), he contrasts this to the experience of firms in Japan that successfully used technology to develop their competitive edge in the VCR industry. This was coupled with a long-term horizon for planning.

Culling results from various studies [Sicat (1968), Patalinghug (1980), Hooley (1985), and Cororaton, et. al. (1995)], he concludes that there was a failure in policy and in practice for Philippine industries in considering "the technology factor in achieving long-run competitive advantage." Philippine companies, at best, strive to move towards "best-Philippine-practices" which are way below world class practices.

Comparing results with other countries, particularly that from South Korea, Patalinghug also concludes that it is private sector R&D rather than government R&D that will make a difference.

Clearly, on country level analysis, technology strategy in the Philippines is virtually reactive, if not non-existent. Most firms may not have realized the importance of technology in business strategy or these firms are unable to exploit the competitive advantages technology may offer for one reason or the other.

An opportunity is presented for examining the latter premise. SGV Consulting together with Arthur Andersen has just completed a survey of Philippine Manufacturing from June/July 1997. Their stated purpose was to obtain a reading on issues facing Philippine manufacturing companies in the face of global competitiveness and how they are addressing such challenges. The results, however, came in before the July 11 depreciation of the peso. Hence, these issues may have changed in importance and these changes cannot be perceived from the survey results. Nevertheless, the peso depreciation can most probably have a strong impact on prices, a major issue cited, and on imports.

The survey findings can be summarized as follows:

1. Challenges – Market/Environment Factors

There are two major challenges cited. High Import Prices (68%) and Cheap Imports (58%) are easily explainable by the advent of trade liberalization and are easily affected by the peso depreciation. The third major challenge, High Financing Costs (48%), while a domestic issue, is also being aggravated by ongoing monetary crisis.

The other issues of Long Supply Lead Times (41%) and Supply Problems (40%) are more logistics management concerns that affect operational efficiency.

2. Challenges – Customer Demands

Customers are demanding Lower Prices (92%) while requiring Quicker Response Times (83%) and Improved Product Quality (75%). Other demands were More Product Innovation (65%) and Shorter Cycle Times (64%).

It is worthwhile to note that the above customer demands reflect the four areas of focus in an operations strategy: cost, quality, flexibility, and speed of delivery.

3. Solutions Implemented

The survey mentions only the solutions pursued and implemented by the firms. No mention was made of the means or enablers of the solutions.

The solutions implemented with their success rates were:

- a. Cost Reduction – 86% pursued / 64% success
- b. Inventory Reduction – 81% / 63%
- c. Skills Upgrading – 79% / 54%
- d. Business Process Reengineering – 72% / 38%
- e. ISO 9000 – 67% / 40%
- f. Employee Suggestion Schemes – 58% / 44%
- g. Shop Floor Improvement – 57% / 43%
- h. Performance Incentivization – 57%/35%
- i. Outsourcing – 55% / 17%
- j. Electronic Data Interchange – 56% / 32%
- k. MRP Systems – 40% / 19%
- l. Enterprise Resource Planning Systems – 22% / 18%
- m. Vendor Partnership – 50% / 25%
- n. Customer Partnership – 46% / 18%
- o. Supply Chain Management – 41% / 21%

4. Barriers Faced

Clearly, the firms surveyed have definite ideas of their challenges and the solutions to meet these challenges. What was not clear from the survey was the success rate. Implementation in the survey seems to have been deemed synonymous to success. However, the firms identified the barriers to success. Surprisingly, the top five (5) barriers are HRD related or “people issues” as the survey report states. Only a quarter of the firms cited management issues as barriers. Below are the barriers identified:

1. Lack of Preparatory / Refresher Training - 42%
2. High Employee Turnover - 24%
3. Lack of Incentives - 24%
4. Union Resistance - 24%
5. Lack of Employee Support - 23%
6. Lack of Noticeable Results - 23%
7. Lack of Planning - 22%

Discussed above is in effect a snapshot of a major sector in the Philippine Economy. Conclusions that may be drawn and their implications for an integration of technology strategy with business will be discussed in the section on Implications for the Philippines.

TECHNOLOGY AND BUSINESS STRATEGY: A LITERATURE REVIEW

Hamel and Prahalad (1994) in *Competing for the Future*, premise that the limits of incrementalism have been reached. Continuous improvement to gain advantage has ceased to become a viable strategy. Most companies seek competitive advantage by reengineering and even inventing the basis for competition. They do so by being more “foresightful”, imagining products and even industries that do not exist yet and creating them. In so creating these erstwhile non-existent products or industries, these firms preempt their rivals

and create core competencies that constitute the firms' competitive advantage. Most of the examples they cite involve the use of technology.

Porter (1985) in *Competitive Advantage*, prefaces his book by stating that "Competitive Advantage is at the heart of a firm's performance in competitive markets." As firms face increasing global competition, competitive advantage becomes more important. Sustaining this advantage is even more important. To Porter, many firms' strategies fail due to their "inability to translate a broad competitive strategy into specific action steps required to gain competitive advantage." To implement a business strategy requires an understanding of the sources of competitive advantage – the principal drivers of competition. Using the value chain as a tool for analysis of these drivers, Porter identifies these drivers and discusses the individual strategies necessary to use these drivers to achieve competitive advantage. Among the foremost sources of competitive advantage that Porter cites is technology.

A recurring theme in business strategy literature is the imperative to modify the bases for competition in any given industry. Porter, Hamel and Prahalad, Dussauge (1992), Noori (1990), Burgelman, Maidique and Wheelwright (1995) have all espoused the need to transform competition in a given industry or even create new industries to sustain a firm's ability to compete in an ever-changing, highly competitive global market place.

Often, the strategy is to leverage a firm's expertise to enter new industries or create new products. In their article, *The Core Competence of the Corporation* (1990), Hamel and Prahalad cited how firms like Sony, Canon, Casio, 3M have used their core competencies in spawning unanticipated products. Sony's competence in miniaturization has allowed it to develop the 8mm camcorder; Canon's imaging technology expertise has enabled it to be a major player in the personal copier market; Casio has given us pocket TVs and miniature card calculators; 3M has developed a myriad of products all derived from its competence with adhesives and sticky tape. Dussauge points to Corning's success in expanding to a range of businesses

like fiber optics, fiber-glass insulation, etc. by applying knowledge of glass technology, its core competence.

Pervading these literatures is the role technology, or more specifically, technological innovation, plays in enabling these strategies to be realized. Technology as a source of competitive advantage is not a recent insight in business literature. Frohman as early as 1982 had published an article in the *Harvard Business Review*, *Technology as a Competitive Weapon*. He does not dispute that US companies need to use technology as a weapon to remain competitive. However, he stresses that it is not merely enough to invest in technology. Rather, firms must consider other aspects of the organization in order for a technology strategy to succeed. In effect, he argues that technology strategy must be consistent with overall business strategy. Dussauge and Noori discuss the issue of strategic technology management thoroughly in their books. Noori concentrates on managing the impact of technology on the firm while Dussauge discusses the impact of technology on business strategy and the organization's structure, process and culture.

TECHNOLOGY STRATEGY AND BUSINESS STRATEGY – INTEGRATING FOR COMPETITIVE ADVANTAGE

Porter (1985) discusses the importance of technology in attaining competitive advantage. Technology has become the principal driver of competition, playing a major role in structural changes in existing industries and creating new industries. Easily, one can cite the changes in the competitive parameters of third-party logistics providers. Information and transportation technology have enhanced the capabilities of firms in this industry to the point that they have become an alternative to in-house logistics in the value chain of companies.

Technology has further restructured industry with the eclipse of hitherto entrenched companies and the rise to eminence of new firms. Porter argues that many of today's pre-eminent firms are so because of their exploitation of

technological change opportunities. To him, technology is among the prominent factors that can change the roles of competition.

Porter, however, cautions against viewing technological change as valuable for its own sake. People perceive that competing in “high-technology” industries is a guarantee of profitability. “Low-tech” is looked down upon. Using “high-tech” guarantees solutions to business problems. “Low-tech” is the cause of problems. This perception has been engendered by the much-heralded successes of firms in using technological innovations to gain leadership in their industries. Many firms were, thus, encouraged to invest even more in technology, often without any critical analysis. This has often led to a worsening of a firm’s competitiveness rather than the much-expected industry leadership. To Porter, high technology does not often lead to profitability. Technological change is only important if it has a significant impact on a firm’s competitive advantage and/or the industry’s structure. Only if the impact is beneficial to the firm should it adopt the innovation.

Porter, in *Competitive Advantage* (1985), examines all the issues on technology, industry structure, and competitive advantage and proposes a framework for formulating technology strategy. Predictably, he uses the value chain as the basic integrative framework for developing a technology strategy. He prescribes, the steps as follows:

1. Identify all technologies and sub-technologies in the value chain;
2. Identify relevant technologies under development or in other industries;
3. Determine how key technologies are likely to change;
4. Determine which technologies, present and future, are likely to have significant impact for competitive advantage and industry structure;
5. Assess the firm’s relative strengths in the important technologies;
6. Assess the cost of technological change to upgrade the firm’s capabilities;

7. Select the appropriate technology strategy that considers all the important technologies while enhancing or reinforcing the firm's overall business strategy;
8. Reinforce the technology strategy at corporate level.

Frohman gives the following conditions for a successful technology strategy:

1. Top management orientation or "fluency" with the technology that enables more focused decision-making.
2. A set of project selection criteria (quantitative and qualitative) that will support and maintain technological leadership.
3. Reinforcing systems and structure that give priority to technological matters by:
 - a. Providing a close connection between business and technological decisions; and
 - b. Being consistent with other company systems.

Burgelman, et.al., discuss in great detail the fits' between technology strategy and business unit strategy, and business unit and corporate level technology strategy. The book concentrates on providing a general management perspective on technology, innovation, and strategy. A detailed discussion is made of designing and evolving a technology strategy, integrating the technology strategy with business strategy, and implementing the strategy.

In designing a technology strategy, Burgelman, et. al. argue that an evolutionary process perspective provides a useful framework for formulating a technology strategy and integrating it into the firm's broader competitive strategy. They contend that technology strategy is built on technical competencies and capabilities, and tempered by experience. The linkages show the evolutionary learning process of designing technology strategy. A firm's technology strategy is a function of the technological competencies, in terms of quantity and quality, that support the strategy. The firm's experience results from implementing technology strategy. It is a cycle of development,

feedback, and adjustment. To help formulate technology strategy, Burgelman, et. al. suggest answering the following questions:

1. Which distinctive technological competencies are necessary to attain and maintain competitive advantage?
2. Which technologies should be used and embodied in core products?
3. What level in an organization should be responsible for technology development?
4. How should technology be sourced?
5. When and how should new technology be introduced in the market?
6. How should technology be organized and managed?

Clearly, the substance of technology strategy firstly lies in the acquisition and deployment of appropriate technology. Secondly, the ways in which the performance of the various technology strategy tasks contribute, cumulatively, to the advancement and entrenchment of firm's competencies and capabilities constitute an important consideration in technology strategy formulation. The authors have provided a framework to conceptualize evolutionary forces that shape technology strategy (see Exhibit 1). Some similarities are seen in this framework with Michael Porter's famous five competitive forces framework. To assist in conceptualizing these forces and in developing the appropriate technology strategy, it is suggested that aside from the six questions posed above, strategic planners should refer to Hamel and Prahalad in their definition of core competencies:

"The collective learning in the organization, especially how to coordinate diverse production skills and integrate multiple streams of technologies."

Their criteria for identifying a firm's core competencies:

1. Should provide potential access to a wide variety of markets;
2. Have a significant contribution to the customer benefits;

3. Difficult to imitate.

Having the answers to these questions and using the Hamel and Prahalad concept of core competencies, any planner can then determine a firm's technology strategy by integrating this with business strategy. To help map the various factors that are posed by Burgelman, et.al., Porter, and Hamel and Prahalad, the following framework is offered (see Exhibit 2).

This framework seeks to integrate the four dimensions of technology strategy with the experience in practice. Using this framework enables technology strategy to be comprehensive, embodying consistent answers to the questions posed by the four dimensions, and integrated, relating to the various modes of experience. By being comprehensive and integrated, technology strategy contributes toward a firm's business strategy.

AN INTEGRATED TECHNOLOGY AND BUSINESS STRATEGY: IMPLICATIONS

The biggest potential for applying an integrated technology and business strategy using the framework discussed in the previous section is in manufacturing. The National Center for Manufacturing Sciences (NCMS) of Ann Arbor, Michigan, in its NCMS Collaborative Manufacturing Agenda of May 31, 1996, identified four categories of trends affecting the manufacturing sector, economic, technical, social, and political. Exhibit 3 lists these more influential or significant trends under each of the four categories. The purpose in identifying these trends is to help meet manufacturing needs to solve problems currently ignored. These problems need to be addressed if the manufacturing sector is to compete in a global economy by being leaner but more productive. Specifically, the NCMS Agenda contends that to remain competitive, firms must:

1. Continue to produce high-quality products;
2. Increase new product introduction rates;
3. Increase affordability of their products; and

4. Respond quickly to changing customer needs.

To become leaner and productive while achieving the above objectives, manufacturing firms must derive their new productivity from technology, knowledge, and the integration of technology into their manufacturing organizations. In effect, manufacturing must change. To achieve this transformation, technology must be leveraged to achieve increased productivity.

What and how are these technologies used? In North America, NCMS determines that there is an increase in workers engaged in information processing (data collection, analysis, and information-based decisions) from 28% in 1960 to about 40% in 1980. The increased use of Information Technology (IT) has improved productivity by allowing manufacturing organization to become more efficient through fewer management layers and faster decision-making capability on the production line. This has improved quality and reduced product costs.

IT advances, however, provide more than just faster decision-making. Because more accurate, faster and timely performance data about production processes are made available, the machines themselves can be made more flexible, more accurate, safer, and more environmentally responsive. Thus, if IT is coupled with advanced production technology, manufacturing transformation can be accomplished using technology making the following impacts as seen in Exhibit 4.

In conclusion, to achieve competitiveness, manufacturing must be transformed. Technology is the principal driver of transformation. The capability to use technology will determine to a large extent the speed and effectiveness of the transformation. Technology strategy and business strategy must be integrated to achieve maximum capability and innovation activities are an integral part of technology strategy.

Innovation is a complex process with uncertain outcomes. Even purchasing appropriate new production machinery requires a high level of knowledge and skills. This means that a company's strategy towards innovation is dependent on its accumulated expertise. A firm's choices are often limited to those areas where it has accumulated relevant technological skills. Companies' technology strategies therefore differ. They are not based solely on simple commercial choices using financial and/or economic justification measures or the outcome of easily implemented choices between different technologies. Companies need an awareness of what a new technology can do for them in their particular circumstances. This awareness is company-specific and requires a capacity to evaluate developments in the context of the company's activities. This capacity has sometimes been called 'intelligence management'.

This is why an R&D capacity is usually considered such an important component of technological innovation – not so much for the products or processes that it produces, but the internal expertise it provides for all types of technology acquisition and development. This has led some analysts to suggest that (at least for fully industrialized countries) the presence of R&D activity within a firm is generally essential for any form of innovation to occur. A lower level of R&D in a company necessarily implies a lower level of technology. The OECD claims that a company needs at least an intermittent R&D capacity for innovation.

The claims about the importance of R&D to innovation remain to be fully tested in rapidly industrializing countries. It has been suggested that what is required in less developed countries are in-house technical skills and appropriate prior experience of successful adaptation. This proposal is supported by studies of the 'East Asian' model of technological innovation, by Japan, Taiwan and South Korea. Here, increased engineering, technical and production skills lead innovation, with fundamental research and experimental development following only much later. This is quite clearly the model being followed by Malaysian industry, at least for the technology intensive

manufacturing sectors like electronics and consumer appliances (Malaysian Survey of Innovation in Industry, 1994).

Diffusion of technology is also a critical step in industrial innovation, and a measure of national technological capacity. The OECD has undertaken a study of the diffusion of technology embodied in technologically sophisticated intermediate and capital inputs purchased by firms in eight countries. Significant differences were found between countries and between industry sectors. The report concludes that 'technological intensity, productivity and competitiveness may depend as much on how technology diffuses through products and processes as on the internal R&D effort in each industry'.

IMPLICATIONS FOR THE PHILIPPINES

If the United States views its manufacturing sector as a strategic asset and, through NCMS, recognizes the need for the sector to undergo change to remain competitive in a global economy, the same must hold true for the Philippines.

Philippine manufacturing companies must recognize the need to change in order to meet the challenges of an increasingly competitive market. The SGV Consulting/Arthur Andersen survey shows that they have correctly identified the key factors that affect competitiveness. These may be summarized into four categories: cost, quality, flexibility, and speed of delivery.

To meet these challenges, it is expected that the solutions should be technology-oriented if the current thinking is to be followed. Rightly so, the Philippine companies have recognized and implemented solutions that are technology related. The survey however, has not dwelt on how much success was achieved in implementation. Also, no indication was made as to the relationship of these solutions to the business strategy of the firms. What can be deduced, however, is that these firms face a formidable barrier in

implementing technology strategy. A major barrier cited by companies is lack of preparation/refresher training, a very important factor in achieving technological capability. Adding the next four major implementation barriers, the deduction can be made that two of the four dimensions of a successful technology strategy is still lacking in Philippine companies. These are resource commitment and organizational fit. These two dimensions are as vital to successfully integrating technology strategy to business strategy.

To illustrate the point, a simple study was done in which two companies in the printing industry were asked about their technology and business strategy (Macapanpan,1997). Printing is one industry where technological advances in IT and imaging technology among others have made it imperative for companies to adopt, adapt or perish. One company has opted to commit fully to a technology strategy that supports its business strategy. It has recognized that price, quality and responsiveness are the key success factors and technology is the avenue to achieving these. The other company also recognizes the key success factors. However, it is not in a position to acquire and deploy the necessary technology. The resulting performance of the companies may be illustrated by their proposals for a printing job. Both were requested to offer proposals to print 2,000 copies of a simple four-color brochure. The company which had an integrated technology and business strategy was able to offer the same delivery dates with one-fourth the quoted price of the other company. It was company's newer technology that allowed it to be as responsive at a much lower cost with the same, if not better, quality.

The SGV study was, as it admits, a quick reading on the business challenges faced by Philippine manufacturing companies and how they face these challenges. A more comprehensive and in-depth study must be made to determine how the firm's formulate their business and technology strategies to meet these challenges. A study of these firms' innovation activities will provide a glimpse of the technology strategies these firms have adopted. Using the approach suggested in this paper will provide a clearer picture on how the Philippines will fare in the competitive global economy.

THE STUDY

The study of Philippine private sector innovation activities was made through a survey of selected Philippine companies from the following industry groupings as per DTI classifications:

1. Food Processing
2. Textile and Garments
3. Metals and Metal Fabrication
4. Chemicals
5. Electronics and Electrical

It must be noted that the DTI classifications encompass a wide spectrum of companies in each industry grouping. It was difficult to isolate, at the outset, the companies that were engaged in mere trading and those engaged in manufacturing. As an example, the Electronics and Electrical Industry Classification contains firms engaged in semiconductors, an area sensitive to technological innovation, and firms engaged in the manufacture of electric fans, where technology is not so critical and where innovations are at best in the form of product “packaging” (making the product aesthetically attractive). It is within these limitations that the survey was conducted. These limitations also pose a problem when inferring any conclusions about innovation activities from the survey results.

The survey questionnaire is presented in Appendix B. Development of the questionnaire was based on the following objectives:

1. Identify firms as innovative or non-innovative.
2. Firms can be considered to have engaged in innovation activities if they have, over the past 5 years, done the following:
 - a. carried out R&D activities as defined;
 - b. developed new products;
 - c. developed new processes;
 - d. acquired new technology;

- e. transferred technology to another firm; or
 - f. applied for a patent.
3. Identify the organizational structure, size, and financial structure of the firms engaged in innovation activities;
 4. Determine the variables that influence the firms' innovativeness such as :
 - a. Type of innovative activities undertaken
 - b. Extent of innovation activity
 - c. Capabilities of persons undertaking innovation activity
 - d. Sources of information for innovation
 - e. Benefits/Objectives of innovation
 - f. Expenditures for innovation activities
 5. Expectations and perceptions of government influence on innovation

The questionnaire was patterned after the questions asked in the 1994 Malaysian Survey of Innovation in Industry. This survey in turn was prepared based on several innovation studies made in developed countries. The Philippine survey, however, sought not to put emphasis on R&D but on innovation activities as a whole due to reasons previously discussed.

In addition to the survey, focused interviews were conducted to gain deeper insights into private sector innovation activities and to validate survey results.

The study, however, is limited in its scope because of the difficulty in focusing on companies that are truly engaged in innovation as part and parcel of their business strategy.

FINDINGS (Refer to Appendix C)

As stated in the section describing the study methodology, there was a wide spectrum of firms classified under each industry classification. This

makes it difficult to state any categorical finding for each industry. The Chemical Industry, for example, has firms that are mere distribution arms of major international chemical companies. These local firms do not engage in any R&D except to assist local buyers in incorporating or adapting their chemicals into the buyers' processes.. Local chemical manufacturers, on the other hand, are basically commodity chemical makers, an undertaking not requiring any significant innovation activity.

A. CHARACTERISTICS OF FIRMS ENGAGED IN INNOVATION

1. The survey showed that approximately 65% of the firms claim to have conducted some form of innovation activity. Nearly 50% consider themselves as having conducted high-technology types of innovation activity and the majority conduct at least medium level technology activities. A more in-depth study is indicated, probably focused interviews of each firm to pinpoint their exact level of innovation.
2. Most of these firms performing innovation are corporations with assets of Php 15 million and above, have an employment of at least 100, revenues of above Php 50 million. It can be inferred that only big firms engage in innovation and that these are the 'leaders in their industry. The small firms may just be 'along for the ride, not even considered 'followers'.
3. Innovation activities are perceived by the firms to improve their competitiveness through improved product quality, lower production costs, and enhanced marketing performance. Government standards and regulations and environmental concerns are not important drivers for innovation activities. As predicted by literature and studies, firms will formulate their technology strategy to support their overall business strategy.

B. CHARACTERISTICS OF THE INNOVATION ACTIVITIES OF THE FIRMS

1. The most prevalent innovation activity of the firms is new product and process development. The interviews have elicited the information that these new products and process development activities are often focused on adapting existing products and processes from abroad to the Philippine conditions. This type of innovation activity may, at best, be considered as applied R and D.
2. The next two common activities are the acquisition of new technology and R&D activities. Again, interviews and the experience of the author suggest that R&D activities are often concentrated on adapting/testing alternative materials for use in the company's products. Acquisition of new technology is often undertaken to keep the company competitive in the Philippine market. New technology acquired is often only considered new in the Philippines. Only the Electronics and Electrical Industry puts more emphasis on acquiring really new technology. This is because the 'semiconductor' firms' products are primarily exported and must therefore be competitive in the world market. The steel industry, which have been the focus of studies on competitiveness, have not acquired any significant new technology in spite of the recommendations in the studies. The same is true for the textile industry which has fallen behind in modernizing their equipment to remain competitive, quality- and cost-wise.
3. R&D activities claimed are actually applied research and development rather than basic R&D. Only about 7 firms employ Ph.D.s and only about 20 have masteral degree holders performing any innovation activity. A majority employ only college graduates or lower in their innovation activities implying a very low level of innovation activity.
4. The firms plan to follow the same pattern of innovation activities for the next five (5) years. The development of new products and processes are sourced mainly from consultancy services, competitor monitoring, and suppliers of materials and equipment. New technology, if acquired will

consist mostly of purchasing equipment from the United States, Japan, Taiwan, and Germany. Technology licensing and consultancy services are the other usual means of acquiring technology.

5. Ideas for innovation activities are also usually sourced from the outside in the form of consultancy services, information on competitor activity generated by monitoring, purchase of technology, tangible and intangible, and the recruitment of manpower with the requires skills. Internally, the development of manpower is seen as the main source of ideas. Internal R&D is not relied upon except by the firms in the Electronics and Electrical Industry. Government research institutions rank very low as a source of innovation ideas. From interviews, the perception of the firms is that these research institutions lag even in monitoring technology developments in their respective fields.
6. Financial constraints such as risk and rate of return, lack of financing, and taxation are the major hindrances to innovation. Technical constraints such as lack of information on new technologies, deficiency in external technical services, innovation costs, and uncertainty rank next as barriers to innovation. Others mentioned include difficulty in obtaining patents, low technological standards, lack of skilled personnel, and lack of opportunities for cooperation with other companies.
7. The main expectations of the firms from the government by way of support for innovation activities is in the form of incentives and the provision for and making available specialized training and professional skills. Secondly, the firms would like assistance in the form of easier access to markets and financing.

CONCLUSIONS

Philippine firms realize the value of innovation. They conduct some form of innovation activity to improve their competitiveness. However, they are, at best reacting to developments in the market. Their main activity is in

developing new products and processes. Actually, the main thrust of this activity is adaptation of existing products and processes from abroad to the Philippine market. The firms have no plans for any substantial R&D over the next five years. Even their innovation activities are carried out by baccalaureate degree holders, suggesting a very minimal research capability. Their ability to gear up to a higher level of innovation activity is hampered to a large extent by financial constraints exacerbated by lack of the requisite intangible technology principally in the lack of technical and professional skills and knowledge. Based on the technology strategy framework discussed above, Philippine firms are deficient in experience and organization to fully exploit technology as a source of competitive advantage.

This situation is not helped by the lack of government assistance and support. Government has been remiss in aligning the educational system toward a globally and technologically competitive economy. The requisite technical and technological skills and knowledge are not provided by the Philippine schools. Government research institutions have not diffused their findings to the private sector.

DIRECTIONS FOR FURTHER STUDY

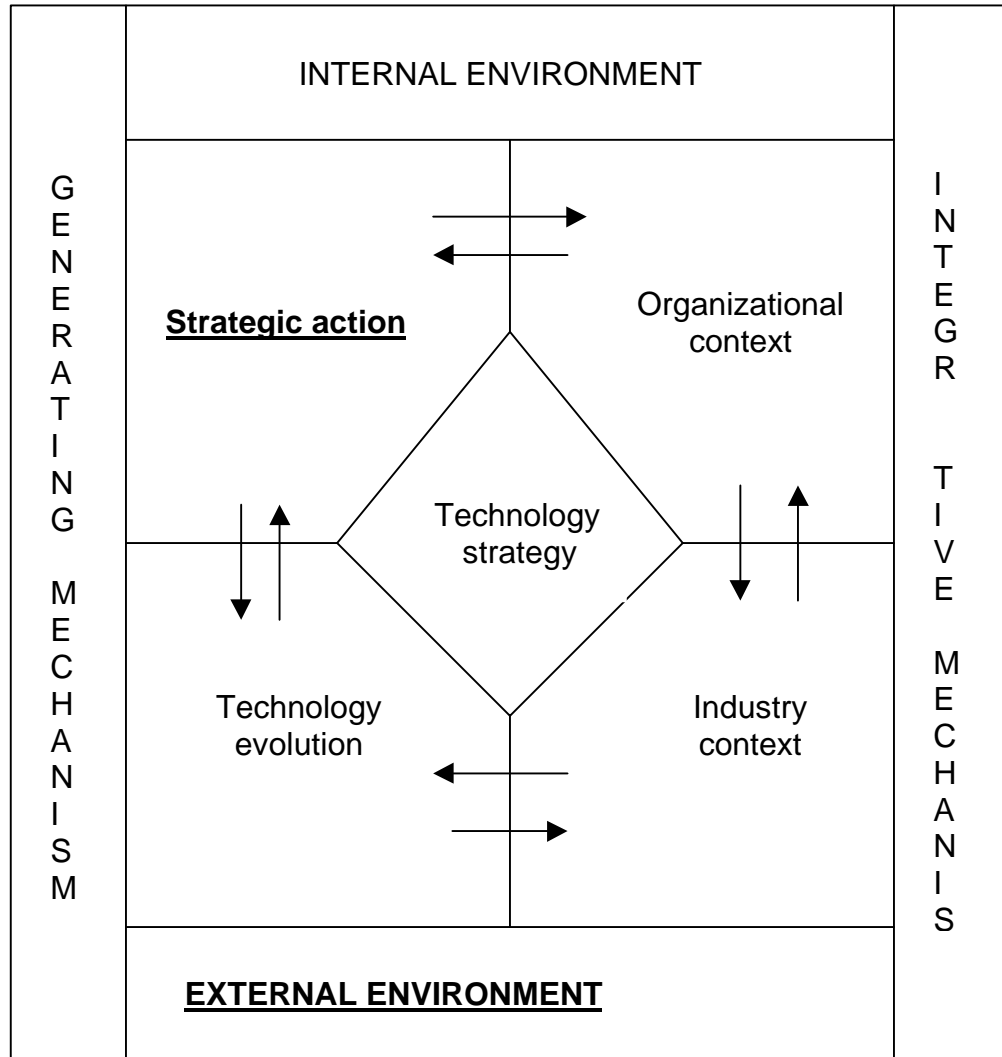
This study can be developed further into deeper studies of more focused groupings than the DTI classifications. The classifications can be subdivided by a criteria that assigns firms on the basis of the importance of technology in its overall competitive business strategy.

The first step may, therefore, be to determine the desirable technology strategies for each classification and, then, to evaluate the performance of these firms. This proposed study will be valuable to policy makers in mapping any plans and policies for making these industries competitive in the world market.

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**EXHIBIT 1
DETERMINANTS OF TECHNOLOGY STRATEGY**



Source: *Strategic Management of Technology and Innovation, 2nd Edition*, by Robert A. Burgelman, Modesto A. Maidique, and Steven C. Wheelwright, IRWIN, p39.

EXHIBIT 2
FRAMEWORK FOR TECHNOLOGY STRATEGY

<u>Modes of Experience</u>					
<u>Substance</u>	External Technology Sourcing	Internal Technology Sourcing	Product Develop- ment	Process Develop- ment	Technical Support
Competitive Strategy stance					
Value Chain stance					
Resource Commitment stance					
Management stance					

Source: *Strategic Management of Technology and Innovation, 2nd Edition*, by Robert A. Burgelman, Modesto A. Maidique, and Steven C. Wheelwright, IRWIN, p.45.

EXHIBIT 3 TRENDS AFFECTING MANUFACTURING

ECONOMIC TRENDS

- Continued rapid unpredictable change
- Inability to cope with change
- Globalization of markets, information, and business
- Shrinking market segments
- Emergence of regional economic blocs
- Increasing conflict between growth and the environment
- Nations losing control to global business
- Increasing difficulty to borrow money
- Growth of multinational virtual corporations
- Shorter product life
- Smaller production lot size
- Increased custom information content

TECHNICAL TRENDS

- Increased automation and integration
- More readily available technology
- Increasing use of virtual reality
- More prolific information technology(IT)
- Continued focus on environment
- Increased demand for smart mechanical devices
- Reduced product design cycle
- Increased interest in renewable energy
- Development of new and exotic materials

SOCIAL TRENDS

- Inability to keep up with technology
- Widening variance in literacy and education
- Rising levels of specialized skills
- Vanishing notion of permanent employees
- Higher average age in workforce
- Increasing world population
- More economically disadvantaged individuals
- Mass migration to developed countries
- Acceptance of non-traditional family structure
- Redefined gender roles
- Growing number of discouraged youth

POLITICAL TRENDS

- Decreasing credibility of politicians
- Decline of employment in large companies
- Lack of a national information infrastructure
- Increased tolerance for small, localized wars
- Emerging new models for capitalism and democracy
- Potential country break-ups

EXHIBIT 4 IMPACTS OF THE TRANSFORMATION OF MANUFACTURING (From NCMS Collaborative Manufacturing Agenda, 1996)

Implementation Was

- Large capital budgets
- Big-ticket items
- Less people, more automation
- Technology is intrinsically good
- Complex/Integrated systems are the best
- Get turnkey systems the easy way
- Don't understand it

Is Becoming

- Scaled-back or limited budgets
- Small total cost, incremental
- Balance people and automation
- Technology balanced with business and workforce
- Simpler, modular approach
- Do-it-yourself, and personal involvement
- Understand it completely

Internal Process Was

- Large-scale systems
- Large projects with long development time
- Deliver results at end
- Higher development cost
- Productivity is not an issue
- Customers not involved

Is Becoming

- Building block approach
- Incremental projects with short development time
- Quick results and benefits
- Low development cost
- Productivity improvement
- Joint participation

- Home-grown solutions
- Go it alone
- Funding only by the manufacturing technology

Equipment Usage Was

- Complex , integrated
- Works well when up
- Difficult to fix
- Lack of understanding by workforce
- Technology intimidating
- High overhead costs
- Support is sporadic and comes in large data dumps
- Costly to acquire

- Buy, if possible
- Seek partners, do collaborative development
- Cost share with internal and external customers

Is Becoming

- Simple, modular, semi-manned
- Works well and almost always
- Easy to fix or replace
- Invented, selected, implemented fully
- Technology invisible
- Low overhead costs
- Support is consistently available and assists
- Inexpensive to acquire

APPENDIX A

A NOTE ON INNOVATION

What is innovation?

Innovation is defined by the Organization for Economic Cooperation and Development (OECD) as in the box below. In summary, innovation is the sum of the processes of discovery, invention, product development, process creation and development and organizational change, and the diffusion and uptake of all these processes.

Innovation can result from major technological breakthroughs (for example, the jet engine, penicillin, transistor) or from a series of small, incremental changes which often result in innovations with the greatest commercial importance (for example, the eight-fold increase in efficiency of electric power plants; reductions of over half in the jet fuel required per passenger kilometer).

The OECD recognizes seven phases (not necessarily sequential) in the innovation process:

- (a) R&D;
- (b) Tooling-up and industrial engineering;
- (c) Manufacturing and start-up and pre-production development;
- (d) Marketing for new products;
- (e) Acquisition of disembodied technology (patents, designs, know-how, licensing, etc.);
- (f) Acquisition of embodied technology (machinery, and equipment),
and
- (g) Design

Definition of technological innovation and diffusion (Source: OECD)

Technological innovations comprise new products and processes and significant technological change of products and processes. An innovation has been implemented if it has been introduced on the market (product innovation) or used within a production process (process innovation). Innovations therefore involve a series of scientific, technological, organizational, financial and commercial activities.

A **product innovation** is the commercialization of a technologically changed product. Technological change occurs when the design characteristics of a product change in ways which deliver new or improved services to consumers of the product.

A **major product innovation** is a substantially new product, significantly different from previously manufactured products, and based on radically new technologies or new uses of existing technologies;

An **incremental process innovation** involves significant performance enhancement or improvement to an existing product.

A **process innovation** occurs when there is a significant change in the technology of the production of an item. This may involve new equipment, new management, and organization methods, or both.

Diffusion is the way in which innovation spread, through market or non-market channels. Without diffusion, an innovation will have no economic impact.

In recent years much international work has been dedicated to the development of specific quantitative indicators of technological innovation. The aim has been to provide answers to questions such as:

- (a) How do firms acquire innovative capacity?
- (b) What are the main non-R&D inputs to innovation?
- (c) What is the impact of innovation on corporate performance?

The OECD approach focuses on:

- (a) measuring the extent of technological innovation (i.e., product and process technology) in firms and industries;
- (b) the objectives of technological innovation (e.g., replacing products or developing new export markets);

- (c) the innovative attitude, behavior and activities of companies – where do they obtain innovative ideas, what are the barriers or incentives to innovation;
- (d) the effect of technological innovation on the performance of the company or industry;
- (e) the costs of technological innovation; and
- (f) the diffusion of technologies within and between industries, and use of technologies in particular industries.

The main focus of international surveys of **industrial innovation** to date has been on technological innovation, as defined. Although this definition encompasses ‘new management and organizational methods’, innovations in organizational practice or corporate strategy tend to be overlooked, not least because they are hard to measure and the first edition of the manual gives little guidance.

Investigation of new markets and sources of supply for raw materials or semi-manufactured inputs to production can be considered as ‘non-technological’ or organizational innovation. ‘Soft technologies’ such as just-in-time manufacturing or total quality control arrangements are another important aspect of organizational innovation.

Also neglected in many surveys are innovations in services, again partly because the innovation phases specified in the OECD manual appear more applicable to tangible products and processes than to services.

Organizational innovation and innovation in services industries are touched upon in the Malaysian national survey on innovation. However, for reasons explained in Chapter 2 this coverage is limited, and our main findings concern technical innovation in the manufacturing sector.

Impediments to innovation

Innovation is a complex process with uncertain outcomes. Even purchasing appropriate new production machinery requires a high level of knowledge and skills. This means that a company's strategy towards innovation is dependent on its accumulated expertise. As Pavitt comments: 'A firm's choices are limited to those areas where it has accumulated relevant technological skills'. Companies' technology strategies therefore differ. They are not based solely on simple commercial choices about relative factor cost or the outcome of easily implemented choices between different technologies. Companies need an awareness of what a new technology can do for them in their particular circumstances. This awareness is company-specific and requires a capacity to evaluate developments in the context of the company's activities. This capacity has sometimes been called 'intelligence management'.

This is why a R&D capacity is usually considered such an important component of technological innovation –not so much for the products or processes that it produces, but the internal expertise it provides for all types of technology acquisition and development. This has led some analysts to suggest that (at least for fully industrialized countries) the presence of R&D activity within a firm is generally essential for any form of innovation to occur, and that a lower level of R&D in a company necessarily implies a lower level of technology. The OECD claims that a company needs at least an intermittent R&D capacity for innovation.

The claims about the importance of R&D to innovation remain to be fully tested in rapidly industrializing countries. Many years ago Bell and Hill suggest that what is required in less developed countries are 'in house technical skills and appropriate prior experience of successful adaptation'. This proposal is supported by studies of the 'East Asian' model of technological innovation, that is by Japan, Taiwan and South Korea. Here, increased engineering, technical and production skills lead innovation, with fundamental research and experimental development following only much

later. This quite clearly the model being followed by Malaysian industry, at least for the technology intensive manufacturing sectors like electronics and consumer appliances.

Diffusion of technology is a critical step in industrial innovation, and a measure of national technological capacity. The OECD has undertaken a study of the diffusion of technology embodied in technologically sophisticated intermediate and capital inputs purchased by firms in eight countries. Significant differences were found between countries and between industry sectors. The report concludes that 'technological intensity, productivity and competitiveness may depend as much on how technology diffuses through products and processes as on the internal R&D effort in each industry'.

Indicators that measure the diffusion of technological innovation are therefore important for Malaysia. It is beyond the scope of this report to present comprehensive measures of technology diffusion such as extent of inter-industry flows of specific technologies. However, some information on the importance of inter-firm and intersectoral cooperation (e.g., through-shared R&D, licensing, joint ventures) is given.

Organizational characteristics of successful innovators

As suggested above, R&D is not the only, and often not even the most important, initiating factor in innovation. New technical ideas and inventions are necessary conditions for innovation; but they are by themselves not sufficient. Other conditions may include:

- a) integration and synthesis of technical knowledge with potential market demands.
- b) An entrepreneurial individual or organization willing to take economic risks; and
- c) An organizational system able to manage the innovation process to a successful completion.

A recent review of large innovative companies suggests that they share the following characteristics:

- a) a reconciliation of the centralism required for exploitation of core technologies and the decentralization required for their effective implementation;
- b) a process of learning ('learning organization') that enables them to build upon their core competencies; and
- c) methods of resource allocation that balance requirements for short term profitability with the creation of longer term opportunities (i.e., long and short term technology strategies).

Innovation has therefore been described as an 'interaction between opportunities (held out by technology or the market), capabilities and strategies'. A firm's capabilities lie, for example, in its engineering, design, research and marketing resources which it must assemble into a coherent technological innovation strategy.

One of the tasks of the analyst of technological innovation is to describe the various strategies used by different companies and industries in different circumstances, to provide a measure of the relative importance of different inputs and effectiveness of organizational models. While this report touches on the same aspects of organizational innovation, a detailed examination of company organizational models and strategies is beyond the scope of a national industry-wide statistical survey. Thus the report therefore contributes to this task rather than fulfilling it. It paints a broad picture of industrial innovation in Malaysia which supports and is informed by case studies of various industries carried out by analysts mentioned earlier.

(Adapted from Chapter 1 of the 1994 Malaysian Survey of Innovation in Industry)

APPENDIX B

SURVEY FORM ON PRIVATE SECTOR ACTIVITIES ON INNOVATION

I. GENERAL INFORMATION

COMPANY NAME _____

ADDRESS _____

TEL NOS. _____ FAX NO. _____

E-MAIL _____

MAIN LINE OF BUSINESS _____

OTHER LINES _____

II. FIRM STRUCTURE

1. TYPE OF OWNERSHIP (Please Check)	UPON ESTABLISHMENT	PRESENT
Single proprietorship	<input type="checkbox"/>	<input type="checkbox"/>
Corporation	<input type="checkbox"/>	<input type="checkbox"/>
Joint Venture	<input type="checkbox"/>	<input type="checkbox"/>
Subsidiary *	<input type="checkbox"/>	<input type="checkbox"/>
Others (Pls. Specify)	_____	_____

*Name of Mother Company _____

Address _____

2. DATE OF ESTABLISHMENT _____

3. TOTAL ASSETS** (Please Check)	UPON ESTABLISHMENT	PRESENT
PhP 150,000 and below	<input type="checkbox"/>	<input type="checkbox"/>
PhP 150,000 - 1,500,000	<input type="checkbox"/>	<input type="checkbox"/>
PhP 1,500,000 - 15,000,000	<input type="checkbox"/>	<input type="checkbox"/>
PhP 15,000,000 - 60,000,000	<input type="checkbox"/>	<input type="checkbox"/>
PhP 60,000,000 and above	<input type="checkbox"/>	<input type="checkbox"/>

** Exclusive of Land on which the business entity's office, plant, and equipment are situated.

4. EMPLOYMENT (Please Check)	UPON ESTABLISHMENT	PRESENT
50 and below	<input type="checkbox"/>	<input type="checkbox"/>
51 - 99	<input type="checkbox"/>	<input type="checkbox"/>
100 - 199	<input type="checkbox"/>	<input type="checkbox"/>
200 - 399	<input type="checkbox"/>	<input type="checkbox"/>
400 - 699	<input type="checkbox"/>	<input type="checkbox"/>
700 - above	<input type="checkbox"/>	<input type="checkbox"/>

5. REVENUE (Please Check)	UPON ESTABLISHMENT	PRESENT
PhP 500,000 and below	<input type="checkbox"/>	<input type="checkbox"/>
PhP 501,000 - 9,999,999	<input type="checkbox"/>	<input type="checkbox"/>
PhP 10,000,000 - 49,999,999	<input type="checkbox"/>	<input type="checkbox"/>
PhP 50,000,000 - 99,999,999	<input type="checkbox"/>	<input type="checkbox"/>
PhP100,000,000 - 499,999,999	<input type="checkbox"/>	<input type="checkbox"/>
PhP500,000,000 - above	<input type="checkbox"/>	<input type="checkbox"/>

III. INNOVATION ACTIVITIES

PLEASE TAKE TIME TO READ THE ATTACHED NOTE ON INNOVATION . THE NOTES WILL DEFINE AND CLARIFY THE TERMS IN THIS PART OF THE QUESTIONNAIRE.

1. Over the last 5 years, did your company perform any of the following activities?

	<u>YES</u>	<u>NO</u>
a. Carry out R & D activities by itself	<input type="checkbox"/>	<input type="checkbox"/>
b. Develop or introduce new or substantially new products	<input type="checkbox"/>	<input type="checkbox"/>
c. Develop or introduce new or substantially new processes (such as production technology or machinery)	<input type="checkbox"/>	<input type="checkbox"/>
c. Acquire new technology	<input type="checkbox"/>	<input type="checkbox"/>
d. Sell or transfer technology outside the company	<input type="checkbox"/>	<input type="checkbox"/>

f. Apply for any patent in the Philippines or any other country

2. What academic background do the personnel who perform innovative activities possess?

	<u>Ph.D.</u>	<u>MS/MA</u>	<u>BS/BA</u>	<u>OTHER</u>
d. Carry out R & D activities by itself	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Develop or introduce new or substantially new products	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Develop or introduce new or substantially new processes (such as production technology or machinery)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. To what extent did your company carry out innovation?

Company acquired (purchased) new technology only, no internal development of technology. Applied R&D results of mother company; adaptation of mother company's products.

Company developed or introduced new or improved products and/or processes.

Company carried out its own R&D and/or applied for patents and/or sold or transferred technologies out of the business.

4. How does your company expect to carry out innovation in the next 5 years?

Company will acquire (purchase) new technology only, no internal development of technology. Will apply R&D results of mother company; adaptation of mother company's products.

Company will develop or introduce new or improved products and/or processes.

Company will carry out its own R&D and/or apply for patents and/or sell or transfer technologies out of the business.

5. What are the sources of ideas/information for your company's innovation activities? How important or significant are these sources? Please rate them according to the following rating system:

- 1 - Not important/significant**
- 2 - Slightly significant**
- 3 - Significant**
- 4 - Very Significant**
- 5 - Crucial**

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
a. R&D					
a) Internal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Performed by parent or associated companies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Identify new product concepts and production technology by:					
a) consultation with users	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) monitoring competitors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) consultation with suppliers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Recruiting manpower with the required skills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Purchase of technology					
a) Tangible (machinery and equipment)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Intangible (technical information, patent, licensing, franchising, employing consultants)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Development of manpower skills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Development of pilot production	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Imitation (Benchmarking, reverse engineering)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Joint ventures with innovative companies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Professional conferences and meetings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Professional journals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. Patent information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l. Fairs and exhibitions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m. Acquisition of innovative firms (takeovers)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n. Cooperation with :					
a) Government research Institutions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Institutions of higher learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

c) Others (Pls. Specify) _____

6. How do you protect any innovation in your company? Please rate as to their importance (using the rating scale as in Question 4).

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
a. Be ahead in the market	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Secrecy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Complexity of design	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Registration of design	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Patents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Other methods (Pls. Specify) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. How did your company acquire technology? Please check as many as is applicable.

	From the Philippines	From Abroad
1. Purchase equipment	<input type="checkbox"/>	<input type="checkbox"/>
2. Acquire from within the business group	<input type="checkbox"/>	<input type="checkbox"/>
3. Licensing/purchase of rights	<input type="checkbox"/>	<input type="checkbox"/>
4. Hire skilled employees	<input type="checkbox"/>	<input type="checkbox"/>
5. Results of R&D contracted out	<input type="checkbox"/>	<input type="checkbox"/>
6. Use of consultants	<input type="checkbox"/>	<input type="checkbox"/>
7. Takeover of company with the technology	<input type="checkbox"/>	<input type="checkbox"/>
Patent pooling	<input type="checkbox"/>	<input type="checkbox"/>
Others(Pls. Specify)_____	<input type="checkbox"/>	<input type="checkbox"/>

8. If technology was acquired from abroad, which countries were the sources?

a. Purchase of Equipment

<input type="checkbox"/> Japan	<input type="checkbox"/> England
<input type="checkbox"/> United States	<input type="checkbox"/> Italy
<input type="checkbox"/> Taiwan	<input type="checkbox"/> Other (Pls. Specify) _____

Germany

b. Technology Licensing

Japan

England

United States

Italy

Taiwan

Other (Pls. Specify) _____

Germany

c. Consultancy Services

Japan

England

United States

Italy

Taiwan

Other (Pls. Specify) _____

Germany

d. R&D Contracting

Japan

England

United States

Italy

Taiwan

Other (Pls. Specify) _____

Germany

e. Patent Pooling

Japan

England

United States

Italy

Taiwan

Other (Pls. Specify) _____

Germany

9. Please rate the significance of the different innovation activities performed

by your company (Pls. Use the scale used in Question4):

1 2 3 4 5

a. R&D

b. Training

- c. Acquisition of Tangible Technology
- d. Acquisition of Intangible Technology
- e. Tooling up
- f. Pilot Production

10. Please give an estimate of the expenditures incurred annually for each of the above. Please write the number most corresponding to the expenditure:

- 1 - PhP 50,000 below
- 2 - PhP 51,000 - 100,000
- 3 - PhP 101,000 - 500,000
- 4 - PhP 501,000 -1,000,000
- 5 - PhP 1,000,000 above

- | | <u>1</u> | <u>2</u> | <u>3</u> | <u>4</u> | <u>5</u> |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| a. R&D | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b. Training | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c. Acquisition of Tangible Technology | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d. Acquisition of Intangible Technology | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e. Tooling up | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| f. Pilot Production | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

11. What were the benefits/objectives of the innovative activities? How significant was each? (Pls. rate as in Question4)

- | | <u>1</u> | <u>2</u> | <u>3</u> | <u>4</u> | <u>5</u> |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| a. Create new markets | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b. Increase market share | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

- c. Maintain market share
- d. Extend product range
- e. Improve product flexibility
- f. Replace products being phased out
- g. Improve product quality
- h. Lower production costs
- i. Lower design costs
- j. Improve working conditions/safety
- k. Meet government standards, regulations, legislation
- l. Reduce environmental damage
- m. Others (Pls. specify) _____

12. What factors hinder innovation? How significant are they to your activities?

- | | <u>1</u> | <u>2</u> | <u>3</u> | <u>4</u> | <u>5</u> |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| a. Financial risk | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b. Lack of financing | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c. Financially unjustifiable | | | | | |
| a) Pay-back period too long | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) IRR too low | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) Other financial criteria not met (Pls. specify) _____ | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

- d. Lack of information on technologies
- e. Deficiencies in the availability of external technical services
- f. Patents hard to get
- g. Lack of technological opportunities
- h.. Lack of opportunities for cooperation with other companies or science and technology organizations
- i. Standards are low
- j. Lack of customer responsiveness to new products or processes
- k. No need to innovate due to earlier innovation
- l. Uncertainty in timing of innovation
- m. Innovation easy to copy
- n. Lack of skilled personnel
- o. Innovation costs difficult to control
- p. Government legislation and regulation
- q. Taxation
- r. Other Factors (Pls. specify) _____

IV. GOVERNMENT POLICIES AND REGULATIONS

1. How have government policies, legislation and regulation influenced your company's innovation activities? Please rate on the basis of significance.

¹ ² ³ ⁴ ⁵

2. On the basis of their consequences, please assess the following forms of government incentives and regulations concerning innovation activities of your firm and your industry.

Rating	Consequences
1	No Effect
2	Slight Effect
3	Significant Effect
4	Very Significant Effect
5	Crucial

GOVERNMENT INCENTIVES/ REGULATIONS			<u>FIRM</u>			<u>INDUSTRY</u>				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
1. Duty drawback	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Lower preferential tariff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Preferential credit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Regulation on foreign ownership	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Exemption from corporate income tax	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Reduction in taxable income	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Exemption/reduction of taxes on imported	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Exemption/reduction of taxes on imported raw materials	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Exemption from capital gains tax	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Exemption from other taxes and fees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. In what ways must government provide support? Pls. check as many as is appropriate:

- Providing for an educated work force
- Making available specialized training and professional skills
- Ensuring university and public sector research capacity and providing private sector access to them

- Ensuring access to markets and financial capital
- Provide incentives for innovative activities
- Ensure protection of intellectual property
- Encourage diffusion of technologies by loosening intellectual property rights regulations
- Others _____

ACCOMPLISHED

BY: _____

POSITION : _____

DATE _____

APPENDIX C
SURVEY RESULTS

TABLE 1
BENEFITS OF INNOVATION TO BUSINESS

RANK	BENEFIT
1	IMPROVED PRODUCT QUALITY
2	INCREASED MARKET SHARE
3	CREATE NEEW MARKETS
4	MAINTAIN MARKET SHARE
5	LOWER PRODUCTION COSTS
6	EXTEND PRODUCT RANGE
7	IMPROVE PRODUCT FLEXIBILITY
8	LOWER PRODUCT DESIGN COSTS
9	IMPROVE WORKING CONDITIONS/SAFETY
10	MEET GOV'T STANDARDS, REGULATIONS
11	REPLACE PRODUCTS BEING PHASED OUT
12	REDUCE ENVIRONMENTAL DAMAGE

**TABLE 2
EXTENT OF CARRYING OUT INNOVATION**

RANK	ACTIVITY
1	CO. DEVELOPED NEW PRODUCTS/PROCESSES
2	CO. ACQUIRED NEW TECHNOLOGY
3	COMPANY CARRIED OUT R&D

**TABLE 3
PATTERNS OF INNOVATION ACTIVITIES
FOR THE PAST 5 YEARS**

RANK	INNOVATION ACTIVITY
1	DEVELOP NEW PRODUCTS
2	CARRY R&D ACTIVITIES
3	ACQUIRE NEW TECHNOLOGY
4	DEVELOP NEW PROCESSES
5	PATENT APPLICATION
6	TRANSFER TECHNOLOGY

**TABLE 4
INNOVATION PLANS FOR THE NEXT 5 YEARS**

RANK	ACTIVITY
1	CO. WILL DEVELOP NEW PRODUCTS/PROCESSES
2	COMPANY WILL ACQUIRE NEW TECHNOLOGY
3	COMPANY WILL CARRY OUT R&D

**TABLE 5
QUALITY OF MANPOWER PERFORMING
INNOVATION ACTIVITIES**

RANK BY DEGREE				INNOVATION ACTIVITY
Ph.D.	MS/MA	BS	OTHER	
4	2	1	3	DEVELOP NEW PRODUCTS
4	2	1	3	CARRY OUT R&D ACTIVITIES
4	2	1	3	DEVELOP NEW PROCESSES

TABLE 6
IMPORTANCE OF INNOVATION ACTIVITIES PERFORMED

RANK	ACTIVITY
1	TRAINING
2	RESEARCH AND DEVELOPMENT
3	ACQUISITION OF TANGIBLE TECHNOLOGY
4	PILOT PRODUCTION
5	ACQUISITION OF INTANGIBLE TECHNOLOGY
6	TOOLING UP

TABLE 7
EXPENDITURES INCURRED ANNUALLY

RANK	ACTIVITY
1	ACQUISITION OF TANGIBLE TECHNOLOGY
2	PILOT PRODUCTION
3	RESEARCH AND DEVELOPMENT
4	TRAINING
5	TOOLING UP
6	ACQUISITION OF INTANGIBLE TECHNOLOGY

TABLE 8
MEANS OF ACQUISITION OF TECHNOLOGY

RANK	MEANS OF ACQUISITION
<i>FROM THE PHILIPPINES</i>	
1	HIRE SKILLED EMPLOYEES
2	CONSULTANTS
3	ACQUIRE FROM WITHIN BUSINESS GROUP
4	R&D CONTRACTED OUT
5	PURCHASE OF EQUIPMENT
6	PURCHASE OF RIGHTS
7	TAKEOVER OF COMPANY PATENT POOLING
<i>FROM ABROAD</i>	
1	PURCHASE OF EQUIPMENT
2	CONSULTANTS
3	PURCHASE OF RIGHTS
4	ACQUIRE FROM WITHIN BUSINESS GROUP
5	R&D CONTRACTED OUT
6	HIRE SKILLED EMPLOYEES
7	PATENT POOLING
8	TAKEOVER OF COMPANY

TABLE 9
SOURCES OF TECHNOLOGY FROM ABROAD

RANK OF SOURCE						METHOD OF SOURCING
A	B	C	D	E	F	
1	2	3	4	5	6	PURCHASE OF EQUIPMENT
1	2	4	3	5	5	TECHNOLOGY LICENSING
1	2	4	3	5	6	CONSULTANCY SERVICES
1	2	3	3	3	ρ	R&D CONTRACTING
1	2	3	2	2	ρ	PATENT POOLING

Legend:

A US
 B Japan
 C Taiwan
 D Germany
 E England
 F Italy

● NO MENTION

TABLE 10
SOURCES OF IDEAS FOR INNOVATION

RANK	SOURCE
1	CONSULTANTS
2	MANPOWER DEVELOPMENT
3	PURCHASE OF INTANGIBLE TECHNOLOGY
4	MONITORING OF COMPETITORS
5	INTERNAL R&D
6	MANPOWER RECRUITMENT
7	SUPPLIERS
8	PURCHASE OF TANGIBLE TECHNOLOGY
9	PILOT PRODUCTION DEVELOPMENT
10	R&D BY PARENT/ASSOCIATED COMPANIES
11	PROFESSIONAL JOURNALS
12	PROFESSIONAL CONFERENCES AND/OR MEETINGS
13	INSTITUTIONS OF HIGHER LEARNING
14	FAIRS AND EXHIBITIONS
15	GOVERNMENT RESEARCH INSTITUTIONS
16	IMITATION
17	JOINT VENTURE WITH INNOVATIVE COMPANIES
18	PATENT INFORMATION
19	ACQUISITION OF INNOVATIVE FIRMS

TABLE 11
METHODS OF PROTECTING INNOVATION

<u>RANK</u>	<u>METHOD</u>
1	BE AHEAD IN THE MARKET
2	SECRECY
3	COMPLEXITY OF DESIGN
4	REGISTRATION OF DESIGN
5	PATENTS

TABLE 12
FACTORS HINDERING INNOVATION

RANK	FACTOR
1	FINANCIAL RISK
2	INTERNAL RATE OF RETURN (IRR) TOO LOW
3	PAYBACK PERIOD TOO LONG
4	LACK OF FINANCING
5	GOVERNMENT LEGISLATION/REGULATION
6	TAXATION
7	LACK OF CUSTOMER RESPONSE
8	LACK OF INFORMATION ON NEW TECHNOLOGIES
9	DEFICIENCIES IN AVAILABILITY OF TECHNICAL SERVICES
10	INNOVATION COSTS DIFFICULT TO CONTROL
11	LACK OF TECHNOLOGICAL OPPORTUNITIES
12	UNCERTAINTY IN TIMING OF INNOVATION
13	LOW STANDARDS
14	LACK OF OPPORTUNITIES FOR COOPERATION
15	NO NEED TO INNOVATE DUE TO PREVIOUS INNOVATION
16	LACK OF SKILLED PERSONNEL
17	PATENTS HARD TO GET

TABLE 13
EFFECTS OF GOVERNMENT INCENTIVES AND REGULATIONS
ON INNOVATION ACTIVITIES

<u>RANK BY EFFECT GOVERNMENT INCENTIVE/REGULATION</u>	
<u>ON FIRM LEVEL</u>	
1	PREFERENTIAL CREDIT
2	EXEMPTION/REDUCTION OF TAXES ON IMPORTED RAW MATERIALS
3	EXEMPTION FROM CAPITAL GAINS TAX
4	EXEMPTION/REDUCTION OF TAXES ON IMPORTED CAPITAL STOCK
5	EXEMPTION FROM CORPORATE INCOME TAX
6	REDUCTION IN TAXABLE INCOME
7	DUTY DRAWBACK
8	REGULATION OF FOREIGN OWNERSHIP
9	LOWER PREFERENTIAL TARIFF
10	EXEMPTION FROM OTHER TAXES AND DUTIES
<u>ON INDUSTRY LEVEL</u>	
1	EXEMPTION/REDUCTION OF TAXES ON IMPORTED CAPITAL STOCK
2	EXEMPTION/REDUCTION OF TAXES ON IMPORTED RAW MATERIALS

3	EXEMPTION FROM OTHER TAXES AND DUTIES
4	EXEMPTION FROM CAPITAL GAINS TAX
5	EXEMPTION FROM CORPORATE INCOME TAX
6	REDUCTION IN TAXABLE INCOME
7	LOWER PREFERENTIAL TARIFF
8	DUTY DRAWBACK
9	PREFERENTIAL CREDIT
10	REGULATION OF FOREIGN OWNERSHIP

TABLE 14
GOVERNMENT SUPPORT EXPECTED FOR INNOVATION

RANK	GOVERNMENT SUPPORT EXPECTED
1	MAKE AVAILABLE SPECIALIZED TRAINING AND PROFESSIONAL SKILL PROVIDE INCENTIVES FOR INNOVATION ACTIVITIES
2	ENSURE ACCESS TO MARKETS AND FINANCIAL CAPITAL
3	PROVIDE FOR AN EDUCATED WORKFORCE
4	ENSURE UNIVERSITY AND PUBLIC SECTOR RESEARCH ACTIVITY AND PROVIDE PRIVATE SECTOR ACCESS TO THEM
5	ENSURE PROTECTION OF INTELLECTUAL PROPERTY
6.	ENCOURAGE DIFFUSION OF TECHNOLOGY BY LOOSENING INTELLECTUAL PROPERTY RIGHTS REGULATIONS