# FEASIBILITY STUDY OF A TECHNOLOGY PARK IN THE DILIMAN SCIENCE COMMUNITY

## Foreword

*by Andre S. Publico*
*Department of Mechanical Engineering*
*University of the Philippines Diliman*

*Immediately after his graduation from the UP with a Bachelor of Science degree in Mechanical Engineering (1954), Ruben A. Garcia began a long and dedicated service to the nation and to the University of the Philippines as an engineering educator. His teaching career was interupted only when he went for his MS degree at Stanford University (1957) and Ph.D. degree at University of Minnesota (1971). For his dedication and excellence as a Professor of Mechanical Engineering, he received various awards including the UP Service Award (1977), UP Alumni Award (1979), NRCP Achievement Award in "Industrial and Engineering Education" (1979), and "Confucius Award" (1997). Even after his retirement from UP in 2000, he continued as a Professorial Lecturer of the UP Mechanical Engineering Department to hone the minds of mechanical engineers.*

*It was during his term as the Dean of the UP College of Engineering (1985-1991) that Dr. Garcia became interested in Technology Parks and their role in the industrialization of a country. The initial inspiration came during the 1986 National Science and Technology Week held at the National Engineering Center where two papers were presented: "Research Parks" by Jose de Castro and "Technology Parks in Foreign Countries" by Perfecto Guerrero. With the help of several faculty members and funding from NRCP, he embarked on a project which resulted in the following paper entitled "Feasibility Study of a Technology Park in the Diliman Science Community." Almost 20 years after writing this paper, Dr. Garcia still believes in the vision that is embodied in this paper. According to him, for this vision to come true, several conditions must exist: leadership by those who are in the position to implement it, support from the national government in terms of national policy and funding, collaboration between the UP College of Engineering and the UP physical science departments, strong linkage between the academe and the industry, and focus on high-tech industries.*

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RUBEN A. GARCIA*

## EXECUTIVE SUMMARY

Science and Technology (S & T) are integral components of the fundamental concerns of any government, namely economic development, national security and welfare of its people. Scientific research and development (R & D) are therefore essential to the achievement of the government's goals which, in the context of the above, include industrial development, defense, health, provision of food, shelter and energy, enviromental protection, use and conservation of natural resources, transport and communication.

As shown by the experiences of developed and newly-industrializing countries, technology parks are established primarily to provide a healthy environment for the birth of initiative and the commercialization of R & D results. A place where pioneering small and medium scale industries are born and nurtured, the technology park could contribute to greater productivity and higher rate of generating more income and employment, for the country at large.

As a center for research and as a mechanism for symbiotic cross-fertilization of ideas and of technology transfer, the technology park requires a location where access to scientific researchers backed by laboratories with sophisticated equipment is readily available.

Diliman is one place where there is a great concentration of brainpower: the educators, the researchers, the students, not to mention the administrators. It is also a place where some of the best insfrastructure and facilities locally available could be found. And in addition, within a one-kilometer radius are located other academic institutions and research entities such as Ateneo, Maryknoll and New Era Colleges as well as PAEC, PNOC-ERDC and others.

Two surveys were conducted to find out what would be the essential features of the Technology of the Philippines. (See appendices for the sample forms used in the survey). One was among the faculty and key personnel of both the UP College of Engineering and the National Engineering Center while the other was directed towards various enterprises.

* College of Engineering, UP-Diliman, Quezon City

Results of the surveys showed that a Technology Park should be established and the location chosen unanimously by the respondents is the UP Diliman. The details of the other features and the possible ventures desired by the prospective companies are discussed in one of the chapters.

Since it is hoped that Philippine products will be competitive in the world market, it is necessary that these must not only be of high quality but must also be produced efficiently and economically. For the Philippines to compete successfully, the proper niche in the product spectrum must be identified and having found that niche, aggressive development must take place. To do so, active research will be needed to backstop these efforts. The Diliman Technology Park can play a very important role in this.

To ensure a high degree of success in setting up the Diliman Technology Park, two (2) phases of implementation with a maximum duration of five (5) years each are suggested. Phase I involves the piloting of the technology park concept utilizing the available facilities at the U.P. College of Engineering (UPCE) and the National Engineering Center (NEC), which will cater from two (2) to five (5) small high technology enterprises.

It is suggested that the initial fund requirements of about P10 million for Phase I be provided for by the Department of Science and Technology (DOST) or its appropriate councils and the Department of Trade and Industry (DTI) while the UP contribution will be the available building spaces and laboratories at UPCE and NEC.

On the other hand, Phase II will involve the relocation of the pilot enterprises in Phase I and the setting up of the new infrastructure in the designated area of the U.P campus for the Diliman Technology Park. This would cater to about thirty (30) small and medium - scale enterprises. It is likewise suggested that the major cost requirements of about P23 million and US $5.69 million for implementing the first five (5) years of Phase II, which covers the land, infrastructure, equipment and operating expenses be provided for by DOST, DTI, DPWH (Department of Public Works and Highways), Agencies for International Cooperation and the University.

It is envisioned that the Technology Park will become self-sustaining with projected income of P6.6 million per annum from space rentals alone. The estimated annual operating cost is P4.6 million.

In terms of organization, it is suggested that the U.P. Engineering Research and Development Foundation (UPERDFI) constitutes a project team to implement Phase I and Phase II under an agreement with the principal sponsors of the project namely U.P., DOST and DTI.

## THE DEVELOPMENT OF HIGH TECHNOLOGY SMALL FIRMS: SOME POLICY IMPLICATIONS

It is said that industrial innovation is a pathway by which scientific and technological capability can contribute to economic and social progress. As a process, innovation involves technological factors and the concommitant aspects of finance, production, management, marketing and research and development. For industrial innovation to grow and prosper, the necessary conditions must exist for the right combination of the above factors to occur.

The importance of the Technology Park is that it combines all the above ingredients and provides a healthy environment for the birth of initiative and the commercialization of research and development results.

### 2.1 The Experience of Developed Countries[1]

This role of the Technology Park has long been recognized in the developed countries. The first "Science Park" was established in 1951 at Stanford University and is credited as being the catalyst for the development of the famous Silicon Valley. Other well known research parks in the United States are the Research Triangle, North Carolina, the Oak Ridge Park, Tennessee which centers around the Oak Ridge National Laboratory, home of the atomic bomb, Routes 128 and 1495 in Massachussetts tapping the well-known Massachussetts Institute of Technology and Rensselaer Polytechnic Institute with the park at East Greenbush, New York. The number of technology parks in the U.S. peaked to 81 in 1971 and after the closure of several parks due to failure to provide the right academe industry innovation environment, the parks are once more going through another period of growth. The success of the parks has been attributed to increased spending on research and development for national defense, the space program and energy.

In the United Kingdom, the most significant feature of British Technology parks is the major role played by the universities in the creation of the parks. One explanation of this interest on the part of the universities is the view that technology parks are investment and income generating projects which contribute to the support of the university in the same way as the land grants.

In Australia, technology parks are of recent vintage especially in the western and southern parts where there are less industries than on the east coast. Overall, the development of technology parks was mainly due to local economic, industrial and political factors than as a result of national policy.

[1] Perfecto K. Guerrero, Technology Parks in Foreign Countries, a paper presented during the 1986 National Science and Technology Week held in NEC/UP Diliman, QC, July 9, 1986.

## 2.2 The Experience of Newly Industrializing Countries[2]

In South Korea, the commercialization of R & D results is done through a mechanism which is quite different from technology parks. The industrial research institute known as KIST for Korean Institute of Science and Technology was established in the late 1960s. This spearheaded Korea's leapfrogging into technological self-reliance, followed in the early 1970s by the establishment of daughter institutes for shipbuilding, electronics, telecommunications, petrochemicals, materials, energy and defense. The birth of these institutes depleted the staff of KIST. But by 1974, KIST scientists had developed many ideas which were on the verge of commercialization. In 1975, KIST decided to establish a research commercialization company called Korea Technology Advancement Corporation or K-TAC.

K-TAC has the following purposes: commercialize research results using know-how generated by the various research institutes, marketing and sales of research results and industrial rights, sale of prototype equipment and by-products of R & D, sponsorship of additional R & D when required, and management assistance.

Thus, K-TAC sells technology to interested companies. Examples of technology sales in recent years: fluorocarbon refrigerant specially chemicals, optical fibers, antibiotic, high temperature ceramics. Companies which bought the technologies have reported profits.

Singapore, the newest of the developing countries to mount a challenge in the world market against industrialized economies, established its Science Park in 1981 as part of a new industrial strategy to promote higher value-added, higher skill and technology-intensive industries. Prior to this, Singapore's labor-intensive and low value added industrial structure had been encountering competition with neighboring countries as well as increased international protectionism. The new development policy found expression in the promotion of high technology, science based industries as automation and robotics, microelectronics, information technology, biotechnology, materials science and precision engineering.

The Science Park of Singapore is located on a 15-hectare site next to the National University of Singapore, the Institute of Systems Science and the recently established Institute of Molecular and Cell Biology. The Science Council of Singapore administers the Science Park. The proximity to the National University is aimed at fostering close interaction and exchange of knowledge and ideas between university staff and industrial researchers.

The Singapore Science Park formally opened in January 1984 and as of date has fourteen tenants working on robots, microcomputers, biotechnology for mush-

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[2] Ibid

rooms, tea, coffee, cocoa, CAD/CAM systems, diagnostic kits, microelectronics, heart valves, flavors and fragrance.

Singapore indeed has grown from its traditional role as a regional port and distribution center in the 1960s, an international manufacturing and service center in the 1970s and now has its sights on developing into a center of science-based manufacturing and knowledge-intensive technical activities. Its R & D expenditure has grown from 0.2% in 1978, 0.3% in 1982, 0.6% in 1984 and growing.

In Taiwan, the Hsinchu Science-Based Industrial Park (HSIP)[3] has been in operation for 10 years. It grew from empty tea fields into a busy Park with export sales of $1 billion this year and employing 60,000 workers among 200 companies by 1990 with a projected export sales of $9 billion by 1997. Around 6% of HSIP revenues are spent for R & D compared to 1% national average, and the products from the Park have 52% add-on value compared to 35% of the rest of Taiwan. Only companies with strong R & D capabilities are accepted in the Park. If the staff has less than 30% engineers and scientists, the company's application is rejected by the HSIP review board.

Even the People's Republic of China has a Park situated in Zhongguancun[4], a high-technology industrial zone, northwest of Peking, near Peking and Qinghua Universities and the Chinese Academy of Sciences. Of the 170 privately-owned companies in the Park, three-quarters are owned by their staff and 78% of the ventures are producing computers and related electronics-along Electronics Street. In 1987, industrial production from companies along Electronics Street was more than $160 million.

Finally, in Malaysia, its S/T policy emphasizes the promotion of technology transfer activities from local R & D institutes to the commercial sector with a view of transforming present industries from those of "import substitution" to "export production". As mechanisms for technology transfer, Malaysia's Industrial Master Plans calls for the setting up of Technology Transfer Centers which provide consultancy and advisory services on choice and application technology, Technological Information Networks, Technology Corporations which serve as brokers for purchase of technology and distribution by licensing to small and medium-scale industries and Technology Parks which are expected to accelerate absorption of new, indigenous technologies by start-up industries.

Malaysia has on the drawing board a plan to establish a $60 million project on a 13 acre prime land which will comprise a Hi-Tech Centre, Business Exchange Center, Family Recreation Center, Commercial Complex and Apartment Houses.

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[3] Glenn Smith, Hsinchu: High Tech in the Park, World Executive's Digest, April 1988.

[4] Welcome to Sinicon Valley, Asiaweek, April 8, 1988.

## 2.3 The Concept of Technology Parks[5]

As shown by the experience of developed and newly-industrializing countries, Technology parks are established primarily to provide a vehicle for symbiotic cross-fertilization of ideas and of technology transfer between industrial firms on the one hand and universities and research institutions on the other. These parks are usually cooperative undertakings.

There are a variety of ways by which the cooperation is accomplished. Commonly, a technology park is composed of several individual enterprises located on land owned by the university. Each one is extremely specialized and as a business enterprise, requires all the elements of a business firm: LAND, LABOR, CAPITAL AND ENTREPRENEURSHIP.

The university provides the land and the brain power comes from its academic community.

The industrial firm with the help from the Park provides the risk capital and management of the enterprise. The capital is used for setting up the infrastructure and research facilities, for providing support for the researchers and the supervising faculty members, for providing management and support personnel, and for operating the enterprise. The management of the Park is overseen by a board of directors composed of the highest possible level persons of both the firms and the university. Preferably, these persons should be in the policy-making level of both parties, i. e., members of the board of directors and board of trustees of the firm and the university, respectively.

## 2.4 Lessons for Policy-Making

There are many lessons that can be learned from the study of the experiences of many successful technology parks around the world. In particular, an analysis of the phenomenal successes of many high technology small firms located in the Route 128 are near Boston and Silicon Valley complex south of San Francisco in the United States is specially useful to planners in developing countries contemplating similar technology parks.

These lesssons can be summarized as follows:

1. The local availability of capital is only a part, although an important part, of the total explanation for the success of those technology parks.

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[5] Jose Ma. De Castro, Research Parks, a concept paper presented during the National Science and Technology Week held in NEC/UP Diliman, Q.C. July 9, 1986.

2. Other factors necessary for success include the presence of skilled white and blue collar labor; specialist material linkages; and research and development, including sources of local information.

Before national and local government agencies devote large amounts of capital to the promotion and development of new Silicon Valleys and technology parks in developing countries, there must be a clear understanding of all the conditions that the necessary for the success of these areas.

An environment conducive to the formation and growth of technology parks will not be achieved by merely renaming dilapidated industrial areas as technology parks or by the more vigorous extension of existing financial assistance to small firms. The development of successful technology parks require a more subtle long-term policy approach directed at building up a resource infrastructure over the years. The introduction of financial assistance must be based on an understanding of growth processes and a commitment on the part of the developers and policy makers to a long term strategy for the whole region or area. Success will not be achieved by piecemeal schemes directed at individual companies.

The local resource factors critical for the success of technology parks include:

1. Local linkages in the form of suppliers & customers;
2. Research and development;
3. Labor;
4. Innovation finance; and
5. Pool of management and specialist advisers

## 2.5 Linkages

Most of the firms located in the technology parks that were studied neither purchase "raw materials" in the true sense nor produce a finished product recognizable to the final consumer. They occupy production niches that are predominantly links in a chain of manufacturing from true raw materials to the finished product linking many electronic and instrument firms that work together to produce sophisticated finished products. Most of the products of these small products are of high value. They require a large number of input components from many suppliers.

Because of the relatively high value of raw materials and products, transport costs are a small proportion of the total price to the customer.

Economic viability for the small firms is assured through the specialist knowledge of conception and production inherent in the product. The high value added in production is not so much the cost of input materials plus shopfloor labor than the abstract input of human technical ability during development. It is the technical input of human design expertise that contributes the bulk of value added to high technology production in small firms.

Without the potential for high product prices facilitated by a superior or unique specification, the unit costs of production would in many cases be prohibitive.

### 2.6 Research and Development

In many high technology small firms, the chief executive or owner is a qualified engineer. Hence it is likely that the reason for the firm's existence was the initial product idea of such an individual. There is rarely much conflict between the specific R & D objective and the wider aims of the firms since the key decision maker is frequently the technical innovator.

Virtually all high tech companies will make effort to preserve their competitive technological edge through some form of evolutionary R & D.

Part-time R & D is particularly common in small firms. It is a compromise between the need for innovation through R & D and the high cost and full-time R & D staff.

With increasing firm size, the owner/key innovator role becomes impractical for the founder due to the demands of other administrative areas in the expanding business. Full-time R & D staff is then employed.

These are usually three reasons for R & D:

1. development of new products (the main objective);
2. incremental improvements in product design;
3. alleviating technical bottlenecks in production.

An externally available source of technical information such as a university gives a significant boost to the internal R & D effort of small firms.

Despite the problem of R & D costs, high tech firms remain viable bacause they pass on the high cost of R & D to their customers through the eventual price of the product. This is because of the relative uniqueness of their product specification, ensured by the R & D effort.

### 2.7 Labor

In technology parks with their strong emphasis on value-added in production through human R & D and production skills, labor is of great importance. Shortages in local labor skills can stifle the innovation performance of high tech small firms.

The employment needs of most firms tend to be long term and incremental in nature. Typically a small firm is established in the founder's home, with small premises and a small labor. In the early stages the labor demands of the firm are dictated by profitability. Hopefully, growing demand and profits prompt the hiring of additional workers when they are needed.

Since both the development and production phases of manufacture in high tech firms are generally skilled-labor-intensive, there is less need for semi-skilled or unskilled workers.

### 2.8 Finance

Most high tech small firms rely on the personal savings of the founder for the initial capital to start the business. The business is often begun while the founder remains employed at a large company. The full-time operation of the firm takes place only after a trial period in which sales and experience are accumulated. Such an approach is fundamentally incremental, and although relatively slow, it offers the major advantage of reducing the risks of setting up.

In addition to internal sources, investment finance may come from three major external sources: government grants & loans; bank finance; and private venture capital.

Government incentives can provide a boost to the overall resource of the firm even when they are not the main source of capital, expecially if such assistance is in the form of grants or low- interest loan.

The reasons for not utilizing government assistance are many but the most frequently quoted general reason is government red tape.

Many of the comments on the problems of government incentive delivery also applies to banks. Processors of loan applications are financially but not technically qualified personnel who do not see the sales potential of the proposed innovation for which finance is requested. Criticism also centers on the long time taken to decide on loan application.

Venture capitalist performs a useful function by making another source of investment capital available to entrepreneurs. Among Silicon Valley entrepreneurs, venture capitalists are known as particularly good at picking winners and a willingness to bank these judgements rapidly with large amounts of cash. Because many of the venture capitalists are ex-businessmen with technical training and a practical knowledge of production, they are eminently qualified to judge both business acumen of potential recipients and the technical viability of the product. Since the venture capitalists hold the purse strings, they are able to advance money very quickly once they have made the decision.

Many venture capitalists are themselves entrepreneurs who have "sold out" or been "bought out" in the past, thus accumulating the capital and expertise necessary to begin their own venture capital business.

Much of the resistance to government assistance would be largely removed if future incentives were delivered in a more flexible manner with a delivery approach credible to small firm owners. The delivery system might adopt many of the strengths of the venture capitalist and approach.

### 2.9 Specialist Advisers

Because of the technical orientation of the small firms, he will need the assistance of specialists in the legal, management, accounting and other fields that the university can make available. Research of successful small firms indicated that while success may have been technology-led, the firms were also competent in the area of finance, marketing and management through the involvement of specialist advisers.

## THE DILIMAN SCIENCE AND TECHNOLOGY COMMUNITY

As a center for research and as a mechanism for innovation and technology transfer, the technology park requires a location where access to scientific researchers backed by laboratories with sophisticated equipment is readily available. In addition, the site must be one where power, water and transportation are easy to come by. Finally, enough free space within which to build future ancillary buildings for pilot plants or dedicated laboratories is required.

### 3.1 The Area

The University of the Philippines is an ideal location since it fulfills all the foregoing requirements. In addition, within a one-kilometer radius are located other academic institutions and research entities. Among the academic institutions are:

1. The Ateneo de Manila University with its Philippine Institute of Physics and Applied Chemistry
2. Maryknoll College
3. New Era College

National government centers in the area are:

1. The Philippine Nuclear Research Institute (formerly PAEC)
2. The Philippine National Oil Corporation's Energy Research and Development Center
3. The Fuels and Appliance Testing Laboratory of the Office of Energy Affairs

A regional research institution is also found near the site - The Southeast Asian Ministers of Education Organization's Regional Center for Educational Innovation and Technology (INNOTECH).

Thus the proposed location of the technology park is ideal as it would be in the center of potential research ferment.

### 3.2 A Detailed Look at Resources

In the immediate vicinity of the proposed site are five potential research contributors to the technology park. These are the College of Engineering, the National Engineering Center, the Institute for Small Scale Industries, the College of Home Economics and the U.P. Computer Center. The College of Science and the College of Business Administration, the School of Economics and the Law Center could also be active participants.

### 3.2.1 The College of Engineering & the National Engineering Center

Within the College of Engineering and the National Engineering Center of the University of the Philippines exists a pool of highly trained individuals, exposed to the sophisticated research environments of many universities abroad. Table 3.1 lists recent and ongoing researchers by faculty members.

The College of Engineering and the National Engineering Center are well-equipped with laboratories in different disciplines. Some of the equipment of the different laboratories of the College, while serviceable for student work, are already aging and require considerable rehabilitation, upgrading, and in some cases replacement. Tables 3.2 and 3.3 list the areas of research for which laboratory equipments are available.

### 3.2.2 The Institute for Small Scale Industries

The Institute for Small Scale Industries is geared for training of small entrepreneurs and industries in addition to its research and extension functions. As such it has a number of trainers not just in entrepreneurship and small business management but also in the areas of pneumatics, low-cost automation, digital and programmable logic controllers and electro-pneumatic control systems. While these are primarily for training, they can become usable for research on basic control components for manufacturing processes and production lines.

### 3.2.3 The College of Home Economics

The College of Home Economics has a Food Processing Pilot Plant, a Food Laboratory, and a Garment Pilot Plant. The Food Processing Plant provides a venue for research in food preparation and preservation. The Food Laboratory, in addition to student experiments, conducts research on quality of food specially with respect to its chemistry and possible contaminating agents and pollutants. The Garment Pilot Plant provides research facilities in the mass production of garments as contrasted to custom sewing or tailoring of garments.

### 3.2.4 The University of the Philippines Computer Center

Equipped with a mainframe and a number of microcomputers, the U.P. Computer Center has the potential to assist in and support research on software.

## 3.3 Prospects

Considering the foregoing, it is apparent that existing resources, both human as well as physical, with some input of capital are readily available for the rapid setting up and functioning of the technology park.

It only remains to identify the niche in research which the proposed technology park should initially engage in, improve the corresponding laboratories, and start up.

Table 3.1 : List of Recent or Ongoing Research Projects

| TITLE | AUTHOR |
|---|---|
| 1. Pyrolysis of Rice Hulls | Elsie M. David |
| 2. Microelectronic System | Miguel T. Escoto |
| 3. Machine Equipment Design & Development | Manuel V. Hernandez, Jr. |
| 4. Computerization of Student Records | L.D. Francisco and R.D. Saquing |
| 5. Chromatography for Fuel Analysis | Angela D. Escoto |
| 6. Data Logger | Regano G. Benito |
| 7. Electronic Tachometer | Alfredo Diaz Jr. |
| 8. Leachingo Laterites | Manolo G. Mena |
| 9. Machine Design Computer Program | Manuel Ibanez Jr. |
| 10. Hydrologic Forecasting Model | Leonardo Q. Liongson |
| 11. Digital Control Lab | Rafael N. Mantaring |
| 12. Biogas Production | Wilfredo I. Jose |
| 13. Finite Element Studies of Ambuklao & Caliraya Dams | Ronaldo I. Borja |
| 14. Uninterruptible Power Supply System | Miguel T. Escoto |
| 15. Development of a Computer-Aided Instruction Package for Prod'n Systems | Nestor O. Raneses |
| 16. Systems Impact Effectiveness of Technical Skills Training | Nestor O. Raneses |
| 17. Multi-Attribute Approach to the Measurement of Productivity in Engineering Educational Inst | Aura V. Castillo |
| 18. Development of Integrated Microcomputer Aided Inst. Package for Prod'n System | Raneses, F. Crisostomo |
| 19. Production of Semi-Refined Carrageenan | D. Nicdao |
| 20. Fish Dryer | Angela Escoto and J. Salvacion |
| 21. The Waste Utilization Value Thesis stud: J. Tio | Wilfredo I. Jose |
| | W. I. Jose; |
| 22. Hydrolysis of Coir Dust | W. I. Jose; Thesis stud: E. Crescencia |
| 23. New Bicreactor Systems | W. I. Jose |
| 24. Investigation of a Rice-Hull Gasifier/Ignition Unit | R. G. Benito |
| 25. Computer Modelling of Solar Assisted Warehouse Dryer | Thesis Adviser: Regano G. Benito |
| 26. Investigation of the Performance of Solar Air Collector | Thesis Adviser: Regano G. Benito |
| 27. Investigation of the Performance of Spouted Bed Gasifier | Thesis Adviser: Regano G. Benito |
| 28. Investigation of the Performance of Combined Up-Draft Down-Draft Gasifier | Thesis Adviser: Regano G. Benito |
| 29. Investigation of the Performance of a Solar Water Pump | Thesis Adviser: Regano G. Benito |
| 30. Recovery of Cr & V from Chromite Tailings | Meliton U. Ordillas & Manolo G. Mena |
| 31. Recovery of Nickel by Segregation Process | Manolo G. Mena |
| 32. Gasifier Monitoring Project in the Philippines | Ruben A. Garcia |
| 33. Drying Characteristics of Ipil-Ipil Wood | Thesis Adviser: Ruben A. Garcia |
| 34. Driving Cycle Studies on Fuel Consumption | Dissertation Adviser: Ruben A. Garcia |
| 35. Coal Fragmentation Studies in a Fluidized Bed | Dissertation Adviser: Leopoldo V. Abis |

Table 3.1 (Cont'd) : List of Recent or Ongoing Research Projects

| TITLE | AUTHOR |
|---|---|
| 36. Design, Performance Analysis and Modeling of a Combined Updraft-Stratified Downdraft (CUSD) Gasifier | Dissertation Adviser: Ibarra E. Cruz |
| 37. Driving Cycles-Development of a Model to Simulate Fuel Use and Eliminate the Effects of Driving Style During Test | Dissertation Adviser: Ruben A. Garcia |
| 38. Performance Evaluation and Mathematical Modeling of a Gasifier-Assisted Oil Fired Furnace Utilizing Low-Grade Philippine Coal and Agricultural Wastes | Dissertation Adviser: Ibarra E. Cruz |
| 39. Parallel High Rate Fermentation of the Soluble and the Suspended Solid Components of Pig Manure | Dissertation Adviser: Wilfredo I. Jose |
| 40. Optimal Hydrothermal Dispatch | Dissertation Adviser: Francisco Viray |
| 41. Instrumentation for Field Monitoring of Gasifier Systems | Dissertation Adviser: Ruben A. Garcia |
| 42. Development of an Energy Conservation Manual for Rural Areas | Dissertation Adviser: Wilfredo I. Jose |
| 43. Studies of the Performance Characteristics of a Compartmentalized Chilled Water Storage Tank | Arturo B. Santos |
| 44. An Investigation of the Performance of a Solar Dryer for Agricultural Products Using Packed Bed Storage and Supplementary Fuels | Thesis Adviser: Ruben A. Garcia |
| 45. Predicting the Performance of Solar Dryers with Packed Bed Storage (Passive Systems) | Alfredo F. Diaz |
| 46. Fluidized Bed Gasification for Ricehusk | Thesis Adviser: Ibarra E. Cruz |
| 47. Solar Thermal Pumping System | Michael L. Dalida |
| 48. Rice Hulls Gasification Using Cross-Draft-Updraft Gasifier (CUS) | Brenda G. Cabanilla |
| 49. Gasification of Agriculture Residues Using a Small-scale, Batch-fed, Downdraft Gasifier | Honorina L. Lacar |
| 50. Thermal Cracking of Tars and Hydrocarbons in a Down-draft Gasifier | Thesis Adviser: Teodorico F. Festin |
| 51. Performance Analysis of FPS Collectors Using Computer Simulation Method | Thesis Adviser: Ruben A. Garcia |
| 52. Development of Simulation Procedure for Evaluating Energy Use Changes Due to Variations in the Operational Parameters of Refrigerator | Thesis Adviser: Regano G. Benito |

Table 3.2 : List of Research Areas in the College of Engineering

| Department | Research Areas for which Equipment Exist |
|---|---|
| Chemical Engineering | Chemical Analysis ; Unit Operations |
| Civil Engineering | Materials Testing ; Soil Mechanics |
| Electrical Engineering | Power Systems ; Communication Systems<br>Computers ; Electronics |
| Engineering Sciences | Software Development |
| Geodetic Engineering | Geodesy ; Photogrammetry |
| Mechanical Engineering | Power and Energy ; Tool & Die |
| Mining & Metallurgical Engineering | Batch Testing ; Foundry<br>Metallurgical & Metallographic Processes<br>Extractive Mettalurgy ; Electro Microscopy |

Table 3.3 : List of Research Areas in the National Engineering Center

| Center | Research Areas for which Equipment Exist |
|---|---|
| Industrial Research Center | Materials & Industrial Product Testing |
| Training Center for Applied Geodesy & Photogrammetry | Geodesy & Photogrammetry |
| National Hydraulic Research Center | Water Resources Engineering<br>Coastal Engineering<br>Mathematical & Computer Modelling<br>Industrial Product Testing |
| Building Research Service | Materials Research<br>Building Components & Systems |
| Transport Training Center | Transport Planning<br>Mathematical & Computer Modelling<br>Traffic Engineering & Management |
| Specialized Laboratories | Energy<br>Machine & Equipment Design & Fabrication<br>Electronic Equipment Design & Fabrication<br>Computer Software Development<br>Systems Development |

## THE TECHNOLOGY PARK

The Technology Park is envisioned to contribute to the achievement of national goals. It is a tool for economic development and an enterprise for national progress. It is a place where pioneering small and medium scale industries are born and nurtured. To realize their great potential for growth in the local and international markets, these precursors of new industries need the advanced knowledge resident in universities and research institutions.

The proposed park is to be located inside the University of the Philippines Diliman (UPD) campus in Quezon City. Fig. 1 shows the proposed site and its environs. The users of the Park will have easy access to the reservoir of knowledge, expertise and laboratory facilities housed in the various colleges and units of the university as well as in other universities, colleges and scientific research centers in the vicinity.

Users of the Park can also avail of adequate building spaces for product development or light manufacturing and other facilities like telecommunications, main frame computers and storage. Personnel of Park clientele may also enjoy the housing and recreation facilities in the Park.

In addition to the physical facilities, the Park offers various services like marketing studies, feasibility studies, essential services needed for the establishment of new business entities, reproduction of documents and a data bank of information on advanced technologies. The Park also helps in securing low-cost capital and other incentives for the entrepreneurs.

### 4.1 Objectives

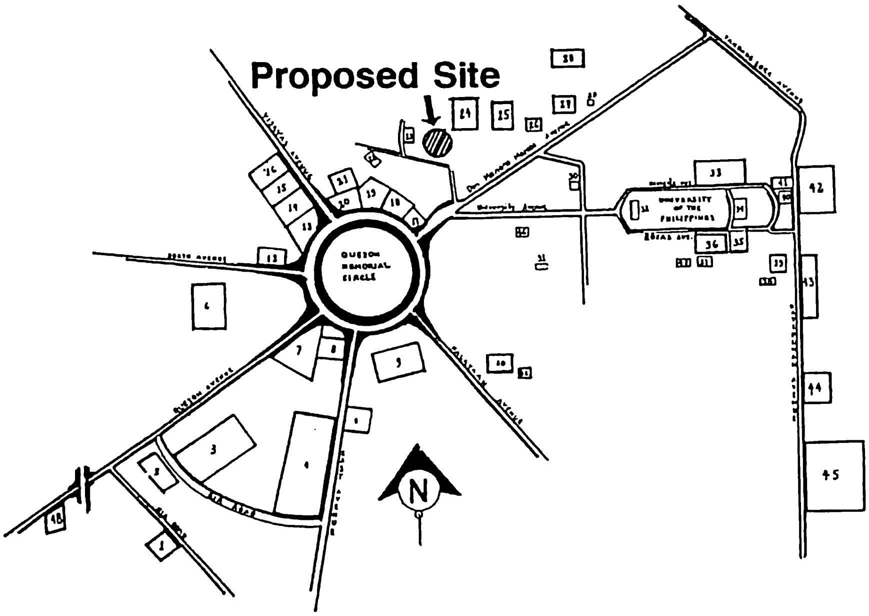
The development of new industries and strengthening of existing ones are the primary objectives of the Park. These are achieved by:

(1) encouraging and nurturing new enterprises based on advanced technology;

(2) assisting entrepreneurs in starting pioneering technology-based industries;

(3) providing the necessary infrastructure, services and a solid technology base;

(4) being a venue of transferring technology from the research laboratories to industry;




LEGEND:

1. Nat'l Irrigation Administration
2. Nat'l Power Corporation
3. PAGASA
4. Central Bank of the Phils.
5. Phil. Heart Center
6. Phil. Science High School
7. Lung Center of the Phils.
8. Nat'l. Kidney Institute
9. Quezon City Hall
10. Claret School
11. Holy Family School
12. Bu. of Mines & Geosciences
13. Min. of Agriculture
14. Media Center
15. Min. of Natural Resources
16. Bu. of Forest Dev't.
17. PHILCOA
18. Min. of Agriculture
19. Phil. Tobacco Administration
20. BAEX
21. Nat'l. Bu. of Plant Industry
22. Nat'l. Hydrautic Research Center
23. Arboretum
24. PAEC
25. PNOC-RSD Center
26. Innotech
27. Asian Institute of Tourism
28. New Era College
29. PSSC
30. Inst. of Small Scale Industries
31. Bu. of Animal Industry
32. UP Administration Bldg.
33. UP Eng'g Complex (Coll of Eng'g, NEC, TTC)
34. UP Main Library
35. UP Coll. of Science
36. UP Coll. of Arts & Letters
37. Natural Science Research Institute
38. Weather Bureau Observatory
39. UP Coll. of Home Economics
40. UP Coll. of Business Administration
41. UP Coll. of Economics
42. MWSS
43. UP Integrated School
44. Maryknoll College
45. Ateneo University
46. UP Marine Science Institute
47. UP Inst. of Science & Math Education Dev't.
48. Phil. Inst. of Volcanology & Seismology

**Figure 1. Proposed Site of Technology Park in U.P., Diliman, Q.C.**

(5) providing a fertile environment for innovation and creativity for the development of new products.

### 4.2 Benefits

By promoting the creation of new industries with high-growth potentials and improving the competitiveness.of existing ones, the Park will contribute to greater productivity and higher rate of generating more income an employment for the country at large. It will also contribute to the advancement of science and technology in the country by encouraging greater participation of people in this area to find solutions to real-life problems. The introduction of new and advanced products and their wide usage will contribute to the improvement of the quality of life.

To the entrepreneurs, several advantages are offered. Ready access to the advanced technology resources and expertise of the university and nearby research institutions is realized by locating their operations in the Park. These include availability of specialized laboratories, scientists and researchers as well as a cost-effective labor force from the well-trained graduate and undergraduate students. The various services that the Park offers in the form of assistance in formulating and implementing technical, managerial, marketing, manufacturing and other project strategies make it beneficial to settle in the Park during the incubation period of a new enterprise.

The University of the Philippines and other institutions nearby also stand to benefit from the Park. It provides a direct linkage with industry making these institutions more relevant to national problems and goals. Additional income will accrue to university personnel and students who will participate in the operations in the Park, either as consultants, researchers and the like. By exposing the faculty to real-life problems, it will help develop their knowledge and expertise further and will eventually result in the strengthening of academic programs by increasing the vigor of involvement of the faculty, students and others in pushing the horizons of practical knowledge. Finally, the university itself will reap additional funds from the rent and other fees accruing from the operations.

### 4.3 Initial Preferred Features

Two surveys were conducted to seek the opinion of the respondents regarding the essential features of the park and its working relationships with UP. One survey (see Appendix A) was among the faculty and key personnel of both the UP College of Engineering (UPCE) and the National Engineering Center (NEC). The other survey (see Appendix B) was directed towards a broad spectrum of various enterprises.

Table 4.1 shows the profile of respondents in two groups, the UPCE/NEC group and the industry group.

Of the 70 respondents from UPCE/NEC, 97% are willing to be consultants in the Park and 40% are willing to be the entrepreneurs themselves.

As to how they are going to be paid as consultants, 37.1% prefer straight salary, 35.1% want to be part-owners of the enterprise by being issued stock certificates, while 28.6% prefer royalty as compensation. Of the 11 responding administrators from the UPCE/NEC, all are willing to share the resources of their institution for the use of Park clientele. Eight or 72.7% are willing to share their facilities, 81.8% are willing to share their equipment and 90.9% are willing to share their human resources. The terms of sharing are rental for the physical facilities (90.9%) and a fixed percentage of income derived from the contracting company in the Park be given to the mother unit of the shared personnel (72.7%).

Among the 70 respondents from the UPCE/NEC, 80% are of the opinion that the Park facilities should be a combination of existing ones in UP and new infrastructure while 5.7% recommend that a completely new infrastructure be built for the Park. Incidentally 11.4% want to limit the facilities of the Park to existing UP facilities. The latter group is probably thinking of minimizing the required investment to set up the Park. Moreover, 54.3% see that the Park should have its own personnel organization for the administration and coordination of Park operations. Also, 85.7% are of the opinion that the Park administration office shall offer support services as a form of incentive for its clientele, such as project feasibility studies (62.9%), market studies (51.4%), office services like reproduction and the like (47.1%) and financing (40%). Accessibility of the many libraries in UP were cited by 81.4% as a form of incentive.

Among the types of projects and/or products that the Park should promote, 11.4% are for software development and programming services while 5.7% each are for computer and electronics, product development and systems analysis. Each of the other suggestions come from 5.7% of the respondents or less.

The second survey, conducted among the top executives in industry, revealed some concurring opinions with the UPCE/NEC respondents. In particular, the responses of 35 companies who answered the questionnaire are as follows: Twenty-five or 78.1% agree that the Technology Park can help in the industrial development process in this country and 81.3% indicated that such a park can help them in some way. Only one out of the 35 say that the Park will not help his company, a consulting firm. The rest have no opinion. After prioritizing the ways in which the Park could help them, the top four choices are:

| | RATING * |
|---|---|
| 1. improve the quality of existing materials, products and processes | 70.9% |
| 2. develop new products or materials | 66.9% |
| 3. solve technology related production problems | 58.3% |
| 4. increase productivity | 43.4% |

The other choices garnered no more than 5.6% rating each. In general, both the UPCE/NEC and industry overwhelmingly agree that a Technology Park should be established. In particular, 7.1% of the UPCE/NEC respondents expressed strong interest in product development, the second choise of industry.

As to what industries the Technology Park in Diliman should cater to, the top six choices of industry are:

| | RATING * |
|---|---|
| 1. instrumentation and controls | 62.6% |
| 2. computer software | 62.6% |
| 3. food processing | 60.0% |
| 4. consumer electronics | 51.4% |
| 5. metal working | 50.0% |
| 6. computer hardware | 47.7% |

One of the two top choices of industry does not match with the indicated interest of the UPCE/NEC community, i.e., only 2.9% of the UPCE/NEC respondents have a strong interest in instrumentation and controls.

However, there is a good match on the other top choice, computer software, i.e. 11.4% of the UPCE/NEC respondents indicated the same preference.

Concerning the necessary physical facilities and support personnel in the Park, the top four choices of industry are;

| | RATING * |
|---|---|
| 1. laboratory and testing facilities | 91.4% |
| 2. good communication system | 85.7% |
| 3. available consultants (technical, managerial, financial, etc.) | 80.0% |
| 4. basic waste and pollution control facilities | 74.3% |

The top choice of industry has a direct bearing on the state of the laboratory facilities in UPCE/NEC, the University of the Philippines in general and in nearby institutions. For the initial operation of the Park, only those laboratories that have a direct use in the Park will have to be in excellent operating conditions. As pointed out in the last chapter, some of these laboratories need a major amount of rehabilitation work. Thus the type of companies that will initially settle in the Park will detemine which laboratories should be given priority in the rehabilitation program.

The third choice of industry is an excellent match with the willingness of the UPCE/NEC respondents to be consultants (97%) in the Park. In addition, the fact that 75% of the responding companies expressed their need for people of high-technology expertise to do research for them is an excellent match to the willingness of the UPCE/NEC respondents to be consultants.

Among the thirty-five (35) respondents, 62.5% want to avail of laboratory and testing facilities while 37.5% want to avail of consultants.

As to what incentives for the entrepreneurs the Park should offer, the top three choices of industry are:

| | RATING * |
|---|---|
| 1. venture capital with low interest | 68.6% |
| 2. subsidy from the government | 65.0% |
| 3. assistance in marketing new products | 57.9% |

The first choice suggests that a financial institution or at least an office of such an institution may be necessary inside the Park to service this need. As for subsidy from the government, this could at least initially take the form of current incentives covered by the Omnibus Investment Code and the like which could later be augmented, specifically for the Park clientele.

Regarding the terms of compensation for using the Park, the top four choices of industry, in terms of number of response are:

| | FREQUENCY * |
|---|---|
| 1. fees to the University | 45.7% |
| 2. fixed rent | 40.0% |
| 3. use of facilities by University for teaching | 25.7% |
| 4. donation to the University | 22.9% |

The first and second most frequently cited form of compensation matches the perception of the administrators in UPCE/NEC that their physical resource should be rented (90.9%) and that a fixed percentage of the income derived by their personnel from companies in the Park should be paid by the enterprise concerned to the mother unit in the University (72.7%).

* RATING - an "equivalent" percentage of the 35 respondents who would have made the item their first choice.

* FREQUENCY - number of responses divided by total number of respondents in percent.

Only 19 out of the 35 (53.4%) responding companies expressed a preference for a site of the Park; 11 of the 19 find the proposed site ideal while two respondents each are for the reclaimed site in Manila Bay and in UP Los Banos, respectively. The other sites have only one respondent for each, including the area between UPCE and College of Arts and Sciences in the UP campus at Diliman. The rest have no opinion.

The companies were explicitly asked about what production ventures or projects they will be interested in doing at the Park. Their answers were as diverse as the respondents since they are very specific. Twenty possible projects were cited; Table 4.2 is a list of the twenty projects, the proponent company, the industry to which they belong and the responding company officer. It is significant that 56.5% of the proponents are company presidents and 13% are vice presidents - a total of 69.5% are top executives. A large majority of the proposed projects jibe with the top two choices of industry on the ways in which the Park could help them, i.e., improve the quality of existing materials, products and processes and develop new products or materials. It maybe noted that these proposed projects are not concentrated in any one industry.

During the interim period when the physical facilities for the Park are in the process of construction, acquisition and rehabilitation, two or three projects with excellent potentials for success may already be undertaken. These will utilize temporarily spaces in existing buildings of the UPCE/NEC. The details of these initial implementation are described in the next chapter.

**Table 4.1 : Profile of Respondents**

**A. UP College of Engineering/National Engineering Center: total no. = 70**

**1. Position**

| | |
|---|---|
| Faculty | 60 % |
| Researchers (non-faculty) | 27 % |
| Administrators | 5.7 % |
| Undetermined | 7.3 % |
| | 100 % |

**3. Highest Degree**

| | |
|---|---|
| Ph. D. | 11.4 % |
| M.S. | 27.1 % |
| B.S. | 41.4 % |
| Undetermined | 20.1 % |
| | 100 % |

**2. Department**

UP College of Engineering

| | |
|---|---|
| Engineering Sciences | 12.9 % |
| Electrical Eng'g. | 11.4 % |
| Mechanical Eng'g. | 10.0 % |
| Civil Eng'g. | 7.1 % |
| Chemical Eng'g. | 5.7 % |
| Met./Mining Eng'g | 5.7 % |
| Geodetic Eng'g | 2.9 % |
| Shops | 2.9 % |
| | 70 % |

National Engineering Center

| | |
|---|---|
| Main Office | 10 % |
| Transport Training Center | 10 % |
| Building Research Service | 7.1 % |
| National Hydraulics Research Center | 2.9 % |
| | 30 % |

## B. Industry : total number = 35

**1. Position**

| | |
|---|---|
| President | 40 % |
| Gen. Manager | 25.7 % |
| Vice President | 8.6 % |
| Exec. Sec./Chairman | 8.6 % |
| Others | 17.1 % |
| | 100 % |

**2. Industry**

| | |
|---|---|
| Manufacturing/Fabrication | 45.7 % |
| Associations | 11.4 % |
| Consultancy | 11.4 % |
| Government | 8.6 % |
| Computers | 5.7 % |
| Electric Power | 5.7 % |
| Construction | 5.7 % |
| Marketing | 2.9 % |
| Electronics | 2.9 % |
| | 100 % |

### Table 4.2 : Production Ventures or Projects Industry is Interested in Doing at the Park

| Production Ventures or Projects | Company Name(s) | Industry | Company Officer |
|---|---|---|---|
| 1. Instrumentation and Control | National Power Corp.<br>Kanlaon Eng'g Corp. | electric power<br>fabrication | Vice Pres. - R&D<br>President-Mgr. |
| 2. Metal Working/Steel mfg. | National Power Corp.<br>Phil. Sinter Corp. | electrical power<br>steel mfg. | Vice Pres. - R&D<br>Manager-Ads. |
| 3. Steam Boiler mfg./ maintenance | Supertech Ind'l Corp. | Boiler sales, Installation | President |
| 4. Indigenous raw mat'l for sanitary protection prods. | Johnson & Johnson | sanitary products | Vice Pres.-Opns. |
| 5. R & D of indigenous and non-traditional construction materials (low cost)/cement | Segovia Design Assoc<br>Trans - Asia | Bldg. Planning & Design<br>Eng'g & Const. | Design Manager<br>President |
| 6 Pollution Control | Ramcar | battery mfg. lead smelting | President |
| 7. Substitution of Imported mat'ls w/ local mat'ls | Ramcar<br>Edcop | battery mfg.<br>Eng'g Consultancy | President<br>President |
| 8. R & D of Eng'g mat'ls, e.g. dielectrics/raw mat'l testing | Philec | electrical prods. | President |
| 9. Pencil Mfg./cosmetics and personal care products. | Fortune Tobacco Corp.<br>Sanaea | tobacco products<br>marketing | President<br>President |
| 10. Electronic eqpt. using local materials | Telex Computer Corp. | electronics, computers | Senior Customer Engineer |
| 11. Adhesives, sealants, coating | Vulcan Ind'l Corp. | adhesives, sealant | Technical Mgr. |
| 12. Product dev't for Coconut raw materials | Phil. Coconut Auth. | coconut eqt, research | Deputy Adm. |
| 13. Seminars, Exhibits in tech. | Online Advanced Systems | software, minicomputer | Systems Eng'r. |
| 14. Food processing/power generation | Directric Industries | machines, aircon/ref | President |
| 15. ceramics raw mat'ls processing ceramic ware products for rural areas/machineries | Ceramic Assoc. | vitreous china sanitary wares | Technical Manager |
| 16. R & D of irrigation matters | National Irrig. Adm. | irrigation adm. | Administrator |
| 17. Powder Metallurgy | Amason Industries | welding prods./parts | President |
| 18. Carbide Metal mfg. | Amason Industries | welding prods./parts | President |
| 19 Rubber manufacture | Sime Darby | rubber tires mfg. | Plant Manager |
| 20. Semiconductor | Zilog Phil. | electronics, semiconductor | President & Gen. Manager |

## PROJECT COSTS, FINANCING, IMPLEMENTATION AND RISKS

### 5.1 Implementation Phases

To ensure a high degree of success in putting up the Diliman Technology Park at the U.P. Campus in Diliman it is proposed that implementation be carried out in two phases: Phase I will involve the piloting of the technology park concept utilizing building spaces available at the U.P. College of Engineering and the National Engineering Center. For this phase some two (2) to five (5) small, high technology enterprises may be invited for an initial five (5) years of operation which is also the maximum duration for Phase I. At the same time during this period it is expected that the preparations, including the setting up of the infrastructure, the negotiations with participating companies or entrepreneurs, and arrangements with financing institutions for Phase II of the project shall be undertaken. Phase II will involve the relocation of the pilot enterprises in Phase I and the setting up of the new enterprises in the designated area of the UP campus for the Diliman Technology Park. Phase I ends as soon as Phase II starts. Hence, the duration of Phase I could be less than five years.

### 5.2 Phase I

Based on the results of the survey mentioned in Chapter 4, the top choices as far as industries to which the technology park would cater are the ones dealing with (1) instrumentation and controls, (2) computer software, (3) food processing, (4) consumer electronics, (5) metal working, and (6) computer hardware. It would be ideal to have six (6) pilot enterprises, each one dealing with one of the industries cited.

The former textile laboratory building at the U.P. College of Engineering as well as building spaces at the 3rd and 4th floors of the National Engineering Center shall be made available for small enterprises during the pilot phase of Phase I of the technology park. The former can be earmarked for enterprises which require the use of heavy equipment and a larger manufacturing or production area while the latter is being proposed for enterprises which will use light equipment requiring less floor space. The 4th floor of the NEC building would be ideal for software companies or those dealing with electronics or microprocessor devices since part of this area houses the NEC microelectronics laboratory and the NEC computing facility.

The setting up of a pilot enterprise dealing with food processing will depend upon the availability of space and willingness of the U.P. College of Home Economics to accommodate this project.

Phase I will require the upgrading of laboratory facilities at the UPCE and NEC particularly those that will be serving the pilot enterprises. For example, UPCE laboratories dealing with instrumentation and controls, computer hardware and metal working would need to be upgraded. In the same manner, the NEC microelectronics laboratory would have to expand its capabilities. This upgrading program is not intended for phase I only but also for Phase II where a larger scale of operations is expected. An added benefit of this upgrading program would be the improvement of the quality of instruction and research at the UPCE.

Initial estimates for the financial requirements of Phase I are around P10.0 M. This amount is broken down as follows:

P4.0 M for the initial upgrading of laboratory facilities

P3.5 M for the repair and maintenance activities required for the building spaces

P2.5 M for the administration of project during this phase

Spread over a 5 - year period the financial requirements are as follows:

| | | |
|---|---|---|
| Year 1: | P4.0 M | for laboratory upgrading |
| | P1.0 M | for building repairs |
| | P0.5 M | for administration |
| | P0.5 M | for maintenance |
| Year 2 Up to Year 5: | P500,000 | for maintenance |
| | P500,000 | for administration |

In summary form the financial requirements are:

| Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| P Million | 6.0 | 1.0 | 1.0 | 1.0 | 1.0 |

The above financial requirements do not include the requirements for putting up the infrastructure for Phase II as well as other attendant preparatory activities which are discussed in Section 5.3.

It is proposed that the initial fund requirements for Phase I (year 1) be provided for by the Department of Science and Technology or its appropriate councils and the Department of Trade and Industry. The existing building spaces at UPCE and NEC would be the initial contribution of the University. The funding requirements for the rest of the 5-year period of Phase I is expected to be generated partly from space rentals and other fees paid by the pilot enterprises and partly from assistance coming from DOST.

In terms of organization, it is proposed that the U.P. Engineering Research and Development Foundation (UPERDFI) enter into an agreement with the principal sponsors of the project namely UP, DOST and DTI for the management of the project. UPERDFI would then constitute its project team to implement Phase I.

### 5.3 Phase II

The major cost requirements for Phase II are for: (1) land, infrastructure, and (3) initial operation.

Land with an aggregate area of ten (10) hectares shall be set aside by the University of the Philippines for the Park. An initial land area of five (5) hectares (50,000 sq.m.) shall be made available for Phase II which is expected to cater to about thirty (30), small and medium - scale enterprises. This 5-hectare land is valued at around P 50 M.

Infrastructure shall consist of the following:

* One (1) building with a total floor area of 3,500 sq.m. which could accommodate twelve (12) medium size firms.
  Estimated Cost: ........ P 21 M
* One (1) building with a total floor area of 2,000 sq.m. designed to house eighteen (18) small firms.
  Estimated Cost: ........ P 12 M
* One (1) administration and facilities building, with a total floor area of 2000 sq.m., to house the administration offices, exhibit hall, auditorium, multi-purpose hall, communications and computing facilities.
  Estimated Cost: ........ P 12 M
* Laboratory Equipment: ........ 20 M
* Roads and pavements: ........ 10 M
* Water System: ........ 4 M
* Power Distribution System: ........ 6 M
* Transport vehicles: ........ 2 M
* Telephones and Intercom: ........ 6 M
* Computer: ........ 15 M
* Furniture and Equipment for the Park Administration Office: ........ 2 M

Total Infrastructure including furnishings and equipment........ P 110 M
(Exchange rate: P 21.00 = US $1) $5.24 M

Some firms may be allowed to build infrastuctures of their own on designated areas based on agreements to be made with the University.

It is also expected that the firms which will lease space in the industrial buildings will improve and/or renovate their units according to their requirements.