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STUDY ON MANAGEMENT AND PLANNING OF R & D SUPPORTING FACILITIES (TECHNO CENTRE) FOR KULIM HI-TECH INDUSTRIAL PARK IN MALAYSIA

FINAL REPORT

SUMMARY

November 1995

JAPAN INDUSTRIAL LOCATION CENTER
NIPPON KOEI CO.,LTD

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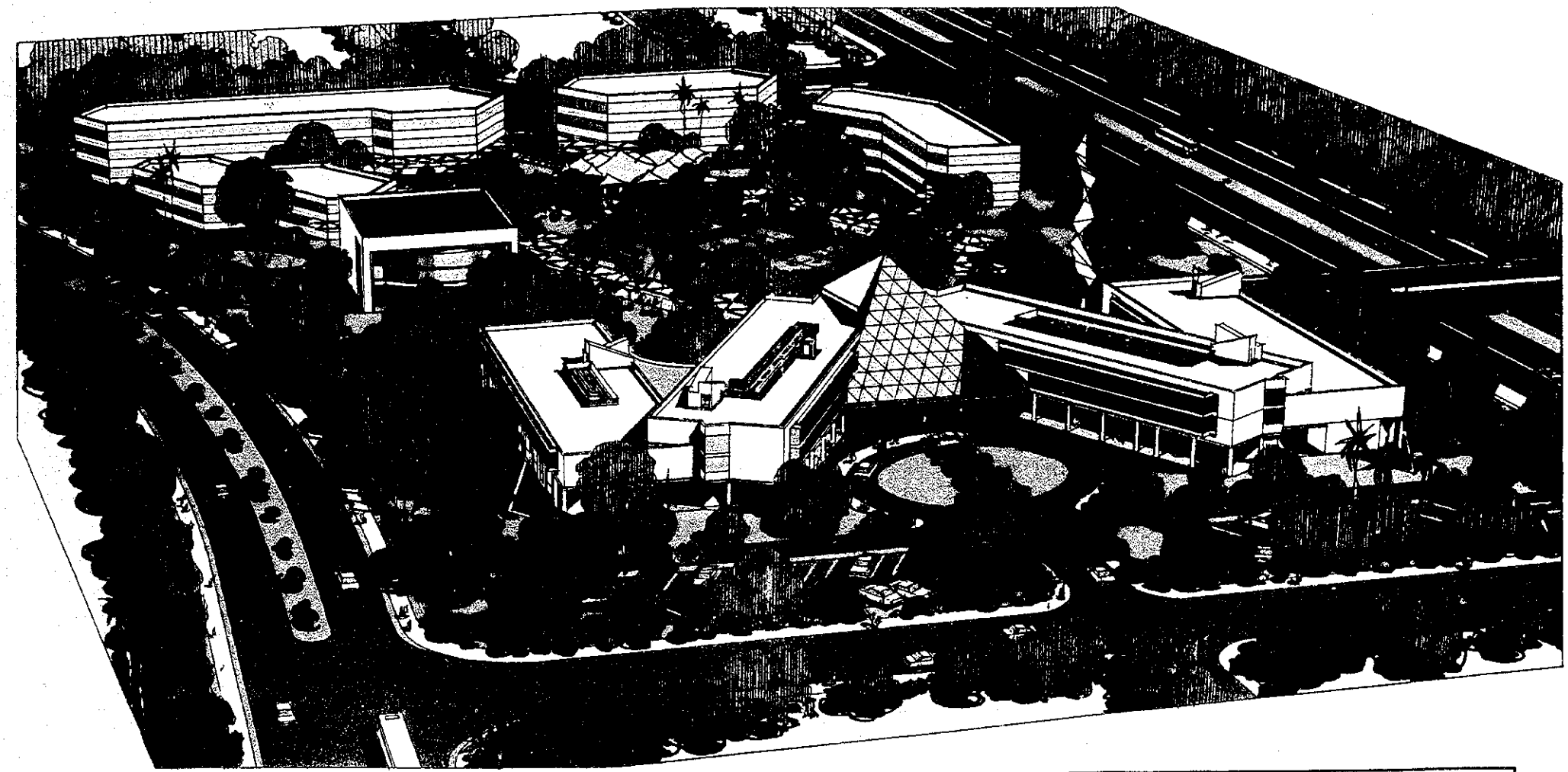

Architectural Image of Kulim Techno Centre

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INTRODUCTION

The Malaysian economy has been enjoying a high growth rate over the past decade due to the success of forming a series of industrial complexes and inviting foreign enterprises to locate in that country. Under this economic development, the Kulim Hi-Tech Industrial Park was planned as the base for promoting the progress of industrialization for the northern part of the Malaysian Peninsula. The plan called for inviting high-tech enterprises to the northern region in order to cope with the high tech era as an industrial complex, and to direct the flow of economic development to the northern district. Thus, in order to entice high-tech enterprises into the northern region, the Kulim Techno Centre will be opened to offer support services to research and development and services for nurturing support businesses as an incentive for these enterprises.

However, the rapid change in the world's industrial economy in the past two years has effected a major change in the location concept of the group of enterprises from advanced industrial nations that are unfolding their operations globally. The importance of regional demand in the Asia-Pacific region has increased rapidly. As seen in Japan-U.S. economic negotiations, the emphasis on international trade has rapidly changed from trading final goods to trade of parts and components. This change is not seen only between Japan and the United States. Amidst the formation of a wide-area manufacturing network aimed by the overseas-type economic integration of the Pacific region, the enterprises that set up operations in existing industrial complexes are now being forced to speedily examine the re-modeling of network-type manufacturing systems as plants for exporting high-tech parts.

In addition, the Malaysian economy that has so far enjoyed growth and development is not only being pressed to make a major shift in industrial structure, but also is being forced to face new difficulties in terms of the conditions for industrial locations.

First of all, one can hardly expect technological transfer or the forming of regional ethnic capital under the method that envisages economic development by inviting foreign enterprises into the industrial complexes and relying on import and export trade conducted by them. It is easy for foreign enterprises to come and leave (functional

replacement), and the frenzied movement of such functional replacement will significantly impact regional economies and labor structure.

Secondly, the past decade of growth has changed the Malaysian economy into one suffering from labor shortage. Notably, there has been a progressive shortage of man power in specialized technical fields.

Thirdly, the successes of new industrial policies and policies to invite foreign capital in the more advanced countries, such as Singapore as well as Thailand and Vietnam, are beginning to cause concern for the lowering of the relative position of the Malaysian industry amidst the shift being made from the base-type manufacturing method to wide-area manufacturing method.

In addition, the Malaysian economy is at a state where its development policy, notably its industrial development policy, scientific technology policy, human resources development and policy for educating employees in research are all at a major turning point.

It is only natural that the regional and federal government's expectations and the awareness of roles as well as the perceptions of foreign enterprises will change toward the raison d'etre of the Kulim Hi-Tech Industrial Park and the concept of the Kulim Techno Centre.

The Malaysian Government too is at this important phase. While longing for the success of the Kulim Hi-Tech Industrial Park, the federal government has positioned the Kulim Techno Centre as a national project that goes beyond regional interest. Under the comprehensive cooperation of the EPU that coordinates all organizations, including the various centralized organs, respective state governments, national organizations, the Kedah State Development Corporation in charge of constructing these organizations and government organizations of various classes, the Malaysian Government has researched and investigated the establishment of the concept and methods of operation.

The Techno Centre proposed here is designed to be an advanced structure that will form the core of the mechanism to entice into the region high-tech industries essential for leading Malaysia into this new era of development, and to further expand the sophisticated industrial bases.

However, leading edge technologies and the industries that use them cannot be nurtured overnight merely because the centre is equipped with superior equipment. This can be realized only if the people who operate these facilities are trained and the organizations to

support the operations are established. Progress is seen daily in leading edge technologies, and the contents of the facilities develop with the passing of time. It will be necessary to staff these facilities with experts who have acquired new technological expertise that are above the levels seen in existing corporations in the industrial complexes.

As a leading project for promoting the switch to the formation of a high-tech manufacturing network, an effort must be made to exert leadership in creating a network to convert the existing industrial complexes throughout the nation with the new concept. In order to recover lost time and induce leading edge companies into Malaysia, not only from advanced industrial nations but also from neighboring nations, the first prerequisite will be to rapidly start up the Kulim Techno Centre at the earliest possibility. For this, one must not merely wait for personnel to complete training under the present research and education system. This is because Singapore, Hong Kong and Taiwan are all recruiting personnel from all over the world. The Kulim Techno Centre must be used as a means to recruit personnel from all over the world. It is extremely important to seek the transfer of personnel and technology from within a global network, and promote education and training for high-tech business in order to incorporate the Malaysian economy into the network for advanced industrial regions. Based on this necessity, it is necessary to promote technology and nurture it as speedily as possible. Moreover, in order to keep up with the world's technological advances, the Kulim Techno Centre must plan to promote the transfer of technology by recruiting the necessary personnel and organizations through close cooperation with private enterprises, and think about utilizing these resources until the necessary personnel can be trained within the nation. This is the business objective of the Kulim Techno Centre.

It is eagerly hoped that this national project will be staffed with superior leaders and management teams to make it a success, so that the development of Northern Malaysia will serve as the locomotive to drive the "2020 Project".

I OVERVIEW OF THE BACKGROUND OF THE STUDY

Current status and policies of Economy and Industry, Science & Technology, and Human Resource Development are reviewed as the background of the Study.

I.1 Current Situation and Prospects of Malaysian Economy and Industry

During a decade industrialization in Malaysia has been remarkable. Manufacturing sector resulted in top of GDP share, employees, and overseas trade. On the other hand, this rapid industrialization caused expansion of capital and intermediate goods import, high wage, and labor shortage. In 1990's foreign investment tend to decline, furthermore, existing foreign companies consider to move out of Malaysia.

Above situation Government of Malaysia adopted following measures.

- Continuation of current investment incentives and their restrictive application for foreign investment
- Continuation of incentives for new investment and new establishment of incentives for reinvestment
- Promotion of decentralization measures of industry such as the distribution of industries to underdeveloped areas
- Promotion of strategic projects
- Encouragement of domestic investment

I.2 Present Status and Policy of Science and Technology Development in Malaysia

Government of Malaysia recognized that improvement of S & T was the most effective measure to enter the developed country in future. However, she faced the following issues;

- Small amount of R & D expenditure
- Shortage of Researchers

- Concentrated Budget allocation to the certain field of R & D and regions
- Shortage of R & D support industries
- Apathy to R & D activities by the society

Under the above situation, Cabinet Committee on Science and Technology chaired by Prime Minister and National Council for Research and Development(MPKSN) were established. The role of the former is to formulate policies, strategies, and programs aimed at S & T development and to sound and evaluate their progress. And the latter is to submit advice to Cabinet Committee and MOSTE to decide the R & D areas of priority, and to monitor the progress of project, etc. The strategies for Science & Technology development recomended by above organizations are as follows.

- Improvement of infrastructure for R & D activities
- Development of market-driven technologies and their expansion
- Development of Human Resource for R & D activities
- Advancement of social recognition for R & D activities

To achieve the target, Government prepares many incentives. In the future, private sector shall be a prime moter of R & D activities.

I. 3 Present Human Resource Development and Policy

The shortage of human resource causes bottleneck for not only industrial development and economic growth but R & D activities. Government of Malaysia, therefore, emphasis that Human Resource Development (HRD) is the most urgent issue. However, there are critical issues for HRD.

- Lack of training and higher educational institutions for science and technology
- Lack of instructors and their training centres
- Concentration of educational organizations around KL

In order to overcome these difficulties, policy measures adopted by the Government are as follows.

- Establishment of training facilities and upgrading the existing organizations

- Promotion of private sector to the training and education fields
- Shift to labor saving production system
- Introduction of foreign expertize
- Establishment of information system/programs on the labor market

To implement of said measures leads to achieve the following targets of economic and industrial development.

- Continuous growth of economy
- Nurturing the competitive industries
- Establishment of industrial structure with high wage
- Establishment of intraindustrial netwark
- Creation of new Demand
- Creation of new business and their improvement

II REVIEW OF EXISTING PLAN

"Techno Centre" was planned in the existing plan of KHTP, namely previous JICA Study conducted in 1992 and Master Plan. During last five years, the circumstances of socio-economy were dramatically changing, the concept of Techno Centre should be restructured in line with this change. Here review of the existing KHTP project focusing on its objectives and progress will be conducted. Then qualitative analysis on the effect of KHTP to the sourounding region will be tried.

II.1 Objectives of KHTP Development

The initial objectives of the KHTP development were as followings.

-To establish the growth centre through the integration of the high-tech industriesand R & D functions

-To propose the new development method characterized as the harmonious development with industries, academy, amusement, and habitation

-To propose the development to minimize damage to the surrounding natural environment

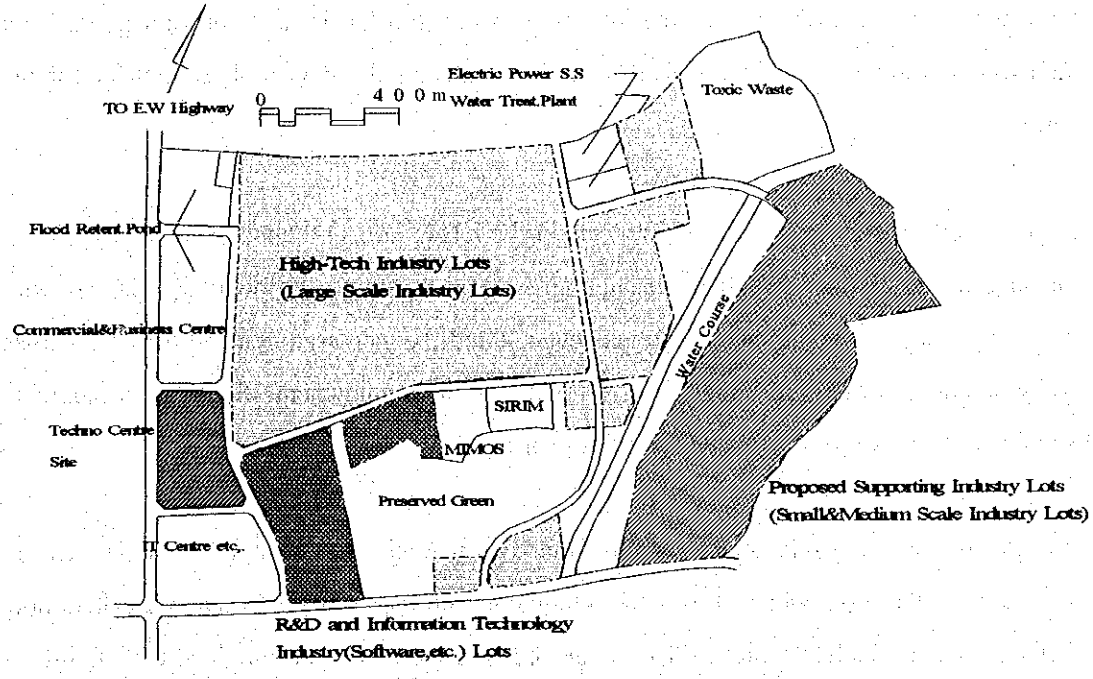
The said objectives is evaluated as useful at presents. The existing KHTP plan lacked the viewpoint of globalization and information improvement; nevertheless, the dramatically change of globalization and networking began at that time. The concept of Techno Centre studied here shall include above important matters.

II.2 Present Status of KHTP Project

KHTP having total land area of 1,448 ha is constituted of six zones.

Currently the first portion of the High-Tech Industrial Zone (H.I.Zone) where Techno Centre will be set up has been completed, approximately 250 ha, which accounts for about 60% of the H.I Zone. In R & D Zone government agencies are going to set up their branches, SIRIM and MIMOS. These agencies will construct facilities on their own, expected to be

ready in the latter half of 1996.



FigureII.2.1 Layout Plan of Phase I (Industrial Zone)

Currently, with two companies are admitted to the industrial zone and negotiation is underway with 9 companies. The majority of companies are related to the manufacturing of silicon wafer. Over 90% of the these firms are foreign companies.

In parallel with the major high-tech factories, supporting industries will be encouraged to move into the smaller lots in the vicinity of large factories.

II.3 KHTP's Role in Regional Plan and National Objectives

The KHTP is currently positioned as one of pivotal projects within the KDAP (Kedah Development Action Plan). This project is an essential project for Kedah State to accomplish its "economic macro frame" for the year 2000. However, the KHTP is not a project only for Kedah State. Within the context of proximity, and cooperation of the accumulation of existing industries and mobility of labour force, this project also has intimate relations with the states of Penang and Perak in terms of promoting industrialization of these states.

From a micro-economic standpoint of view, the objectives of KHTP are 1) to invite high-tech industries to accumulate manufacturing industries in Kedah State, 2) to mutually heighten one's technological level through the industries within the KHTP and through tie-up with industries in the vicinity of the KHTP, and 3) to enhance the industrial technology for the entire state.

Expected effect from these new investments in the KHTP are 1) the inducement effect from the investment 2), income effect through growth in corporate production, and 3) other induced effect such as the increase in tax revenue and the increased demand for new homes and purchasing power resulting from an increase in employment. Such a considerable multiplier effect can be anticipated from this project.

Promoting various exchange programs and tie-up with the economic entities to be accumulated in Penang which already has a high concentration of industries and excellent port facilities and the KHTP which will be expected to have a new accumulation of high-tech industries will contribute greatly to the development of the northeast region.

Another region that will impact the economy of the KHTP is the Northern Growth Triangle (IMT-GT: Indonesia-Malaysia-Thailand Growth Triangle). The IMT-GT project attempts to energize the markets of the growth triangle, with Malaysia, Indonesia, and Thailand maintaining close contact to play contributing roles to the promotion of investments and the development of infrastructure, and by encouraging trade and exchanges between private companies that will be invited to locate in the regions.
Since the KHTP in Kedah State will give birth to new industrial accumulations, these accumulations of industries are expected to play an important role in the IMT-GT.

III DEMAND FOR TECHNO CENTRE

III.1 Framework and Method of Needs Analysis

The needs analysis of the Techno Centre consists of three steps.
At the first step, the questionnaire survey was conducted with 579 firms in Malaysia to find out the trends and interests toward KHTP and Techno Centre.
At the second step, among those firms that showed some interest, 76 firms were selected to cover the wide range of industrial classifications to find out the specific needs for the Techno Centre based on interview survey.
At the third step, an industrial structural survey was conducted to analyze the trends of High-Tech industry development, and target industries to find out the future needs for the Techno Centre.

III.2 Questionnaire Survey Results

The number of enterprises which replied to the questionnaire, amounted to 220, which corresponds to 38% of the total number of 579 enterprises.

More than 50% of 211 answered enterprises points out a lack of skilled workers and lack of unskilled workers as current problems on management and operation regardless of ownership.
More than 50% of 132 answered enterprises points out the lack of access to expertise (59%) and lack of access to research facilities (50%) for current problems on R & D regardless of manufacturing type. Out of 220 answered enterprises, nearly 60% replies positively on expansion plan on R & D in the future. The local enterprises are slightly more aggressive than foreign enterprises. Among the fields of R & D in the future, Electronics is a predominant target and followed by new materials and mechatronics .
68% of 185 answered enterprises points out a lack of time for training and education, and 56% indicates a loss of investment due to job-hopping problems on HRD. Out of 220 answered enterprises, nearly 90% replies positively toward expanding plan on HRD in the

future regardless of ownership.

Out of 220 enterprises, 94 enterprises showed interest in locating new factories in KHTP. Out of 94 enterprises, 12 enterprises mark "Yes" and 82 enterprises mark "Possibly". With regard to the utilization of the Techno Centre, 143 enterprises (65 % of reply) show an interest. Out of 143 enterprises, 36 enterprises marked "Yes" and 107 enterprises mark "Possibly".

The expected services available in the Techno Centre are to receive seminar & training, information, testing, consulting, and measurement services.

Expected facilities for the Techno Centre are an information centre, open laboratories and rental facilities.

Companies' list resulted by this study shall be utilized as the potential clients' list through the continuous survey.

III.3 Results of the Cross Section Interview Survey

The number replied available amounted to 71, of the total number of 76 enterprises surveyed. The results of the interview survey are described hereinafter.

The present status on R & D activities is summarized below.

- A majority of foreign enterprises is currently conducting basic R & D activities in their parent enterprises. The improvement of production process is conducted locally. A part of foreign enterprises has a plan to transfer a part of R & D functions from their parent enterprises.
- A majority of local enterprises are not conducting R & D activities.
- Testing and calibration services have been conducted in SIRIM, SISIR, and other private institutions. Some enterprise points out that they have problems such as

taking long time for their services and limited capacity of their services.

- A most product performance, durability, and failure analysis are conducted in-house.
- Simple measurement and mechanical testing are conducted in-house.

The present status on HRD activities is summarized below.

- A majority of foreign enterprises sends manager class to their parent enterprises for training management capability for a few month.
- Many enterprises are supporting their workers for attendance of various seminar held in KISMEC (Kedah Industrial Skills and Management Development Centre), FMM, USM, NPC(National Productive Centre), NIOSH(National Institute of Occupational Safety & Health), etc.
- Some large enterprises is conducting training for workers based on original manuals.
- Local SMIs are carrying out training mainly through OJT for skilled and unskilled workers.
- All enterprises surveyed point out that they can not retain technologies due to job-hopping of skilled workers. Many enterprises adopt the countermeasures such as increasing salaries and improvement of labor conditions.

The present status on information system is summarized below.

- The computer system is introduced in electric/electronic enterprises for the purpose of sales promotion and market research activities.
- The information system of data base / library and internet has not been utilized in almost enterprises.

Out of 76 enterprises, 16 enterprises showed strong interest in locating new factories in KHTP. With regard to the utilization of the Techno Centre, 64 enterprises (84 % of target enterprises) showed strong interest.

A majority of enterprises showed more interest toward the following various testing & calibration / measurement services.

- structural analysis and microscopic observation
- material analysis and element identification
- environmental impact test of products
- load test of products
- dimension, sharp and surface measurement of products
- measurement of electric/electronic characteristic
- prototype production
- test for inferior goods
- durability test of products
- performance test of materials, products and equipment for production, etc.

Expected facilities and equipment for various testing & calibration /measurement services in Techno Centre are as follows.

- Gas Chromatograph
- Universal Testing Machine
- Torque Testing Machine
- Micro Hardness Tester
- Profile Meter
- Electric Conductivity Meter
- Impact Testing Machine
- Hardness Tester
- Surface Roughness Tester

Expected services on HRD including seminar & training are as follows.

- Many enterprises showed an interest toward training services on operation know-how of machines and repair method of machines for their engineers.
- Some enterprises showed an interest in training services on know-how of management and QC for skilled workers such as managers and supervisors.
- A few local enterprises showed an interest toward training services on technology of production development and process development.

Expected services on information are as follows.

- Some enterprises showed an interest toward information services on procurement method of equipment and parts
- Some enterprises wished information services on the latest standard for materials and parts and the latest journals for technology.
- A few enterprises wished information services on subcontractors and vendors.

Expected other services related pollution control are as follows.

- Some enterprises showed an interest toward monitoring services on the quality of industrial waste water.
- Some enterprises showed an interest toward R & D services on the treatment of solid waste.

III.4 Evaluation of Needs for the Techno Centre

The needs on functions and services for the Techno Centre are summarized below, judging from the results of mail questionnaire survey and interview survey.

- R & D including various testing, measurement, and calibration services
- HRD including seminar & training services on operation know-how of machines and repair method of machines, know-how of management and QC for skilled workers, and technology of production development and process development
- Information services on procurement method of equipment and parts, latest standard for materials and parts, latest journals for technology, and subcontractors and vendors
- Other services related pollution control such as monitoring services on the quality of industrial waste water and the treatment of solid waste

The major needs on facilities and equipment to be provided by the Techno Centre are summarized below, on the basis of the results of the mail questionnaire survey and the interview survey as well as reconfirmed questionnaire survey.

- Gas chromatography
- Electric conductivity meter
- Universal material testing machine
- Torque testing machine
- Micro hardness tester
- Laser surface measuring instrument
- Profile meter
- X-ray microanalyser
- Scanning electron microscope
- Constant temperature/ humidity chamber
- Thermal impact durability testing machine
- LCR meter
- Spectrum analyzer, etc.

Considering the circumstances mentioned above, overall investment demand can be concluded at more than 240 firms. The estimated demand for utilization is judged to be sufficient for the development of the Techno Centre in KHTP.

III. 5 Needs From Industrial Structural Shifts

1. Three Structural Shifts

In the discussion of industrial policy in High-Tech industrial park, it is imperative to define "HighTech".

There are two aspects in HighTech as follows;

1) HighTech as product,
2) HighTech as process.

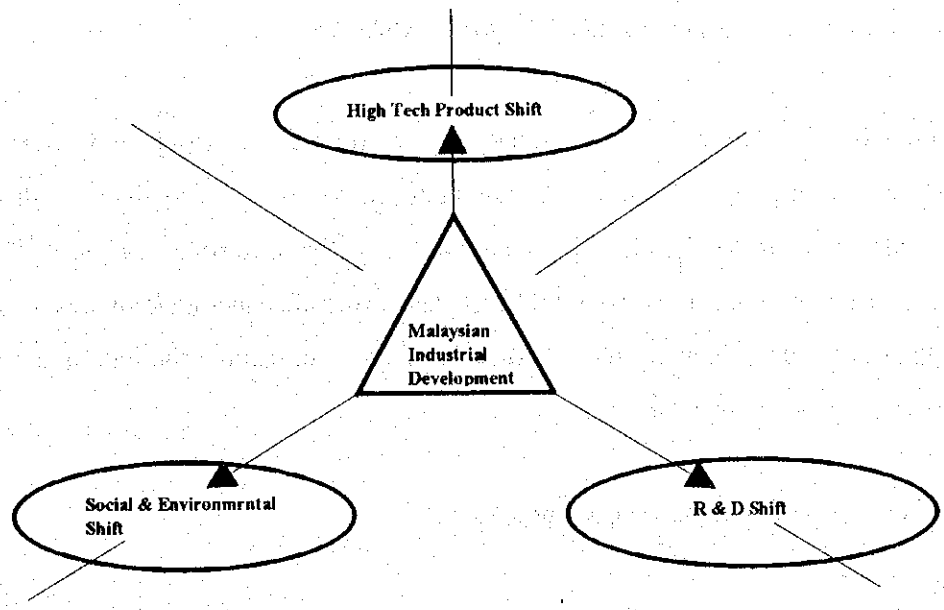
High-tech products are the products themselves that undergo model changes and product obsolesce as a consequence of continuous technological development. It requires both product development and process development capabilities to bring into High-Tech products.

High-Tech process refers to the upstream manufacturing activities in manufacturing processes which include product development, product design, and process development. In the analysis below we differentiate the move toward High-Tech product as **High-Tech Product Shift** and the one toward High-Tech process as **R & D Shift**

The mandate of the KHTP is to play a leading role in transforming the Malaysian economy to a higher value-added production economy. The shift toward High-Tech products and shift toward High-Tech process both serves to this end. The first step in **R & D shift** is to move from simple assembly work to the inclusion of process engineering.

Our survey revealed that the manufacturing sector in the northern region was undergoing transformation in three directions; High Tech Shift, R & D Shift, and Social &

Environmental Shift. High Tech Shift represents a move by established firms to a higher value-added product in assembly work. R & D Shift is observed in local manufacturing sector to move up in manufacturing processes to include more product development and design work in Malaysia. These two moves are taking place separately and require different public support in promotion. EU's new industrial standards and stricter pollution control in Malaysia are posing new technical requirements for Malaysian manufacturers. The Techno Centre should respond with technical support along these three dimensions.



Although Malaysia needs to pursue a shift to more R & D activities in High-Tech products, the current trends indicate that a shift toward more high tech and shift toward more R & D are taking place separately. A shift toward more high tech is a trajectory that is pursued by large multinational corporations in Malaysia while a shift toward more R & D involves more locally grown enterprises. This has some bearing on KHTP in its selection of high-tech firms.

One social change that is impacting the manufactures, especially in electronics industry, is new standards being implemented in European Union. CE marking requirements corresponds to stricter accountability demanded on producers under the notion of product liabilities.

In Malaysia Department of Environment enforces a strict environmental control, often stricter than that carried out in the U.S. or Japan. On the other hand local capabilities in monitoring, hazardous waste treatment, and neutralization are lacking. KHTP provide a waste depot which offers collective means to treat wastes.

2. High-Tech Industries in Northern Region of Malaysia

In the Northern Region, a wide range of electric and electronic industries always constituted a large proportion of the manufacturing sector. Semiconductor industry has been representative of so called high-tech industry within electronics industry. The firms located in this region represents world top class firms in semiconductor business. Since 1990 hard disk drive industry has emerged in this region, making the region as centre of electronic high-tech manufacturing.

(1) Semiconductor and Hard Disk Industry

Semiconductor Industry

All of the factories located in Malaysia undertake the finishing processes of semiconductor manufacturing. After the circuit is completed on wafers, the finished wafers are brought to Malaysia for bonding and packaging.

There are indications for upward integration in the manufacturing processes of semiconductors. The wafer production requires a stringent precision process control under super-clean environment with very stable power supply and abundant water supply. The KHTP can meet these demanding qualifications as a site for wafer production. Several investors have approached KTPC and the negotiations are underway.

Wafer fabrication is far more demanding than the finishing processes in light of technical requirements. Wafer fabrication requires class 10 level* clean room for the operation and a large amount of purified water. Monitoring requires PPB to PPT level of accuracy in comparison to ordinary PPM level analysis**.

Since the manufacturing processes are limited in Malaysia, analysis and testing needs in semiconductor industry is limited compared to hard disk drive industry at the moment.

Hard Disk Industry

Hard disk is one of the-high tech devices that is characterized by a constant innovations. The main products are processed in a Class 100 level clean room since slight contamination could lead to product failure. The components must be cleaned to remove contamination so the industry in any level uses a large quantity of water.

(2) Specific Testing Requirements

The current testing and analysis needs come largely from hard disk drive industry. Our analysis will focus on the needs from hard disk drive industry with some reference to the future wafer fabrication needs.

Surface Analysis

Surface Analysis is needed to detect the contamination and failures on the surface of the components.

Scanning Probe Microscope or Scanning Tunneling Microscope is used to analyze the three dimensional character of these hard disk components. In Malaysia there is few institutes that are equipped with other than Scanning Electron Microscope.

* Class indicates a number of particles larger than 0.5 micron that exist within one inch cubic feet.

** PPB represents Parts Per Billion, and PPT, Parts Per Trillion while PPM is Parts Per Million, all of which indicate density of dissolved elements.

Ionic Contamination

The head of hard disks are very sensitive to corrosion. Wafer has to be clear with any ion to avoid short-circuit. Therefore, the water used in the manufacturing processes has to be free from ionic contamination. The compounds such as nitrite, chlorite, sulfite, and bromide have to less than 0.5 PPB in the water. Ion chromatography is the equipment to measure ion contamination. Dionex is the only known maker that can supply the equipment that can measure above PPB level contamination.

Material and Chemical Analysis

For sensitive devices the PCBs have to be tested in many aspects. However, local labs are not equipped with Gas Chromatography, Mass Spectrometer, or Atomic Absorption Spectrometer. Currently most of these tests are conducted in Singapore.

Water Analysis

In hard disk and semiconductor industry, a large quantity of purified water is used for cleaning.

Atomic Absorption Spectro-photometer is commonly used to measure the contaminating elements in water. Recently, a new equipment, Inductively Coupled Plasma Emission Spectrometer is often used to measure elements in water at PPT level. Water is inspected at an interval of one month on 10 to 12 items.

Mechanical Test

For both hard disk drive and semiconductor industry mechanical properties of the materials such as flatness and hardness are important factors in quality control.

Electrical Testing

So called performance tests and failure analysis are conducted mostly in-house in large establishments and external services are rarely hired. There are a large demand in the calibration of the measurement and monitoring equipment. The engineers interviewed contend that the large backlog in calibration and insufficient quality in service are incurring unnecessary amount of expenses in their operations.

3. High-Tech Industries and Environmental Management

HighTech for production of High-Tech products often uses various substances, for example rare metals, rare earth, and organic solvents, and many of which are hazardous.

Normally, hazardous waste are treated and disposed of by specialist treatment businesses, but in Malaysia, these businesses has not been fostered, so currently, many enterprises has been stored and managed them on the factory site. The problem of the treatment of hazardous waste is often indicated as a major problem even in interview surveys.

Currently, the work of establishing international environmental standards is being made in progress. The details involve the systematic management and measurement of the environmental activities of enterprises and their transmission to the outside. This standard is ISO14000, and it is commonly called the Environment ISO.

This standard will affect product design, methods of manufacturing, and selecting of raw materials and also will influence ways of collecting and publishing environmental data. For enterprises that provide services such as manufacturing and selling products overseas, failure to observe this newly enacted standard may result in severe trading difficulties. Further, to all intents and purposes, it will become a domestic standard, and is predicted to affect even enterprises that do not engage in overseas trading or in business with overseas.

4. Movements to World Standardization and Law of Product Liability (PL)

Current movements to standardization are concentrated on the three issues of matters relating to quality control, matters relating to environmental management and matters relating to safety.

Standards on quality control have been implemented in every country with the history of industrialization. At present, since enterprises that export to world markets, particularly within the EU area, are often required to adopt these standards such as ISO series as a mandatory condition for doing business, enterprises exporting to the European market have

to adopt them.

There is still no movement as yet towards the world standardization of safety. But, in Europe, safety standards are being issued in each product field. This is called the CE marking system and these standards have the potential to become virtually world standards. The first reason is that European standards sooner or later will be on the agenda of the ISO because the European standards are likely to anticipate world standards. A second reason is that the CE marking has closely relation with Product Liability (PL) laws. In the countries where PL law has been set down, the EN virtually apply even in areas where the EN are not obligatory.

Especially the electrical and electronics fields which have the greatest exports are the most serious. CE marking in this field consists of three directives such as the safety of machinery directive, the electromagnetic compatibility (EMC) directive, and the low voltage electric appliance directive.

Techno Centre can be expected to perform testing and measurement services for a company to gain accreditation. In this case, the field with the highest demand is the EMC field.
The reason for this is that firstly, it is a new standard that will start from the 1st January, 1996, and in that sense, there are not yet testing and measurement organizations in existence anywhere in the world. Secondly, demand for facilities by enterprises will be high because measurement facilities are extremely costly and because it is difficult for individual enterprises to get them ready. Thirdly, the area around Penang has a fair degree of concentration of the electrical and electronic industries which are Malaysia's leading industries. And electronic-related enterprises can be expected to move into the KHTP. This means that it is expected to be adequate demand of testing and measurements for Techno Centre.

IV CONCEPT FOR TECHNO CENTRE

IV.1 Strategic Management Plan for Techno Centre

1. Goals and Basic Policies

The first objective of the Techno Centre is to provide state-of-the-art technical support to attract and ensure the operations of high-tech industries in KHTP and secondly to provide services to promote industrial deepening to enhance value-added productivity of the manufacturers in the northern region of Malaysia.

The Techno Centre can contribute to a great deal to electronics industries located in and surrounding area by supporting R & D activities.
It is a conservative strategy to focus on electronics industries which have clear potentials. Nevertheless, such strategy does not exclude the possibility for the expansion to other industries. If the choice for target industries is conservative one, the approach for technological building for the Techno Centre should be an aggressive one.

The equipment planned for Techno Centre are not only very expensive but also require highly skilled operators. Nevertheless it is an imperative to acquire such analytical capability and skills to promote High-Tech industries and close the gaps with advanced industrialized countries.

The ultimate goal of the Techno Centre is to support R & D activities. However, if the Techno Centre is solely dedicated to the support for R & D activities, the Techno Centre will not be able to avoid having idle capacities. On the other hand, analysis and testing for the quality control in High-Tech industries have grown to a sizable market. Although R & D and quality control have different purposes, the processes have much in common. In quality control, the detection of defects is only the first step and the ultimate goal is to find the cause for the failure. The research capability beyond simple physical and chemical analysis for diagnosis is also an expertise necessary for R & D.

For the above reasons, our strategy is to focus on the failure analysis needs arising from quality control at an initial period. The experience and know-how acquired through providing failure analysis services will become a valuable asset for R & D activities in the future.

2. Strategies for Rapidly Advancing Technologies

The facilities planned for the Techno Centre are most advanced scientific equipment because the centre is intended to service High-Tech industries. Technological development in these industries are so rapid that the product cycle has shortened to less than a year in most products. As a consequence of technological development, it is quite probable that the current selection of equipment become obsolete in a few years. Though we have planned the second stage expansion to increase the capacity of the Techno Centre, professional re-assessment of the equipment purchase plan is highly recommended in a few years.

What is most crucial in developing capabilities to support High-Tech industries is the development of expertise to utilize the advanced equipment. It is necessary to have a practical plan for human resource development. The development of human resources in highly scientific fields cannot be achieved through formal training, but depends on on-the-job training. The problem of obtaining qualified professionals who train other people is a common big problem for both KHTP and the Techno Centre.

IV.2 Functions and Services

1. R & D Support

(1) Material & Surface Analysis Service

Material and surface analysis requires a high precision analytical equipment accompanied by expertise to conduct. Although we do not know exactly what types of manufacturing will emerge in KHTP in the future, the facilities capable of servicing hard disk drive

industry should be able to meet the most demanding technical needs at angstrom and ppt level measurement.

(2) Testing for Electronics Products

As EU implements stringent testing requirements for any sale within Europe, there are new testing demands such as for electro-magnetic susceptibility. These tests require a special facility of large investment such as anechonic chamber. Such a facility does not at the moment exist in Southeast Asia, thereby making the Techno Centre an unique institution which attracts a wide customers.

(3) Monitoring for Environmental Control

Industrial waste and effluent, as an inevitable consequence of large concentration of manufacturing establishments, could cause a damage to the surrounding environment and human settlements. High-Tech industries especially tend to use various rare toxic gases and liquids and present a potential risk to the environment. Therefore, stringent pollution control and waste management are prerequisites in advanced industrial estates. Therefore, the Techno Centre should provide efficient and prompt effluent testing for the factories.

The target industries of the Techno Centre, electronics industries such as hard disk drive and semiconductor industry use a large volume of purified water. The analysis of water at the intake and after the purification is an important process for quality control. At the same time, the waste water analysis is essential for pollution control.

The three areas of testing and analysis are proposed to be an each independent centre. Such division comes from a technical specialization. However, the three areas of specialties have to be well coordinated to provide quality in testing and analysis services of the Techno Centre.

2. Incubation

In view of the objective of building indigenous manufacturing capabilities, there should be some incubation functions in the northern region. Since small firms are not as mobile as the larger firms, it is better to offer local assistance for local ventures from Penang and Kedah regions.

The concentration of electronics industries in northern region of Malaysia, centering around Penang area, has generated a market size has begun to spur local supporting industries and production machinery industries in the neighboring areas. Backward integration in industrial linkages has taken place; the components industry and supporting industry have spung up.

The Techno Centre should provide office space for incubation and retail and open labs to facilitate R & D activities of these start-up firms as well.

3. Human Resource Development

The most common problem was shortages of both operators and engineers. The turn-around among engineers are much lower, but shortage is a serious problem in upgrading manufacturing processes in Malaysia.

The training to be offered at Kulim should correspond to the specific needs to assist industrial deepening in the region. Since the next steps for Malaysian manufacturing are to acquire process engineering technologies and product development technologies.

4. Information Services

A well organized library is a traditional source of information for research activities. Due to a limited users, the library in the Techno Centre cannot be extensive as owned by

universities. The journals must be limited to the specialized fields of the KHTP such as electronics and information technology.

Assistance in information technology and network services from Information Technology Centre should improve connectivity of those firms located in KHTP. On-line database and internet should handle a bulk of research needs since it saves money and space.

Information service at the Techno Centre should include Procurement/Vendor Information Service as on-going survey cum information service.

Besides these physical outlay, the crucial element in effective research is a well-trained librarian who knows the ways to find the items that researcher look for. A librarian should be proficient in database search as well.

5. Exchanges

Personal network is not visible. Nevertheless it is the basis for any investment or R & D. In that sense the Techno Centre should become a focal point for personnel networks. Specifically the Techno Centre should start with informal meetings, salons, and forums of entrepreneurs, engineers, and researchers and proceed to more formal expert networks. Organizational effort should contribute to further prompt intellectual activities and investment opportunities.

IV. 3 Organization

The organizational structure of the Techno Centre is based on three factors, i.e., functional division, partnership division, and financial viability division.

A partnership with a private firm is desirable where possible, but no single firm offers a variety of services that the Techno Centre offers. Therefore, analysis and testing services are divided into three distinct centres. The services that the Techno Centre offers has a varying degree of financial viability. Some services such as HRD are more financially self-sufficient than other services. Information Technology Centre will become a part of the Techno Centre when it is completed, but currently is under planning by the USM.

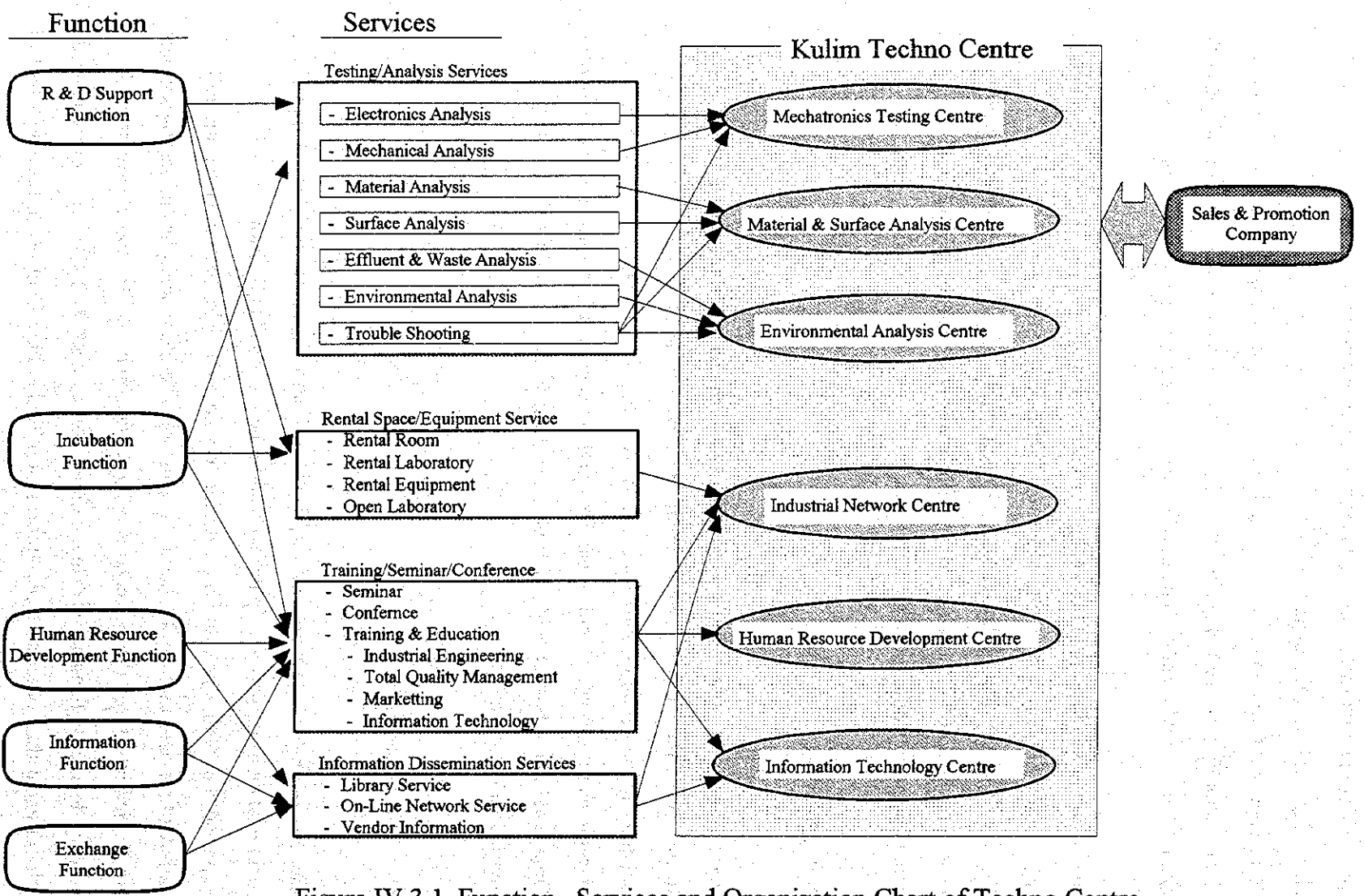


Figure IV.3.1 Function , Services and Organization Chart of Techno Centre

The rest of the services which has a characteristics of public service are grouped into one centre, i.e. Industrial Network Centre.

In Addition to these 6 centres, our proposal is to set up one sales company. A privatized sales arm will be more efficient and dynamic to changing needs.
The suggested organizational chart in Figure IV.3.1 is the division of functions and services according to these criteria.

IV. 4 Formation of Techno Centre

1. Basic Policy in Management of Techno Centre

In view of total management system of the Techno Centre, a few important issues are presented in the development of the Techno Centre as an institution.

(1) A Few Important Issues

Expertise Requirement

Analytical needs of high-tech industries cannot be met only with the installation of high performance measurement machines without the accompanying expertise. The only solution to shorten the period of expertise development is to invite well-experienced organizations to take part in the provision of professional services of Techno Centre. Private corporations in industrialized countries do already provide such services of high quality.

Public-Private Partnership

The goal of the Techno Centre is to provide the technical and laboratory services of highest level in Asia. Private sector's participation is crucial in providing high level services with efficiency, but public cause and financial viability conflict with each other in management. Techno Centre has to provide the mechanism to remove risks for these companies to participate.

Lowering Risk for Private Participation

Public-Private partnership of differing format appears to be a workable solution to solve the above-mentioned dilemma of financial viability and public service to upgrade the manufacturing sector in the region.

(2) Role & Responsibility

Public-private partnership often requires the coordination among different characteristic sectors. On each stage such as planning, launching, and operation, coordination with correspond organizations shall be needed.

Management structure shall be set up the structure which private companies can function along with their objectives and capabilities.

(3) Creating the Techno Centre Organization

Techno Centre projects often have a strong public aspect such as contributing to regional industry, fostering high tech enterprises, and supporting the upgrading of the technology of supporting industries. Therefore, it is desirable to establish the Techno Centre with capital from sources such as the government or public bodies.

In the light of the high specialization, the capacity to supply high quality services and adaptiveness in accommodating enterprise requirements, it is essential for each centre to be a project under the guidance of the private sector.

2. Management Structures

The Techno Centre consists of six centres, a sales promotion company, and management divisions for facilities, etc. Except for ITC (where USM is the operation nucleus), the project nucleus is not fixed.

There are two kinds of project formation.

Type 1 (Total Management Type) is the type whereby a public body carries out the entire project. Because it is difficult to foster people with a high degree of talent in a short period, the project startup is delayed. However, it is relatively easy to receive public assistance.

Type 2 (Lease Type Management I) is where a public body purchases the Techno Centre facilities and equipment, and manages the entire Techno Centre, and commissions private enterprises with the projects of each centre. At this point, for three centres (the Mechatronics Testing Centre, the Material & Surface Analysis Centre, and the Environment Analysis Centre), it is desirable that the work consignee simultaneously carries out the management of the relevant centre because specialized technology is required for the management of the facilities and plant and equipment prepared. For the other centres, the work consignee only carries out the project and does not manage the facilities or plant and equipment.

Techno Centre promotion is conducted by bodies and organizations involved with the projects carried out by Techno Centre and by boards that provide support and guidance. A detailed promotion structure is shown in Figure IV.4.1 and a detailed list of members is as shown in Table IV.4.1.

Board of Academic Science and Technology

The Board of Academic Science and Technology is the body that investigates and brings about specific responses and policies to the tasks listed below in promoting projects. This board is the kernel for liaising with the Techno Centre.

-Investigation of Techno Centre projects for the promotion of process development and product development
-Specific investigations and selection of facilities and plant and equipment to be installed by the Techno Centre
-Survey research for inspection and analysis requirements
-Future important industrial fields and directions in their accommodation

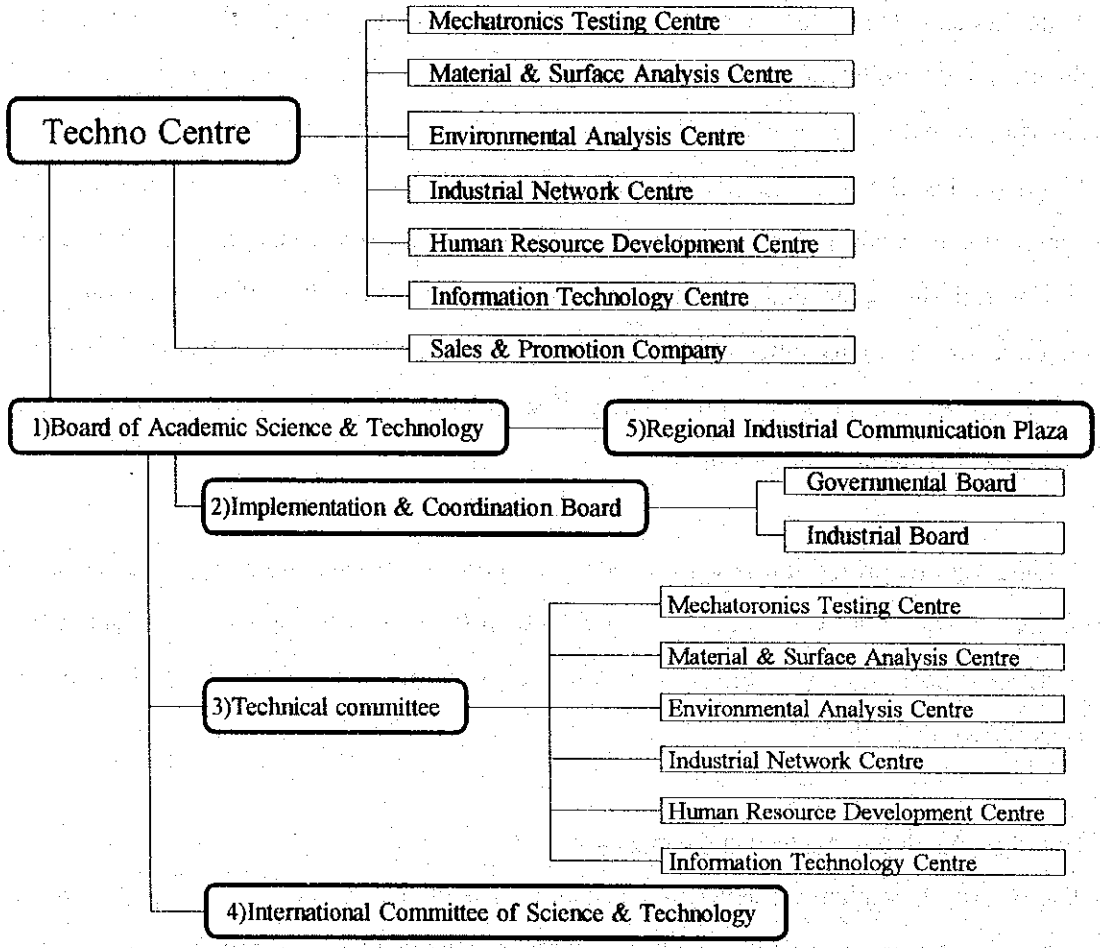


Figure IV.4.1 Structure of Techno Centre project promotion

Table IV.4.1 Proposed member on each board & committee

	Government						Private		
	a)	b)	c)	d)	e)	f)	g)	h)	i)
1)Board of Academic Science and Technology	○	○	△	△	△	○			○
2)Implementation & Coordination Board	○	○	△	△	△	○	○	○	○
3) Technical committee			△	△	△	○	△	△	△
4)International Committee of Science and Technology	○			△	△				○
5)Regional Industrial Communication Plaza		○	○ △	○ △	△	○	△	△	○

Note: Administrator (○), Engineer(△)

a) Federal Government (EPU,MOSTE,MIDA,MITI .,etc)
b) State Government (Kedah,Penang, Perak)
c) Governmental Research Institute (SIRIM, MIMOS.,etc)
d) University (USM, UTM., etc)
e) Kulim Techno Centre (Six Centres)
f) Related Organization (KSDC,KTPC.,etc)
g) Tenant in KHTP
h) High-Tech Companies in North Region
i) Industrial Organizations (Chamber of Commerce .,etc)

IV.5 Roles of Related Organizations

The roles of organizations related to the Techno Centre must be examined from the viewpoints of four different levels. These are, 1) Industrial Estate as the KHTP development level, 2) regional level such as Kedah, Penang, and Perak, 3) the Malaysian national level, and 4) the international level.

The following table summarizes the above.

Table IV.5.1 Roles of each organization

	Organizations	Relationship with the Techno Centre
Viewpoint of industrial estate development level	Tenanted enterprises, R & D companies	Users
	MIMOS / SIRIM	Users, cooperation
	KTPC / KSDC	Parent bodies of project promotion, operation nuclei
Viewpoint of regional level	Kedah State government	Cooperation (financial support)
	SIRIM branch office	Complementary (cooperative) and liaising functions
	Private enterprises	Users
	Penang and Perak state government	Cooperation, liaising
Viewpoint of national level	USM / UTM	Project participation (liaising, cooperation, use)
	EPU	Project promotion (coordination)
	MOSTE	Project promotion (cooperation)
	MIDA	Project promotion (cooperation)
	SIRIM	Liaising / complementing
	TPM	Liaising / complementing
	Private enterprises	Tenant
Viewpoint of International level	Research institutions	Tenant, liaising
	Higher education institutions	Use (liaising)
	Private testing & analysis institutions	Use (operation of part of the facilities)
	Private enterprises	Users, tenants
	Associations, etc.	Liaising
	Foreign government	Cooperation

IV.6 Function/Services/Facilities/Equipment of Techno Centre

Here, maintained function, content of service of each center, and facilities and equipment were examined.

1. Mechatronics Testing Centre

(1) Objective

This centre is made to promote upgrading of electric and electronic industry, leading industry in a Malaysian economy, to be able to adjust smoothly a new international standard.

(2)Activities

The centre will conduct various testing of adaptability to the standard, especially EMC, equipped with Anechoic Chamber which it is difficult for each enterprise to equip and maintain. And it has further business of certification the conforming to the standards, of being an agency of application to standards, of supplying information on standards, and of being a consultancy service for adaptation to standards.

It is necessary to obtain a guarantee that this centre is a proper laboratory for the standard from a proper organization in case of providing testing or measurement services for adaptation to standard. To certify the product which is exported to every country in the world, a proper person should test or measure the product by a proper method in facilities which have proper examination equipment.

Activities

1) The first phase

- The EMC is mainly placed.

2) The second phase

- Endurance of the semiconductor in addition to EMC is examined.

3) The third phase

- In the field of electronics, technical innovation is so drastic that it is necessary to investigate how the centre do at the third phase in the step of the second phase.

(3) Facility Plan

Refer to Table IV.7.1

(4) Organization system

1) Recruiting and Training

The researcher is required to have a knowledge as a specialist for testing, and to be able to take adequate advises about the measure of the product which has something wrong, to be familiar with the standard and to have ideas how to pass the standard, especially in the EMC field.

2) Organization system

Organization structure

The business department provides the consultancy service, the agency service of application to various standards, and the certification service. The two employees are proposed.

The testing and measurement department provides various testing and measurement services related to electronics and gives some advice regarding a defective product. The EMC testing and measurement is independently conducted by EMC engineering laboratory which under the testing and measurement department. The number of employees is 3 for EMC and 1 for the other examinations in the first phase. These number of employees are increasing in proportion to the number of requested testing and measurement of each phase.

Manpower Plan

	1st phase	2nd phase	3rd phase
Business department	2	2	2
Testing & measurement department	4	6	6
(EMC)	(3)	(4)	(4)
Total	6	8	8

Management structure

EMC engineering laboratory is thought to be entrusted to the private sector. For the laboratory has necessity to gain the guarantee of the standard, the considerable demand is expected, there is a enterprise which wants to manage this laboratory, and the business of this laboratory can be separated from the other business of Mechatoronics Testing Centre.

2. Material & Surface Analysis Centre

(1) Objective

Material & Surface Analysis Centre will be the central organization within the Techno Centre to support the development of high-tech industries such as semiconductor and hard disc drive industry. Initially the centre will enhance the quality control of high-tech industries and gradually supplement the R & D capabilities in process design and product development.

(2) Activities

The centre will provide the analysis and measurement services of materials, parts, and products for the industries in the KHTP and its surrounding areas with a particular focus on hard disk drive and semiconductor industry.

The centre will also provide consulting services on production methods and quality control through failure analysis based on advanced micro-area analysis.

1) 1st Phase

At the first phase the goal of the centre is to build foundations for basic analyses and research for semiconductor, metal, and ceramics. The major areas of analyses are;

- Composition Analysis
- Surface Analysis
- Structure Analysis
- 3D Composition Analysis

2)2nd Phase

Based on the basic capabilities developed during the first phase, at the second phase the centre will be expanded to conduct the analyses in further micro-areas and to offer more comprehensive analytical services for semiconductor and hard disk producers.

3) 3rd Phase

In accordance with the development of the KHTP, the revision of target industries are carried out and re-equip the centre to meet the changing needs.

(3)Facility Plan

Refer to Table IV.7.1

(4) Organization

1)Recruitment and Training

The researchers qualifications are the degrees in physics or chemistry, and experience with actual analysis. It is known to take more than three years of on-the-job training with proper guidance and without experienced leaders it sometimes take 5-10 years to build competitive expertise. Judging from the urgency of the services, it is recommended to affiliate with a well-established private laboratory for smooth start-up.

2) Manpower Plan

	1st Phase	2nd Phase	3rd Phase
Researcher	9	13	15
Administrator	1	1	2
Total	10	14	17

3. Environmental Analysis Centre

(1) Objective

Through the services offered in inspecting water quality and offering measurement services to enterprises established in the KHTP and to related regional enterprises, assistance is given to them for managing environmental preservation.

The facility will be used as a comprehensive service organization for offering water-related inspection, measurement, and consultation for the peripheral regions and all Malaysia.

(2) Activities

Policy

Target field of this centre is inspection and measurement of liquid. And at the next step, the centre aims inspection and measurement of air.

Activities

1) The first phase

Inspecting and analyzing water, particularly pure water, and soil quality of water and soil used by enterprises

Analyzing waste water, sludge, and fluids in intermediary state

-Inspection and measuring toxic materials:

Inspecting and analyzing organic toxic substances

Inspecting and analyzing inorganic toxic substances

-Inspecting and measuring non-toxic substances: Measuring BOD, COD, SS, etc.

Consultation services for waste water disposal facility and other facilities

2) The second phase

-To unfold area of expertise into gaseous substances in addition to water quality

3) The third phase

-While the third phase may include noise and vibration, a full study will be made at the second phase level since many new facilities may be needed.

(3)Facility Plan

Refer to Table IV.7.1.

(4) Organization

1) Recruiting and Training

When the centre will launch, it will be difficult to line up the professionals for inspection and measurement required by the centre. Therefore, such personnel will be recruited form private corporations that handle similar work. It is important to build the business organization by involving enterprises that can form joint ventures from the planning stage. By utilizing the know-how of these enterprises, the technological level of the Environmental Analysis Centre will be enhanced.

2) Organizational Structure

The Environmental Analysis Centre consists of two departments, Technical Supporting and Analysis Department and Business Department. The activities of the former is to analyze and inspect water and air, to offer consultancy services for installing environmental facilities, to analyze the needs for new environmental analysis, and to submit management plan.

The activities of the latter is to train of employees, to dispatch employees to outside, and to promote technological exchange with universities and personnel exchange.

A part-time researcher system will be inaugurated to supplement any shortfall of researchers.

Manpower Plan

	1st Phase	2nd Phase	3rd Phase
Researcher	7	9	11
Management of accounting	1	2	2
Total	8	11	13

4. Industrial Network Centre

(1) Objective

The objective is to enhance the technological level of existing enterprises in the northern region of Malaysia, to create assembly network, and to create and foster new enterprises within the network.

(2) Activities

Basic Policy

Of the functions of the Techno Centre explained earlier, the improvements made in the conditions for the organizational formation of product innovation and assembly support the creation of investment opportunities, and also provide support for start up, growth, exchange, R & D, and information to businessmen who wish to turn their investments into business projects.

Activities

-The following functions will be available as facilities for start up and growth support.

Start-up support: Operating rental laboratories

Growth support: Operating open laboratories

Support prototype production industries

-Exchange Programmes

In order to pursue the objectives described above, it will be necessary to start from whatever is close at hand. The centre will schedule the following plans.

- Opening Kulim High-Tech Salon

This will be a membership salon held about once a month. An attempt will be made to promote exchange of information among the members in a free atmosphere. The target members will primarily be corporate proprietors. There are many cases where opportunities for exchanging opinions lead to new businesses.

- Opening general workshops

A three-day workshop to be held twice or three times a year. The target audience will be corporate and university researchers. The results of the workshop will be published as workshop proceedings. The centre will also consider creating data base to record the proceedings.

- Opening special workshop (private)

This will be a work shop held about once a month. A separately organized officer's meeting will determine the topics to be discussed and the lecturer to be invited. The audience will be researchers and the like of member enterprises.

-Offering Information

Library service--> Data bank retrieval service --> Multi-media service

This service section will start by promoting information exchange service for the following information required by businessmen.

Text retrieval service for technical text, journals, and other technical information

Proceedings of workshop held in business exchange programmes

- Corporate Information Service

Service to offer information on parts and parts materials by data base

Information service on vendors

-Networking

Promote networking by group of enterprises that use the technology centre's services

1) The networking will start by creating a loose organization or organizing information exchange meetings or to stage exhibitions, and gradually transform the organization into a more specialized and solid set up.

In any event, it is important that the organization is flexible to accept changes.

2) The next stage is to form various unions, associations or federations from industrial groups or groups sharing common interests when the time comes for establishing and forming larger groups that encompass entire groups.

3) These will be important infrastructures for people and society for the industrial networking era as "element pools" that flexibly interchange networkings. Moreover, to maintain the high-tech quality of the centre is to create investment opportunities and product knowledge through technical communication conducted within the infrastructure.

(3) Organizational Structure

A major objective of this centre is to create a wide human network than to possess technical quality. For this, the centre will aggressively utilize personnel from the private sector for securing human resources. For example, it is necessary to assign people with unique background such as those who are involved in projects to develop businesses on an international scale, or those who are knowledgeable about the industries in the northern region.

Manpower Plan

	1st Phase	2nd Phase	3rd Phase
Exchange Department	4	4	4
Planning Department	2	3	3
Business Management Department	2	2	2
Total	8	9	9

5. Information Technology Centre

(1) Objective

The IT Centre led by USM was planned as a facility to promote the development of computer software and particularly educational projects in the field of information technology. The purpose of the centre is explained below.

- To facilitate the exchange and transfer of information technology knowledge and applications
- To encourage the use of information technology in industries
- To act as a resource centre for IT development
- To act as a reference centre for IT
- To function as a communication hub
- To attract industries to locate at the KHTP
- To become the focal point of an IT or Software Park

(2)Activities

The IT Centre is an organization (public research organization) operated by USM, and its scope of business covers information technology (IT). Its main business content is shown below.

- Training Courses
- Seminars and Workshops
- Consultancy
- Provision of Computing Facilities
- Reference Centre
- Communication Centre

(3) Facilities

The facilities consist of the IT Centre building and software park.

(4) Organizational Structure

The staff for training, consultation, and research are basically provided from USM on a part-time basis. However, it is necessary to fill these positions with full-time staff.

(5) Cooperation with Other Centres

The IT Centre is to conduct training projects in the field of IT with various laboratories. There is a need to have intimate cooperative ties with the Human Resource Development Center and various business areas (notably in CAD/CAM area) to effectively use personal computers and work stations which will be installed for the training courses.

6. Human Resource Development Centre

(1) Objective

The objective is to nurture industrialist, engineers, and technicians in the northern region of Malaysia who will be directly involved in production and R & D activities and work within the plants as well as to foster personnel who are capable of responding to the global movement on standardization.

(2) Activities

Basic Policy

The training and education for nurturing personnel requires a high degree of know-how. At the same time, an important point in making this succeed is whether there is a human network is a wide range or not.

This centre educates personnel by directly hooking up with work sites. The results from the education do not only involve personnel, but also information that are disseminated through the Industrial Network Centre and IT Centre. This in turn contributes to the totality of Malaysia' science and technology education and for industrialization as a whole.

Activities

The training contents are selected on the following perspective:

-Training on quality control and production process management

-Training on standardization of product and production

-Training on automation and efficiency

Training System

Training system will be adopt middle-term programmes, 2-4 week.

Therefore, the training centre shall have lodging facilities.

(3) Facilities Plan

While it is desirable to have an AV Room and a simultaneous interpreting system as basic facilities and equipment.

As for the specific equipment and facilities, these will be decided after consulting with the business partner.

(4) Organization Structure

Since the actual operations are entrusted to external organizations, the number of employees at the centre is held to a minimum.

The task of planning adjustment involves promoting training projects while establishing cooperative links with external organizations for task consignments, and to conduct publicity activities on the importance of these training projects, and to utilize administrative support measures for the training projects. (usage of HRDF).

Manpower Plan

	1st Phase	2nd Phase	3rd Phase
General manager of centre	(1)	(1)	(1)
Management of facilities and equipment	(1)	(1)	(1)
Planning	1	2	2
Business management	1	1	1
Total	2-4	3-5	3-5

7. Sales and Promotion Company

(1) Objective

Instead of assigning individual marketing staff at each centre to take orders, it will be more effective to offer higher quality services to the users, and expand business by establishing an organization and sections that perform the comprehensive order taking duties for the three centres.

Thus, an unified organization, or "sector" separate from the three centres should primarily perform marketing and such organization will cultivate demand for the services in common for all of the three centres.

(2) Activities

The major contents of operations are as follows:

- To promote demand for testing, inspection, and analysis for the three centres
- To corporate of he three centres
- To offer services as intermediary or for introducing persons and organizations to solve problems within companies
- To study and research on future inspection and analytical functions for the three centres

Scope of Business

The business territory basically will involve companies located within KHTP to which priority will be given to meet their demands first. However, it will be difficult to run a profitable operation on these companies alone. Therefore, the territory shall cover the regions of KL and Johor where there are heavy concentrations of industries, centering around the northern states of Kedah, Penang and Perak.

(3) Organizational Structure

Organization

The most important operation for this organization is to develop demand for the services offered by the three centres. In order to promote these businesses, it is necessary to assign personnel who are knowledgeable about the three centres, those who are familiar

with the respective fields and those who have specialized knowledge.

Notably, for managerial personnel, it is necessary to use persons who have specialized knowledge and detailed knowledge of the industries. The staff working under the managers must have specialized knowledge and business senses.

Manpower Plan

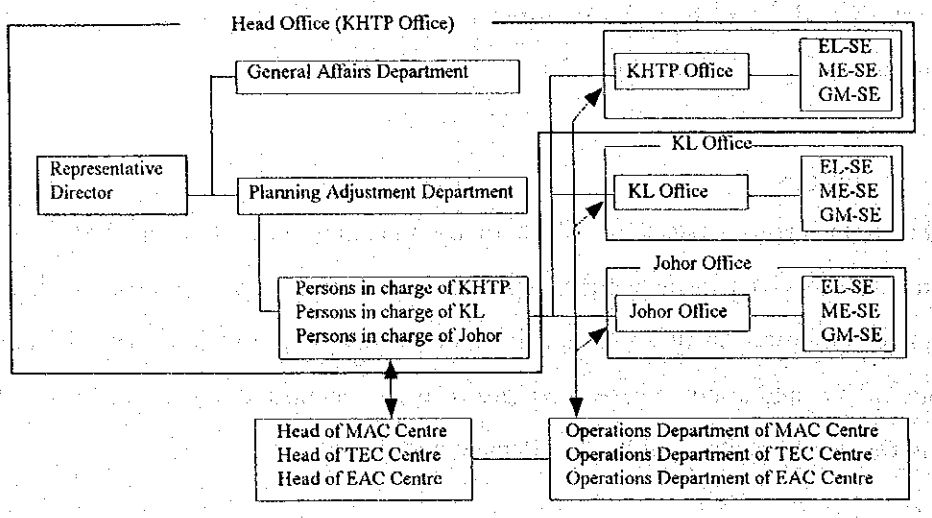
1) Manpower plan is based on the following policy.

- Assigning sales persons by each industrial category
- Assigning liaison personnel to link the centres with industries and government
- Assigning personnel on regional basis
- Assigning liaison personnel to overseas markets.

Among these, the most important would be the business efforts on industry basis because the most important thing is to develop individual market channels.

2) Organization

Organizational Structure Roles of Each Department



	First Phase	Second Phase	Third Phase	Role and Business Content
Representative Director	1	1	1	Channel to business and government circles Sales activity by top management
Planning Adjustment Department	1	1	1	Formulate order taking activity plan, marketing strategy etc Mutual adjustment of three dispersed offices
Persons in charge of KHTP				
Persons in carge of KL		1	1	
Persons in charge of Johor				
Persons in charge of Overseas markets	1	1	2	Develop overseas markets
General Affairs Department	2	2	3	Accounting etc.for all
Head of KHTP Office	1	1	1	Operational base for kedah,Penang,and Perak states
EL-SE	3	9+1	10+1	
ME-SE	3	(One manager still undecided)	(One manager still undecided)	Operational base for overseas territories including Thailand,Singapore and Indonesia
GM-SE	3			
Head of KL Office	1	(1)	(1)	Marketing base for the territory of KL, Selangor and Malacca states
EL-SE		1	3+1	
ME-SE		1	(One manager still undecided)	
GM-SE		1		
Head of Johor Office			1	Marketing base for the territory of Johor state and Singapore
EL-SE				
ME-SE				
GM-SE				
Total	15	19	24	

* The post is taken by the one selected from among the Sales Engineers of these fields
EL-SE (Electronics fields Sales Engineers)
ME-SE (Micro-Electronics field Sales Engineers)
GM-SE (General Manufacturing field Sales Engineers)

IV. 7 Selection of Facilities and Equipment

Based on the management strategies of the Techno Centre, the facilities and equipment to be introduced will be sophisticated system from the initial phase. The outline plan of each centre describes the list of the equipment to be procured.

For the technical Appeal and financial stability of the Techno Centre, the selection of the equipment;

-Should be based on the sound needs of the users in the KHTP and the surrounding areas,

-Should be advanced and unique to make the Centre as an excellent research laboratory,

-Should promote the R & D capabilities and shift to high-tech industries.

Table IV.7.1 List of Equipment

Unit(RM '000')

	1st phase	2nd phase	3rd phase	Total
A. MECHATRONICS TESTING CENTRE				
(1) EMC Engineering				
- Anechonic Chamber	8,600			8,600
- Instruments	4,300			4,300
sub Total	12,900			12,900
(2) Electronics Testing				
- High Temp & humidity burn-inn test system		860		860
- Electronic voltmeter	5 × 5 = 25			25
- Digital multimeter	10 × 5 = 50			50
- Oscilloscope	11 × 5 = 55			55
sub Total	130	860		990
B. MATERIAL & SURFACE ANALYSIS CENTRE				
(1) Material Analysis				
- Dynamic micro hardness tester	110			110
- Brinnel hardness tester	30			30
- Surface roughness tester	120			120
- Three dimensional profiler	1,370			1,370
- Torque testing machine	80			80
- Impact testing machine	50			50
- True circle tester	160			160
- Universal material testing machine	550			550
- Scanning ultrasonic microscope(SUM/SAM)	860			860
- Differential scanning calorimeter	100			100
- Differential thermal analyser	75			75
sub Total	3,505			3,505
(2) Material Surface Analysis				
- Electron probe X-ray microanalyser (EPMA/EDS)	3,480			3,480
- Transmission electron microscope (TEM)	2,140			2,140
- X-ray photoelectron spectrometer (ESCA)		2,570		2,570
- Secondary ion mass spectrometer (SIMS)	3,430			3,430
- Scanning auger electron spectrometer (AES)		3,140		3,140
- Scanning probe microscope (SPM)		720		720
- Scanning Tunneling microscope (STM)		2,000		2,000
- Focused ion beam system	2,000			2,000
- FE-Scanning electron microscope (FE-SEM)			1,500	1,500
- Raman spectrophotometer		1,060		1,060
- Microscopic picture storage unit	220			220
- Fourier transform infrared spectrophotometer	110			110
- X-ray fluorescence spectrometer	1,290			1,290
- X-ray diffractometer	400			400
- Optical microscope	85			85
- Specimen making equipment	1,140			1,140
sub Total	14,295			25,285
C. ENVIRONMENTAL ANALYSIS CENTRE				
- Atomic absorption spectrophotometer	190			190
- -do-(Flameless)	250 × 2 = 500			500
- Ion chromato analyser	100 × 2 = 200			200
- Gas chromatograph	70			70
- Gas chromatograph mass spectrometer	320			320
- High performance liquid chromatograph	170			170
- Inductively coupled plasma mass spectrometer	1,030			1,030
- Inductively coupled plasma spectrometer		460		460
- Ultrasonic nebulyser		140		140
- O.D meter	7 × 3 = 21			21
- pH meter	10 × 3 = 30			30
- Spectrophotometer	20			20
- Constant Temperature humidity chamber	92			92
- Thermogravimeter	72			72
- Water purifier	30			30
- Total organic carbon analyser	125 × 2 = 250			250
- Total nitrogen analyser	285			285
- Silica analyser	170			170
- Fume and waste fluid Treatment equipment	2,860			2,860
sub Total	6,310	600		6,910

Unit(RM '000')

	1st phase	2nd phase	3rd phase	Total
D. PROTOTYPE PRODUCTION				
- CNC precision lathe			570	570
- Lathe			200	200
- Drilling machine			70	70
- Universal tool grinder			80	80
- CNC vertical milling machine			630	630
- Precision surface planar			630	630
- Bench grinder			12	12
- Bench drilling machine			10	10
- Jig plate			60	60
- Metal band saw			200	200
- Plate bending machine (Brake press)			140	140
- shearing machine			140	140
- Electric welding equipment			23	23
- Oxi-acetylene welding apparatus			5	5
sub Total			2,770	2,770
E. LABORATORY EQUIPMENT				
- Drying oven	12 × 5 = 60		12 × 5 = 60	120
- Centrifuge	20 × 5 = 100		20 × 5 = 100	200
- Autoclave	20 × 5 = 100		20 × 5 = 100	200
- Water distilling unit	15 × 5 = 75		15 × 5 = 75	150
- Refrigerator	26 × 5 = 130		26 × 5 = 130	260
- Draft chamber	52 × 5 = 260		52 × 5 = 260	520
- Center table	20 × 10 = 200		20 × 10 = 200	400
- Side table	10 × 90 = 900		10 × 90 = 900	1,800
- Side sink	10 × 20 = 200		10 × 20 = 200	400
- Cabinet	12 × 20 = 240		12 × 20 = 240	480
- Shelf	10 × 20 = 200		10 × 20 = 200	400
- Glass ware & utensils	75		75	150
sub Total	2,540		2,540	5,080
F. OTHERS				
- Work station	30 × 4 = 120			120
- Server	90			90
- Personal computer	6 × 60 = 360			360
sub Total	570			570
Total	40,250	10,950	6,810	58,010

V SPATIAL DESIGN OF TECHNO CENTRE

V.1 Basic Policy

The Techno Centre will be located in one of the lots along the trunk road running north-south. These lots can be collectively called the "Business and R & D Core" of KHTP. It will be the basic policy of this Study Report to have the Techno Centre play a central role in the Business and R & D Core. This can rightly be claimed given the wide range of R & D support services and the long range perspective vested with the Centre toward the industrial development of the region and the country as a whole.

V.2 Spatial Layout

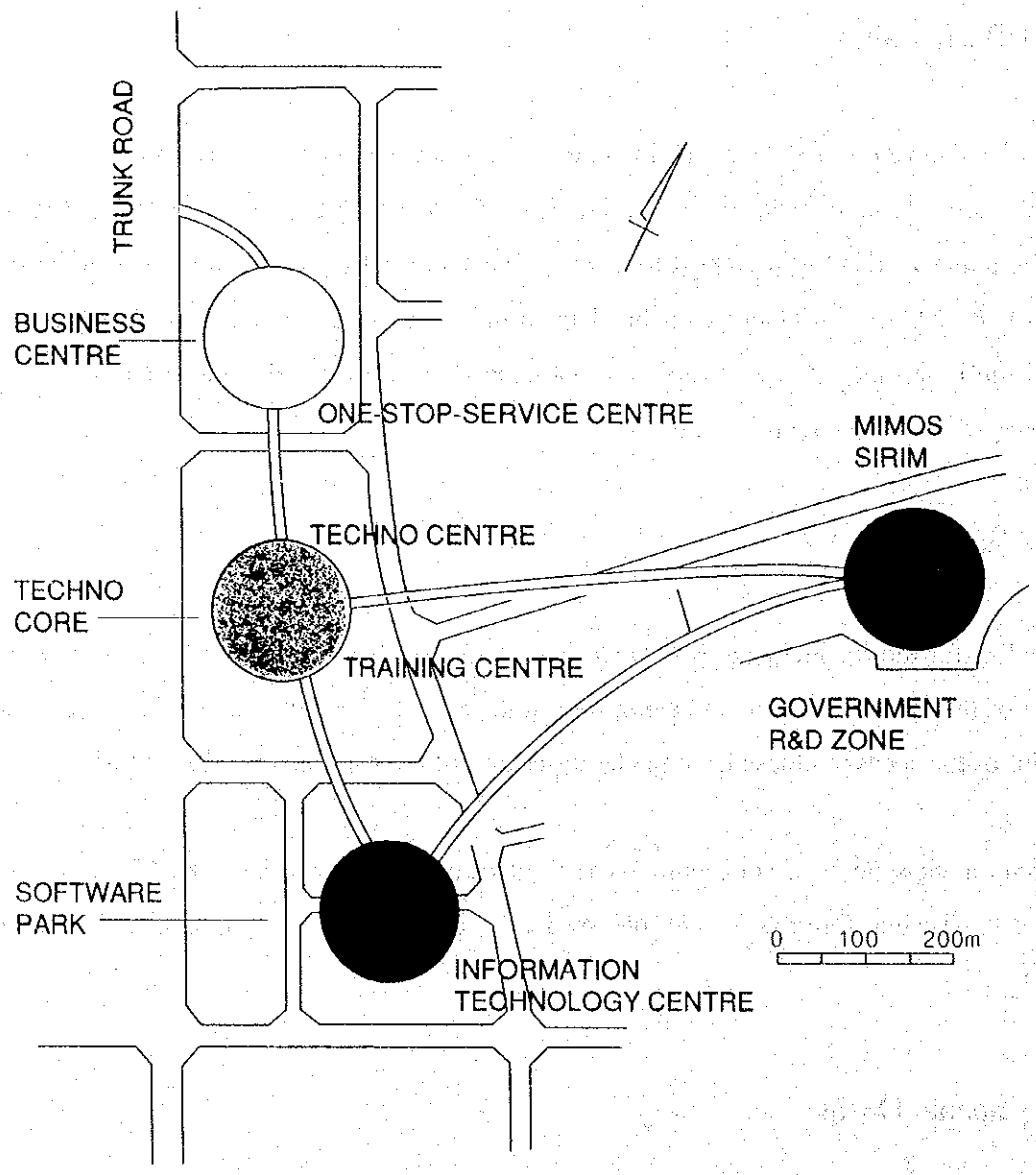
The lots for the Business and R & D Core are laid down encircling the factory lots on the west side of the industrial estate and along the trunk road. The layout is dually ideal from the view point of the access to these from the factories and of the approach for the visitors.

From the view point of connecting these Centres and Zone physically and functionally as well as of the Techno Centre's central role, evidently, the one illustrated in Figure V.2.1 seems the best.

V.3 Spatial Design

The whole lot where Techno Centre will locate could be collectively called the Techno Core and will be designed as a complex; in between the Techno Centre on the north and the training centres on the south, a plaza will be placed as a gathering spot for the entire Business and R & D community.

It is recommended to have the plaza play a very significant role in the Business and R & D community creating a very pleasant space with greenery landscaping and artificial structures



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) ECONOMIC PLANNING UNIT, THE GOVERNMENT OF MALAYSIA STUDY ON MANAGEMENT AND PLANNING OF R&D SUPPORTING FACILITIES (TECHNO CENTRE) FOR KULIM HI-TECH INDUSTRIAL PARK	Figure V.2.1 Spatial Relationship of Business and R&D Core Japan Industrial Location Centre Nippon Koei Co., Ltd.

and furniture. The plaza might as well be provided with access roads for vehicles connecting with such places as R & D Zone or Town Centre by a ramp or an overbridge as illustrated in Figure V.3.1

V.4 Architectural Design

1. Architectural Design

Architectural design of the Techno Centre will be carried out in the following sequence:

- Architectural design concept
- Scope of services rendered at the Centre
- Space requirement for each service
- Functional relationship of each space
- Movement lines of people and goods
- Safety and security

In view of the discussions on the necessity, objectives and function of the Techno Centre, the following concept will be laid down:

- Malaysia's aspiration toward industrial advancement
- Symbolic identity as the centre for high-tech drive
- Modern technology
- Subtlety of the minds of people of Malaysia

Several key words will be employed as media to represent the above notion as given below:

- Colonnade reminiscent of Mosque
- Courtyard and plaza, where minds of people meet
- Atrium, also the same as above
- Metal and glass representing modern technology
- Water or pond, representing serenity and purity

Functional relationship among the various rooms and spaces corresponding services in Techno Centre will be analysed to achieve horizontally and vertically efficient arrangement. The result is illustrated in Figure V.4.1

Thought will be given to the following aspects in shaping the overall feature of the building.

- Symbolic identity
- Close relation with the Plaza
- Inviting feature of approachway for visitors

Train of thought would in the end lead to the **M-letter shaped winged building** as shown on the right bottom.

The winged shape of the building would enable the assignment of functions wing by wing. A clear separation of functions eliminates the conflict of movement lines of people and goods. Central wings will stand higher than the others to secure a feeling of stability and to draw the eyes of people toward the centre.

An atrium will be placed in the centre of the building and upper space of it will be voided up to the roof which will be entirely covered with glass on steel structure. The glazed roof will be sloped up toward the junction of the wings constituting a triangle roof. The pergola frames are encroaching into the atrium on the Plaza side for an easy access for the outside community on this side.

If necessary, the building could be expanded wing by wing. To put a floor on top of the other is practically a little hazardous if not too difficult. Steel structures instead of reinforced concrete can be used for this purpose using dry-construction method minimizing the chance of disrupting the ongoing operation. Horizontal expansion on the other hand is rather easy on the ground floor at the east and west wings in north-south direction.

Upon examination of the sizes of laboratory for various purposes, a column line grid of 6.5 m (bay) and 8 m (span) accompanied with 4 m intermediate central span is found to be very

flexible and versatile in use. This grid will snugly accommodate various types of laboratories and incubation rooms. This grid will be used as the unit module throughout the building.

Because of the flexibility of the unit module as introduced in the above paragraph, conversion of a room from one purpose to another can be done, where with the provision for the utility shaft for piping, cabling and air ducting, an incubation room can be converted to a laboratory quite easily, and vice versa.

Exterior finishes of the building will be either of aluminum curtain wall which, though a little expensive, would imply the shifting from concrete age to metal age in the construction industry giving a high-tech sort of feeling, or ceramic wall tile which will give the building a sedate and neat impression if properly done, something desirable for a research laboratory.

If the Centre is to play a more important role than just a local centre, it would have to be a relatively large building. Increasing the capability of testing and measurement will be easy once the finance has been secured whereas the expansion of the building is time consuming, hence it is a wise investment to have a little extra allowance of space to the building.

2. Anechoic Chamber

An anechoic chamber will be constructed independently to the man building for its special features. The chamber has to be large in plan as well as in height with heavy insulation on walls and ceiling without a window. Testing objects may vary from small electronic gadget to large driving engine, the fact that requires easy access from outside. A test will last for hours or days, so even a bed room will be needed for the testing personnel.

3. Building Services Systems

Domestic water will be tapped from the water main running along the sub-road, of which demand is estimated at about 40 t/day (200 l/day/person x 200 persons).

House waste water will be discharged into the waste water pipes running nearby. One the other hand, waste water from the laboratory sink and gas scrubbers for draft chambers will have to be handled separately from the house waste water on account of toxic substance contained therein.
Solid toxic waste coming out of the laboratories will be collected in special containers and taken to the toxic waste depot of KHTP.

Total power demand at the Centre is estimated at about 2,300 kVA (15,000 m^2 x 150 VA/m^2). Power will be received at power receiving room where voltage will be stepped down from 11kv to 415/240 V, in three phase, four-wires supply system. Emergency power generator will not be considered.

For the microanalyses and environmental analyses at the laboratories pure gas such as N_2, H_2, Ar will be used. These gas will be supplied individually to each requirement by gas cylinders as a central supply station can not be justified due to the small demand as a whole.

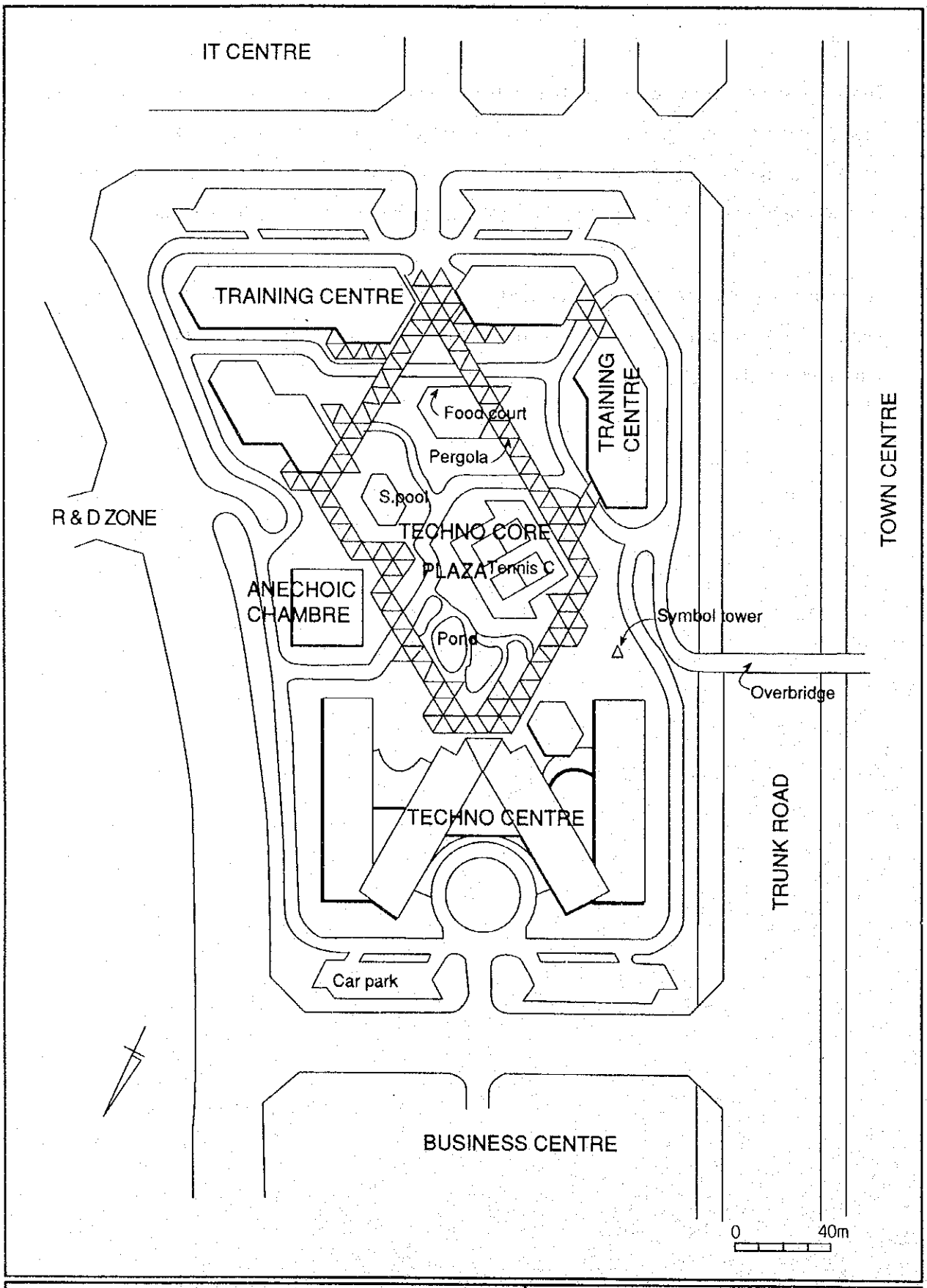
Air conditioning system will be consisted of inverter controlled self-contained room air conditioners and self-contained packaged air conditioners with air duct system both accompanying air cooled condensing units. The former will mainly be used for offices, laboratories and the like while the latter for public or common spaces such as corridors, halls, etc.

Fume exhaust systems will be provided individually to such laboratory equipment and analyzers as draft chambers, atomic absorption spectrometers, gas chromatographs etc. Air exhaust duct for the fume will be connected to scrubbers to remove toxic substance as required and the scrubbing water will be conducted to the laboratory waste water disposal plant as previously discussed.

The fire protection system will be provided in compliance with the applicable fire code of the region. Particular attention will be paid to that for the anechoic chamber for its special feature; non-window, heavily insulated building.

Entry to some analysing laboratories, research laboratories, incubation rooms etc. by an unauthorized person will have to be restricted. Security control in this regard will basically be carried out by security guards posted at the critical spots. If deemed appropriate ID card system will be introduced providing electrical locking system to the required doors.

If deemed appropriate all the building services systems will be monitored and controlled centrally by electronic computers. A control room will be set up with control console and all indicating panels.



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) ECONOMIC PLANNING UNIT, THE GOVERNMENT OF MALAYSIA STUDY ON MANAGEMENT AND PLANNING OF R&D SUPPORTING FACILITIES (TECHNO CENTRE) FOR KULIM HI-TECH INDUSTRIAL PARK	Figure V.3.1 **Techno Core Layout Plan** Japan Industrial Location Centre Nippon Koei Co., Ltd.

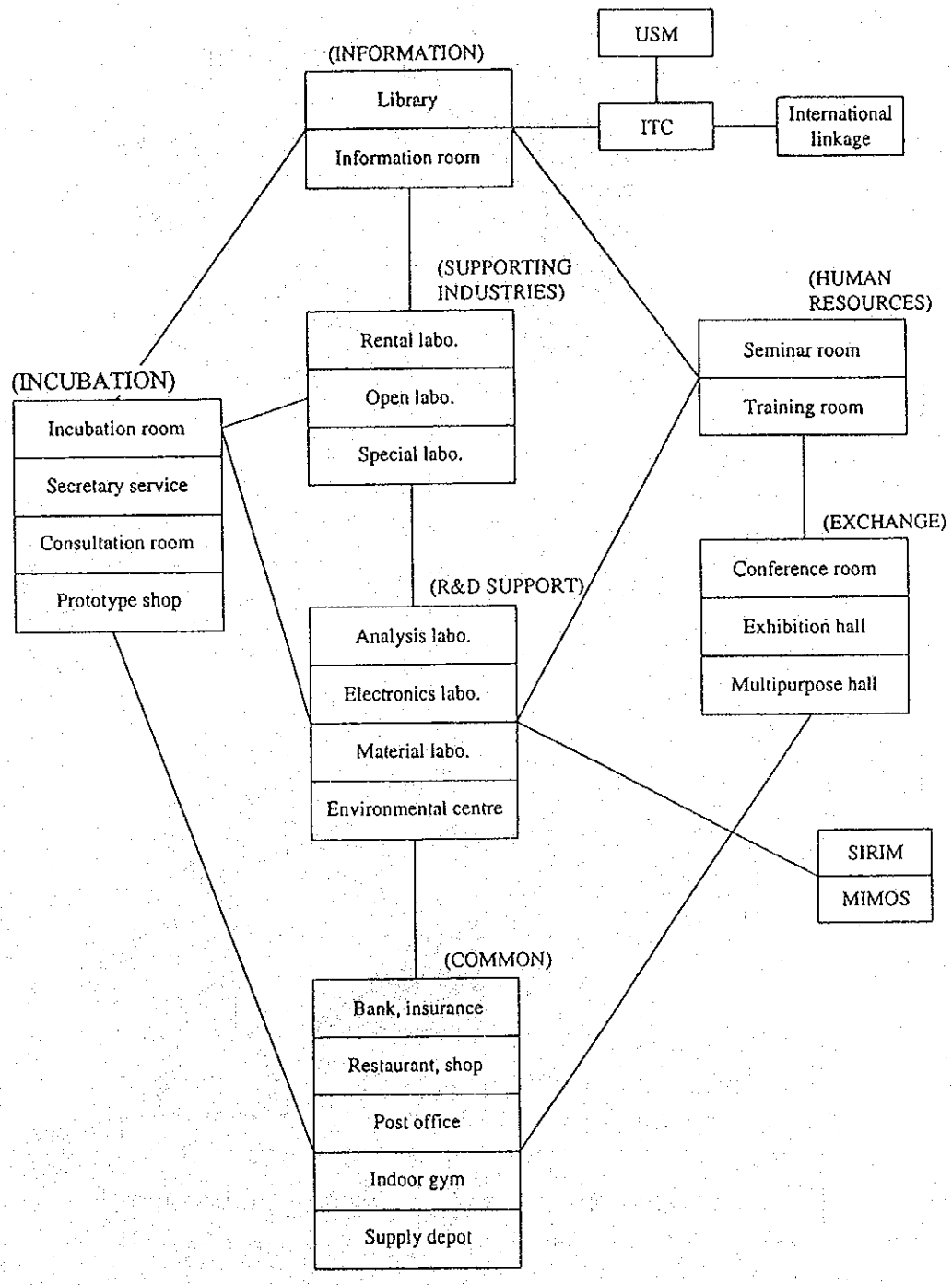
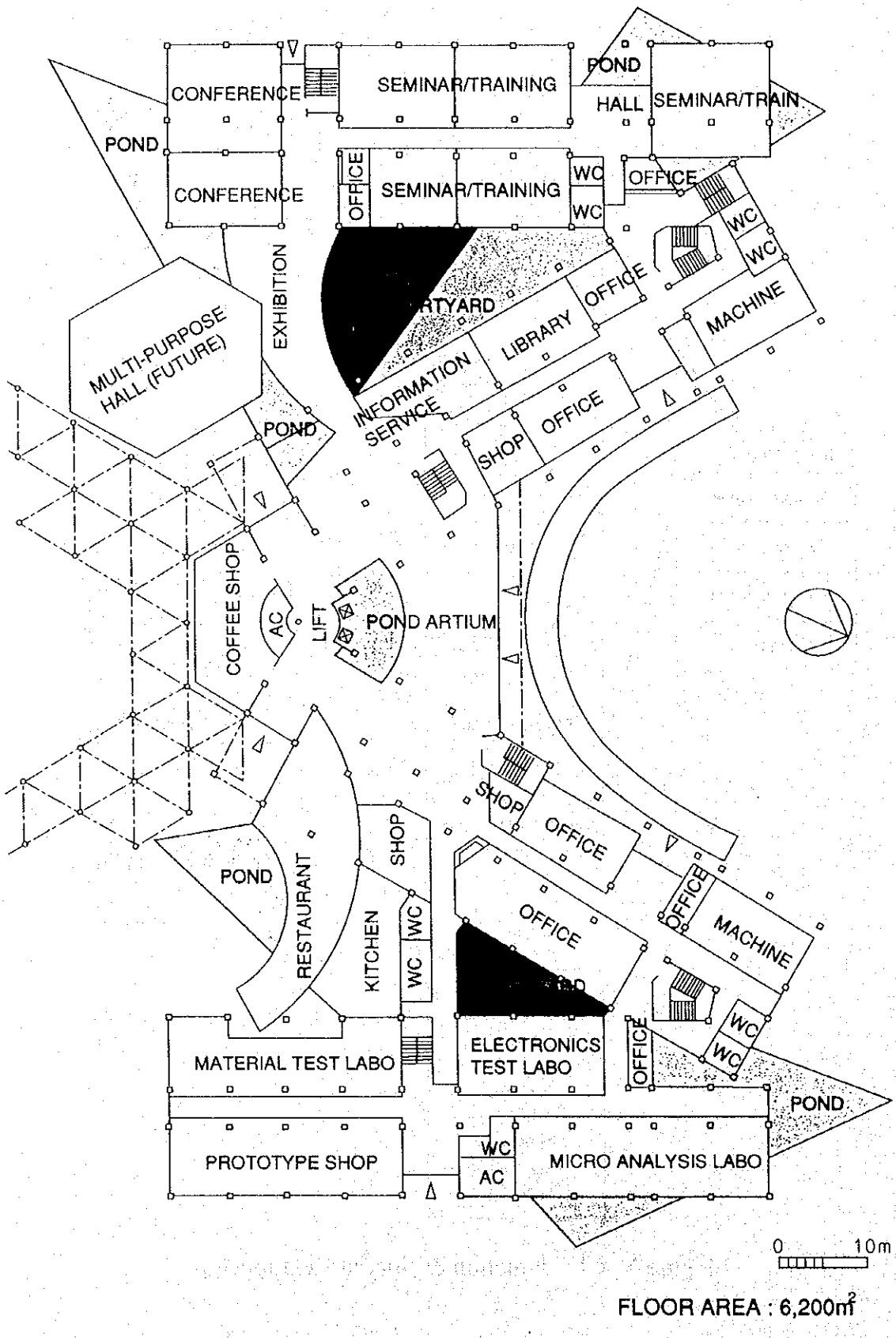
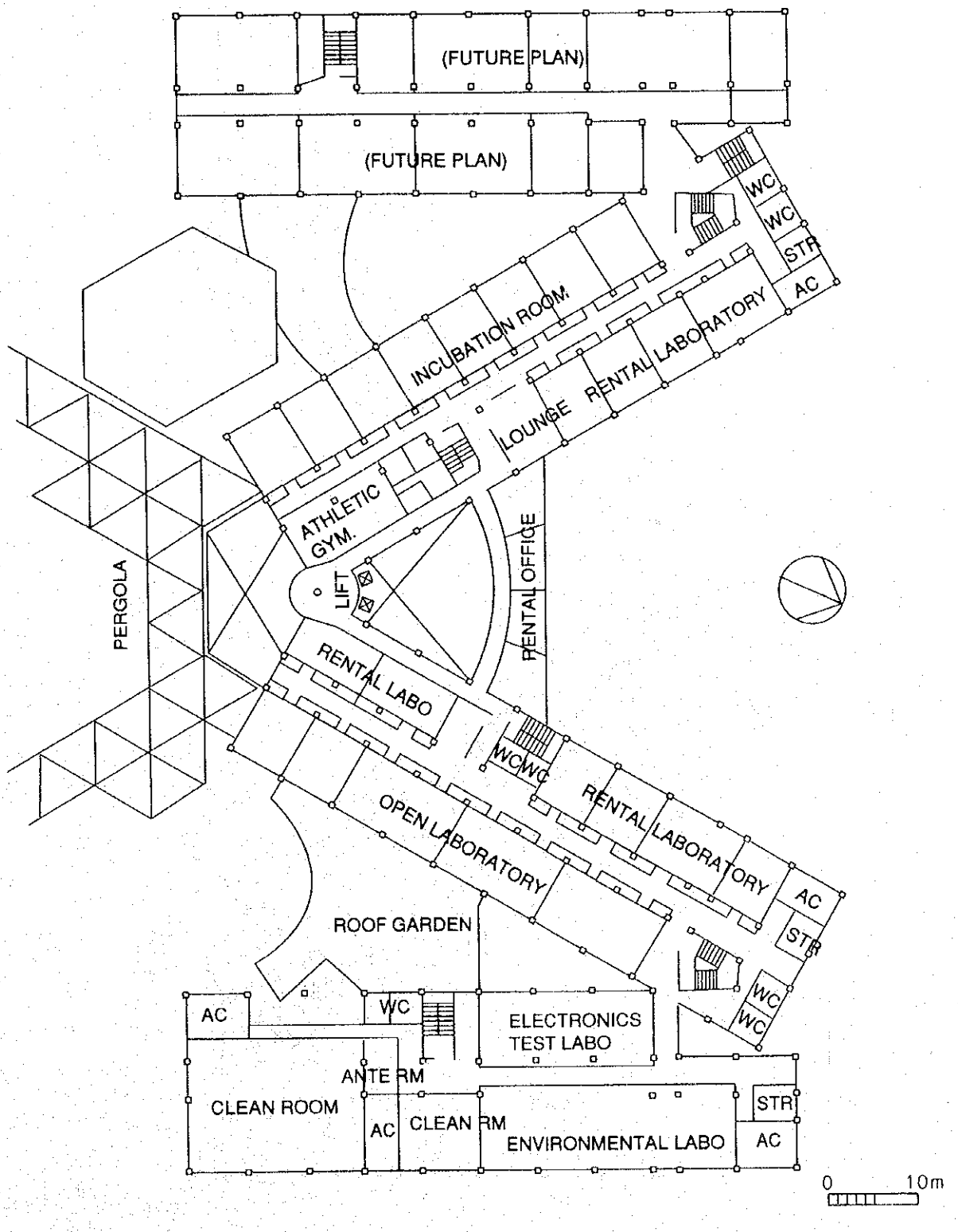


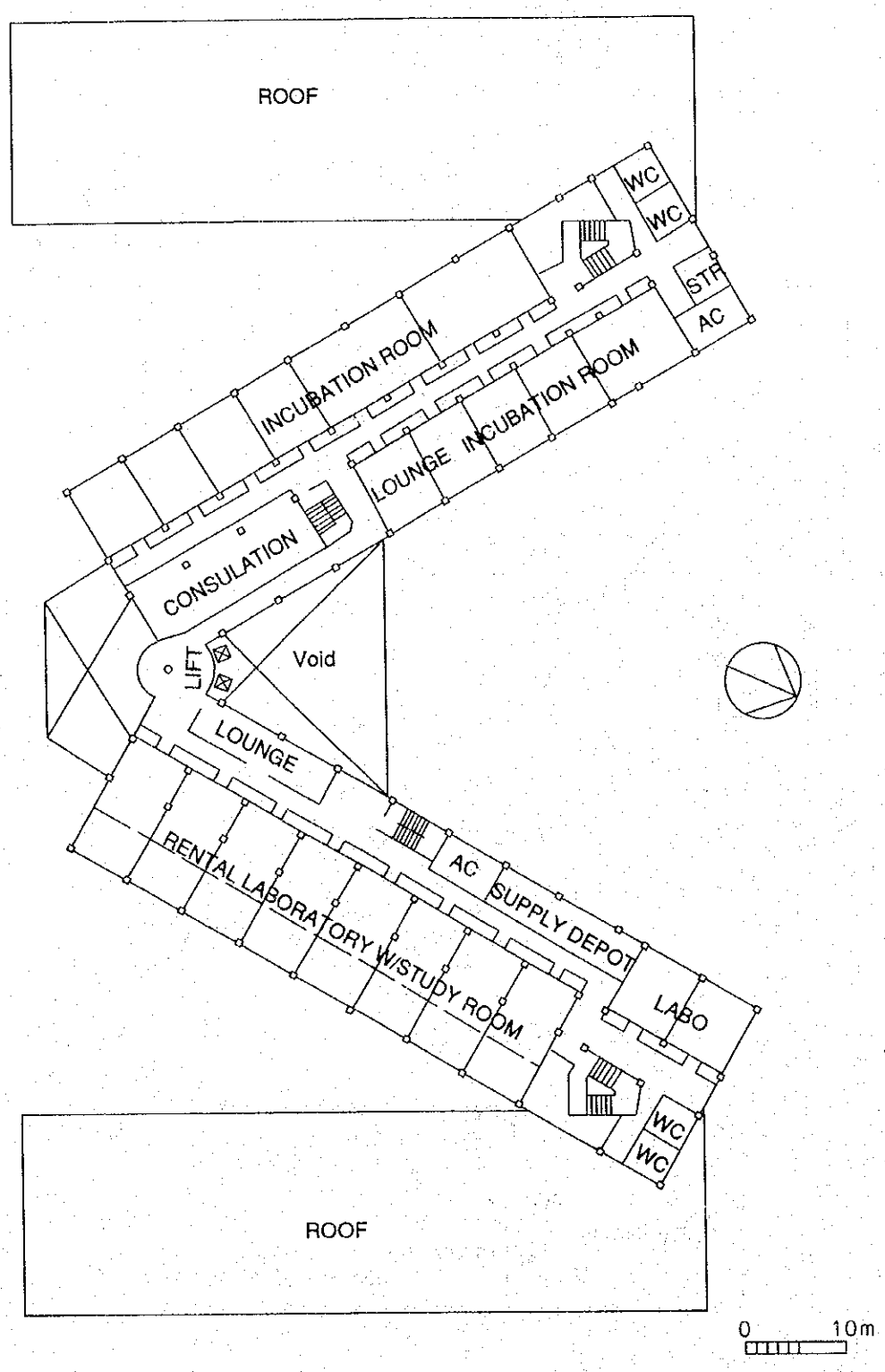
Figure V.4.1 Function & Spatial Relationship



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) ECONOMIC PLANNING UNIT, THE GOVERNMENT OF MALAYSIA STUDY ON MANAGEMENT AND PLANNING OF R&D SUPPORTING FACILITIES (TECHNO CENTRE) FOR KULIM HI-TECH INDUSTRIAL PARK	Figure V.4.2 Techno Centre Ground Floor Plan Japan Industrial Location Centre Nippon Koei Co., Ltd.

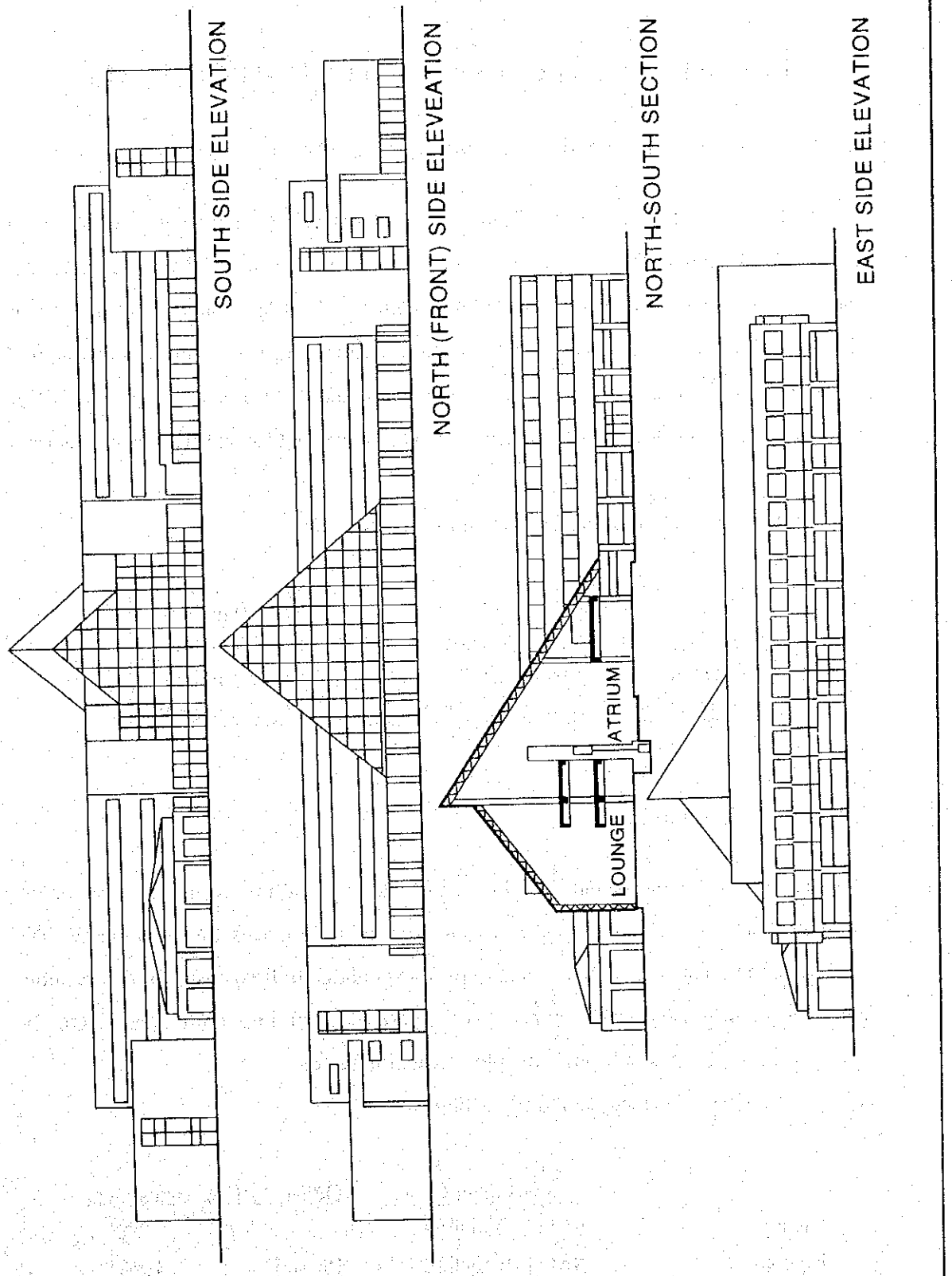


JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) ECONOMIC PLANNING UNIT, THE GOVERNMENT OF MALAYSIA STUDY ON MANAGEMENT AND PLANNING OF R&D SUPPORTING FACILITIES (TECHNO CENTRE) FOR KULIM HI-TECH INDUSTRIAL PARK	Figure V.4.3 Techno Centre 1st Floor Plan Japan Industrial Location Centre Nippon Koei Co., Ltd.



FLOOR AREA : 2,730 m²

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) ECONOMIC PLANNING UNIT, THE GOVERNMENT OF MALAYSIA STUDY ON MANAGEMENT AND PLANNING OF R&D SUPPORTING FACILITIES (TECHNO CENTRE) FOR KULIM HI-TECH INDUSTRIAL PARK	Figure V.4.4 **Techno Centre 2nd Floor Plan** Japan Industrial Location Centre Nippon Koei Co., Ltd.



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) ECONOMIC PLANNING UNIT, THE GOVERNMENT OF MALAYSIA STUDY ON MANAGEMENT AND PLANNING OF R&D SUPPORTING FACILITIES (TECHNO CENTRE) FOR KULIM HI-TECH INDUSTRIAL PARK	Figure V.4.5 Techno Centre Elevations & Section Japan Industrial Location Centre Nippon Koei Co., Ltd.

VI FINANCIAL ANALYSIS OF TECHNO CENTRE

VI.1 Prediction of Demand for Techno Centre Services

We first consider market scale of Northern 3 states (Kedah, Penang, Perak) as a prediction of demand for services at Techno Centre. In case of EMC test and measure, the enterprises send products to their home country such as Japan now. This shows that the demand for Anechoic chamber will prevail throughout Malaysia, furthermore all area of South East Asia, if only a condition is given. In short the prediction of demand for services in this report should be realized to be a basic demand for starting business in each centre.

The results of prediction of demand are shown as follows.

1. Mechatronics Testing Centre	RM 12.0 million
2. Material & Surface Analysis Centre	RM 13.7 million
3. Environmental Analysis Centre	RM 2.5 million
4. Human Resource Development Centre	RM 2.2 million

VI. 2 Cost Estimation

The capital cost for the facilities, inclusive of building, road pavement, etc. and for the equipment in the respective centre is estimated at 1995 prices for each phase. The operation and maintenance cost (O&M cost), excluding staff expense, for the facilities and the equipment is basically estimated at the percentage of the acquired cost. Here, the acquired cost is estimated capital cost plus escalation factor.

The percentage is principally assumed as follows.

	Investment Cost	O&M Cost per Investment	
Facility	RM28.73 million		2%
Equipment	RM58.01 million	Phase I	10%
		Phase II	7%
		Phase III	7%
Total	RM86.74 million		

Table VI.2.1 Construction Cost Summary

(1,000RM at1995 Prices)

	1st Phase (1996-2000)	2nd Phase (2001-2005)	3rd Phase (2006-2010)	Total
Facility				
1. Building	23,160	2,000	570	25,730
2. Road Pavement	500	300	1,000	1,800
3. Landscaping, etc.	300	300	300	900
4.Utilities	300			300
Sub-total	24,260	2,600	1,870	28,730
Equipment				
1. Mechatronics Testing Centre	13,030	860	1,500	15,390
2. Material & Surface Analysis Centre	17,800	9,490	0	27,290
3. Environmental Analysis Centre	6,310	600	0	6,910
4. Information Technology Centre				0
5. Industrial Network Centre	2,540		5,310	7,850
6. Human Resources Development Centre	570			570
Sub-total	40,250	10,950	6,810	58,010
Grand Total	**64,510**	**13,550**	**8,680**	**86,740**

* The Cost for Design & Construction supervision for the facilities is assumed as follows;

1. Building	8%
2. Road Pavement	5%
3. Landscaping,etc.	5%
4. Utilities	5%