APPENDIX-I

ELECTRIC/ELECTRONIC INDUSTRY

I. ELECTRIC/ELECTRONIC INDUSTRY

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I. ELECTRIC/ELECTRONIC INDUSTRY

1. OVERVIEW OF ELECTRIC/ELECTRONIC INDUSTRY

1.1 Structures

Statistics (Annual Survey of Industries 1996 Interim Report) summarize the activities of the manufacture of electrical machinery, apparatus, appliances and supplies (ISIC 383) as tabulated below. There were 42 enterprises with 25 employees or more.

Basic Indicators of Electric/Electronic Industry (1995)

No. of Establishment (1)	Employment (2)	Output (Rs mill.) (3)	GVA (Rs. mill) (4)	GVA ratio (4)/(3)	GVA per Worker (Rs.) (4)/(2)
42	6,793	3,777	1,803	48%	265,490

In the course of this Study, a questionnaire survey was conducted to 50 electric/electronic enterprises, which include the 42 companies referred above and other small enterprises. Major findings on the structures of the industry are summarized in the following tables.

Character of Organization

Large Enterprise: Multi-national	1
Large Enterprise: Other than above	9
Medium Enterprise: Multi-national	5
Medium Enterprise: Other than above	22
Small Enterprise	12
Self-employed/Cottage enterprise	1

As shown above, most enterprises (80%) are small and medium industries (SMIs).

Private Limited Liability Companies occupy a major share of 72%. The years of establishment are fragmented, but most of the enterprises have been established since 1980.

Type of Organization

Public Company quoted	2
Public Company unquoted	1
State-owned Company	1
Private Limited Liability Company	36
Others	10

Year of Establishment

Before 1980	8
During 1980s	19
During 1990-1994	13
During 1995-1999	10

In terms of capital scale, most of them are small enterprises. Majorities (80%) are of 100% Sri Lanka capital, while foreign capital participation accounts for 20%.

Paid up Capital and its Character

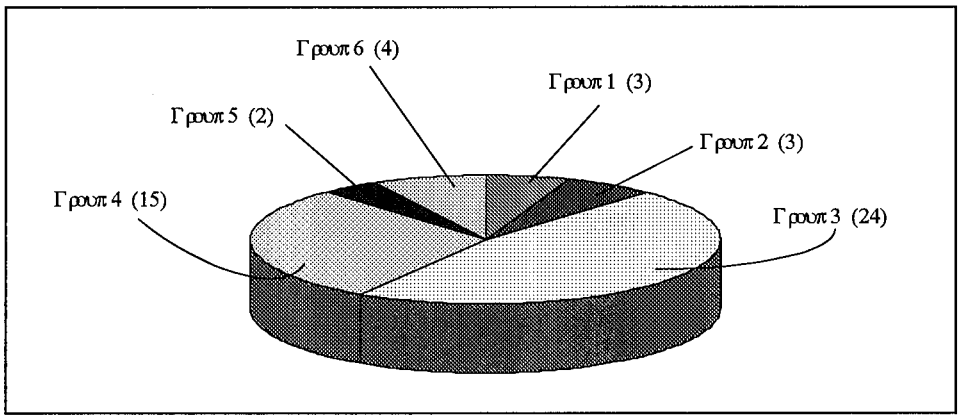
Rs. million	No
-0.9	13
1 - 9.9	17
10 - 49	11
50 - 99	4
100 -	4

Character	No
100% Sri Lanka	41
100% Foreign Capital	6
Joint Venture with Foreign Country (More than 50% are foreign)	0
Joint Venture with Foreign Country (More than 50% are Sri Lanka)	4

The electric/electronic enterprises in Sri Lanka are classified into six groups judging from product and production types, as well as technology bases, i.e.,

Group 1 Home appliance (Electronic)
Group 2 Home appliance (Electric)
Group 3 Electrical appliance
Group 4 Electrical parts
Group 5 Industrial products (Electronic)
Group 6 Industrial products (Electric)

According to the questionnaire survey, the numbers of enterprises in each group are found as shown in the following.



Classification of Electric/Electronic Enterprises

1.2 Production and Inputs

1) Scale in Sales and Production

Based on several statistics, it is estimated that total sales of electric/electronic enterprises amounted to about Rs. 3,820 million, with GVA of about Rs. 1,800 in 1998. GVA in 1999 is estimated to be about Rs. 2,070 million.

Sales Range

Sales (Rs million)	
-0.9	4
1 - 9.9	11
10 - 49	14
50- 99	6
100 - 499	9
500 - 999	1
1000 -	3

Growth Rate of Production

Growth rate	
Negative	1
1 - 2 %	2
3 - 5 %	4
6 - 9 %	4
10 - 20 %	14
21 % or more	14

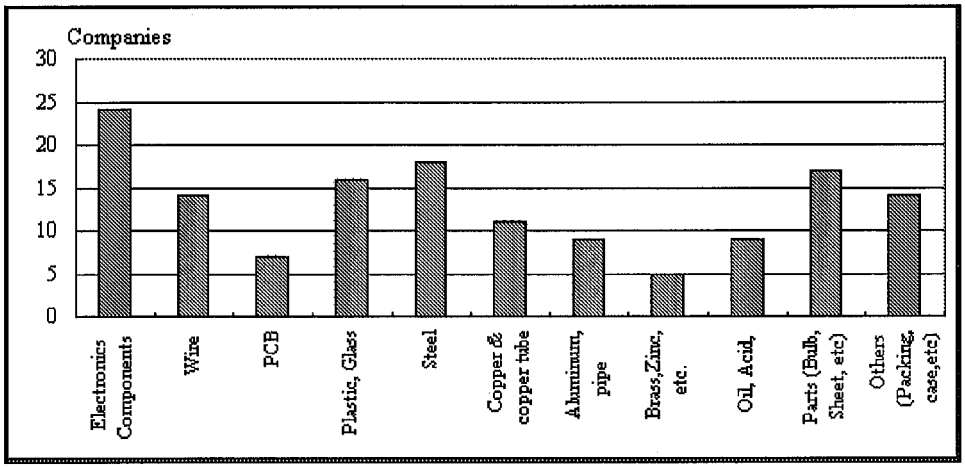
Results of the questionnaire survey indicate that the existing enterprises are small in scale of sales, but most enterprises are achieving a growth in production.

2) Raw Materials

The questionnaire survey revealed that current import ratio of raw materials is quite high. 38 enterprises out of total 48 surveyed rely more than 50% of their raw materials on imports; i.e., 22 enterprises rely 90-100 % of their raw material on imports, 10 enterprises for 70-89%, and 6 enterprises for 50-69%. The average import ratio of raw materials is 72%. Many enterprises manifest their interests in using parts and components produced

domestically in the future, reducing the import ratio.

Major import items of raw materials and parts are clarified as shown below. In general, quantity of the material import by each enterprise is small, which might have resulted in relatively high import prices.

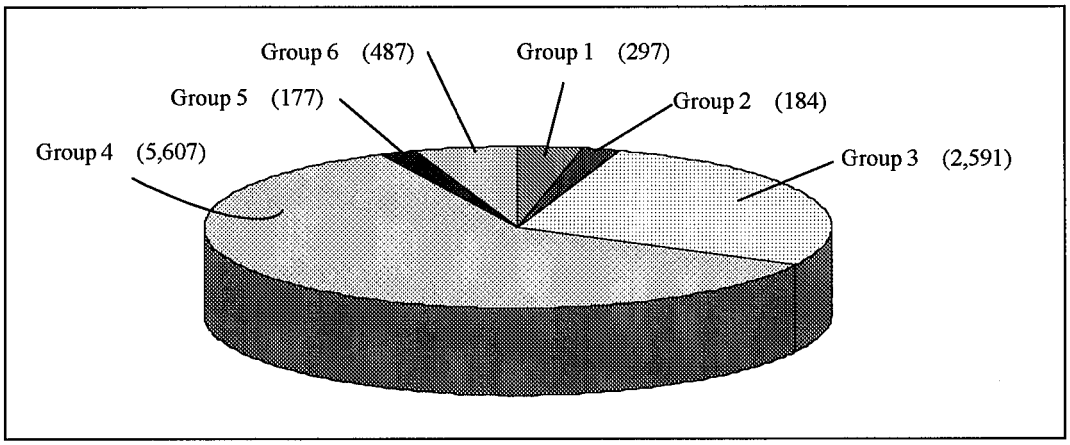


Major Import Items of Raw Materials and Parts

Origin of raw material imports varies widely. Major origin countries are Singapore (25 companies), Japan (20), EU (18), China/Hong Kong (16), India (16), Korea (15), and USA (6). It is noted that 16 enterprises listed Sri Lanka as a source of raw materials.
It is also noted that 25 enterprises are importing 100% directly from raw material suppliers, while 9 enterprises are mainly dependent on direct sourcing but through a middleman.

3) Employment

According to the questionnaire survey, the electric/electronic industry employs about 9,340 workers. Their distribution to each group of enterprise is illustrated below.

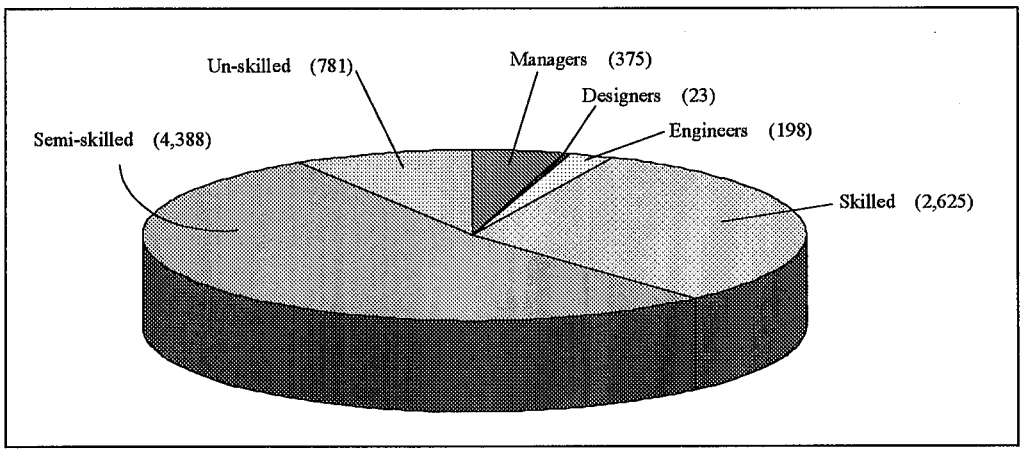


Distribution of workers by scale of enterprise varies widely, as shown in the table below.

Distribution of Employment in Electric/Electronic Industry

	No of Firm by Employment Size				Total No of Firms	Total Workers	Average Workers
	Below 25	25-49	50-99	Over 100			
Group 1		1	1	1	3	297	99
Group 2		2		1	3	184	61
Group 3	10	3	5	6	24	2,591	108
Group 4	3	2	3	7	15	5,607	374
Group 5			2		2	177	89
Group 6		2		2	4	487	122
Total	13	10	11	17	51	9,343	183
Sri Lankan Firms					41	3,887	95
Foreign Firms & JV					10	5,456	546

Workers in the electric/electronic industry are clarified by skills as shown below.



Skill Level of Workers

1.3 Products and Market

1) Products-Market Matrix

A products-market matrix indicates current situation of domestic demands and production, as well as future capabilities of exports to major destination. Utilizing this matrix analysis, one can find the current manufacturing and potential markets. This is a rather qualitative approach, but it is useful to step into the selection of targeted products. The table on the following page shows the analysis and results of this selection.

Products-Market Matrix

	Sri Lanka		India	SAARC	ASEAN	Europe	USA	Japan
	Demands	Production	Possibility of Exportation in the Future					
(1) Home Appliance/Electronic								
Color television	O	O	Δ	Δ	X	X	X	X
Personal computer	O	O	X	X	X	X	X	X
Video cassette Recorder	Δ	X	X	X	X	X	X	X
Radio-cassette tape recorder	O	O	Δ	Δ				
Video movie	X	X	X	X	X	X	X	X
Communication devices	NA	X	X	X	X	X	X	X
Telephone equipment	NA	X	X	X	X	X	X	X
(2) Home Appliance/Electric								
Air conditioner	X	X	X	X	X	X	X	X
Refrigerator	O	O	X	X	X	X	X	X
Washing machine	Δ	O	Δ	Δ	X	X	X	X
Cleaner	O	O	Δ	Δ	X	X	X	X
Electric fan	O	O	Δ	Δ	X	X	X	X
Rice-cooker	O	O	Δ	Δ	X	X	X	X
Electric pot	O	O	Δ	Δ	X	X	X	X
Fluorescent light equipment	O	O	Δ	Δ	X	X	X	X
Flashlight equipment	O	O	Δ	Δ	X	X	X	X
(3) Electrical appliance								
Electric bulb	NA	O	O	O	X	X	X	X
Fluorescent light	O	O	O	O	X	X	X	X
Switch	Δ	O	O	O	X	X	X	X
Socket	Δ	O	O	O	X	X	X	X
Outlet	Δ	O	O	O	X	X	X	X
Breaker	Δ	O	O	O	X	X	X	X
TV Antenna	O	O	O	O	X	X	X	X
(4) Parts								
Semiconductor	NA	X	X	X	X	X	X	X
Resister	NA	X	X	X	X	X	X	X
Capacitor	NA	X	X	X	X	X	X	X
Coil	NA	O	O	O	O	O	O	O
Transformer	NA	O	O	O	O	O	O	O
Speaker	NA	O	X	X	X	X	X	X
Dry cell battery	Δ	O	X	X	X	X	X	X
Storage battery	Δ	X	X	X	X	X	X	X
Printed circuit board	O	O	O	O	O	O	O	O
Fuse	Δ	O	Δ	Δ	X	X	X	X
(5) Industrial Products/Electronic								
Telephone accessories	NA	O	Δ	Δ	X	X	X	X
Ringing and tone generator	NA	O	Δ	Δ	X	X	X	X
Electric wire, Cable, Cord	NA	O	Δ	Δ	Δ	Δ	Δ	Δ
(6) Industrial Products/Electric								
Generator	NA	O	Δ	Δ	X	X	X	X
Transformer	NA	O	Δ	Δ	X	X	X	X
Electric Power Panel	NA	O	Δ	Δ	X	X	X	X

O; Yes Δ ; Maybe X; No

O; Big or Increasing Δ ;so so X; Small or Devreasing

2) Exports/Imports

Trade statistics show that Sri Lanka records a huge trade deficit in electric/electronic products. The trade deficit reached Rs. 23 billion in 1998, and export value accounted for only 15% of import value. The major origin of import is EU which accounts for 40% of total imports. Among the SAARC countries, India is the largest import origin. The

export/import statistics in the SAARC region indicate that a degree of linkage in terms of trade in electric/electronic products is still low in SAARC. The amount of imports and exports of electric/electronic products in 1998 is tabulated below.

Imports/Exports of Electric/Electronic Products

(Rs million)

Origin/Destination	Import	Export	Balance	Ratio (Ex/Im)
UK	2,863	291	-2,572	10%
France	1,160	36	-1,124	3%
Germany	1,824	628	-1,196	34%
Sweden	1,463	171	-1,292	12%
Switzerland	1,080	470	-610	44%
other EU	2,297	222	-2,075	10%
India	1,154	57	-1,097	5%
other SAARC	36	36	0	100%
Japan	3,310	739	-2,571	22%
China/Hong Kong	2,184	120	-2,064	5%
S. Korea	2,747	153	-2,594	6%
Singapore	1,418	374	-1,044	26%
other SE Asia	1,757	339	-1,418	19%
USA, CANADA	2,673	281	-2,392	11%
Others	1,267	225	-1,042	18%
Total	27,233	4,142	-23,091	15%

Source: Trade Statistic of Sri Lanka 1998
* Figures are sum up of all electrical machinery and equipment (HS 85).

According to the questionnaire survey, there are 24 enterprises which have no export amount, while 9 companies export 90-100% of their production. It is presumed that such export-driven companies are those with foreign capital investment. There is a clear preference to future export business, as the number of companies having no interest in export are limited to only 9.

Destination of exports is also widely ranged from the SAARC countries except India (16 companies), EU (14), Japan (7), and ASEAN except Singapore (6). At the moment, export destinations tend to go "West". Some expect that they increase their exports mainly to USA and Korea.

India (17 companies) and China (14) are listed as the major competitors for the domestic industry. Other rivals are Korea, Japan, Singapore, ASEAN and EU. For the next ten years, India and China will continue to be the biggest rivals. This is somewhat easy to understand,

because they have huge market in their home country as well as cost competitiveness utilizing cheap labor cost.

It is added to note that 28 enterprises are making 100% direct marketing, while 11 are marketing via a middleman.

1.4 Technology and R&D

1) Technology Level and its Characteristics

The questionnaire survey (51 enterprises) and factory inspections (13 enterprises) suggest that each group of electric/electronic products are at different technological levels. General observations on the technological level are listed below.

General Evaluation of Technology Level

No	Group	Technological Level
1	Home appliance/Electronic	Complete Knock-Down (CKD) is a major activity. Progress of technology transfer is quite late.
2	Home appliance/Electric	
3	Electrical appliance	Technology transfer is gradually progressing. Some companies are capable of designing partly.
4	Electrical parts	Most enterprises rely on foreign technology. Fundamental technology is required.
5	Industrial products/Electronic	Many are established & runned by local engineers and have a certain high level technology.
6	Industrial products/Electric	Many are established & runned by local engineers, or technology transferred by JV and have high level.

The technology level of 13 inspected factories has been evaluated as summarized below. In general, factories are paying attention to quality control, but they are still weak in design and development.

Technology evaluation of Inspected Factories

Group No.	Nos. of Inspected Firms	Level of Technology (0 – 5)					
		Development	Electrical Design	Mechanical Design	Produc. Engn'g	Quality Control	Average Score
1	2	0	2.5	1.5	3.5	3.5	2.2
2	1	0	3	4	4	5	3.2
3	4	0.5	3.3	3.5	4	4.3	3.1
4	3	0	2.3	2.3	3.7	4.7	2.6
5	1	2	5	5	3	3	3.6
6	2	0	5	5	3.5	4.5	3.6
Total	13	0.3	3.3	3.3	3.7	4.2	3.0

2) Technology and its Transfer

The questionnaire survey revealed that half of the surveyed enterprises do not use any patent, with the implication that they do not produce technologically advanced products. On the other hand, 13 enterprises claim that they have their own patents, showing a certain level of their technology. Eight companies already have ISO 9000, three are in the process of application, and 26 are planning to apply, which indicate a high level of interests in quality assurance. There is no enterprise who has registered under ISO 14000, but 15 companies have plans to apply.

Most technology transfer is performed through patent companies (12 respondents) and consignors (8). On the other hand, there are 18 companies which have no experience in any technology transfer, indicating that they do not have any access to advanced technology. Major technology and process used for production are assembly (40 respondents), wiring (24), sub-assembly (22), machining (18), molding (16), and stamping (13). Computer uses (e.g., CAD, CAE, CAT, CASE. CIM) are reported by 33 enterprises. Major origins of technology transfer are Japan (8 respondents), EU (8), Singapore (5), Korea (4), China (3), and India (3).

3) Skilled Manpower Shortage

Many enterprises (30) claim that they have a shortage in "skilled-labor/technician" in "staff for R&D" (11), and "staff for quality control" (11). Some expectations are seen for the next ten years, as 22 enterprises are concerned about "skilled-labor/technician", 9 about "staff for R&D", and 6 about "staff for quality control".

Through the factory inspections, it has been noted that most enterprises have a limited number of electrical/mechanical design engineers and they are weak in product design. The shortage of manpower is much more serious in designers than skilled or semi-skilled workers.

4) Training

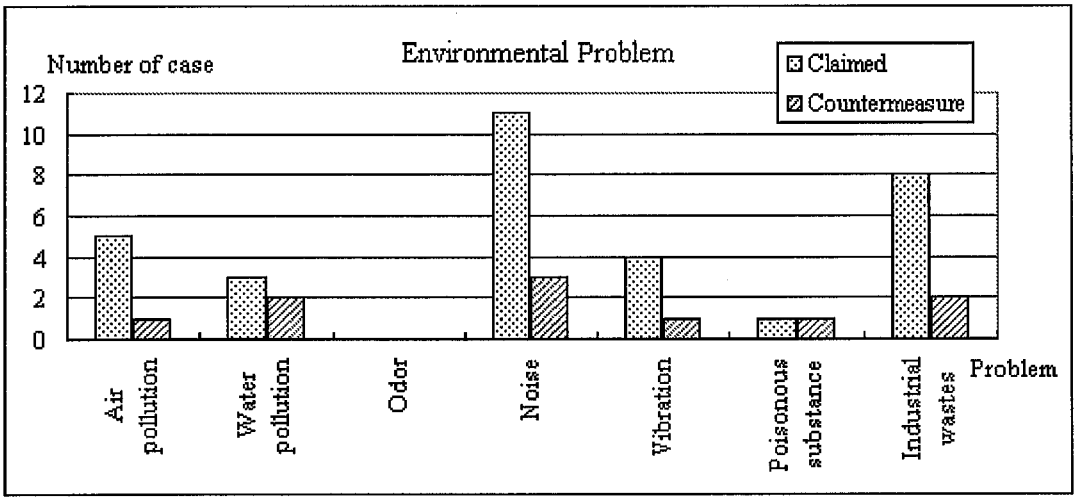
Most enterprises have on-the-job training programs, while there are 13 enterprises which are conducting on-the-job training abroad. It was reported that 12 companies were dependent on public training.

5) R&D

R&D activities are production- and development-oriented. The questionnaire survey indicates that enterprises are conducting "product development" (23 enterprises), "design development" (19), and "production technology" (14). They have the same orientation for the next ten years. The total number of R&D staff is, however, quite small; 4-"scientific researcher", 8-"applied researcher", 16-"Production technology experts", 18-"product development experts", and 18-"scientific researcher". R&D expense is also small; i.e., 9 companies with zero expense, 23 for less than Rs 500,000, and only 5 for more than Rs 500,000. It is also noted that 34 enterprises have no joint R&D activities with others, with the implication that there is little collaboration in R&D activities.

1.5 Environmental Protection

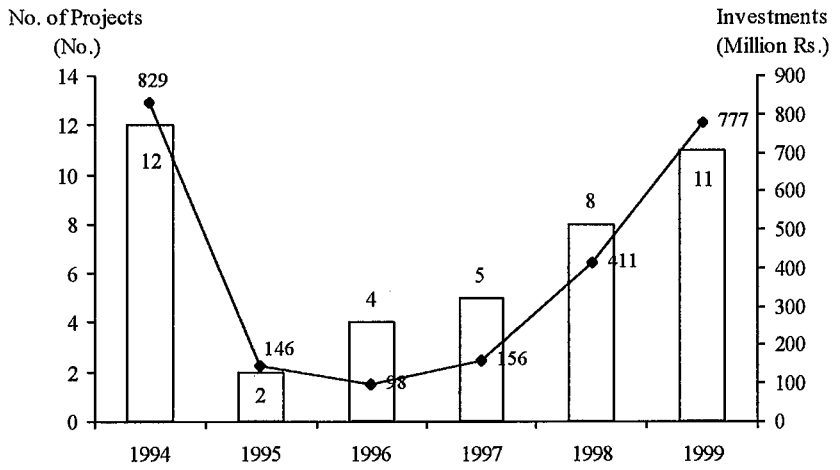
It is generally understood that the electric/electronic industry in Sri Lanka have little possibility to create environmental problems, because its major activities are assembling. Major environmental problems are seen as "noise" (11 respondents), "industrial wastes" (8), "air pollution" (5), and "water pollution" (3), as shown below.



Fortunately, the electric/electronic industry is small in scale, and does not cause serious environmental hazards.

1.6 Investment

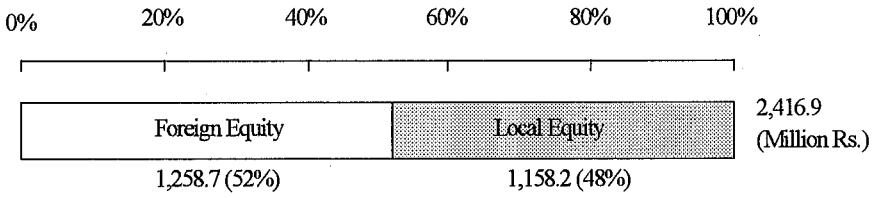
Foreign direct investment (FDI) in the electric/electronic industry (numbers of projects, investment amounts) has been increasing since 1996 as shown below.



Source: BOI

Projects and Investments in Electric/Electronic Industry approved under Sec. 16 & 17 of BOI Law

In terms of equity share on investment in the electric/electronic industry, local equity accounts for 48% as shown below.



Source: BOI

Accumulated Investments in Electric/Electronic Industry

Since the electric/electronic industry is appointed as a thrust industry, the incentives under Section 17 are provided subject to the qualifying criteria. The incentives providing to the electric/electronic industry are tablulated in the following.

BOI Incentives on Electric/Electronic Based Industry (New Export-Oriented)

Description of Activity	Qualifying Criteria			Incentives				
	Minimum Investment in Rs.mn	Minimum Direct/ Indirect Export Requirement (% of output)	Minimum New Employ-ment Required	Full Tax Holiday	Concession-ary Tax at 15%	Import Duty Exemption		Exemption from Exchange Control
						On Capital Goods	On Raw Materials	
New export – oriented industry undertaking an investment in a "Thrust Industry"	50 – 1,499	90%	50	10	10 years after tax holiday	Yes	yes, if utilized for export	Yes
	1,500 – 2,499	90%	50	12 years	8 years after tax holiday	Yes	Yes, if utilized for export	Yes
	2,500 – 4,999	90%	50	15 years	5 years after tax holiday	Yes	Yes, if utilized for export	Yes
	Above 5,000	90%	50	20 years	as per IR Law after tax holiday	Yes	Yes, if utilized for export	Yes

Source: BOI

2. STRENGTH AND BOTTLENECK

2.1 Strength and Weakness

1) Factors Affecting Productivity

According to the questionnaire survey, 39 enterprises out of 50 pointed out that the most critical factor of profitability is material cost. The factory inspection also revealed that material cost accounts for 55-85% of total production cost. This is partly attributable to a smaller scale of economy, because most enterprises are small and they cannot make their purchasing lot of raw materials large. The size of enterprises and their procurement practices lead to a lower competitiveness of the industry.

The second most critical factor of profitability is interest payment for loans. 24 enterprises pointed out that this is a big burden for them. If entrepreneurs need six months from material purchase to product delivery and payment, and if a short-term loan requires 13% interest, interest payment for purchase of material cost reaches nearly 7% of product cost. When compared to an average international figure of about 3.8%, this cost is quite high.

The third critical factor is machine and equipment, which 22 enterprises pointed out. Terms for depreciation for equipment are usually five years in Sri Lanka. Unless the depreciation cost is properly accumulated, renewal of machine and equipment is found difficult. This is one of the reasons why production equipment has not been renewed by many enterprises to enhance productivity.

2) Strength

According to the questionnaire survey, most enterprises claim that their strength is "quality", as pointed out by 47 enterprises out of 50. This is true, in a sense, because most enterprises are making serious efforts for quality control (refer to the Table in Section 1.4). However, enhancement of quality control is still limited at the production line level, and TQC (Total Quality Control) is not followed in most cases; thus, quality level remains much to be improved.

The second point which enterprises consider as a source of strength is "price". However, judging from the high interest rate and short depreciation period, price-competitiveness is somewhat doubtful. Further, 31 enterprises pointed out "production technology/skill" as their strength, which implies that they are unaware of the level of their technology.

Understandings by manufacturers do not reflect a real situation of their products in a correct manner.

3) Technical Level/Weakness

A "product-engineering matrix" describes a current situation of capabilities in different engineering stages. For the electric/electronic industry in Sri Lanka, this matrix has been prepared as shown in the following page.

It is clear in the matrix that there is no "development" capabilities in products except for some industrial products. Both electrical and mechanical "design" capabilities differ a lot depending on groups of products. It is observed that "home appliance" products do not have these capabilities, "electrical appliance" and "electrical parts" have some, and "industrial products" have a certain level of design capability. Enterprises seem to have "production engineering" capabilities only in their producing goods and related area. Quality control at production lines can be evaluated to be at a certain level; however, overall quality control is still insufficient to attain competitiveness in the global market (refer to the Table in Section 1.4).

4) Constraints

The questionnaire survey indicates that the most critical constraint is "external problem/government support" (24 enterprises pointed out) and the second one is "market-related problem".

Among the public services/supports, "custom clearance" is the heaviest constraint as pointed out by 28 enterprises. Some enterprises claim that custom clearance takes quite long time because of a low knowledge level of custom officers about products. "Support to financing" and "investment promotion/incentive" are also considered as constraints, as pointed out by 23 and 19 enterprises, respectively.

"Market-related problem" is another central issue to be addressed. 24 enterprises pointed out "flooding of imported goods" as the most serious problem. This demonstrates a relatively low competitiveness of domestic products in terms of cost and quality, while domestic manufacturers claim that they have confidence in their quality and price. There is also a lack of reliance on "Made in Sri Lanka" products, as well as a tendency that consumers prefer imported products to domestic ones as in the cases of many developing countries.

Product-Engineering Matrix

	Function development	Electrical Design	Mechanical design	Production engineering	Quality control
(1) Home Appliance/Electronic					
Color television	X	X	X	O	O
Personal computer	X	X	X	△	△
Video cassette Recorder	X	X	X	△	△
Radio-cassette tape recorder	X	X	X	O	O
Video movie	X	X	X	△	△
Communication devices	X	X	X	△	△
Telephone equipment	X	X	X	△	△
(2) Home Appliance/Electric					
Air conditioner	X	X	X	△	△
Refrigerator	X	O	O	O	O
Washing machine	X	X	X	O	O
Cleaner	X	X	△	△	△
Electric fan	X	△	O	O	O
Rice-cooker	X	△	△	O	O
Electric pot	X	O	O	O	O
Fluorescent light equipment	X	O	O	O	O
Flashlight equipment	X	O	O	O	O
(3) Electrical appliance					
Electric bulb	X	X	X	△	△
Fluorescent light	X	X	X	X	X
Switch	X	O	O	O	O
Socket/Outlet	X	O	O	O	O
Breaker	X	△	△	O	O
TV Antenna	O	O	O	O	O
(4) Parts					
Semiconductor	X	X	X	X	X
Resistor	X	X	X	X	X
Capacitor	X	X	X	X	X
Coil	X	O	O	O	O
Transformer	X	O	O	O	O
Speaker	X	△	△	△	△
Dry cell battery	X	X	X	△	△
Storage battery	X	X	X	X	X
Printed circuit board	X	△	△	△	△
Fuse	X	△	△	△	△
(5) Industrial Products/Electronic					
Telephone accessories	O	O	O	O	O
Ringing and tone generator	O	O	O	O	O
Electric wire, Cable, Cord	X	O	O	O	O
(6) Industrial Products/Electric					
Generator	X	△	△	△	△
Transformer	X	O	O	O	O
Electric Power Panel	X	O	O	O	O

O: In production
△; No production, but ability is Yes or Technology level is low.
X; No production, No ability

"Limited local/domestic market" and "intensified competition for local market in price" are other constraints, which 18 and 17 enterprises pointed out, respectively. However, it is noted that domestic markets of the electric/electronic industry, particularly of "home appliances/electronic/electric" products, are expected to grow gradually with an economic growth and an increase in household income. When GDP per capita increases twice the level of current US$ 800 by the year 2010, each household will consume more color TVs, washing machine, electric cleaners, and so on. From experiences in other developing economies, sales of TVs are expected to increase to about 2% of total population, i.e., about 400,000 units in Sri Lanka by 2010. Even though domestic manufacturers claim that the domestic market is small in scale, the industry should work out their strategies to cope with the increasing demand in the domestic market. For cost competitiveness, manufacturers should address the issue of "material cost" which represents a largest portion in the cost structure, as discussed below.

"High cost of imported raw materials" is the most serious concern among "raw materials-related problems", which 33 enterprises pointed out. It is because a small scale of procurement and a poor purchasing capability make its cost expensive. "High import duties" is also considered as a serious constraint for assemble industries, which 26 enterprises pointed out. However, the fact is that tariff rate ranges from 0% for CKD (Complete Knock-Down) parts and components, 5% for other parts and components, to 30% for finished products, which appeared to have been designed to promote domestic assembly of electric/electronic products.

Among "finance" issues, a serious problem is "access to commercial loan with low interest", as pointed out by 31 companies. "Depreciation of Sri Lankan rupees" is another concern, as noted by 30 enterprises. Because most manufacturers rely their materials (parts and components) on imports, weak rupee make their cost expensive.

Among "infrastructure-related problems", transportation is the most serious concern. "Traffic congestion" and "poor road condition" are pointed out by 34 and 30 enterprises, respectively. For reference, Malaysia improved its expressway infrastructure significantly for the past 5 years and succeeded in attracting FDIs in the electric/electronic industry.

2.2 Bottleneck on Management

1) Impact of New Environment

The questionnaire survey revealed that there was no serious concern about the "SAARC impacts on business" in the electric/electronic industry, as nearly an equal number of responses shared "positive" and "negative" impacts. "Strong competition" ranked first among responses, indicated by 17 companies. "Good place for raw material sourcing" and "good export market of products" have been pointed out by 16 and 14 enterprises, respectively. India is seen as the "best partner among SAARC countries", as responded by 27 enterprises. It is rather surprising to know that there is no direct interest in SAARC cooperation. However, this could be understood that it is a reflection of the current situation of the electric/electrical industry in Sri Lanka, being an industry which is still domestic market-oriented and records a huge trade deficit against India. It is also true that there is a mixture of expectation and concerns about the impacts of SAARC. It is expected to design a plan to develop the electric/electronic industry to encourage manufacturers to receive fruits of SAARC cooperation in the medium and long term.

2) Supportive Measures

A "product-required support matrix" has been worked out through discussion with Sri Lankan industrialists, as shown on the following page.

It is observed through the matrix that supporting measures in "marketing" would be required particularly for the "electrical parts". In "financial affairs", public support is particularly required for the electric/electronic manufacturers of electric/electronic appliances for the domestic market. In all six sub-groups, the electric/electronic industry faces a shortage of "human resource". In this context, integration of engineering education and practical training is considered to be of greater significance.

Product-Required Support Matrix

	Marketing	Product development	Financial affairs	Human Resource	Enterprise cultivating
(1) Home Appliance/Electronic					
Color television	△	X	O	△	△
Personal computer	△	X	△	△	△
Video cassette Recorder	△	X	△	△	△
Radio-cassette tape recorder	△	X	O	△	△
Video movie	△	X	△	△	△
Communication devices	△	X	△	△	△
Telephone equipment	△	X	△	△	△
(2) Home Appliance/Electric					
Air conditioner	△	X	△	△	△
Refrigerator	△	X	△	△	△
Washing machine	△	X	△	△	△
Cleaner	△	X	△	△	△
Electric fan	△	O	O	△	△
Rice-cooker	△	O	O	△	△
Electric pot	△	O	O	△	△
Fluorescent light equipment	△	O	O	△	△
Flashlight equipment	△	O	O	△	△
(3) Electrical appliance					
Electric bulb	△	X	O	△	△
Fluorescent light	△	X	O	△	△
Switch	△	△	O	O	O
Socket/Outlet	△	△	O	O	O
Breaker	△	△	O	O	O
TV Antenna	O	O	O	O	O
(4) Parts					
Semiconductor	X	X	X	△	X
Resistor	X	X	X	△	X
Capacitor	X	X	X	△	X
Coil	X	O	O	△	△
Transformer	X	O	O	△	O
Speaker	X	△	△	△	△
Dry cell battery	X	X	X	△	△
Storage battery	X	X	X	△	△
Printed circuit board	X	△	△	△	△
Fuse	X	△	△	△	△
(5) Industrial Products/Electronic					
Telephone accessories	△	O	O	O	O
Ringing and tone generator	△	O	O	O	O
Electric wire, Cable, Cord	△	△	△	△	△
(6) Industrial Products/Electric					
Generator	△	△	△	△	△
Transformer	△	O	O	O	O
Electric Power Panel	△	O	O	O	O

O; He has experience, Well managed. No need government support

△; No experience, Ability is Yes. Government support is necessary.

X; No experience, No ability or low level.
Government support is necessary

3) Required Public Support

The questionnaire survey revealed that the electric/electronic industry asks for public supports in "promotion of local-made products (Buy Sri Lanka)", as pointed out by 33 responses. It is widely known that not only private consumers but also the public sector prefer imported products to domestic ones. Many in the electric/electronic industry claim that they lost opportunities to supply their products to the public sector, even though they have confidence in their price and quality in comparison with imported goods. It is important to establish a mechanism to make an open and fair evaluation of quality and price in the public procurement.

"Incentives for modernization of factory" and "export incentives/promotion" are also required for, as pointed out by 27 and 25 enterprises, respectively. Without active investment in plant and equipment, enhancement in competitiveness will not be attainable. Some measures should be taken to stimulate modernization of equipment and promotion of exports.

2.3 Industrial Clustering

1) Potential Linkages

The analysis indicates some directions for industrial clustering of the electric/electronic industry within the industry and with other industries. Assembly products occupy a large share of the electric/electronic industry, and its largest bottleneck is a high cost of parts and components, most of which are imported.

In this context, cost reduction of parts and components is a central issue to be addressed by the assembly industry. If there is a way of sourcing those parts and components from domestic markets, both assemblers and domestic parts and components manufacturers will benefit. The analysis also indicates that there is some potential to realize it. It is noted, however, that technological upgrading of local parts and components should be promoted further (e.g., coil winding technology), and a sub-contract system should be disseminated in order to make an integrated structure of the electric/electronic industry.

A possible way to promote clustering is to introduce technology for print circuit. If the foreign investor is able to encourage technological transfer of print circuit design to local manufacturers through a subcontract system, it will bring about a large "clustering" effect.

An approach to realize such a clustering is proposed later with an idea of "PCB Design and Sample Center".

Another promising area is clustering with information technology (IT). Because software and hardware take the same steps of progress and stimulate each other for development in such product areas as Personal Computers (PCs) and telecommunications devices, positive clustering effects between the electric/electronic industry and IT would be expected. Measures should be taken to encourage clustering between the two industries by means of technology upgrading, manpower development and R&D promotion.

2) Constraints for Clustering

It is observed that manufacturers in Sri Lanka do not rely on each other, and tend to have all necessary functions by themselves. This leads to a small scale of in-house production of various products and take opportunities away from industrial integration. The important thing is that the industry creates a culture and a playing field of sharing information and responsibilities among enterprises. It is vital to share an understanding that both competition and cooperation are important to upgrade a playing field of the industry as a whole. All the industry, academia, and the public institutions should recognize that they need to collaborate with each other to share scarce resources and realize effective industrialization programs. Some ideas and proposals will be introduced in this Study in relation to responsibility sharing and integration of the electric/electronic industry.

3. MASTER PLAN FOR ELECTRIC/ELECTRONIC INDUSTRY

3.1 Framework and Strategies

1) Vision

The Electric/Electronic industry is a focal point of the manufacturing sector for its further growth in the 21st century. A solid foundation of technological base of this sector is to be established to lead further industrialization of Sri Lanka. The analysis on strength and bottlenecks of the country's electric/electronic industry suggests that the industry has potential to be developed further, if a clear vision and strategies are built and shared among all the parties concerned in the industries, academia and the government. Vision for the electric/electronic industry toward 2010 should be stated as follows:

"Sri Lanka's electric/electronic industry should lead further industrialization of the country and promote industrial integration in SAARC."

With this vision, as well as in line with basic strategies of the manufacturing sector development as a whole, targeted products should be specified and efforts should be "concentrated" on these targeted products in accordance with their respective development strategies.

2) Targets

It is proposed that development of the electric/electronic industry be designed to achieve targets as enumerated below.

(i) Increase domestic production ratio of targeted products to share 50% of domestic consumption by the year 2004, establishing a solid foundation of the manufacturing bases.
(ii) Promote "OEM" (Original Equipment Manufacturer) and "export" of targeted products at the latter stage, utilizing strengthened and improved competitiveness of targeted products.
(iii) Promote an increase in FDI (foreign direct investment) to Sri Lanka, particularly in targeted products.
(iv) Achieve a sharp increase in GVA up to around Rs. 15.9 billion by 2010.

3) Basic Strategies

Practically, the electric/electronic industry can be classified into several different groups, according to product types, technological bases and production types. Based on analysis on strength and bottlenecks of the current electronic/electronics industry, it is proposed that six groups are defined as listed below.

Classification of Electric/electronic Industry in Sri Lanka

No	Group	Products (example)
1	Home appliance/Electronic	Television, Video cassette Recorder, Radio cassette recorder
2	Home appliance/Electric	Air conditioner, Refrigerator, Washing machine
3	Electrical appliance	Electric bulbs, Fluorescent light, Switch, Socket, Breaker
4	Electrical parts	Semiconductor, Resistor, Capacitor, Coil, Transformer, PCB
5	Industrial products/Electronic	Telephone accessories, Ringing and tone generator, Telegraph multiplex system
6	Industrial products/Electric	Generator, Transformer, Electrical Power panel

Indicative targets of GVA for the electric/electronic industry is set as summarized below.

Indicative Targets (GVA)

(Rs. Million)

No	Group	1999	2004	2010
1	Home appliance/Electronic	167	540	2,200
2	Home appliance/Electric	115	710	2,040
3	Electrical appliance	165	260	790
4	Electrical parts	1,234	1,980	9,020
5	Industrial products/Electronic	389	610	1,850
6	Industrial products/Electric			
Total		2,070	4,100	15,900

Basic strategies to achieve the above targets should be designed stage-wise for the next 10 years. It is proposed that basic strategies and approaches to accelerate electric/electronic industry be defined as follows:

(i) Identify 2 to 3 " focal products" in each group and concentrate industrial efforts on enhancement of competitiveness in focal products. Eventually, engineering capability will be upgraded to other products, utilizing expected synergy effects of improved competitiveness of focal products.

(ii) Increase basic capabilities in technology evaluation and engineering procurement through introduction of "reverse engineering". These efforts will make it possible to improve quality, cost competitiveness, and development capabilities of new products.

(iii) Improve an image of "Made in Sri Lanka" brand through introduction of formal "testing" system and procedures for electric/electronic products and frequent delivery of testing results to the public.

(iv) Promote "clustering" and collaborative activities among enterprises in the electric/electronic industry, to strengthen engineering capabilities of each company and to enhance further rationalization and restructuring of the industry.

(v) Promote an integrated "support" system for entrepreneurs by establishing "Electro Incubation Complex".

(vi) Improve relationships and responsibility sharing in "research", "development" and "design" among academia, institutes, and the private sector. Introduce a practical curricula in universities and colleges to make it possible for graduates to work as eligible engineers.

(vii) Promote "clustering" and linkages with other closely-related industries such as general machinery, plastic, and information technology (IT).

3.2 Promising Market/Products

1) Selection of "Focal" Products

As previously discussed, it is advisable to identify "focal" products and concentrate industrial efforts on strengthening manufacturing capabilities and competitiveness of those products at the first stage, and then to diversify products at the subsequent stage. Basically, three steps are taken to select "focal" products in each group, as follows:

(i) Products-Market Matrix

A products-market matrix describes current situation of domestic demands and production, as well as future capabilities of exports to major destination. Utilizing this matrix analysis,

one can find out the current manufacturing and potential markets. This is a rather qualitative approach, but it is useful to step into the selection of focal products. The table presented in Section 1.3 shows the results of this selection.

(ii) Import/Export Matrix

An import/export matrix describes the current situation of imports and exports of each electric/electronic product. This table shows a degree of comparative advantage of each product in terms of imports and exports, as well as a degree of integration and dependence on imported products. Tables compiled in Annex-I have been utilized for this analysis and selection.

(iii) Product-Engineering Matrix

A product-engineering matrix describes a current situation of capabilities in different engineering stages. For the electric/electronic industry in Sri Lanka, this matrix has been prepared as shown in Section 2.1.

Based on analysis of three matrix, "focal" products in each group of the electric/electronic industry have been identified as summarized below:

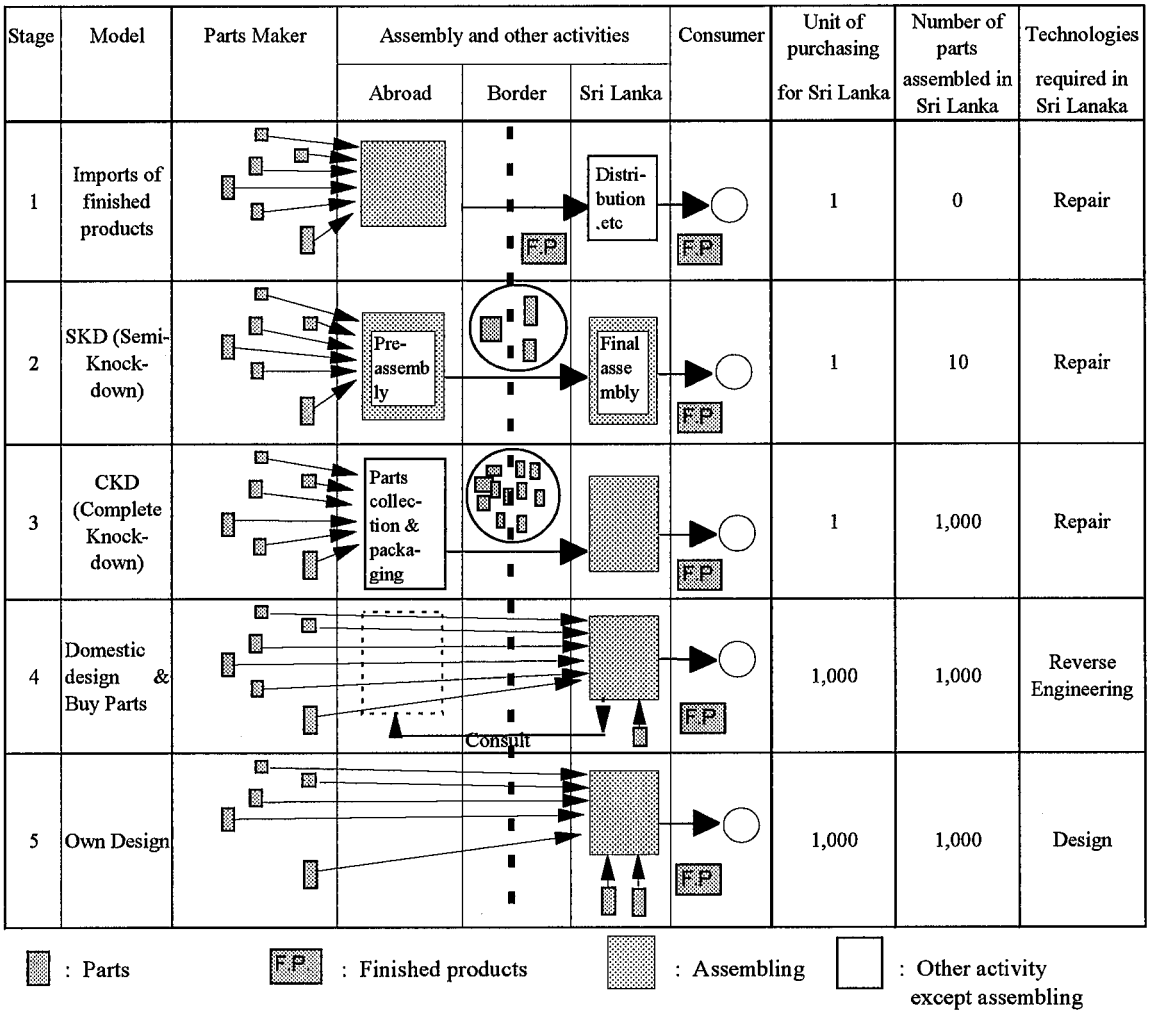
Selection of "Focal" Products

No	Group	Focal Products
1	Home appliance/Electronic	Color television, Radio cassette recorder
2	Home appliance/Electric	Washing machine, Refrigerator
3	Electrical appliance	Switch, Socket, Breaker, etc.
4	Electrical parts	Coil, Transformer, PCB*
5	Industrial products/Electronic	Accessories of Information system
6	Industrial products/Electric	Power distribution panel

* PCB: Printed Circuit Board & its assembly

2) Manufacturing Models

Development measures of the selected "focal" products should be carefully designed, as it is important to have clear understandings that there exist different manufacturing models, depending on the levels and stages of industrialization and technology transfer/upgrading. A general concept of different manufacturing models and progressive stages of technology transfer/upgrading is illustrated as follows.



Manufacturing Models and Stages of Technology Upgrading

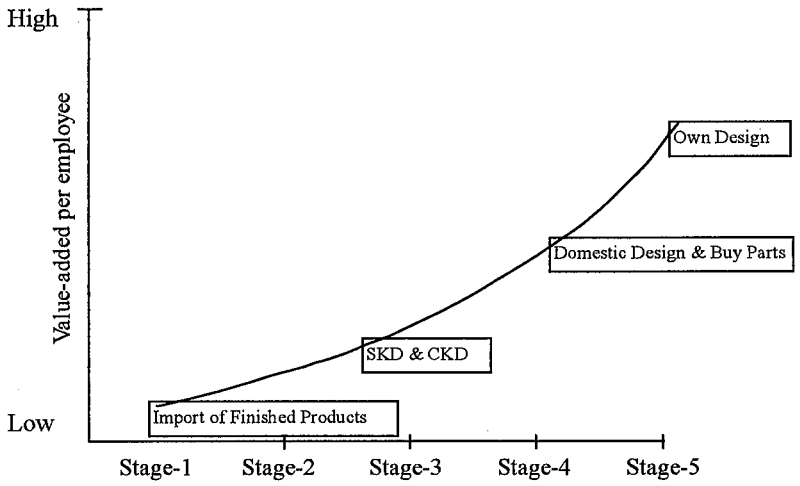
Depending on the level of industrialization, a country experiences five different manufacturing models and stages of technology transfer, starting from "imports of finished products" to "own design" at its final stage. In advanced countries where the manufacturing model has reached the ultimate 5th stage, productivity increase through an introduction of automation technique can offset high labor costs and reduce production cost in a competitive manner. At the same time, mass-production can reduce a unit cost of parts manufacturing. In this way, manufacturing of electric/electronic products in the advanced countries progresses and keeps competitiveness.

In general, SKD (Semi Knock-down) and CKD (Complete Knock-down) products manufactured in Sri Lanka could be more expensive than imported finished ones. It is mainly due to higher raw material costs in SKD and CKD than those of imported products

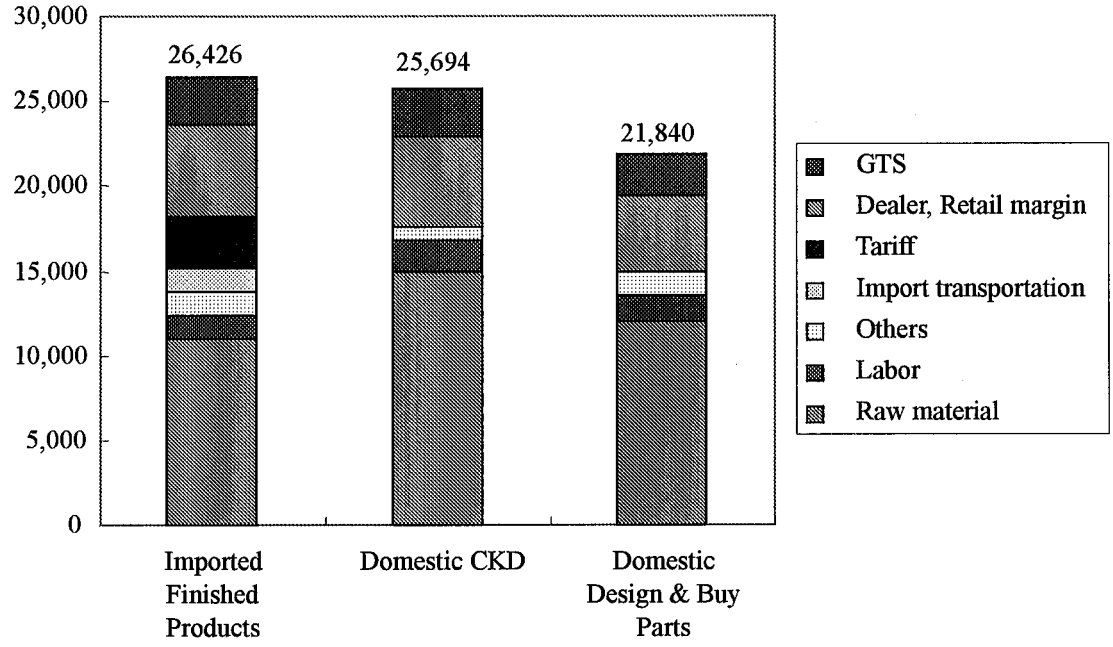
as handling charges are higher due to small scale of economies. At present, most of the products manufactured in Sri Lanka in the groups of "Home Appliance/Electronic" and "Home Appliance/Electric" are at Stage 3. Unless Sri Lanka succeeds in proceeding to the next stage of "Domestic Design and Buy Parts", it might be forced to abandon production capabilities under global competition. The analysis indicates that products in other four groups, i.e., "Electrical Appliance", "Electric Parts", "Industrial Products/Electronic" and "Industrial Products/Electric" are in more advanced levels or Stages 4 to 5. Consequently, these four groups of the industry should further promote technological upgrading, enhance enough technological bases with local human resources, and increase competitiveness in the global market.

It is noted, for reference, that most manufactured electric/electronic goods made in Malaysia are seen at Stage 5, though much technological assistance is extended by Japanese engineers, while electric/electronic goods made in Korea and Taiwan are at Stage 5.

The stages and manufacturing models are closely related to productivity. The value added per employee will usually ascend when the manufacturing stage is upgraded as illustrated below.



To examine an approach for further planning, an indicative cost analysis has been made for the case of "Color TV" which has been recognized as one of the less competitive products and produced by "CKD (Complete Knock-down)". Cost comparison of this product under three different cases of "Import of Finished goods", "CKD", and possible "Domestic Design and Buy Parts" is summarized on the following page.



Cost Comparison of Different Manufacturing Models (Case of Color TV)

Cost Analysis of 20" Color Television (Indicative Figures)

Cost factor	Origin	Import *1		Domestic *2		Domestic	
	Manufac-turing Model	Domestic Design & Buy parts	Cost (Rs)	CKD	Cost (Rs)	Domestic Design & Buy parts	Cost (Rs)
Raw material	a	80%	11,000	85%	15,000	*4 80%	12,000
Labor	b	10%	1,375	10%	1,765	10%	1,500
Others	c	*3 10%	1,375	5%	882	*5 10%	1,500
Ex-Factory price	d	100%	13,750	100%	17,647	100%	15,000
Import transportation	e=d x 1.1	x 10%	15,125	-	0	-	0
Tariff	f=e x 1.2	x 20%	18,150	-	0	-	0
Dealer, Retail margin *6	g=f x 1.3	x 30%	23,595	x 30%	22,941	x 30%	19,500
GTS	h=g * 1.12	x 12%	26,426	x 12%	25,694	x 12%	21,840
Retail price			26,426		25,694		21,840

Notes:

*1: Case of Imported Finished goods from ASEAN, using a real example of one company. This imported products are made in one ASEAN country using "Domestic Design and Buy parts" manufacturing model in that country.

*2: Cost by factor is estimated based on information received by company visits.

*3: Royalty fee, other fixed costs, profit, etc.

*4: Material cost is about 10% higher than import case, because scale of production and parts procurement is smaller.

*5: Increased R&D cost and Purchasing expense through "Domestic Design & Buy Parts" model is estimated at 5%=Rs.750
If the production is 10,000 units, expense is 7,500,000 Rs. which seems to be realistic enough.
(Example: Number of engineers 10 x 200,000 Rs./year = 2,000,000 Rs.)

*6: Dealer & retail margin is settled as the same of 30% as in all cases.

Current retail price of color TV by CKD is estimated to be about Rs. 25,700. Retail price of imported products is assumed to be Rs. 26,400, or only 2.8% higher than CKD products assembled in Sri Lanka, under the custom tariff of 20%. This implies that, if the 20% tariff is eliminated, Sri Lankan CKD TV products would easily lose their cost-competitive edge. In the case of CKD, both raw material cost and labor cost are higher than those of imported products, because handling charge is much higher due to the small scale of economies and complicated labor-intensive assembling procedures.

If designing and engineering capabilities of TVs is elevated, the industry can move forward to the stage of manufacturing model, "Domestic Design and Buy Parts" system, selecting and procuring raw materials by themselves at a lower cost. The production cost of TV with "Domestic Design and Buy Parts" is estimated to be Rs 21,800. If the domestic retail price is kept as the current level of Rs 25,700, companies can earn profits of Rs 3,900 or more. This is a rational to develop the country's engineering capabilities to promote further development of the electric/electronic industry. This is just a simple example of the less cost-competitive products focal, but almost the same situation is predictable in other focal products.

3) Initial Steps Proposed

In view of advantages and disadvantages under the conceivable development scenario, it is proposed that the electric/electronic industry in Sri Lanka would take the following measures as initial steps for development:

(i) Reverse Engineering

It is recommended that "reverse engineering" be promoted for several years by Sri Lankan electric/electronic manufacturers. This will facilitate to go forward to "Domestic Design and Buy Parts" system from the current "CKD" system. When "reverse engineering" is promoted, and technological foundation of parts manufacturing and assembling is established, the industry would enhance competitive purchasing capabilities of parts and components, and even have opportunities of sourcing parts from the domestic market.

(ii) Tariff Structure

Until the electric/electronic industry in Sri Lanka succeeds in growing some areas of parts and components manufacturing, it would be helpful to make a differentiation of parts and components in a tariff structure. For parts and components which will not be produced or less competitive in Sri Lanka even in the future, tariff could be abolished. However, a certain level of tariff should be maintained selectively for parts which could be produced

domestically in a competitive manner such as coils, transformers, structural parts, printed labels, and packing. By applying these measures, further development of domestic parts and components manufacturing will be promoted, and some assembling manufacturers with foreign capital located in FTZ and EPZ might try to procure those parts from the domestic market. With the above in view, it appears appropriate that Sri Lanka keeps the current tariff structure at least until 2004. Eventually, color TV, (tariff of 20% for finished products and 0% for all parts for CKD sets) under "Domestic Design and Buy Parts" system is promoted to increase the country's technological bases. The same is applied for radio cassette recorder (tariff of 30% for finished products and 0% for CKD sets). During the period when assembly manufacturers are supported by those tariff barriers, the industries should promote "reverse engineering" to increase its competitiveness. Through these efforts Sri Lanka would have a room for decreasing tariff for finished products in a gradual manner with an increased competitiveness of the domestic assembly industries.

(iii) Competitiveness with Expanding Markets

If Sri Lanka succeeds in stepping into the "Domestic Design and Buy Parts" stage, the Sri Lankan electric/electronic industry will have a big opportunity of an expansion of market through an adjustment of price levels, namely price reduction. Current consumption level for these products in Sri Lanka is still low and the market is expected to increase in proportion to price reduction. Eventually, the electric/electronic industry in Sri Lanka would enjoy enlarged domestic markets in terms of both increased demands and decreased production cost, which leads to a further enhancement of competitiveness of the industry.

3.3 Technological Upgrading and Quality Control

1) Product Design

"Product" is the most important for all enterprises regardless of manufacturing and of service industries. Product itself, matched with market needs and quality, decides current and future performance of business. For the manufacturing sector, it is essential to create and produce "differentiated" goods. In this context, "design" is a source of the differentiation.

Design is regarded as one part of overall "R&D" activities in general. To make a strategic plan for development of the Sri Lankan electric/electronic industry, it is advised to define "R&D" and "design" in a proper manner and to concentrate its efforts on some specific areas.

Many large electric/electronic enterprises have their own R&D center. Sometimes, only "design" activity center is called the R&D center, because the name "R&D center" sounds better.

Definition of Research, Development and Design

	Main features	Example	Required Period	Possibility of use	Investment
R: Research	Basic theory	Hi-vision system, DVD system	over 5 years	30%	Long term
D: Development	Function development	New IC, New feature, New circuit	around 3 years	50%	Middle term
D: Design	Product design	New model of Color TV, Washing Machine	below 1 year	100%	Short term

By referring to the definitions and understanding above, the Sri Lankan electric/electronic industry should start with and concentrate on "design" activity. Contribution of a successful design in terms of cost, quality and market share is quite large, and less investment is required. Although it depends on products, it usually takes 3～5years for engineers to be capable of designing products by themselves in the case of color TV. Further, the scale of electric/electronic enterprises in Sri Lanka is relatively small; therefore, it is reasonable for them to enhance only design technologies with limited resources. Enhancement of full knowledge and design techniques is particularly important for circuits, parts and components, structure and function of focal products which are manufactured in the company. Eligible engineers and measurement equipment are requisites to make a proper modification of design and products by themselves with enhanced design capabilities.

2) Stage-wise Technological Upgrading

Different technological upgrading approaches should be taken for different groups of the electric/electronic industries. For the first two groups; i.e., "home appliance/electric" and "home appliance/electronic", it is advisable to start with "reverse engineering".

Through reverse engineering, one is able to make a detailed analysis of the cost structure of his/her products (most of them are produced by CKD). Eventually, one could find out advantages and disadvantages of the products, as well as future possibilities of "Buy Parts" for manufacturing. Then, one should analyze and understand basic factors of electric/electronic product design such as circuits, functions and operations, parts' specification, and mechanism. All of these activities should be done by an in-house engineer,

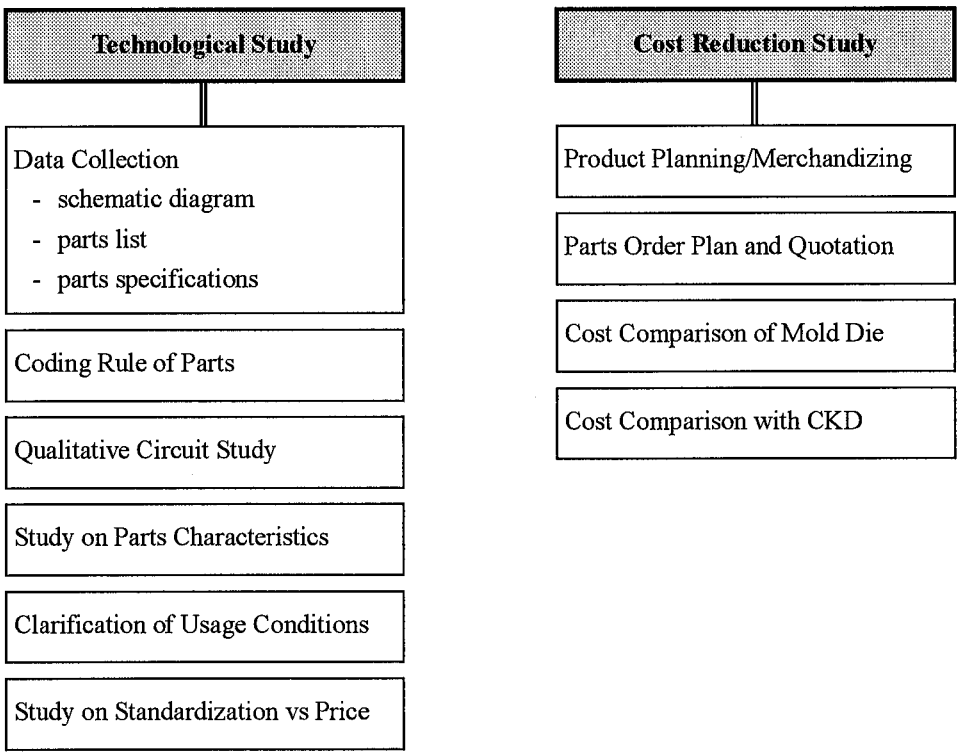
and if it goes well, one may order each part and component separately from different parts and components suppliers to receive a better (cheaper) price and better quality. Also one can ask for a bid from different parts and components suppliers for further cost-down. This leads to increase both in their overall buyer's power and in stimulating effects on parts and components manufacturers in Sri Lanka.

At the second step in "reverse engineering" of "home appliance/electric" and "home appliance/electronic" products, one would compare his/her products with those of competitors, particularly of competitive imported products. If it is inferior to those of competitors, one should find out the sources of differences and try to improve his/her products for technological upgrading. If Sri Lankan enterprises concentrate efforts on this step selectively, they are able to catch up their competitors by increasing technological bases in a certain period of time. The target year to concentrate on this step is set for 2004.

At the third step, one would try to design products by himself/herself. For example, he/she may make mechanical modification of cabinet and electrical modification of circuits. One may face some difficulties and troubles in the course of learning and doing design activities, and in such cases he/she might ask for advice and assistance from foreign partners. One option to cope with this situation in an effective manner is to have an "Electro Technology Center" in Sri Lanka as a non-profit organization (NPO) which is funded and managed jointly by both the government and the private sector. Its major activities would be consultation work for electric/electronic industries, as well as preparation of an official testing procedure for electric/electronic products.

At the fourth and final step, one would try to design his/her own new model, utilizing new tools and function techniques. In the case of other four groups, most enterprises appear to have reached already to the 4th and 5th stages of manufacturing model; therefore, they can start with the third step and above, appropriately.

Promotion of Reverse Engineering



3) Quality Control

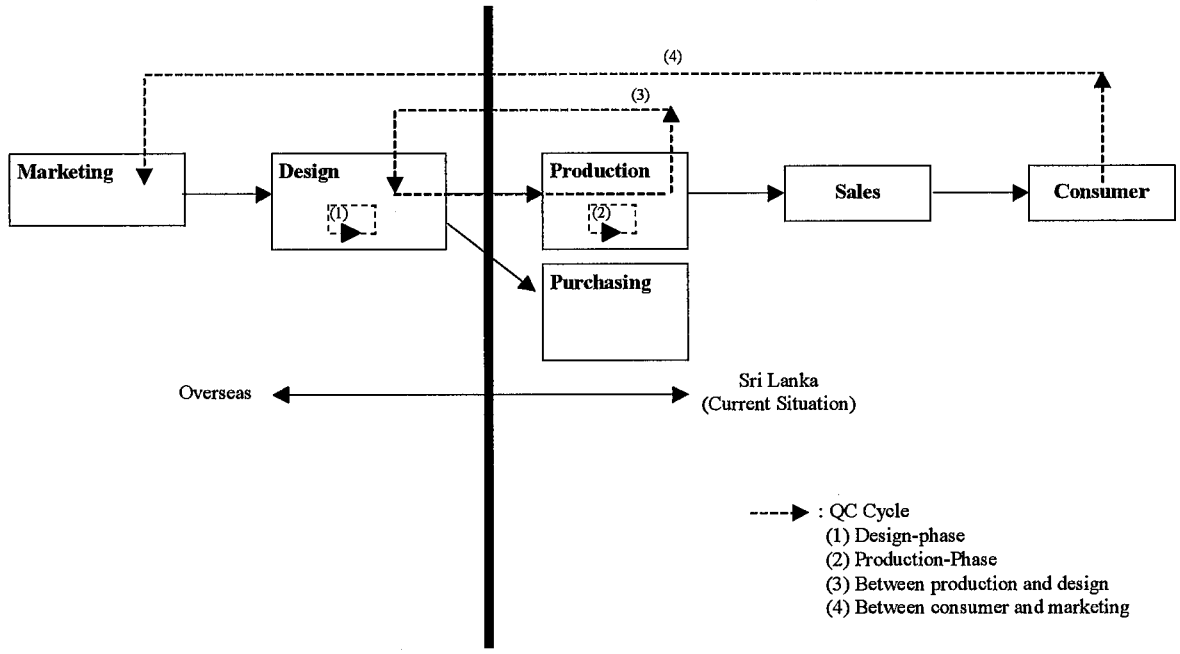
Basically, the four important features of manufactured products are functions, performance, quality and costs. Product planning and design levels pay particular attention to functions, performance and costs (as well as a balance among those). Some products are planned and designed as multi-functioned with high-performance and at high costs (price). Other products are planned and designed to be less expensive with simple function and performance. By analyzing the market conditions and market needs, one should make a detailed plan for several models which have different levels and variations of these three features.

It is emphasized that the fourth feature (quality) is by far important and requisite for all products. Even for a low-priced model, it is not allowed to be featured at high trouble rates, low product life, risk of fire and harmful for users. Level of quality simply leads to a good or bad fame of products and finally decides a level of "brand name". Brand name and reliance on it by consumers is a decisive factor of purchasing behavior. Establishment of a brand name is not an easy task and time-consuming. Unfortunately, the brand name of "Made in Sri Lanka" has not been established yet, and even gives a negative image among consumers. The electric/electronic industry in Sri Lanka should recognize the current

situation and should make comprehensive measures to improve qualities of "Made in Sri Lanka" products.

There is a quality assurance method in which all products are completely inspected and tested at the factory. However, this system is not appropriate for the electric/electronic industry which has a mass-production system of relatively low-priced products. While ordinary shop testing at shipment is important, defects and yields analysis at each shop of production is more important to feedback those information to the design level. With information given at the production level, engineers in design level could analyze the cause of defects and modify its design to let production flow ensure more strict allowance not to cause defects. QC cycle between production and design is requisite to improve an overall quality level. This approach would decrease defect rates at the production level, and consequently decrease trouble rates at the market level. Only engineers at the design level can change or modify design and specification sheets for products; therefore, overall quality assurance depends both on capabilities of design and on good communication between production and design.

A major problem for the Sri Lankan electric/electronic industry is that most enterprises are not pursuing this quality control cycle, particularly for "home appliance/electric" and "home appliance/electronic" products for which this approach is particularly important.



Desirable QC Cycle and Current Limitation

Most manufacturers in Sri Lanka do not have functions of "marketing" and "design" domestically. They rely these activities on foreign partners; therefore, QC cycle between production and design and between consumer and marketing is disconnected. Under such a situation, feedback of information from production to design and the same from the consumer level to the marketing level is quite time-consuming and unrealistic. To solve these problems, too, it is required to enhance design capabilities at home, namely in Sri Lanka.

4) Productivity

Productivity is another important parameter for manufacturing. Higher productivity increases competitiveness of the products, and the Sri Lankan electric/electronic industry should tackle this issue in a more serious manner.

Improvements in productivity heavily depend on appropriate modification of specifications at the design level. Only improvements at the production level by QC circle activities do not always lead to effective improvements in total productivity due to a lack of feedback of information to the design level. If one would bring a new automation machine in a production shop without a designing function, he/she can not make a proper modification of product specifications and cannot realize the highest performance of the new machine. Enhancement and improvement in design capabilities is therefore essential for productivity increase.

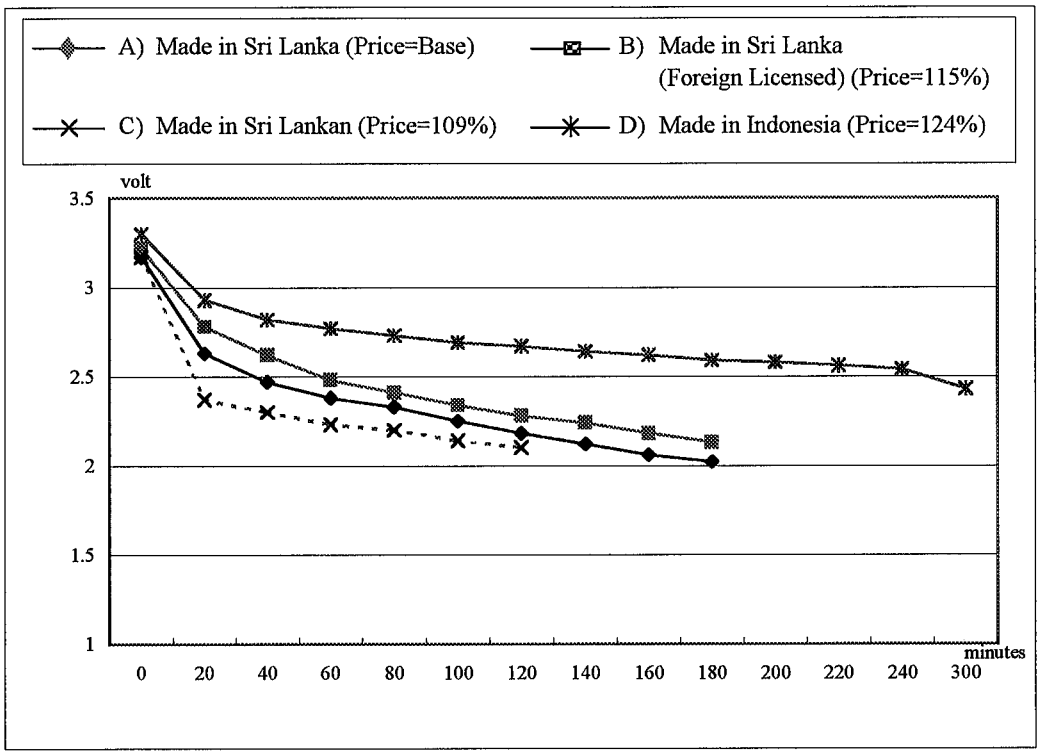
The current Sri Lankan electric/electrical industry is not well equipped in terms of automation. This is partly due to a small scale of production, and manual operation by workers has an economic rational. It is expected, however, that three groups of the industry, i.e., home appliance/electronic, home appliance/electric and electrical appliances, would sharply increase their production, and introduction of automated machines and conveyors would be considered. It is recommended that "PCB Design & Sample Center" be established to make an effective use of automated machines in due consideration of such basic strategies as "concentration" and "clustering".

5) Establishment of Testing Organization

The current image of "Made in Sri Lanka" electric/electronic products is rather poor. Sri Lankan consumers and even civil servants prefer imported products to domestic ones. It is a fact that there are many cheap Made-in-Sri Lanka products of lower quality in the market. The following are some examples:

(a) A technical consultation was requested by a fluorescent manufacturer because of its high defect rate. If the manufacturer has a high defect rate at the production level, it normally brings a high defect rate at the market level, because testing at the factory cannot always reject those defected products.

(b) A product life of dry cells has been checked, with a result that a product life of Made-in-Sri Lanka is shorter than that of imported products, though prices are much



lower.

A Sample Life Test of Dry Cell

This situation is the same as in Japan 40 years ago, and in Malaysia 10 years ago. The industry can solve such issues by challenging a task to change the situation. One important thing is that the overall electric/electronic industry should not get a bad fame of "products with lower quality" because of the existence of some products of the lowest quality. To avoid a vicious circle of quality problem, the industry should establish a fair and open quality assurance testing system, and disclose results widely open to the public, including consumers and the government. In addition, the industry should avoid distribution of lower quality products which have dangers of fire and harmful to consumers by establishing an official safety test and announcement by "safety seal". In Malaysia, a safety test is performed to obtain an "approved seal", and the brand image of "Made in Malaysia" has improved a lot. In Sri Lanka, it is a requisite for the industry to perform both quality

assurance and safety tests to create a better brand image of Made-in-Sri Lanka, and to encourage "Buy Sri Lanka" at the private and public levels.

If the electric/electrical industry in Sri Lanka succeeds in establishing such a system effectively, testing engineers would accumulate their knowledge base of products through daily operation of testing. In this respect, it is recommended that an official testing organization be established in Sri Lanka. This leads to a situation in which testing engineers are educated by "learning by doing" to make them able to work as consultants for reverse engineering. It is realistic to grow several specialized testing engineers in each focal product or in each group clarified in the electric/electronic industry. As experience in testing is quite practical for all engineers to accumulate knowledge of products, it is recommended that a course of learning real testing operations at the official testing organization be introduced to education at universities and colleges.

To heighten the level of the proposed official testing organization in Sri Lanka, technical assistance may be sought from the advanced countries, as in the case of the official testing organization in Malaysia (SILIM). Such experts assigned to Sri Lanka should have experiences in design, including reverse engineering. For the areas of two groups of industrial products, it is not necessary to count on technical assistance, because those industries have a certain level of technological base in Sri Lanka.

Testing should focus on focal products at the beginning, and should be gradually expanded to other products. Testing itself could be open to the public to make a fair justification. Test results should be disclosed widely open to the public in the form of "consumer report" to be issued by the public institution. This would create a fair competitive mechanism among manufacturers in terms of quality assurance, as verified in the advanced countries like USA, UK and Japan where private magazines work as consumers' guide and a catalyst of competition.

It is proposed, in this context, that the official testing organization be established as a joint public-private organization by restructuring current organizational structure in testing. It is also recommended that this organization be closely linked with basic engineering functions in collaborative efforts of the industries. An idea of "Electro Technology Center" is proposed as the country's official testing organization. The scheme and structure of the proposed organization is discussed later in detail.

3.4 Manpower Development and R&D

Human resources is a key to develop technological bases for the Sri Lankan electric/electronic industry. It is important for academia, institutes and enterprises to recognize a proper responsibility sharing among them and to make use of limited human resources and budget.

1) Training for Product Design/Reverse Engineering

Each enterprise in the private sector should be wholly responsible for promoting "reverse engineering". Enterprises should employ and grow engineers to improve their own technological bases, to make a detailed engineering research for their product design, and to increase their competitiveness.

Given this basic policy and assumption, the public sector should not extend direct support to enterprises' efforts on product design and reverse engineering in terms of budget allocation. It is recommended, however, that the government coordinate and encourage development of technological upgrading by extending indirect support to the technological infrastructure, e.g., "Electro Technology Center".

When the industry is advanced to the stage of product design, higher levels of knowledge and technologies are required. At this stage, "Electro Technology Center" may invite engineers for technological transfer, as it has been introduced in Malaysia. These invited engineers could help further reverse engineering and technological upgrading of enterprises. It is important to introduce a "cost sharing approach" in this system. Enterprises that ask for testing and assistance of invited engineers collectively or individually should bear the cost for such services. By an introduction of "cost sharing", a market mechanism of creating a fair ground of competition could be enhanced.

2) Research and Development

Proper responsibility sharing, cooperation and coordination among enterprises are also required for R&D. Even large enterprises often make collaborative activities in research with academia and sometimes with other enterprises. This is to make cost/time effective in development of technologies by sharing resources and information, and to upgrade a field of competition to the advanced level.

As scales of electric/electronic enterprises are rather small in Sri Lanka, it is recommended that their efforts be directed only on improvements in design, and research and development

rely on academia and public institutes. Enterprises may ask research to such institutes by proposing a theme of their interests by sharing appropriate costs. Institutes should, in turn, make coordination and joint research activities with academia, when required, to promote effective research for enterprises and industry as a whole.

Collaboration in R&D

3.5 Restructuring and Enterprise Development

1) Restructuring

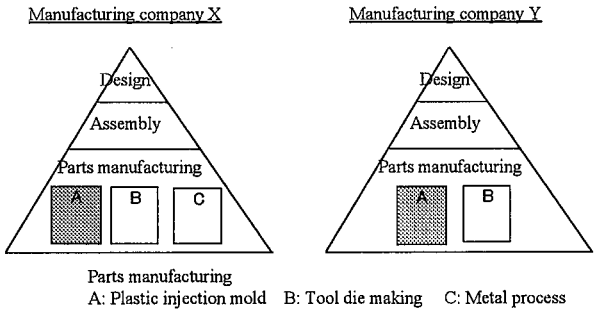
Bottlenecks of the structure of the Sri Lankan electric/electronic industry is summarized as follows:

(i) Each enterprise has or intends to have an integrated structure of manufacturing activities without division of labor, even though they are small. Thus, efficiency in terms of economy of scale is low and actual operation rate of equipment is quite limited, which leads to an increase in their fixed costs.

(ii) Covering wide manufacturing activities with limited human resources in each enterprise brings a fragmentation of scarce resources, and makes it difficult to accumulate technological bases for their original and specialty area.

(iii) There is no cooperation nor collaboration among enterprises, and there are limited numbers of specialized parts suppliers in the domestic market. When an entrepreneur intends to start his/her own business, he/she has to prepare all the functions and activities of manufacturing, which requires a lot of financial resources.

A simple schematic diagram of the current Sri Lankan industrial structure is shown in the following. Most enterprises have all 3-levels of function; i.e., design, assembly and parts manufacturing. It is recommended that a structure of companies and industry be changed to the simpler one to increase efficiencies. A proposed structure is shown as follows.

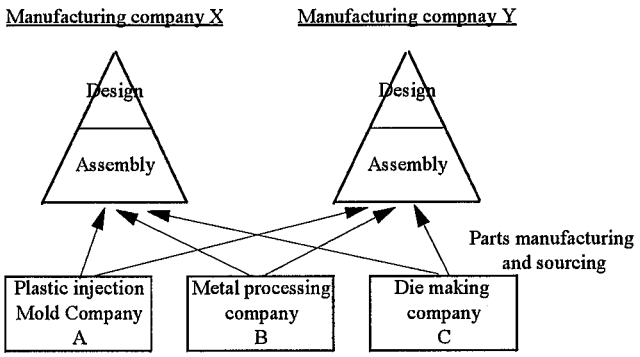


Current Industrial Structure

Here, many enterprises concentrate their operations only on design and assembly, and rely parts manufacturing on specialized parts manufacturers and share these resources among them.

To realize effective industrial restructuring, an option is to set up new joint ventures of parts manufacturing specialized in certain products. Equipment and human resources could be transferred from the existing enterprises to new venture companies. This approach will lead to a concentration of such important resources of equipment and specialized labors in venture companies and to bring about a larger economy of scale.

For example, a new plastic injection mold company could be established, transferring equipment from possible joint owner enterprises in a form of capital. The new venture company would enjoy a larger economy of scale by sourcing parts to several assembly makers, while the existing enterprises that detached parts manufacturing function could concentrate their efforts on design function and promote more effective technological upgrading of their own products. The new specialized parts manufacturers may expand their product range much larger, and may enhance competitive technological base to source higher value added parts and components, e.g., large plastic cabinet for color TV, radio cassette recorder, washing machine, and so on.



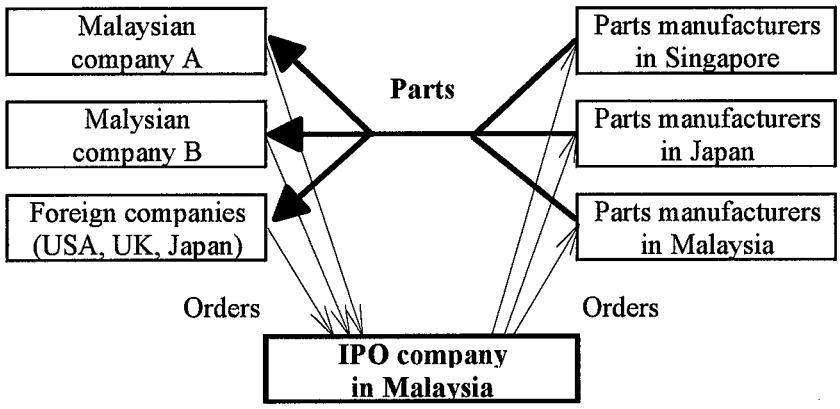
Proposed Restructuring of Industrial Structure

This is an example of plastic mold injection, but this can be applied to metal processing, die making and other related manufacturing activities. It is recommend that industrial restructuring by subcontract be promoted in Sri Lanka with a target year of 2004.

2) IPO(International Procurement Operation)

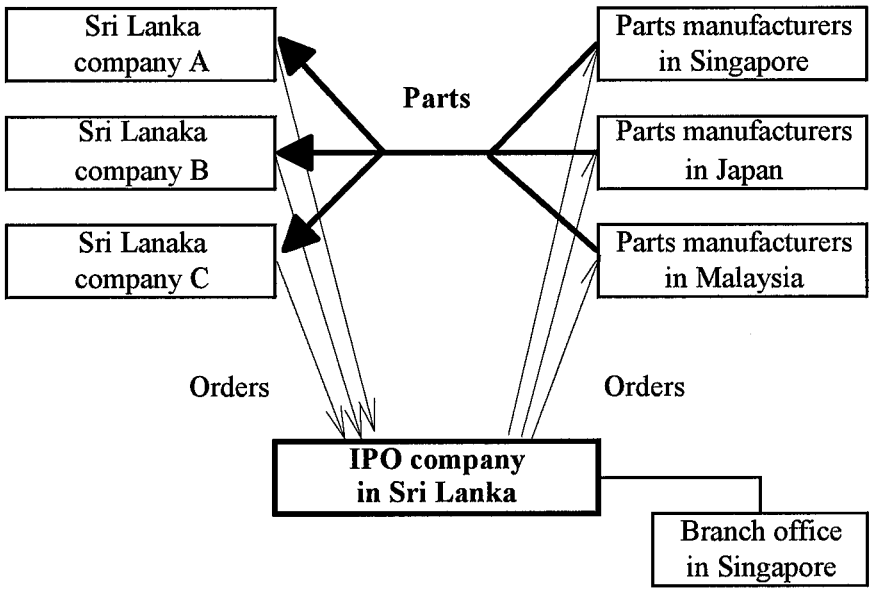
There are many small electric/electronic enterprises in Sri Lanka that purchase parts and components from abroad. Most enterprises are independently doing procurement activities and there is no collaborative or coordinated work for procurement in the international market. Consequently, ordering lot is small, thus the unit cost of parts become expensive. Such enterprises often have to keep inventories of parts for long time, because the minimum order for parts is larger than their required volumes for their small scale operation, thus increasing inventory costs. Eventually, they need more cash flow for their operation, which makes their financial cost much larger. Parts and components themselves might degrade, when they are left as inventory for a long time.

A concept of the International Procurement Operation (IPO), is useful and practical to solve those problems. An example in Malaysia, which is successfully working, is shown below. This is a centralized organization that receives orders of parts and components from domestic manufacturers, finds best suppliers in international markets, and purchases and delivers those parts and components to domestic enterprises. It works as a unique and centralized procurement operation, thus enhances a larger economy of scale and brings about a stronger buyers' power against suppliers in global markets. In the case of Malaysia, IPO is further developed to handle all the procedures of orders even from foreign located enterprises. This satisfies needs of many globalized manufacturing companies (e.g., SONY and Matsushita) which have many assembly plants in different countries.



International Procurement Operation (A Malaysian Case)

In the case of Sri Lanka, IPO should concentrate their efforts on gathering all orders from domestic manufacturers, because there are no large foreign capital assembly manufacturers. It is also recommended that a Singapore branch be operated by IPO, because there are many competitive parts and components manufacturers in Singapore. A number of large Japanese enterprises have their own IPO branches in Singapore. It is further recommended that data for order and delivery be exchanged among IPO company and manufacturers in Sri Lanka through the Internet to increase efficiencies. Data which could be successively accumulated in IPO would increase efficiencies and quality of procurement technique of parts and components. This would also contribute to increase professionals who are eligible for finding and evaluating potential suppliers, proposing new standard parts and components, and negotiating effectively with suppliers.



Proposed IPO in Sri Lanka

IPO could decrease a unit cost of inventories with an increased economy of scale, accumulating stock needs of different parts and components by many enterprises. It should have stocks of general-purpose registers, capacitators, and small size transistors which can also be ordered and used by such other groups as "industrial products/electric" and "industrial products/electronic". Stock of those parts would also match with entrepreneurs' needs to use them for their sample products.

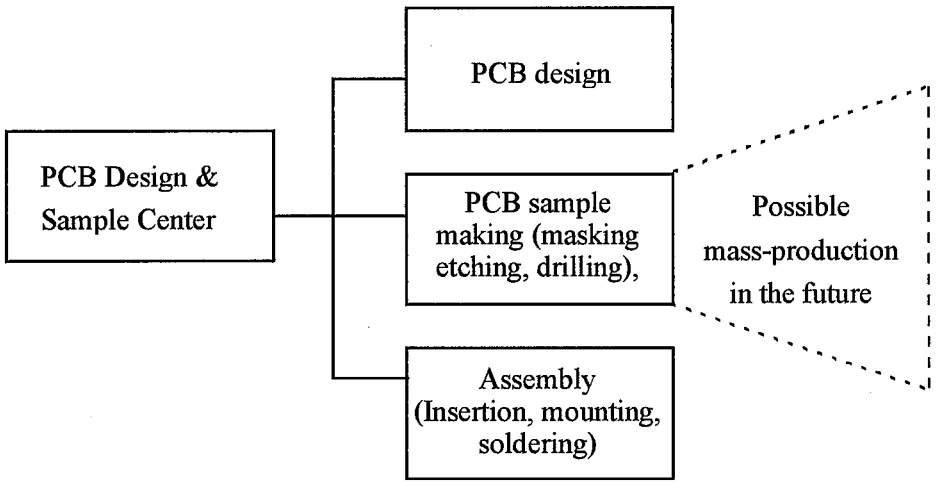
The private sector should be totally responsible for the creation and operation of IPO in terms of capital, operational expenses and management to increase its competitiveness

through an introduction of market mechanism. It is recommended that IPO be established by manufacturers in the Sri Lankan electric/electronic industry by 2004 to match with the industry's increasing needs for those function by an advancement of reverse engineering. Evolution of reverse engineering and an establishment/operation of IPO should be carefully coordinated.

3) PCB Design and Sample Center

Almost all electric/electronic products (e.g., PCs, color TV, radio cassette recorder, washing machine, refrigerator and machinery for industrial use) install printed circuits. PCB (printed circuit board) is a basis of designing electric/electronic products and a basic material to promote the industry and to support entrepreneurs in the country. Trade statistics of Sri Lanka verify the importance of this product, demonstrating high and successively increasing figures.

It is recommended that a "PCB Design and Sample Center" be established by the electric/electronic industry in Sri Lanka to strengthen its technological bases. With some public assistance and support, the Center should have both design function of PCB by CAD (Computer Aided Design) and manufacturing function of circuit boards. Basic function and organization of the proposed PCB Design and Sample Center is shown below.



Function of Proposed PCB Design and Sample Center

As for basic design of printed circuits, it is necessary for the Center to employ and grow engineers who have practical knowledge and skills in these materials by means of CAD. The Center should establish a standard for designing procedures, with a foreign technical assistance when necessary. Eventually, engineers in the Center could make technical

assistance and guidance to manufacturing enterprises to promote further improvements in Sri Lanka's design capabilities.

The Center will import a "raw board" for sample making of printed circuits. It will introduce an advanced machinery (multiple layer PCB machine) which could make various printings based on different design. Upon introduction of advanced printing machines, overall technological transfer in usage and maintenance is required for production engineers. Sample making of a print board by drilling would be done by an NC (numerical controlled) machine. If PCB production technology advances to a satisfactory level for mass-production sometime after a start of the operation, the Center could receive real orders of circuit boards and work as a mass-producer of those products. The Center should take the same measures for assembly work, insertion and mounting, as sample making.

It is recommended that preparation for establishment of the proposed PCB Design and Sample Center be implemented by 2004. The Center could be established as a joint venture by public-private cooperation at the beginning. When management and operation become under control, it could be transferred to a 100% private entity. Private enterprises located close to the Center could use CAD equipment of the Center by sharing an appropriate and reasonable cost. This could be of great help for clustering of business activities by entrepreneurs located close to the Center, and could contribute to further development of the advanced technology in Sri Lanka.

When the Center succeeds in enhancing technological bases to produce mother board of printed circuits in a large scale, it could supply its products to FDI enterprises located in FTZs, and even take orders from advanced PC manufacturing countries such as Taiwan as OEM (Original Equipment Manufacturer) suppliers. The existence of PCB Design and Sample Center could even contribute for promotion of FDIs of PCB assembling manufacturers. This could also contribute a lot to development of Information Technology (IT) industry in Sri Lanka.

3.6 Clustering Program

Effective cooperation and coordination of development programs amongst related industries is of vital importance for Sri Lanka. This is recognized as an issue of "clustering". When development of two groups of electric/electronic industry as "home appliances/electric" and "home appliances/electronic" is advanced, it definitely has positive impacts on both electrical parts and components industry and plastic industry. Large size TVs and

refrigerators require many plastic parts and components for structural use (e.g., cabinet, metal processed products, printings and packing). If those related enterprises and industries make a closer relationship in terms of information sharing and feedback of productivity and quality issues, they have a larger potential to be developed together in more advanced ways. This is defined as positive "clustering" effect.

1) Clustering with Plastic industry and Machinery industry

A possible scenario of clustering effect with the plastic industry in the case of color TV is discussed first. Domestic production of color TV in Sri Lanka starts with CKD, in which the industry only has a small scale of business. At the subsequent stage, the industry should try to use domestic parts to reduce its production cost. It is easier for the electric/electronic industry to procure plastic parts from the domestic market. When it succeeds in procuring some parts from the domestic plastic industry and to increase cost competitiveness, both the electric/electronic industry and plastic industry could enjoy an expanded market. An increase in production will decrease unit cost of parts and components, and stimulate more investments in Sri Lanka by foreign parts and components manufacturers. Accumulation of layer of parts and components manufacturers, including plastic-related enterprises, would increase possibilities for them to source their products to manufacturers located in FTZs and EPZs. This is an example of a positive effect of clustering between electric/electronic industry and plastic parts and components industry.

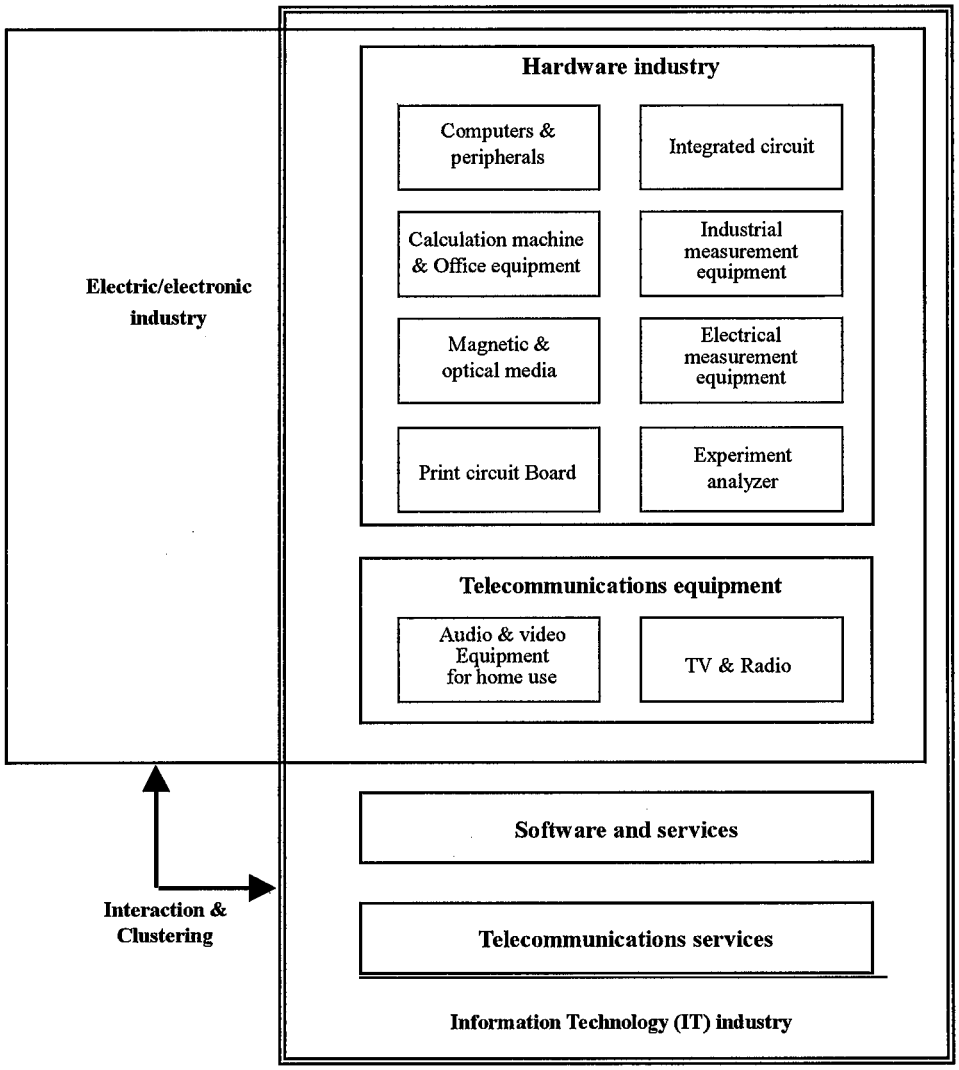
As discussed before, it is recommended that an industrial structure in Sri Lanka be reorganized to establish new companies which concentrate on their specialty fields and have a larger economy of scale. To this end, more collaboration and cooperative work among electric/electronic assembly companies and related newly established companies in plastic injection mold making, metal processing and die making would bring about positive impacts of clustering effect on development of those industries. For example, if a domestic die making company in Sri Lanka enhances technological base of die making for punching imported raw boards, this would benefit both electric/electronic industry and machinery industry.

2) Clustering with IT industry

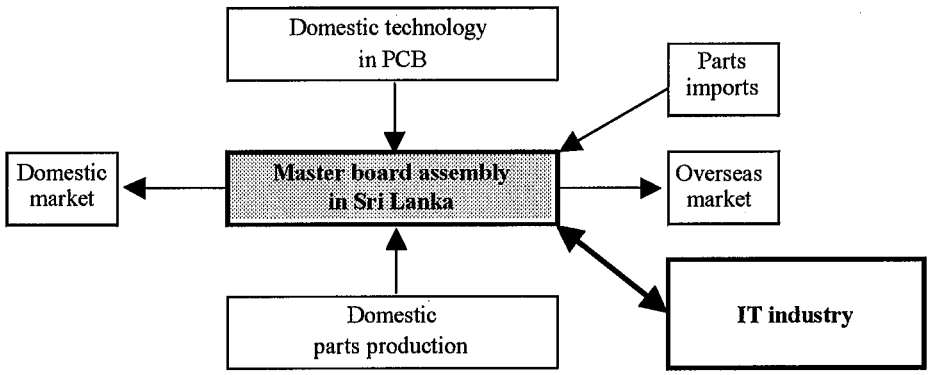
The electric/electronic industry is closely related with the Information Technology (IT) industry. According to the definition of IT industry by the US Department of Commerce, two out of four groups of IT industry (i.e., hardware industry and telecommunications industry) involve products classified as important products in the electric/electronic industry, as shown on the following page. A typical case is seen in personal computers (PCs). From a

hardware point of view, this is a product of the electronic industry, but from a software point of view this is a product of IT industry. Important thing is that hardware does not work without software, and so as the same for hardware without software. In many cases, both hardware and software companies are located collectively, enjoying a promising development prospect both in electronic industry and IT industry, as seen in the Silicon Valley and the Route 128 area in the United States. Because IT industry is one of the target industries in Sri Lanka, measures should be designed to expect a maximum clustering effect between electric/electronic industry and IT industry.

Clustering between Electronic Industry and IT Industry



If a proposed PCB Design and Sample Center is established and succeeds in operation, it would enhance the capability of "master board assembly" at a certain scale, and this would have a significant impact on evolution of IT industry in Sri Lanka.



Possible Scenario of Clustering Effect between Electronic Industry and IT Industry

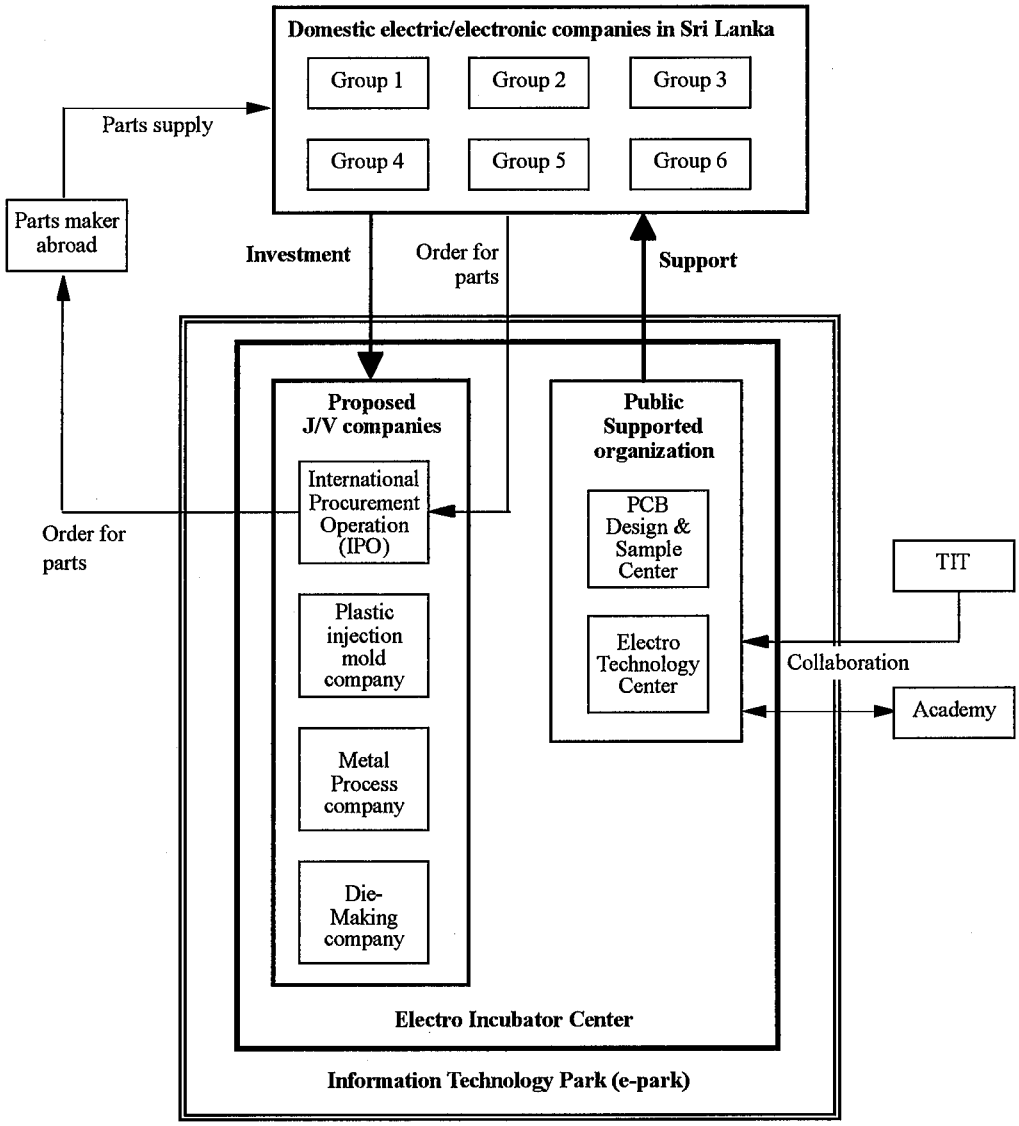
3) "Electro Incubator Complex"

Industrialization of Sri Lanka is still in the infant stages. Paradoxically, it means that the country has a large potential to grow its technological bases of manufacturing, if appropriate industrialization strategies are adopted, including a well designed clustering program.

Again in line with a basic strategy of "concentration", an idea to create "Electro Incubator Complex" is conceived. This is a conceptual and physical complex where all the major development related organizations and enterprises are located in one spot. Development of efficient parts and components industry is one key for further development of the manufacturing industries in Sri Lanka. To achieve this goal, establishment of new joint venture companies in plastic injection mold making, metal processing and die-making is proposed to be collectively located in the Electro Incubator Complex. The proposed "PCB Design & Sample Center", "Electro Technology Center" and an office of "International Procurement Operation (IPO)" would also be located collectively in the Complex.

Concentration and integration of these major functions in the Complex would make better interactive, collaborative activities among them, and would promote effective development. Moreover, entrepreneurs and newly invested companies located there would enjoy an advanced infrastructure with some public support and incentives.

In the event that the Electro Incubator Complex is located inside the "e-park" which is discussed in the part of IT industry, clustering effect between the two industries would be further elevated. A schematic view of the Electro Incubator Complex is illustrated as follows:



Concept "Electro Incubator Complex"

3.7 Financing and Institutional Arrangement

1) Financial Arrangement

To realize the suggested programs for the development of the electric/electronic industry in Sri Lanka, a certain financial arrangement will be required. "Electro Incubator Complex" is one of the most important parts of the proposed programs. Such organizations as "PCB Design and Sample Center" and "Electro Technology Center" would be promoted under the private-public partnership. To this end, the government will be responsible for setting up basic infrastructure, purchasing major equipment and securing foreign experts for technical

assistance. The private sector will be responsible for all other operational expenses. (The government support to the proposed Electric Incubator Complex will be discussed together with the plan for development of "e-park" under the study on IT industry.)

Even in the advanced countries, there are a lot of cases where local governments establish a basic technological infrastructure like "Electro Incubator Complex". For reference, Tokushima Prefecture in Japan recently prepared a center of this type at the cost of around US$ 7 million.

On the other hand, the majority of electric/electronic enterprises lack financial resources, and they are expecting that public support is extended in financing at concessional terms. According to the questionnaire survey, the demand for future borrowing is estimated to be Rs. 430 million for the public loan and Rs. 470 million for the commercial loan. This demand is based on the operation contemplated at the moment by electric/electronic enterprises. If and when the programs proposed under this Master Plan are implemented, the demand for financial borrowing will be further increased. It is recommended that efforts be further made by the government to secure enough funds to meet the demand for such borrowing.

2) Promotion of FDI

Foreign direct investments (FDIs) is expected to share a substantial contribution to increase gross value added (GVA) of electric/electronic industries. The following measures are proposed to promote further FDIs in this sector:

(i) Promote an idea of promising products which are not produced at present, but have a potential to have competitive advantages of Sri Lankan people (e.g., good eyesight, nimble hands and fingers). Such promising products will include small motor, handy telephone, remote control unit, wire harness, mother board of personal computer, customer type small switch and variable resistor.

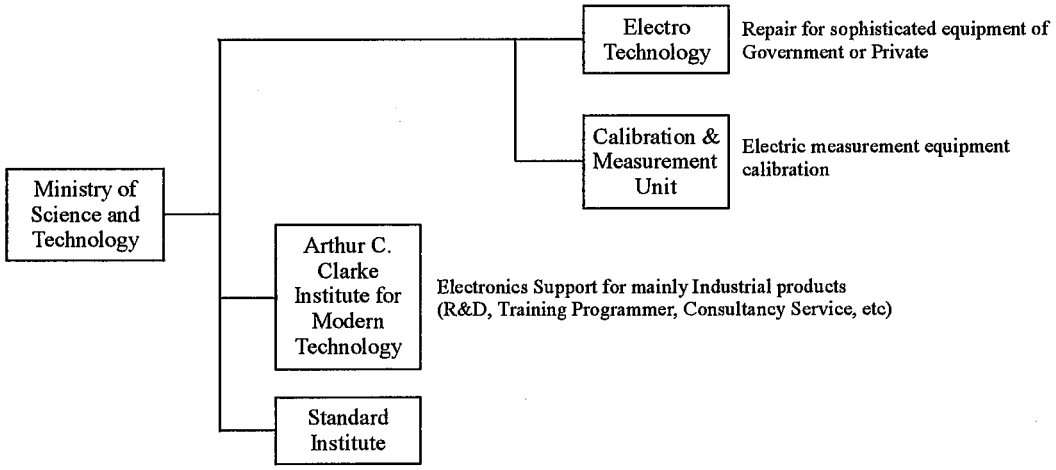
(ii) Extend information about the Electro Incubator Complex and "e-park" as an advanced infrastructure for all assembly work of the electric/electronic industry.

(iii) Establish an official evaluation system of technology, production control and quality control and promote an image that technological upgrading in Sri Lanka has been elevated substantially.

(iv) Prepare advanced infrastructure, particularly at the Electro Incubator Complex or "e-park".

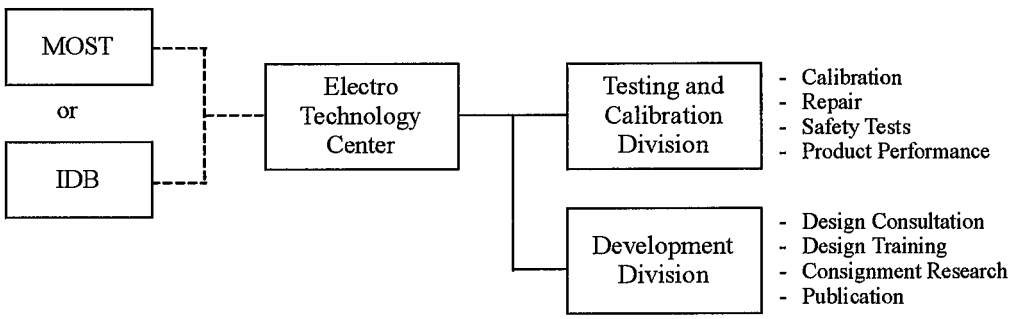
3) Restructuring of Public Institution

In relation to the proposed establishment of the "Electro Incubator Complex", restructuring of several public institutions would be required. The current structure and a proposed restructuring is discussed below.



Current Organization related to Electric/Electronic Technology

The Arthur C. Clarke Institute for Modern Technology (ACCI) contributed significantly to the technology development, including electric/electronics. ACCI's activities in the electric/electronic fields have been diminished in recent years, and they can be revitalized to function as the "Electro Technology Center". Alternatively, the "Electro Technology Center" can be developed as a center to be strengthened under the reinforcement program of IDB (refer to discussions in the Administrative/Legislative/Institutional Study). Anyway, the "Electro Technology Center" should have functions as shown below.



Function of Electro Technology Center

4. ACTION PROGRAM (2000-2004)

Action programs in 2000 - 2004 should be designed respectively for the private sector and the public sector, as proposed below.

1) Measures to be taken by the private sector

(i) Concentrate on promoting "reverse engineering" and enhancing design capabilities (as discussed in Section 3.3. (1), (2))

(ii) Promote industrial restructuring through accumulating and integrating basic functions, increasing mechanization, and establishing J/V parts and components manufacturing companies (as discussed in Section 3.5. (1))

(iii) Establish and operate an office of International Procurement Operation (IPO) to decrease material procurement cost and increase market (as discussed in Section 3.5. (2))

2) Measures to be taken by academia

(i) Reorganize curricula to cope with the changing needs of manufacturing enterprises to much more practical ones, including introduction of a credit system through real operational training at enterprises.

(ii) Collaborate more with the industry, particularly through the proposed Electro Technology Center, and make more research on demand-oriented theme and topics.

3) Measures to be taken by the public sector

(i) Reorganize public institutions and establish the proposed Electro Technology Center. Prepare a formal standard and procedures such as "safety test, "certification" and "official label". Perform both quality assurance and quality test and make open publication of official test results. Issue a technological publication as a source of information sharing (as discussed in Section 3.3. (5)). (See Box in the next page.)

(ii) Establish the proposed PCB Design and Sample Complex strategically in collaboration with the private sector. Consult with foreign advanced countries and secure experts for technical assistance for human resources development (as discussed in Section 3.5. (3)).

(iii) Prepare supporting measures to bring up specialists in engineering procurement and product marketing in the industry.

(iv) Maintain a tariff structure at the current level to promote effective technological upgrading and development of parts and components industry in the country.

4) Measures to promote FDI

(i) Promote the Electro Incubator Complex to invite foreign investors.

(ii) Develop and promote technological upgrading and preparation of advanced technological infrastructure including realization of "e-park".

(iii) Promote further mechanization, increase abilities in production control and quality control.

(iv) Improve basic infrastructure such as roads, telecommunications and electricity supply, at the Electro Incubator Complex and "e-park".

Function of Electro Technology Cener

Testing & Calibration

① Calibration	:	As currently executed by ITI
② Repair	:	As currently executed by ITI
③ Safety Tests	:	(New Function) Tests domestic products and imported products to protect consumers' safety and to guarantee standards for exports.
④ Product Performance	:	(New Function) Tests quality and performance level of domestic and imported products. Test report and be publicized.

Technology Development

① Design Consultation	:	Incorporate and reactivate functions of A.C. Clerk center
② Design Training	:	Training on design through workshop
③ Consignment Research	:	Incorporate and reactivate functions of A.C. Clerk center
④ Publication Research	:	Publish technical information and handbooks

ANNEX-I: Analytical Procedures of Import/Export Matrix

A) Data used

Statistics of Import and Export

Chapter 85; Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles.

Data are Matrix:

466 products items, 181 countries, Quantity, Amount

Year; 1996～1998

B) Selection Procedure

(1) Select the products over 100mill Rs from Import 1998 data.

(2) Select the products over 10mill Rs from Import 1998 data, and select the products increasing the quantity in these 3 years (1996,1997,1998).

(3) Select the product over 1mill Rs from Export data.

(4) From above, eliminate the product items of " parts" and "others".

(5) Finally, check one by one and then select the target products.

(6) As for selected products, add the environmental countries data.

Import/Export Matrix (1/4)

IMPORT Electric/Electronic Products & Parts List

Code No.	Products	1,996 unit	1,997 unit	1,998 unit	1,998 Rs	Tarif f %	Note
85,02	**Electric Generating sets and Rotary Converters**					**Group**	**6**
850211	Of an output not exceeding 75KVA	7,815	1,136	790	143,341,181	5	n
85021209	Of an output 75~375KVA	3,641	177	270	173,065,653	5	n
850213	Of an output exceeding 375 KVA	226	61	4,052	734,703,278	5	n
850231	Wind-powered	31	3	12	150,959,767	5	n
85,04	**Electrical Transformers, static converters and inductors.**					**Group**	**6**
850421	Having a power capacity ~ 650KVA	6,325	10,671	4,797	25,713,711	20	-
850423	Having a power capacity ~10,000KV	617,063	6	23	465,709,555		n
850431	Having a power capacity ~ 1KVA	578,928	693,983	203,413	26,235,588	20	-
850432	Having a power capacity 1~16KVA	51,605	5,883	7,695	19,811,106		-
850440	Static Converters	270,148	355,227	246,630	178,363,286	20	O
85044001	Uninterruptible power supply unit	0	0	16,408	100,498,514	free	n
85,05	**Electro-magnets; permanent magnets and articles**					**Group**	**6**
850590	Others including parts	5,312	4,112	8,081	164,858,892		p
85,07	**Electric accumulators, including separators**					**Group**	**6**
85071009	Lead-acid	196,995	0	200,043	191,973,670	20	p
850730	Nickel-cadminium	15,472	23,537	30,400	52,396,846	10	-
85,09	**Electro-mechanical domestic appliances, with self-contained electric motors**					**Group**	**2**
850910	Vacuum cleaners	2,047	3,536	4,596	17,211,795	10	O
850940	Mixer	25,081	55,525	86,854	88,031,513	10	O
85,11	**Electrical ignition or starting equipment**					**Group**	**3**
851130	Distributors, Ignition coil	77,811	158,238	97,448	20,930,655	5	-
85,12	**Electrical lighting or signaling equipment**					**Group**	**3**
851220	Other lightning or signaling equipment	340,077	411,952	415,283	80,387,137	5	-
851230	Sound signaling equipment	130,827	142,943	169,058	26,034,266	5	-
85,13	**Portable electric lamps**					**Group**	**3**
851310	Lamps	2,905,966	2,652,942	3,370,657	120,581,237	5	-
85,16	**Electric instantaneous or storage water heaters and immersion heaters**					**Group**	**3**
851640	Electric smoothing iron	156,980	206,076	215,108	87,359,798	10	O
851650	Microwave-oven	2,604	3,908	5,370	31,723,847	10	O
851660	Other ovens; Cooker, cooking plates	50,640	71,175	79,169	123,106,899	10	O
851672	Toaster	27,649	29,191	47,982	22,521,401	10	O
85167901	Electric Mosquito destroyer	2,139	2,962	5,703	6,445,866	5	-
85,17	**Electrical apparatus for line telephony or line telegraphy**					**Group**	**1,5**
851711	Line telephone set	14,669	9,519	24,500	37,545,394	5	-
851721	Facsimile machine	2,381	3,117	5,469	82,647,890	Free	-
851730	Telephone, telegraphic SW apparatus	22,270	6,369	867,117	743,402,939	Free	O
851750	Other apparatus, carrier-current system	4,302	97,647	12,194	899,180,051	Free	O
85175009		0	0	11,445	900,716,412	Free	p
85,18	**Microphones and stands**					**Group**	**1**
851850	Electric amplifier sets	2,995	2,982	4,137	20,388,950	10	O
852452	Of a width 4~6.5mm	1,168	835	22,677	3,480,441		-
85,25	**Transmission apparatus for radio telephony, broadcasting or television**					**Group**	**5**
85252001	Incorporating reception apparatus	7,598	10,707	15,773	104,395,273	Free	-
85252009	Incorporating reception apparatus	34,527	86,156	45,984	2,549,022,299	Free	O
85,26	**Rader apparatus, radio apparatus and radio remote control apparatus**						
852610	Rader apparatus	35	167	174	102,595,279	Free	n
852691	Radio navigational aid apparatus	20	42	514	42,885,057	Free	-

Import/Export Matrix (2/4)

IMPORT Electric/Electronic Products & Parts List

Code No.	Products	1,996 unit	1,997 unit	1,998 unit	1,998 Rs	Tarif f %	Note
85,27	**Reception apparatus radio telegraphy or radio broadcasting**					**Group**	**1**
85271209	Pocket-size radio cassette-players	37,501	19,372	11,858	16,617,602	30	-
85271309	Radio cassette record/players	89,587	73,844	81,295	238,646,628	30	O
85271901	Other CKD	2	2,500	3,147	306,003,662	10	O
85,28	**Reception apparatus for television**					**Group**	**1**
85281201	Color TV CKD	13,759	9,964	18,642	171,606,752	Free	O
85281209	Color TV	39,306	60,387	56,534	726,450,997	20	O
85,29	**Parts suitable for use solely or principally with the apparatus**					**Group**	**3**
85291001	Antenna	135,557	76,945	172,330	372,126,534	30	O
85,33	**Electrical resistors**					**Group**	**4**
853400	Printed-circuit	50,120	48,922	116,002	626,018,300	5	O
85,35	**Electrical apparatus for switching or protecting circuit / over 1000V**					**Group**	**3**
853510	Fuses	124,532	121,513	27,123	18,639,562	5	-
853521	Automatic circuit breaker below 72.5KV	4,465	52,662	18,170	24,531,610	5	-
853529	Other	107,466	103,056	40,586	29,901,676	5	-
853530	Isolating SW and make-and break SW	81,332	153,262	225,487	589,431,908	5	O
85,36	**Electrical apparatus for switching or protecting circuit below/1000V**					**Group**	**3**
853610	Fuse	165,041	24,439	125,810	54,520,583	5	-
853620	Circuit-breaker	244,635	292,677	347,744	300,874,632	5	O
853649	Relay, 60V or more	49,380	56,504	51,759	305,188,421	5	O
85365009	SW, Others	179,316	153,387	167,496	141,932,867	30	O
85366101	Lamp Holders	51,693	136,307	50,559	13,384,917	5	-
85,37	**Boards, panels, consoles, desks, cabinets and other bases (85,35~85,36)**					**Group**	**6**
853710	For a voltage not exceeding 1000V	84,007	192,291	83,021	149,083,056	20	O
853720	Exceeding 1000V	80,001	129,037	240,878	350,133,917	20	O
85,38	**Parts suitable for use solely with the apparatus of 85,35~85,37**					**Group**	**6**
853810	Boards, panels consoles, desks, cabinet	18,963	39,501	35,803	115,602,773	30	O
85389001	Metallic component for elec. accessories	86,285	118,593	116,036	130,596,951	10	O
85,39	**Electric filament or discharge lamps**					**Group**	**3**
853922	Tungsten halogen exceeding 100v	3,369,764	8,191,199	13,553,243	131,461,774	30	O
853931	Fluorescent Hot Cathode	982,980	942,865	1,511,742	158,276,372	Free	O
85393201	Metal halide lamps	435,438	306,035	552,526	25,962,872	5	-
85393901	For energy efficient fluorescent lump	1,473,681	1,464,754	1,936,728	109,542,745	5	-
85,41	**Diode, transistors and similar semiconductor device;**					**Group**	**4**
854160	Mounted Piezo-electric Crystal	20,132,824	30,318,720	13,932,478	35,677,994	5	-
85,44	**Insulated wire, cable and other insulated electric conductors**					**Group**	**4**
85445901	Single or multi-cord wire and cable	2,556,518	7,546,280	7,107,233	1,507,711,790	30	-
854470	Optical fiber cable	49,056	87,619	41,770	56,797,807	Free	-
85,45	**Carbon electrodes, lamp carbons, battery carbons and other articles**					**Group**	**4**
854620	Of ceramics	893,986	1,993,330	2,147,954	197,649,771	20	p
854690	Others	29,523	37,479	93,306	38,181,055	20	-
85,46	**Insulating fittings for electrical machines**					**Group**	**4**
854720	Insulating fitting of plastics	14,450	16,063	87,938	107,127,587	30	p

Import/Export Matrix (3/4)

EXPORT Electric/Electronic Products & Parts List

Code No.	Products	1,996 Unit	1,997 Unit	Unit	1,998 Rs	Note
85,02	**Electric Generating sets and Rotary Converters**				**Group**	**6**
850211	Of an output not exceeding 75KVA	28	1	0	0	-
85021209	Of an output 75~375KVA	2	1	0	0	-
850213	Of an output exceeding 375 KVA	66	42	0	0	-
850231	Wind-powered	0	0	0	0	-
85,04	**Electrical Transformers, static converters and inductors.**				**Group**	**6**
850421	Having a power capacity ~ 650KVA	9	68,716	467,112	3,430,98(	O
850423	Having a power capacity ~ 10,000KV	0	8	0	0	-
850431	Having a power capacity ~ 1KVA	1,171,029	1,300,952	1,395,207	496,406,48]	O
850432	Having a power capacity 1 ~ 16KVA	526	0	0	208,724	-
850440	Static Converters	3,738	17	30,036	37,987,64[	O
85044001	Uninterruptible power supply unit	0	0	15	1,165,557	-
85,05	**Electro-magnets; permanent magnets and articles**				**Group**	**6**
850590	Others including parts	271	48	0	216,029	-
85,07	**Electric accumulators, including separators**				**Group**	**6**
85071009	Lead-acid	49,552	0	4	4,825	-
850730	Nickel-cadminium	116	193	0	0	
85,09	**Electro-mechanical domestic appliances, with self-contained electric motors**				**Group**	**2**
850910	Vacuum cleaners	8	3	3	30,210	-
850940	Mixer	49	41	42	73,815	-
85,11	**Electrical ignition or starting equipment**				**Group**	**3**
851130	Distributors, Ignition coil	98	34,303	140,706	590,191	O
85,12	**Electrical lighting or signaling equipment**				**Group**	**3**
851220	Other lightning or signaling equipment	36,928	586	22	6,407	-
851230	Sound signaling equipment	55	20	23	5,676	-
85,13	**Portable electric lamps**				**Group**	**3**
851310	Lamps	12	10	6	12,894	-
85,16	**Electric instantaneous or storage water heaters and immersion heaters**				**Group**	**3**
851640	Electric smoothing iron	19	28	44	79,218	-
851650	Microwave-oven	16,804	5,003	13	35,000	-
851660	Other ovens; cooking plates	61	22	27	71,546	-
851672	Toaster	15	13	8	9,250	-
85167901	Electric Mosquito destroy, ™err	10	9	4	10,934	-
85,17	**Electrical apparatus for line telephony or line telegraphy**				**Group**	**1,5**
851711	Line telephone set	0	0	2	1,500	-
851721	Facsimile machine	2	6	3	102,233	-
851730	Telephone, telegraphic SW apparatus	88	3	54	2,293,67[	O
851750	Other apparatus, carrier-current system	2	2	3	340,929	-
85175009		0	0	3	58,701	-
85,18	**Microphones and stands**				**Group**	**1**
851850	Electric amplifier sets	20	11	1	7,500	-
852452	Of a width 4 ~ 6.5mm	227	2,957	25,762	2,106,80(	O
85,25	**Transmission apparatus for telegraphy, broadcasting or television**				**Group**	**5**
85252001	Incorporating reception apparatus	656	463	474	2,099,963	-
85252009	Incorporating reception apparatus	191	81	2,639	19,282,094	O
85,26	**Radar apparatus, radio navigational aid apparatus and radio remote control apparatus**					
852610	Radar apparatus	0	40	1	73,525	-
852691	Radio navigational aid apparatus	0	0	0	0	-

Import/Export Matrix (4/4)

EXPORT Electric/Electronic Products & Parts List

Code No.	Products	1,996 unit	1,997 unit	1,998 unit	1,998 Rs	Note
85,27	**Reception apparatus radio telegraphy or radio broadcasting**				**Group**	**1**
85271209	Pocket-size radio cassette-players	8	13	13	10,650	-
85271309	Radio cassette record/players	4	8	21	23,575	-
85271901	Other CKD	0	0	45	3,408,662	O
85,28	**Reception apparatus for television**				**Group**	**1**
85281201	Color TV CKD	0	0	0	0	-
85281209	Color TV	60	31	4	47,200	-
85,29	**Parts suitable for use solely or principally with the apparatus**				**Group**	**3**
85291001	Antenna	2,640	56	1,000	170,858	O
85,33	**Electrical resistors**				**Group**	**4**
853400	Printed-circuit	109,237	2,606,596	128,856	576,973,338	O
85,35	**Electrical apparatus for switching or protecting circuit over 1000V**				**Group**	**3**
853510	Fuses	40	0	7	9,104	-
853521	Automatic circuit breaker below 72.5KV	0	15,000	337	521,841	-
853529	Other	5	152	168	333,161	-
853530	Isolating SW and make-and break SW	5,397	0	0	0	
85,36	**Electrical apparatus for switching or protecting circuit below 1000V**				**Group**	**3**
853610	Fuse	104	3,007	14,003	89,293,995	O
853620	Circuit-breaker	109	490	1,005	1,653,020	O
853649	Relay, 60V or more	4,311	173	298	687,754	O
85365009	SW, Others	3,473	4,565	1,546	1,876,916	O
85366101	Lamp Holders	0	4	7,343	2,400,088	O
85,37	**Boards, panels, consoles, cabinets and other bases (85,35~85,36)**				**Group**	**6**
853710	For a voltage not exceeding 1000V	13,538	13,527	23,788	51,219,866	O
853720	Exceeding 1000V	3,332	5,495	16,451	54,075,676	O
85,38	**Parts suitable for use solely or with the apparatus of 85,35~85,37**				**Group**	**6**
853810	Boards, panels consoles, desks, cabinet	1,141,456	1,179,958	1,159,127	604,760,324	O
85389001	Metallic component for elec. accessories	0	0	961	1,892,166	O
85,39	**Electric filament or discharge lamps**				**Group**	**3**
853922	Tungsten halogen exceeding 100v	30,000	100	1,134	69,786	-
853931	Fluorescent Hot Cathode	1,069,576	802,642	606,234	78,054,038	O
85393201	Metal halide lamps	1	58,344	90,266	9,596,880	O
85393901	For energy efficient fluorescent lump	298,871	727,346	96,261	10,120,602	O
85,41	**Diode, transistors and similar semiconductor device;**				**Group**	**4**
854160	Mounted Piezo-electric Crystal	19,321,549	21,470,550	21,410,519	193,260,047	O
85,44	**Insulated wire, cable and other insulated electric conductors**				**Group**	**4**
85445901	Single or multi-cord wire and cable	14,558	82,914	82,564	16,311,439	O
854470	Optical fiber cable	0	441	1,319	1,017,449	-
85,45	**Carbon electrodes, lamp carbons, battery carbons and other articles**				**Group**	**4**
854620	Of ceramics	0	512	0	0	-
854690	Others	1,289	98	22	10,391	-
85,46	**Insulating fittings for electrical machines**				**Group**	**4**
854720	Insulating fitting of plastics	60	180	2,189	310,357	p

APPENDIX-J

INFORMATION TECHNOLOGY SERVICE INDUSTRY

J. INFORMATION TECHNOLOGY SSERVICE INDUSTRY

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J. INFORMATION TECHNOLOGY SERVICE INDUSTRY

1. OVERVIEW OF IT SERVICE INDUSTRY

1.1 Profiles of IT Service Industry

The obstacles to enter into the information technology (IT) service industry are relatively small (e.g., small initial investment, variety of market segment). The gate is wide open, but competition is hard as the IT industry is in the global cradle. For Sri Lanka, characters and/or situations of the industry are completely the same as other countries, including advanced countries. This situation is endorsed by the following evidence:

Enterprises in the IT service industry are young:

Before 1990, only 18 % of the existing enterprises in the IT service industry had been operational. 21 enterprises or 38% of the surveyed enterprises were established during the period from 1990 to 1994, and 31 % were established after 1995. The enterprises in commercial operation under BOI scheme were also set up in the late 1990s (refer to Section 1.2).

Year of Establishment

Categories	n	%
- 1979	2	3.6
1980 - 1989	8	14.5
1990 - 1994	21	38.2
1995 -	17	30.9
n.a.	7	12.7
Total	55	100.0

Source: JICA Study Team

Most of IT enterprises are SMIs:

47% of the surveyed enterprises are SMIs (defined as companies having paid-up capital of less than Rs.10 million). From the viewpoint of employment, enterprises employing less than 30 persons account for 56%. Five companies employ more than 100 persons. Judging from the paid-up capital and number of employment, the IT service industry in Sri Lanka is mainly composed of SMIs.

Capital Formation

Capital	n	%
- 0.9 million Rs.	13	26.5
1-9.9 million Rs.	10	20.4
10-49 million Rs.	16	32.6
50-99 million Rs.	4	8.2
100 million Rs. & More	6	12.3
n.a.	(6)	
Total	49	100.0

Source: JICA Study Team

Scale of Employment

Employment	n	%
1 to 9 employees	6	10.9
10 to 19 employees	12	21.8
20 to 29 employees	13	23.6
30 to 49 employees	11	20.0
50 to 99 employees	8	14.6
More than 100	5	9.1
Total	55	100.0

Employment structure is biased:

Current employment in the IT industry has reached 2,640, according to the questionnaire survey. The average number of employees per enterprise is around 48 persons.[1] The employment structure is characterized by a higher proportion of Administration and Sales which account for 13.4% and 13.3%, respectively. This is partly attributable to the fact that the major business is hardware and software sales. IT professionals, which include researchers, system engineers, and programmers, are about 930 persons in total, representing about 35% of total employees.[2]

Employment Structure

	Employees	%	Ave.*
Administration	355	13.4	6.5
Sales	352	13.3	6.4
Researcher	56	2.1	1.0
S/E	517	19.6	9.4
Programmer	359	13.6	6.5
Operator	129	4.9	2.3
Others	872	33.0	15.9
Total	2,640	100.0	48.0

*: Employees per company, unit: person
Source: JICA Study Team Questionnaire Survey.

Major equipment for the Industry is PC:

As the capability of PC increases, second by second, in both speed and storage capacity, development of computer software becomes available by PC in the wide area. The computer systems are also changing from a main frame to C/S (client & server).

Number of Equipment

	Company	NC*	Ave.**
Main Frame	2	n.a.	n.a
Midrange Computer	21	99	4.7
Unix Server	8	51	6.4
NOS Server	7	8	1.1
Others	12	40	3.3
Minicomputer	7	120	17.1
Workstation	30	279	9.3
PC Server	39	126	3.2
PC	46	1,591	34.6

*: Number of computers, **: Average number of computers per company
Source: JICA Study Team.

[1] Employment by the BOI companies in operation is 1,715. Excluding the duplicated six companies, there is an additional 800 employees in the computer software industry.

[2] The employment structure of Software Development and Data Processing Services in the Japanese SME (employees of less than 50 persons), the percentage of the S/E and programmer to the total are over 40% and 30% respectively. The bigger the company operates, the larger the S/E's proportion.

By reflecting such a change in the systems, most enterprises have midrange computers, workstations, PC servers, and PC.

1.2 Investment

BOI approved a total of 62 projects in Computer Software, of which 59 projects were approved under Section 17 of the BOI law and the remaining 3 projects under Section 16. Out of 59 projects approved under Section 17, agreements were concluded for 40 projects, of which 17 projects are in commercial operations (see Table below). The earliest project was approved in March 1991 and commenced its operation in October 1991. More than 80% of the approved projects are concentrated in the last three years from 1997 to 1999. 40 agreement-status projects are also in the similar tendency to the approved-status. In addition to 17 projects of commercial-operation-status, 6 projects were under construction as of the end of October 1999.

BOI Projects by Status and by Year

	Approved	Agreement	Operation
1991	1	1	1
1992	1	0	0
1993	1	2	1
1994	1	1	1
1995	0	0	1
1996	3	3	2
1997	10	4	1
1998	20	12	7
1999	22	17	3
Total	59	40	17

Source: BOI Data

There are 14 projects established by 100% Sri Lankan capital, while there are 25 projects of 100% foreign investment and 20 projects of Sri Lanka – foreign J/V. Total investments amounted to around Rs.3.5 billion. As for employment, 17 projects in operation created 1,715 jobs, and more than 6,000 jobs will be offered when the approved and agreement-status projects start their operation.

BOI Status Projects under Section 17

	TOTAL	Approved	Agreement	Operation
No. of Projects	59	19	23	17
Sri Lanka100%	14	2	8	4
Foreign 100%	25	7	8	10
J/V	20	10	7	3
Investment (Rs. mill.)	3,452	1,288	1,391	772
Local	1,650	584	920	146
Foreign	1,802	704	471	626
Employees (prs.)	7,709	2,697	3,297	1,715

Source: BOI

The number of projects and investment by country of origin are summarized in the table below. The top three investor countries in the number of projects are USA, UK, and India. The investment amount of Sweden is the highest, followed by UK and USA.

Number of Projects and Investment Amount by Foreign Countries

	TOTAL		100%		J/V	
	Projects	Investment	Projects	Investment	Projects	Investment
AUSTRALIA	4	99.510	4	99.510	0	
BELGIUM	2	17.700	2	17.700	0	
GERMANY	4	36.213	3	11.213	1	25.000
HONG KONG	2	86.500	2	86.500	0	
INDIA	6	31.463	1	3.300	5	28.163
JAPAN	3	71.681	2	66.500	1	5.181
LUXEMBOURG	1	43.500	0		1	43.500
NEW ZEALAND	1	6.000	0		1	6.000
RUSSIA	1	5.000	0		1	5.000
SWEDEN	2	645.000	1	225.000	1	420.000
UAE	1	70.000	1	70.000	0	
UK	9	132.622	4	95.200	5	37.422
USA	11	130.461	6	85.029	5	45.432
	47	1375.650	26	759.952	21	615.698

Source: BOI

1.3 Market

Computerization is in the cradle:

Obviously the extent of computerization is a base for the domestic IT services industry market. There is no authorized statistic data of the number of working computers in Sri Lanka, and it has been estimated on the basis of the existing survey, the questionnaire survey, and the trade statistics.

The Sri Lanka Computer Vendors Association (SLCVA) submitted a report on a market research on the computer industry in August 1997. The survey was conducted by interviews with its member companies and some other vendors. This interview survey revealed that around 40,000 of computers were installed or sold in the last 12 months, including PC, Mini, and Workstation. PC accounted for 96.5% of the total installation. About 85% of the total PC (or 33,742 units) was imported, and the rest was assembled locally. The installed computers by type are summarized below.

Number of Installed Computers (1997)

	Installed Computers			Of which in 1996/7		
	Total	Import	Local	Total	Import	Local
PC stand alone	8,218	7,856	362	1,688	1,593	95
PC networked	30,357	24,599	5,758	6,789	5,254	1,535
Minicomputer	431	424	7	101	101	
Workstation	961	863	98	304	274	30
Total	39,967	33,742	6,225	8,882	7,222	1,660

Source: Report on a Market Research on the Computer Industry, August 1997, SLCVA

The above 40,000 units of computers do not represent the total installed computers in Sri Lanka. Further reference is made to the imported computers during the period from 1992 to 1998 as follows:

Quantity of Imported Computers and Peripherals

(units)

Description	1992	1993	1994	1995	1996	1997	1998
Portable digital automatic data processing machine	4,611	27,497	6,143	7,629	4,830	5,459	8,526
Comprising in the same housing at least a CPU and IO units					1,772	599	3,323
Other, presented in the form of system					641	137	366
Digital processing units other					10,889	3,696	4,081
Input or Output Units	13,170	11,926	6,887	5,904	1,703	7,677	14,475
Storage Units	7,124	18,997	15,418	3,827	107	646	2,408
Other units of automatic data processing machines					1,278	6,427	8,355
Others					5,349	9,134	22,384

Source: Customs Office

The computers in the previous table include "portable digital automatic data processing machine", "comprising in the same housing at least a CPU and IO units", "other, presented in the form of system", and "digital processing units other". The items of "input or output units", "storage units", "other units of automatic data processing machines", and "others" are mainly peripherals though some of them are combined to the computer system. The number of computers imported from 1992 to 1998, therefore, is estimated to be about 90,000 units at least. If the rate of locally assembled computers to the total sold computers (20% in 1996/7) is applied, the number of working computers in Sri Lanka is estimated to be around 112,700 units. The number of PCs is, therefore, estimated to be around 109,000 units including locally assembled ones. This estimate, however, should be underestimated. It will be safe to say that the total number of working computers in Sri Lanka is not beyond 200,000[3].

The computerization in Sri Lanka, therefore, is far behind the NIEs ASEAN, and other countries. In order to expand or promote the IT services industry in Sri Lanka, further computerization should be promoted.

Internet shall be the backbone:

Privatization of the Internet, which was born as the ARPANET and developed by the NSF (National Science Foundation) in the USA, began with the establishment of private ISPs in the late of 1980s. In fact, the Internet attracted wide attention from the 1990s. The epoch came in 1993 when the Mosaic (the first Web browser) was distributed openly. The Hosts (Domains) numbered more than 56 million in July 1999, an increase from 1.8 million in July 1993, at a growth rate of 78 % per annum. In parallel with this growth in hosts, the number of Internet subscribers have expanded tremendously and reached 133.2 million in the world in 1998.

Compared with the global explosion of the Internet, the situation in Sri Lanka is in the infant stage. The Internet age in Sri Lanka began in 1997. In 1996, there were seven Data Communications Services (DCS) enterprises with 355 subscribers. The Sri Lanka Telecom (SLT) started to provide Internet services in the same year. The number of DCS subscribers in 1997 were 11,745, of which 87 % enjoyed the Internet services. The number of subscribers reached 17,214 at the end of 1998 and 21,777 in June 1999. Despite a rapid increase in Internet subscribers, Sri Lanka still remains at a low level of subscription. The number of

[3] This figure should be underestimated since the computers imported before 1992 and those combined by imported individual units, not assembled ones, were excluded. Furthermore, the computers donated by the donor countries and individually bought in foreign countries were excluded. If the computers were imported in the same volume as in recent 8 years, the total accumulated number since 1965 would be 217,500 units.

Hosts (983 domains) ranked 90th in the world. The number of Hosts per 10,000 inhabitants is only 0.5 (for reference, the number of Hosts per 10,000 inhabitants is 1,065 in Finland and 899 in the USA). In the region of Asia and the Oceania, Australia is the most advanced country with 433 hosts per 10,000 inhabitants. The diffusion rate of the Internet in Sri Lanka is 0.1 %, or remained at the same level as China in 1998.

Situation of Internet in Asia and Oceania

Number of Hosts

Country	Domain	Number of Hosts	HN/ 10,000 person
Japan	jp	1,687,534	134
Australia	au	792,351	433
Chinese Taipei	tw	308,676	143
Republic of Korea	kr	186,414	42
New Zealand	nz	137,247	384
Hong Kong	hk	82,773	134
Singapore	sg	67,060	221
Malaysia	my	47,852	24
Thailand	th	20,527	3.7
India	in	13,253	0.1
Sri Lanka	lk	983	0.5

Source: Network Wizard Inc. and Other

Internet Subscribers

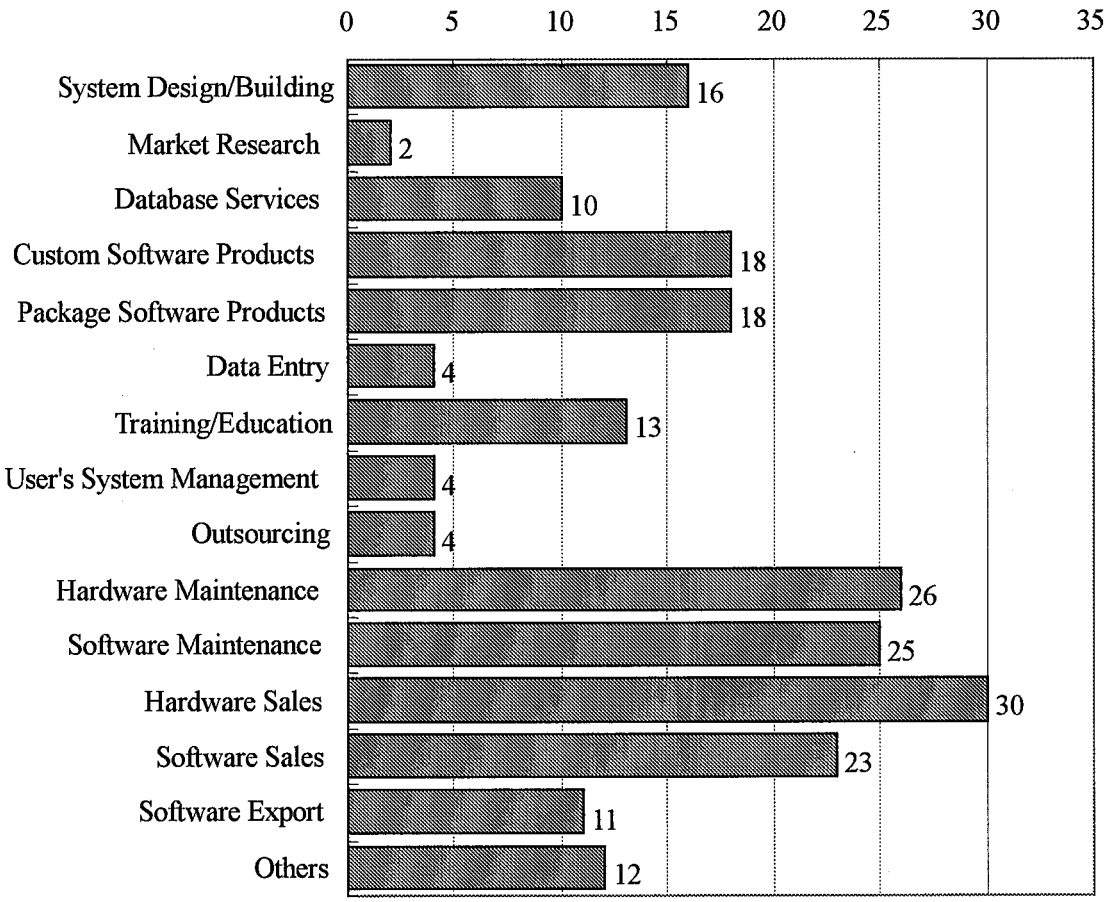
Country	Subscribers	Diffusion Rate	Population
Australia	400	22.2%	1,800
Singapore	55	18.3%	300
Hong Kong	110	18.3%	600
New Zealand	55	15.3%	360
Chinese Taipei	300	14.3%	2,100
Japan	1,400	10.8%	13,000
Republic of Korea	200	4.6%	4,400
Malaysia	40	2.0%	2,000
Thailand	65	1.2%	5,500
India	40	less than 0.1%	91,100
Sri Lanka	2.2	0.1%	1,800

Note: Units of Subscribers and Population are 10,000 persons.
Source: Access Media International, 1999

1.4 Types of Business and Turnover

The questionnaire survey revealed that 30 companies or 55% were running Hardware Sales Business. The entries of businesses in data entry, customers' system management, and outsourcing are still relatively small, though they are growing in the developed countries. One of the reasons for a tremendous growth of the IT services industry in India is attributable to the start with data entry and remote solution business.

Types of Business



Source: JICA Study Team Questionnaire Survey

The total amount of turnover is estimated to be Rs.5,576 million according to the questionnaire survey. Under the definition of the IT industry by the US Department of Commerce, (inclusive of Hardware Sales and Hardware Maintenance), the turnover of the IT services industry in Sri Lanka (exclusive of Telecommunications and Broadcasting) was estimated to be Rs.3,944 million in 1998. When the value added ratio to the turnover is assumed to be 40%, the value added by the IT services industry in Sri Lanka is estimated to be Rs.1,820 million,[4] excluding 15 companies of BOI status[5]. It accounted for 0.2% of GDP in 1998. The turnover by type of business in the IT services industry is tabulated as follows.

[4] The value added is calculated excluding the export in accordance with the following formula:
Value Added= {(Total Turnover) – (Software Export)} x 0.4 + (Software Export)

[5] If BOI-status enterprises had the same per-capita turnover as the surveyed companies, the turnover is estimated to be Rs.5,382 million. The value added is, therefore, estimated to be Rs.2,541 million.

Turnover by Type of Business

(RS. 1,000)

Types of Business	Turnover
System Design/Building	438,480
Market Research	13,230
Database Services	75,900
Custom Software Products	339,570
Package Software Products	1,330,170
Data Entry	32,927
Training/Education	204,376
User's System Management	28,460
Outsourcing	27,060
Hardware Maintenance	558,112
Software Maintenance	346,469
Hardware Sales	1,073,705
Software Sales	400,710
Software Export	402,765
Others	303,930

Source: JICA Study Team estimates

1.5 Major Customers

The major customers in the domestic market are found to be as tabulated below.

Domestic Customers

No.	Categories	n	%
1	Central Government	24	47.1
2	Local Government	21	41.2
3	Other Public Sector	30	58.8
4	University	24	47.1
5	Training School/Institutes	20	39.2
6	High School	9	17.6
7	Other Education Organizations	16	31.4
8	Agriculture/Plantation	10	19.6
9	Construction	13	25.5
10	Manufacturer	24	47.1
11	Financing & Banking	30	58.8
12	Communications	25	49.0
13	Transportation	7	13.7
14	Wholesaler & Retailer	24	47.1
15	Real-estate & Construction	9	17.6
16	Other Services	6	11.8
17	Others	4	7.8
	Total	(51)	

Note: Multiple answers by 51 enterprises
Source: JICA Questionnaire Survey.

"Other public sector" and "financing & banking" are major customers, followed by "communications", "central government", "manufacturers", and "wholesaler & retailer".

With respect to foreign customers, 19 companies out of 51 surveyed enterprises have foreign customers. The major subsector is "Manufacturer", followed by "Communications" and "Wholesaler & Retailer". The foreign customers are clarified as summarized below.

Foreign Customers

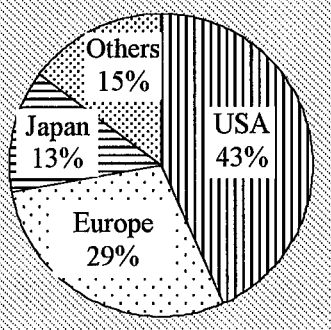
Categories	n	%
Central Government	2	10.5
Local Government	2	10.5
Other Public Sector	2	10.5
University	2	10.5
Training School/Institutes	2	10.5
Other Education Organizations	2	10.5
Manufacturer	7	36.8
Financing & Banking	3	15.8
Communications	5	26.3
Wholesaler & Retailer	4	21.4
Other Services	4	21.4
Others	2	10.5
Total	19	100.0

Note: Multiple answers by 19 enterprises.
Source: JICA Questionnaire Survey

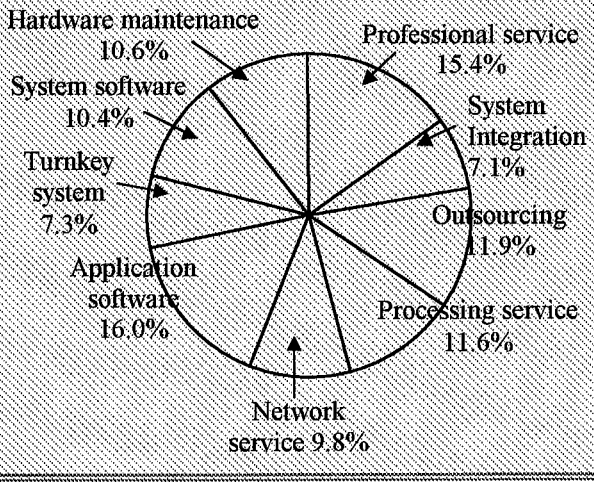
Current Market in the World

The market of IT service industry in the world was estimated to be around US$553 billion in 1997. The USA was the largest market with US$240 billion, followed by whole Europe with US$160 billion and Japan with US$72 billion. The business structure in the USA is also shown below.

World Market
US$553 billion



Business
Structure in USA



1.6 Export

Of the surveyed enterprises, 11 companies have experience in software export. Their export amount is estimated to be Rs.403 million. On the other hand, ten BOI-status companies in commercial operation reported that their export value would be Rs.630 million in software and/or its service. Consequently, the total export value of the IT services industry is estimated to be around Rs.1,000 million in 1999. In the event that all BOI companies in the agreement and approved status are in operation, the expected export value would amount to Rs.7.7 billion, which is 5 times the targets (Rs.1.5 billion) set by the NEDP for 2002 (refer to the Column below). This figure (Rs.7.7 billion) is equivalent to the export value of the "Food, Beverages, and Tobacco" industry or double the "Gems and Jewelry" industry in 1998.

Planned Export by BOI Status Companies

Status	Companies	Exporting Company	Export (Rs. million)
Approved	19	11	5,839
Agreement	23	20	1,249
Commercial	17	10	648
Total	59	41	7,736

Source: BOI

Export Target by NEDP: Computer Software Export

EDB submitted the National Export Development Plan (NEDP) in January 1998, covering the period from 1998 to 2002. The Computer Software was included in the service export sector. Under the NEDP, the computer software export is projected to increase from Rs. 390 million in 1996 to Rs. 1,490 million in 2002, with an average annual growth rate of 25%.

Targets of Computer Software Export

(Rs. Mn)

Year	1996	1998	1999	2000	2001	2002	a.g.r. %
Export	390.63	610.36	762.95	935.69	1,191.11	1,490.14	25.00

a.g.r. = Average Growth Rate during the Planning Period from '98 to '02.

1.7 Telecommunications

Telecommunications is included in the IT industry in a broader sense, as the services by the telecommunications sector range from telephone to information exchange. In this study, however, telecommunications is regarded as infrastructure for the IT services industry.

The liberalization of the telecommunications sector in Sri Lanka started in 1991. SLT was privatized in 1996. After liberalization, private enterprises (24 companies in total) entered into the sector. However, SLT, after privatization, kept the leading position. SLT provides the most of the fixed telephone services and all the international telephone services. The number of employment in this sector reached around 10,900, of which SLT accounted for 80 %.

Fixed Telephone

Investments in the line expansion have been increasing sharply. The increment of lines in 1996 and 1997 was 50,150 and 60,714, respectively. In the year 1998, it was increased by 140,357 lines. In the first half of 1999, such an increment was accelerated by SLT (75,433 lines). By the year 2000, SLT will attain its target to expand 600,000 lines. Due to the rapid expansion of the lines, the waiting list for telephones was reduced from 284,876 at the end 1997 to 244,441 at the end 1998. Since the demand for telephones was further expanded, the waiting list at the end of June 1999 was slightly larger than that of the previous year. The telephone density, however, still remains at a low level, or 2.79 per 100 habitants, though the lines were increased by 2.5 times in the last 5 years.

Cellular Phone

Cellular phone services are provided by four private enterprises. The number of subscribers was around 50,000 or 1/4 of the fixed phone subscribers in 1995. The expansion of the cellular phone reached 20,000 in 1996, 43,000 in 1997, and 59,000 units in 1998. At the end of June 1999, the number of cellular phone subscribers exceeded 205,000 or about 40% of fixed telephones.

Wireless Local Loop Telephone

Two operators are providing WLL telephone services to 82,657 subscribers as of the end of June 1999. The services are now provided mainly in Colombo but the potentials are high in the suburban or rural areas, as the initial investment in line construction is less than the fixed telephone system.

The other telecommunication services are public pay phone, paging services, and data communication service. The performance of the major operators for telecommunications is summarized in the following table:

Telecommunication Services

		1995	1996	1997	1998	1999*
SLT	N. Lines	204,350	254,500	315,241	455,598	531,041
	Waiting	237,800	270,800	284,876	224,441	244,701
	Tel. Density**	1.12	1.39	1.694	2.43	2.79
Cellular Phone	Operators	4	4	4	4	4
	Subscribers	51,316	71,028	114,888	174,202	205,275
	Investment***	4,139	5307	6,870	8,842	8,848
Public Pay Phone	Operators	4	4	4	5	5
	Tel. Booths	1,597	2,152	2,571	4,610	5,252
	Investment***	424	610	718	1,090	1,082
Paging Service	Operators	5	5	5	5	4
	Subscribers	9,565	10,721	10,829	10,511	10,172
	Investment***	210	221	222	222	222
Data Communication Service	Operators	6	7	8	8	9
	Subscribers	273	355	11,745	19,019	23,714
	Investment***	434	574	665	768	810
Wireless L.L. Telephone	Operators	-	2	2	2	2
	Subscribers	-	527	26,381	67,931	82,657
	Investment***	-	1,743	6,796	9,291	11,084

*: End of June 1999, **: per 100 person, ***: Total cumulative investment (Rs. million)
Source: Central Bank of Sri Lanka Annual Report, Sri Lanka State of the Economy 1999

1.8 Manpower

Manpower development or HRD is evaluated from the two viewpoints: pre-employment and post-employment.

Post-employment education/training

About 88% of IT service companies provide their employees with training and/or education. 37 enterprises, or 72% to the total, have in-house training programs. It is reported that 15 companies sent their employees for training abroad. The education/training period appears to be relatively short, 2 to 3 weeks, and it is followed by mid-term training within 3 months.

Education and Training by IT Enterprises; Types and Period

	Short term	Mid-term	Long term	Others	Total
In-house own prog.	20	15	5	4	37
SL organs	16	10	5	-	25
Foreign organs	12	7	2	-	15
No programs	-	-	-	-	5
Others	-	-	1	-	2
Total	24	17	7	4	-

Note: Multiple answers
Source: JICA Questionnaire Survey.

Pre-employment education/training

<<University>>

There are 11 universities in Sri Lanka, except for Open University, as of the end of 1999. Total intake of undergraduates in the 1996/97 academic year was 11,381. The intake by the physical science and engineering faculties, who had the possibilities to join the IT related studies, were 2,027. The total graduates from universities in 1996 were 6,233, of which 1,774 students graduated from the faculties of Science and Engineering. Since the computer science department is a part of such faculties, the graduates from them were quite limited. It is estimated that the higher education systems outputs around 200 graduates per year in computer science, electronics and telecommunications engineering. When such graduates got jobs in private IT related companies, most were employed as system engineers and researchers. Judging from a S/E and researcher ratio to the total employment in the IT industry (27.5%), this rate is relatively low[6]. Obviously, some of the graduates will join the other sectors, so the supply capacity to the IT service industry is further reduced, or it is less than 200 students. Since the BOI approved projects in the IT industry would require that the 1,650 S/E and researchers at minimum within a couple years, the supply by the higher education systems is absolutely insufficient. (The output from universities excludes the Post Graduates but they are less than half of the undergraduates). Other B.Sc. level students are provided by NIBM, ICT[7] (Institute of Computer Technology), and Open University but their output is relatively small.

There are 150 institutes that have computer training courses (457 courses in total) in the country. About one-third or 46 institutes are located in Colombo. Of the total courses, 327 courses are part-time and the average training period is 5.8 months. 107 courses are full time, with an average training period of 6.9 months. The number of IT training institutes by region, as well as courses by type, is summarized in the following tables:

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[6] Refer to the footnote 2 on page J-2.

[7] ICT starts the course of "external degree" for IT. The intake of such course will be 500 students.

Number of IT Training Institutes by Region

Region	Number	%	Region	Number	%
Ampara	2	1.3%	Kegalle	6	4.0%
Anuradhapura	8	5.3%	Kurunegala	13	8.7%
Badulla	6	4.0%	Matale	2	1.3%
Batticaloa	1	0.7%	Matara	6	4.0%
Colombo	46	30.7%	Monaragala	2	1.3%
Galle	9	6.0%	Nuwara Eliya	2	1.3%
Gampaha	15	10.0%	Polonnaruwa	2	1.3%
Hambantota	4	2.7%	Puttalam	5	3.3%
Kalutara	8	5.3%	Ratnapura	2	1.3%
Kandy	10	6.7%	Trincomalee	1	0.7%
			Total	150	100.0%

Number of Courses Offered by IT related Institutes

Course	Numbers	Months
Part-time	327	5.8
Full-time	107	6.9
PT/FT	8	5.8
na.	15	
Total	457	

<<Private Institutes>>

The number of private institutes for IT is increasing because computer literacy is required in enterprises. It is reported that some private institutes are unable to provide training of an acceptable standard. Under this situation, CINTEC in cooperation with ACTOS (Association of Computer Training Organizations) started the National Examination for Information and Communication Technology (NEICT) to standardize the training quality in private institutes. NEICT consists of four stages; national diploma in applied computing, national advanced diploma in applied computing, professional diploma in information and communication technologies, and master diploma in information and communication technologies. The syllabi for each stage are prepared in cooperation with India. At the end of 1999, about 26 private institutes provide lectures for National Diploma along with such syllabi and 9 institutes for National Advanced Diploma. The other two courses are scheduled to start in 2001. The examination is conducted by modules, and CINTEC awards a diploma to successful candidates.

<<Public Institutes>>

The Institute of Computer Technology (ICT) was established in 1987 with the objective of educating students for careers in IT as programmers and systems analysts. ICT has

postgraduate diploma courses and certificate level courses. The regular programs offered by ICT are:

- Postgraduate Diploma: Full time 1 year, 40 personnel
  Part-time 2 years, 40 personnel
- Graduate Training Program: 3-6 months, 200 personnel
- Certificate Courses: 1 year / 3years working experience
- Use of IT for Development: 6 months, 80 personnel
- Software Design & Development: 6 months.

In addition to these regular courses, ICT provides various short term training courses and seminars (e.g. Auto CAD, C/C++, JAVA, LAN, Multimedia Technology, and Internet Technologies). To cope with the shortage of IT engineers, ICT launched a new 3-year scheme; External Degree in IT for 500 students.

NIBM started a diploma course in computer system design in 1979 and a higher diploma course in 1988. Further, in 1996 NIBM started B.Sc. degree program in collaboration with UCD of Ireland. The output of NIBM is 350 graduates from Diploma, 50 from Higher Diploma, and 30 from B.Sc.degree.

SLIIT was established in 1999 and started its Diploma in January 2000. The objectives are human resources development in IT, to strengthen manpower pool in IT, establishment of the Computer Software Development Center (CSDC), and establishment of R&D incubator (RDI). CSDC and RDI will be established in 2001. Diploma course is a full-time two-years program consisting of about 680 lecture hours and around 70 hours for project. Annual intake is 200 on the Colombo campus and plans to expand in the future. Tuition fee is Rs.120,000 in total (this annual tuition fee is equivalent to GDP per capita). The staff of SLIIT is about 30.

1.9 Policy Measures

The BOI law defines two kinds of investment approval; one is known as approval under Section 17 and the other under Section 16. Under the BOI scheme, the IT services industry is defined in a relatively narrow sense; i.e., Computer Software and Data Entry Operation (hereinafter called Computer S/W). Since Computer S/W is appointed as a thrust industry, the incentives under Section 17 are provided subject to the qualifying criteria. The incentives providing to Computer S/W are summarized as follows.

BOI Incentives

Software Development	Minimum direct / indirect export (%)	Minimum new employment	Full Tax Holiday	Concessionary Tax 15%	Import Duty Exemption	Exemption from Exchange control
Domestic market oriented	0-69 %	25 technical persons	5 years	As per IR Tax Law	Yes	No
Export oriented	More than 70%	25 technical persons	8 years	12 years after tax holiday	Yes	Yes

Source: BOI

BOI provides another scheme under Section 16, which provides incentives under the Normal Law. Computer S/W and telecommunications enjoy these incentives (e.g., exemption of import duty of equipments and 5-year-income-tax-exemption). By the end of October 1999, three projects have been approved under Section 16 with investment amounting to Rs.14,350 million and employment of 272 personnel.

Comparison between Sri Lankan and Indian IT Industries

Based on the interview survey in Sri Lanka and India (Bangalore), basic conditions to promote the software industry have been compared as shown in the table below. It should be noted that India began to encourage the IT industry only 15 years ago.

Items		Sri Lanka		India (Bangalore)	
Manpower	Quality	Potential Experience	H M	Potential Experience	H H
	Quantity	Small No. both Degree & Diploma	L	Large No. both Degree & Diploma	H
Market	Domestic	Small (P &F)	L	Small (P) Large (F)	M
	International	Small	L	Large	H
Infrastructure		Shortage	L	Not Sufficient	M
Incentives		BOI Scheme	H	SPTI, GoK Scheme	H
Industry Scale		Small	L	Enough	H
Hardware Industry		Small	L	Good	M
English Communication		Good	M	Excellent	H
Recognition		Fair	L	Excellent	H

Note: H high, M middle, low P present, F future; SPTI Software Technology Park India; GoK Government of Karnataka; Recognition indicates whether the client in the world recognizes it as a software venders base.

Source: JICA Study Team

Incentives in Multimedia Super Corridor (MSC)

The Government of Malaysia provides the financial and non-financial incentives to the MSC-Status organization consisting of companies, institutions, and faculties. One of the features of MSC is to target the "organizations" related to multimedia activities including the manpower development rather than export-oriented companies. It is observed that the Government of Malaysia has the intention to change the basic policy of industrial promotion. Qualification of the criteria for MSC status is summarized below:

> Malaysia is pleased to offer MSC status to Malaysian and international companies prepared to set-up operations within MSC or otherwise contribute significantly and strategically to MSC's development. Companies seeking MSC status and eligibile for incentives will need to fulfill three criteria: **first**, they must be a provider or a heavy user of multimedia products and services; **second**, they must employ a substantial number of knowledge workers; and, **third**, they should be able to outline how they will transfer technology and/or knowledge to Malaysia, or otherwise contribute to the development of MSC and the Malaysian economy. (www.mdc.com.my/status/)

The financial incentives provided by the Government of Malaysia are composed of:

- 5-year-income tax exemption and renewable up to 10 years, or a 100% Investment Tax Allowance for 5 years,
- Duty-free importation of Multimedia equipment, provided that the equipments is used by the MSC-status organs in operation of the business, and
- Provision of R&D grants for the SMEs in MSC that are at least 51% Malaysian owned.

The non-financial incentives are also granted in the following manner:

- Unrestricted employment of foreign knowledge workers for MSC-status organs,
- Provision of the free-ownership restricted in the MSC designated Cybercity*, and
- Freedom to source capital globally for MSC infrastructure development and the right to borrow funds globally with exemption from exchange control requirement subjected to operate its business in the designated Cybercity.

The level of the incentives for MSC-status companies by the Government of Malaysia is the same as that provided by BOI in Sri Lanka except for the qualifying criteria of the export-condition. In the multimedia sector or IT sector, the market is in the world therefore the condition of the export becomes meaningless.

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*: In Malaysia there is a rule of 30% Bumiputra Participation, which requires for all businesses operating in Malaysia to employ Bumiputra (Children of the Land) at least 30% to the total and at every position.

2. STRENGTH AND BOTTLENECK

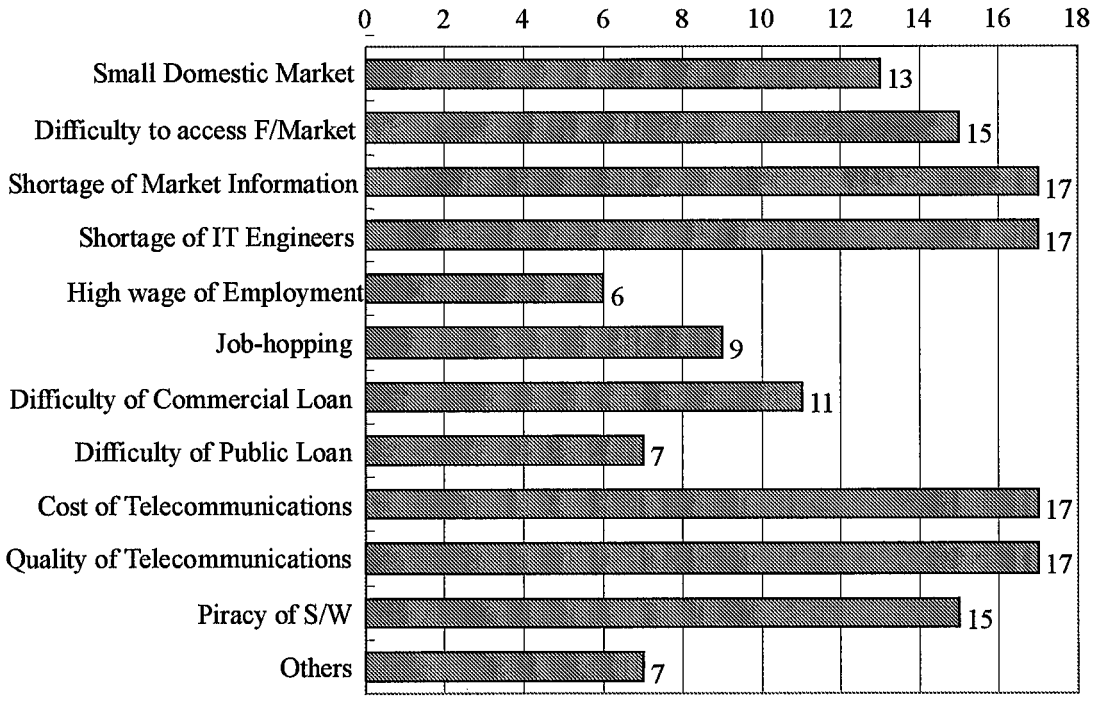
2.1 Weaknesses and Strengths

1) Issues to be Addressed

The major constraints faced by the IT services industry in Sri Lanka are (i) shortage of market information, (ii) shortage of IT engineers, (iii) cost of telecommunications, (iv) quality of telecommunications, (v) difficulty of access to foreign market, (vi) piracy of software, and (vii) small domestic market. These constraints are categorized into three issues as follows:

i) Manpower,
ii) Infrastructure (telecommunications), and
iii) Markets.

Constraints of IT Enterprises Surveyed



Source: JICA Questionnaire Survey

Education / Training system is insufficient to meet the increasing demand:

17 enterprises or 1/3 of the surveyed companies faces the shortage of IT engineers. This shortage becomes more acute when BOI-status enterprises start their operation. Universities are main players to supply IT engineers, but they have difficulties in expanding their capacity. Such difficulties are caused, in principle, by the following:

- Shortage of facilities,
  (Hardware, software, laboratory equipment, Internet services, building space)
- Inadequate flexibility of administrative structure, and
  (Difficulty to cope with a high demand)
- Low evaluation for future potential of IT.

Though NIBM has B.Sc. degree programs, its capacity is limited. Expansion of the capacity is difficult due mainly to the following:

- Lack of resources and staff
- Less attractive working conditions (low wage to occupy the vacant staff position)

SLIIT is a newly established institute that provides 200 diplomas. The first graduates will come out at the end of 2001. On the other hand, private IT institutes are criticized that their trained personnel are inadequate to satisfy the requirements by IT service enterprises. Private institutes are in shortage of qualified instructors, adequate equipment and software, and training materials. Quality improvement of these private institutes is indispensable.

IT service industry requires upgrading of the telecommunications systems:

17 enterprises out of the surveyed companies pointed out that the quality and price of telecommunications should be improved. As products of IT services enterprises are marketed through telecommunications, the high-level telecommunications service at reasonable prices is a key to enhance the IT service industry. The international dedicated line service is almost equivalent to India and Singapore. To be competitive with such countries, more attractive conditions should be provided, as the ordinary international service price is relatively expensive in Sri Lanka. In the near future, the Internet will play a more important role of IT service export. The capacity and speed of the Internet are essential for commercial use. The current international link capacity (2Mbps) is inadequate to meet the demand.

Domestic market is small and foreign market information is limited:

13 enterprises out of the surveyed companies pointed out the limited domestic market as a constraint. Computerization in the industry, public sector, and household is still in the infant stage. The government recognizes such a situation and plans to introduce computers into classrooms and government offices. Further, a small market causes another problem, i.e., piracy. Pirated programs from home-use to business application are found in Sri Lanka. At the less computerized stage, it is usually observed that software is premium of hardware. Developers are apt to disregard such a small market. This habit is expected to continue at the stage of computerization and discourages the incentives to develop various applications, including ad-in programs. 15 surveyed enterprises pointed out the piracy problem.

New industry requires new incentive system:

BOI incentives are effective as the number of approved projects increased in the last 3 years. They are equivalent to the incentives provided by SPTI in India and MSC in Malaysia. On the other hand, it is improbable that investment in the IT industry satisfies the criteria required to employ more than 25 technical personnel and to export their products. The average number of technical personnel of the surveyed enterprises is less than 20, and most of them are unable to enjoy BOI incentives. Since there are many examples of global companies which started with a few employees, the new incentive scheme would be required.

Institutional restructuring enhances competitiveness:

CINTEC, apex organization of IT, covers all the fields related to IT under the limited staff and budget (e.g. computer education from primary school to professional training, office function of IT industry from software to hardware, EDI, Domain name approval). The mission given to CINTEC is beyond its capability. Technological changes in IT are so rapid that the public and private sectors should respond to such quick changes.

2) Strength

Well-educated manpower is only a resource to strengthen the IT services industry. Software development, for example, is labor intensive and requires so-called knowledge-workers. It is learned that one of the major reasons for the rapid growth in the Indian IT industries is rich educated manpower. Although the shortage of technical personnel is now the problem for the IT service industry in Sri Lanka, the potential to supply "knowledge workers" is large enough in Sri Lanka.

IT service enterprises worldwide face the difficulties in the shortage of engineers and rising wages. It is widely known that the IT service industry in Costa Rica and in India expanded their export of software and IT related services to the USA at competitive labor costs. In India, especially in Bangarole, wages of IT engineers are rising and the business condition is getting less attractive than before, though the supply of manpower is attractive. Such difficulty is endorsed by the fact that 6 Indian software companies applied and were approved by BOI for investment in Sri Lanka.

Subject to re-arrangement of educational organizations, the potential supply of "knowledge workers" is the largest asset to develop the IT service industry in Sri Lanka.

2.2 Bottleneck

Bottlenecks to enhance the IT service industry in Sri Lanka are the same as the issues to be addressed for its development, as discussed in Section 2.1. Those issues or bottlenecks are summarized in the following items:

(i) Manpower Development
- Shortage of supply capacity of technical personnel
- Obsolete equipment and education materials in training organizations

(ii) Infrastructure
- Capacity and speed of telecommunications line

(iii) Market
- Small domestic market
- Limited market channel to foreign market

(iv) Organization
- Lack of capability of apex organization for IT
- Lack of cooperation among the ministries and institutions related to IT

The Master Plan for development of the IT service industry in Sri Lanka is formulated to break through these bottlenecks, in a strategic manner in the short term (2000-2004) and in the medium/long term (2005-2010).

3. MASTER PLAN FOR IT SERVICE INDUSTRY

3.1 Framework

Infrastructure is gradually developed:

Based on the population and per-capita GDP projected for 2004 and 2010, the number of telephone subscribers and waiting list (hidden demand) are estimated as tabulated below. In this projection, it is expected that the telephone density will increase to around 5 per 100 inhabitants in 2004 and 7 in 2010, though the diffusion rate of telephones in the whole country will remain at a lower level.

Projected Number of Telephone Subscribers and Waiting List

	1998 (Actual)	2004	2010
Population (POP)	18,774,000	20,167,000	21,630,000
Per capita GDP (GDP/POP)	US$840	US$1,110	US$1,590
Expressed Demand c-1	455,598	960,372	1,465,014
Expressed Demand c-2	-	1,047,095	1,597,305
ED includes hidden Demand	680,039	1,256,110	1,916,150
DELs per 100 habitants	2.43	4.76 – 5.19	6.76 – 7.37

Note: Unit: Population is persons, Express Demand c-1, c-2, and hidden demand are number.
Source: JICA Study Team estimates based on "the Study on Telecommunications Networks in the Democratic Socialist Republic of Sri Lanka, 1996 by JICA".

Internet subscribers exceed 1% of population in 2004:

It becomes a real world that the Internet makes the existing business model change globally. This change will affect manufacturers in their procurement systems, marketing systems, and so on. To survive in the world of a mega competition, the "digitization" in the manufacturing sector is crucial. Under such circumstances, the Internet usage in the business and manufacturing sectors will expand gradually toward 2004 and explode in the subsequent stage. Total number of subscribers to the Internet will exceed 200,000 or 1% of the population in 2004. The experience in the advanced countries suggests that, when the subscribers pass the critical mass or 1% of population, the users increase explosively. Sri Lanka will follow the same pattern. Consequently, Internet users in 2010 will be more than 1.1 million habitants or 5 % of the population[8].

Computerization is accelerated:

The diffusion rate of computers, an index of computerization, is estimated to be in the range from 0.7% to 1.0% in 1998. The computerization will be accelerated to the level of 4% or

[8] Estimate is made on the basis of the experience in the Asia and Oceania countries. It took 6 years to exceed 1% of population in average and to reach 3% within the subsequent 3 years.

800,000 units in 2004, and 10 % or 2.1 million units in 2010. About 1/4 of working computers in 2004 and half in 2010 will be connected to the Internet. To achieve such computerization, the government initiatives will play an important role (e.g., to introduce computers to classrooms, to spread low price computers, and to introduce computers to the government offices).

FDI in the computer software industry grows steadily:

During the last decade, BOI approved 59 projects in the computer software industry of which 52 enterprises or 88% were approved in the last 3 years. 42 projects in the agreement and approved status will be in operation within a couple of years[9]. Since the computer software industry has been designated as a thrust industry, the investment promotion efforts by BOI will be continued. In the event that new measures are taken in addition to the BOI activities, they would accelerate to attract investment in the IT service industry including computer software. It is estimated that 100 BOI-status enterprises in the IT service industry will be in operation by 2004. In parallel to the expansion of FDIs, the domestic investors will enter into the IT service industry. As a result, the total number of enterprises in the IT service industry will be around 200 by 2004. In the latter stage from 2005 to 2010, the projects applied to BOI will decrease if compared with the former period. The turnover of the IT service industry, however, will continue to expand.

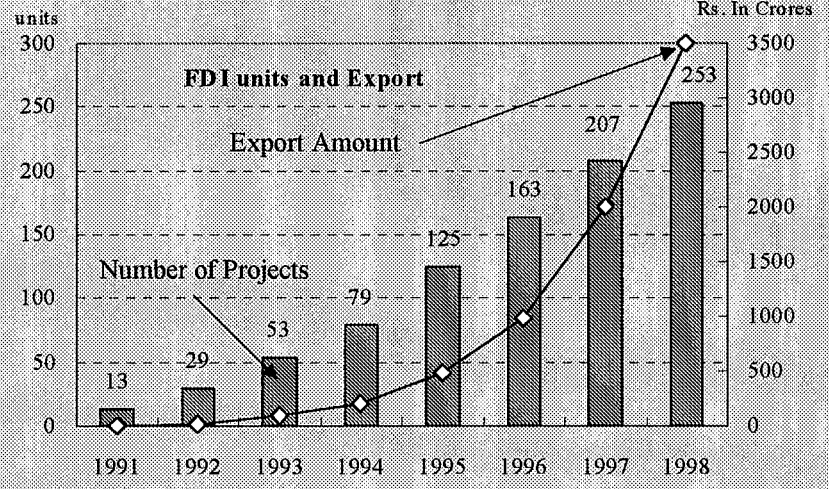
FDI & Export; Bangalore in India:

In 1991, 13 projects were in operation with Rs. 56 million in Bangalore, India. During the period from 1991 to 1998, the number of the projects grew tremendously and the export increased sharply.

FY	FDI units	Export
1991	13	5.6
1992	29	20.6
1993	53	90
1994	79	200
1995	125	480
1996	163	980
1997	207	2000
1998	253	3500

Unit of Export: Rs. Crores

Source: STPU data



[9] The average period between approved-status and operation-status is 7.8 months. As 42 projects are approved at the end of October 1999, most of them will be put into the operation-status within a couple years.

3.2 Vision and Target

1) Vision 2010

The IT service industry is expected to be a leading industry under the new paradigm, and it is enhanced in two stages; the first stage to consolidate the industry bases during the period from 2000 to 2004 (Stage 1) and the later stage to expand the business in both domestic and foreign markets during the period from 2005 to 2010 (Stage 2).

IT service industry establishes its prestige:

In Stage 1, the IT service industry in domestic markets will grow slowly but steadily, as domestic computerization progresses rather moderately. On the other hand, the export-oriented IT service industry will grow rapidly. The main players in this period are 100% foreign investors and Sri Lanka – foreign J/V enterprises. The major foreign markets will be the UK and USA through the investors originated by those countries. In addition, New Zealand and ASEAN countries especially Singapore, Malaysia, and Thailand will be target markets as the domestic market volume exceeds the production (2 to 4 times) in three countries. Japan will be another promising market. By setting these countries as targets for marketing, the export of IT services (i.e., professional services and consultancy services) will expand during this period, and the prestige of the Sri Lankan IT service industry will be established.

IT service industry is boosted:

With the progress in computerization, domestic markets for the IT services will grow further and the IT service industry will be boosted in Stage 2. In all the business societies, e-business will occupy a certain position and demand for the EPR (Enterprise Resource Planning) system, knowledge management system, and SCM (Supply Chain Management) system will be realized. Under these situations, the structure of the IT service industry is expected to change; technological affiliations and mergers will become common and professional technology will be elevated further. Most SMIs will find business in utilizing their technical advantage and concentrate to provide more and more professional service. Some large companies will expand their business to offshore software development.

2) Target

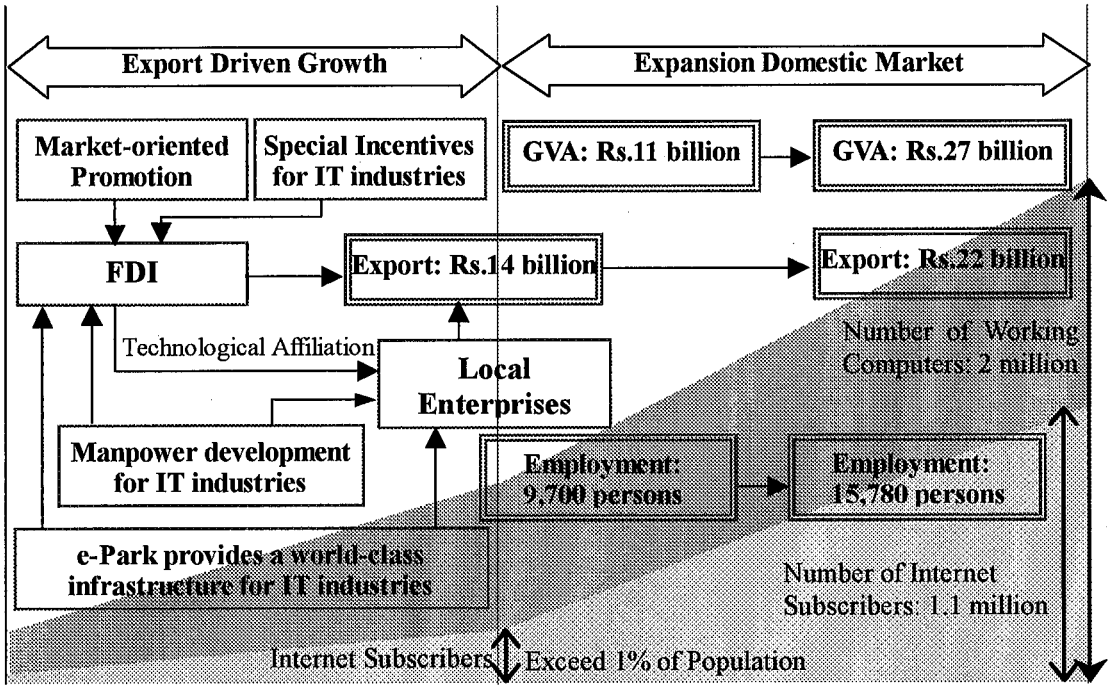
To achieve the Vision 2010, the targets for the IT service industry are set as follows:

Targets of IT Service Industry

	2004	2010
Turnover (Rs. million)	24,800	57,000
Value Added (Rs. million)	10,500	27,000
Export (Rs. million)	14,100	21,800
Employment (Person)	9,700	15,800
Of which are S/E & Programmers	4,400	8,600
Demand SEP / year	670	760

Source: JICA Study Team estimates.

When the targets are combined with the Vision 2010, the scenario for development of the IT industry in Sri Lanka is formulated as illustrated below.

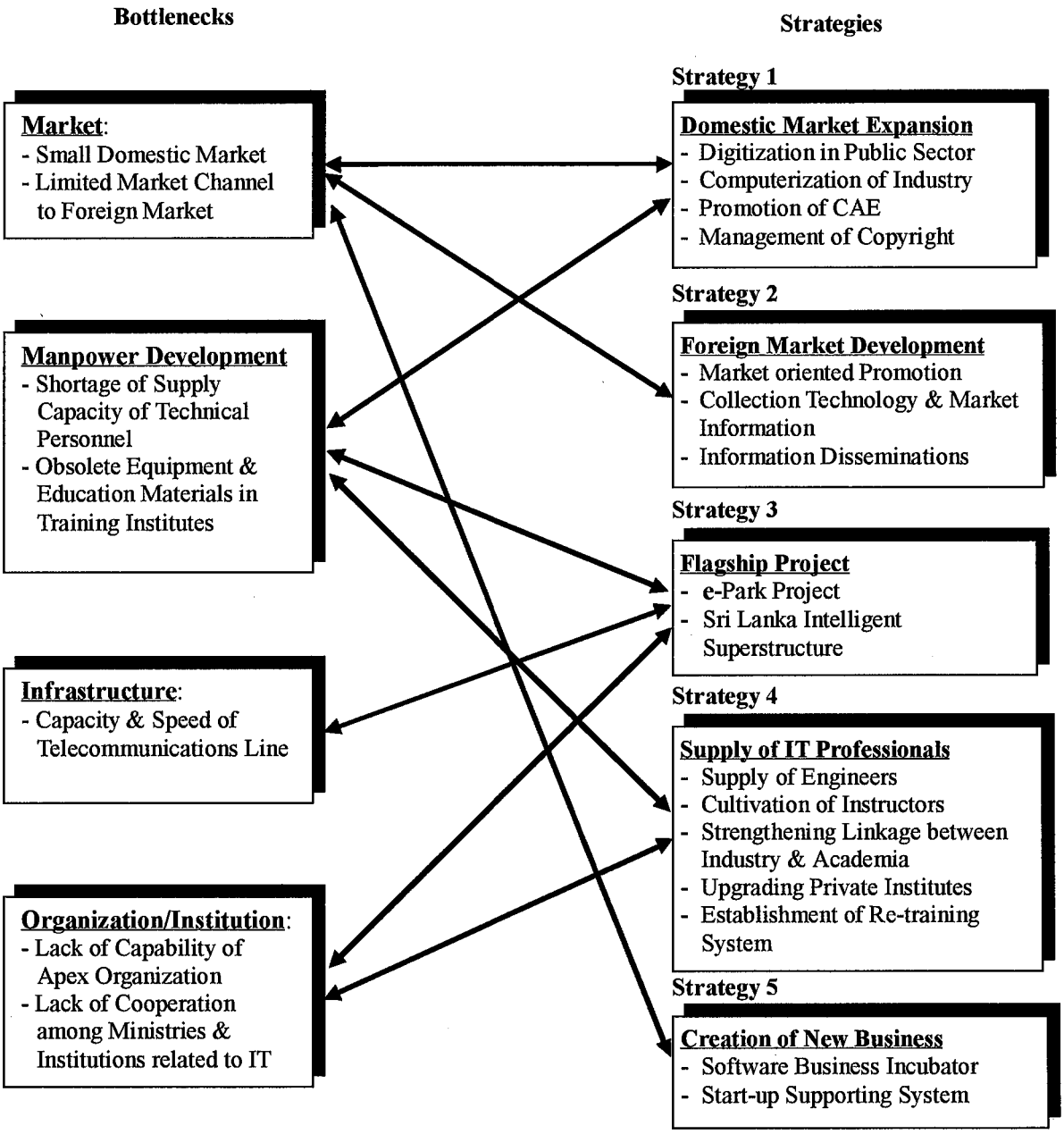


Scenario for Development of IT Service Industry

3.3 Strategy and Development Plan

To achieve the vision and targets, it is required to break through the bottlenecks identified in Section 2.2. The strategies are formulated to solve bottlenecks and attain vision/target. The relation among bottlenecks, strategies, and vision is illustrated as follows:

Relation between Bottlenecks and Proposed Strategies



1) Strategy 1: Domestic Market Expansion:

To promote computerization in every society is a base for the domestic market expansion. To computerize in the society, the public and the industrial sector should take initiative for promotion. Computerization in the public sector, which is a global trend, will secure efficiency and transparency of the public administration. In the industrial sector, on the other hand, the dissemination of computer and telecommunications creates a new business model

and makes an existing model obsolete; i.e., a shift from the vertical model to horizontal model, and every industry face the global competition. Computerization in the industrial sector is urgent.

CAE (Computer Aided Education) is another global wave. A direct effect of CAE is to raise efficiency in education, and an indirect effect is to nurture the future developer of IT and users. The earlier pupils learn computers, the larger effect is obtained. In Sri Lanka, due to a small market in the education sector, the entry into the CAE market by the IT service industry still remains small.

(i) Digitization in Public Sector

Electronics government (E-government), or digital government is expected to raise efficiency and transparency in administrative services. Many countries started to tackle with formation of e-government. The administrative efficiency is enhanced by information sharing and removal of duplication through networking among the ministries. This movement will create business opportunities for the IT service industry.

① Provision of computers to the public office (S^{10})

Movement to e-government is inevitable and it is followed by the government of Sri Lanka. The computerization in the public sector has been lagged at present, and the first step is to expand the number of computers. These computers should be networked in each ministry to promote information sharing within the ministry.

② Government WAN (M-L)

In order to achieve information sharing among the ministries, network will be expanded to establish Government WAN (Wide Area Network).

③ Administrative Information Disseminations System (L)

Opening of administrative information will guarantee its transparency and improve efficiency. A quick response system to the access will be built.

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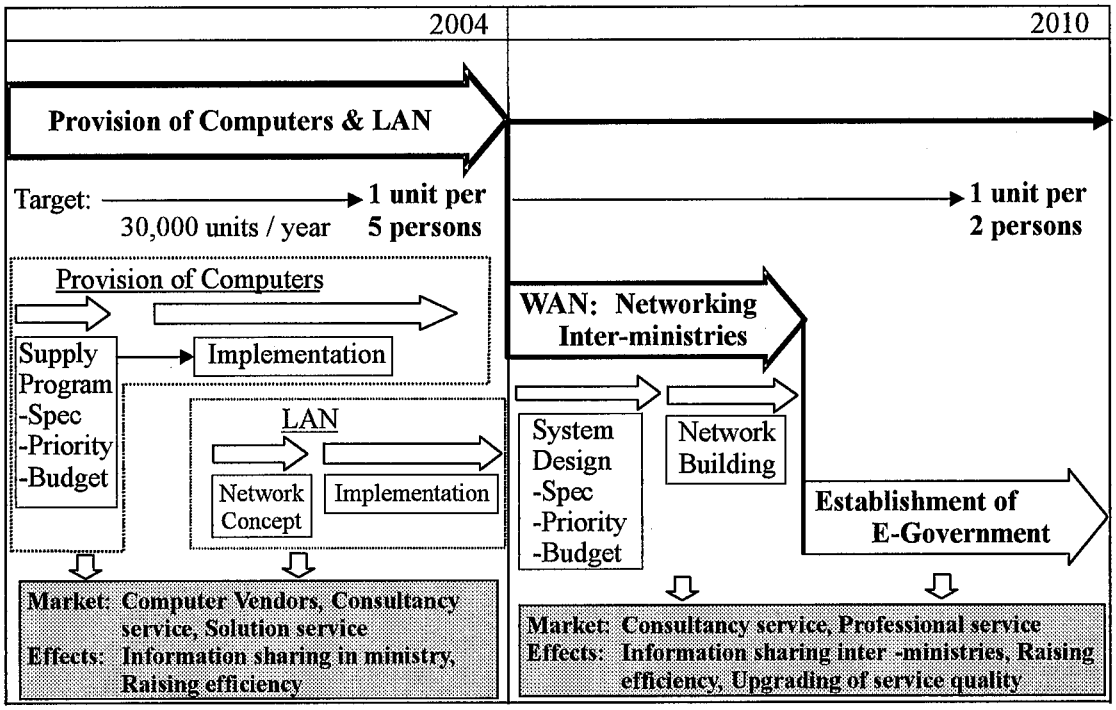
10 S: Short-term, M: Mid-term, L: Long-term, and U: Urgent.



Digitization of Public Sector

(ii) Computerization of Industrial Sector

New business models using the Internet will be expanded in the near future. In fact, the global trend to e-business is eminent despite various issues to be addressed (e.g., standardization, protocol, EDI, etc.). All the business will enjoy a computerized society.

① Support to IT related investment (S)

In order to promote computerization in the industrial sector, it is expected that measures be taken to promote IT related investment (e.g., double deduction for IT related investment, accelerative depreciation for IT related equipments).

② Administrative arrangement for e-business (S-M)

CINTEC has a committee of EDI. By carefully observing rapid progress of EDI and other e-business related matters, it is expected that adequate measures be taken to improve the domestic conditions.

(iii) Promotion of Computer Aided Education

① Provision of Computers to Schools (S-M)

Computers affect the education method. The government recognizes their importance

and has decided to introduce computers to classrooms. The number of computers will be expanded substantially.

② Networking (M-L)

Effect of computers is limited if these are standalone. Networking pulls out its capabilities. Connection to the Internet is also required.

③ Educational Material for CAE (S-L)

Development of materials for CAE (Computer Aided Education) is vital, as web-based educational contents will be developed.

(iv) Management of Copyright

Problem of software piracy invites mal-affect on the IT service industry. Even though the law of intellectual property right exists, it might not protect it from piracy. The Malaysian government, for example, adopted software copyright management system and succeeded in reduction of piracy by 70%. The government of Sri Lanka should adopt a copyright management system by establishing its implementation body.

2) Strategy 2: Foreign Market Development:

According to the questionnaire survey, many IT service enterprises pointed out a shortage of channels to the foreign markets. At the initial stage of IT industry development in India, human-network with overseas Indians who worked in IT enterprises in foreign countries, contributed to open and/or improve the market channels. While in Sri Lanka, development of foreign market channels through overseas Sri Lankan remains at the infant stage even though the brain drain has been experienced. Another tactic to open the foreign market channel is to make use of FDIs.

FDI will be a prime engine to develop the IT service industry during the plan period. BOI designated the computer software industry as a thrust industry and provided its incentives. Singapore and Malaysia, for example, have special programs to promote IT industry in addition to ordinary incentives. To survive in severe competition, it is expected to adopt special programs and strategies additionally.

(i) Promotion of FDIs

① Principle for Promotion of IT Sector (U)

Promotion policy for the IT sector should be reviewed and restructured. The frontier of the IT service industry is expanding rapidly and BOI targeted industries should

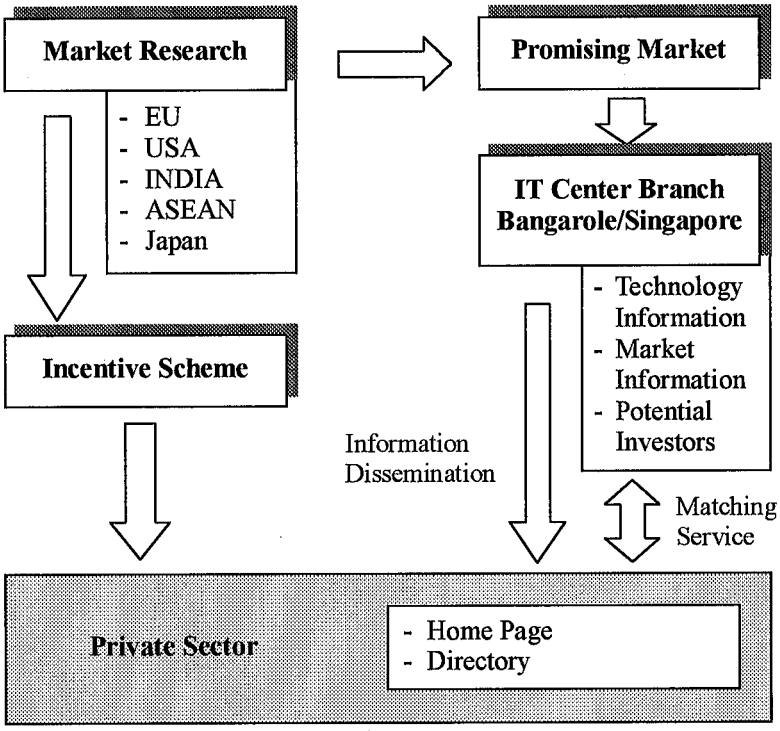
be adjusted.

② Amendment to Existing Incentive System (S)

The IT service industry is promoted as a domestic and export-oriented industry. The criteria for the BOI status under which priority is accorded to export industry, should be examined and improved.

③ Selection of Promising Market (S)

Resources should be concentrated to the selected market. The market character in each country is quite different. For instance, a growth in domestic markets exceeds its exports in the ASEAN countries, system integration and consultancy services tend to shift abroad in the USA and EU, and the demand for CG is large in Japan. Identification of market characteristics is important to find a promising market.



Market Oriented Promotion / FDI

(ii) Collection of Technology & Market Information

① Establishment of IT Center Branch in Promising Market (S-M)

It is suggested that some bases to collect technology and market information be established in the selected markets. Though the Internet becomes a powerful method to collect such information, collection of real time information at the market

has an advantage. Possible location of such bases will be Bangalore and Singapore at first. Such offices will also serve to promote FDIs.

② Building Technology & Market Information Collection and Dispatch System
Collected information will be disseminated to Sri Lankan IT service enterprises through the Internet.

(iii) Information Disseminations

① Improvement of HP (Home Page) of IT Service Enterprises (S)
HP is a powerful method of advertisement. Further, HP is not only advertisement but also a method to provide customer services. Improvement of HP by the IT service enterprise will be promoted.

② IT Service Industry Directory (S-M)
In order to reinforce the market development, a directory of existing IT service enterprises will be published. The directory will include technical performance, available services, and number of staff, as well as a contact person to make it possible to find out technical affiliation and business partner.

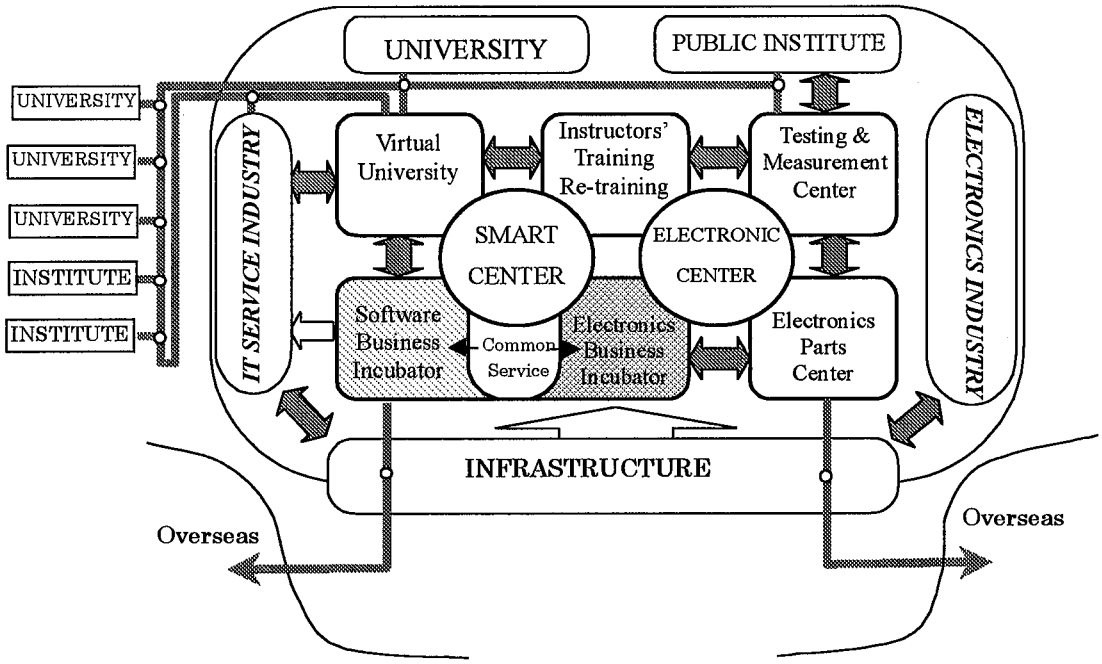
③ Dissemination of IT Related Information through Internet
HP with the directory, flagship projects and other IT related projects, as well as IT policies, are disseminated globally through the Internet.

3) Strategy 3: Promotion of Flagship Projects:

Experience in the Electronics City in Bangalore and MSC in Malaysia suggests that a flagship project enhances the IT industry. In view of the current infrastructure and future plan, the strategy should be adopted to concentrate resources to establish the symbol in the short term and to expand throughout the country in the long term.

(i) e-Park or Technopark Project

As a flagship project, an e-Park or Technopark will be established with proper infrastructure at the international standards. Major components of e-Park or Technopark will be Virtual University, IT instructor training and re-training, Software Incubator, R&D, IT enterprises, and Electronics Center with large and high-speed telecommunications. A conceptional plan for development of Technopark is presented in Annex attached hereto.



Concept of e-Park or Technopark

(ii) Sri Lanka Intelligent Superstructure

In the long run, the whole country will be networked with large and high-speed lines. Enterprises and individuals will enjoy such telecommunications services to expand their business everywhere in the country. In the late 1990s, the volume of data communication tracks exceeded voice communication volume. Therefore, SLIS (Sri Lanka Intelligent Superstructure) is recommended in view of the data exchange.

4) Strategy 4: Supply of IT Professionals

The potential to supply "knowledge workers" is a unique advantage to strengthen the IT service industry in Sri Lanka. The constraints on the supply of such workers lie in the capacity and institutional setting of the education systems. Since change in such systems takes a long time, the adoption of "external degree" by ICT is one of the realistic ways. If the establishment of a new university is difficult, the faculty of the existing university should be restructured. Further, it should be studied whether or not people can enjoy higher education (university education) through the Internet at remote areas.

Both public and private institutes are expected to be suppliers of IT professionals. The registered 150 institutes aim at providing computer literacy training, but the trained people at

such institutes have insufficient knowledge for the requirement of the IT service industry. Some strategies are planned to go through these difficulties.

(i) Supply of Engineers

① Upgrading University Function (S-M)

Universities are responsible for providing IT engineers. Although they face many difficulties, IT faculty should at least be established.

② Expansion of Existing Public and Private Institutes (S)

The current capacity to provide diploma is limited. Demand for diploma in 2004 and 2010 exceeds the targets, as the other sectors also hire such personnel. Expansion of public and private institutes is an urgent task.

③ Establishment of Smart Center for IT (S-M)

The Smart Center is responsible for IT education and training in e-Park or Technopark. Major functions are:

- Smart University
  (Virtual university networked among the existing universities with electronics library conducts collaborative R&D activities with enterprises.)
- Instructors' training function
- Re-training Function
  (S/E and/or programmers with practical experience will join the skill-up training.)

(ii) Cultivation of Instructors

① Establishment of Instructors' Programs (S)

A lack of instructors is a major reason not to expand capacity in NIBM and the private institutes. Under this situation, instructors' training programs are proposed in cooperation with the IT industry and universities.

② Improvement of Working Condition (S-M)

Less attractive working conditions cause a shortage of instructors in the public and private institutes. To keep instructors in these organizations, their working conditions should be improved.

(iii) Strengthening Linkage between Industry and Academia

① On-the-job Training Programs at IT Industry (S-M)

The linkage between industries and universities is relatively weak at present. In order to strengthen it, an on-the-job training program for university students at the IT industry is suggested. A certain credit will be given to students joining this program.

② Collaborative R&D Activities between University and Industry (S-M)

The Smart Center will promote collaborative R&D activities between universities and IT enterprises.

③ Personnel Exchange Programs between University and Industry (S-M)

Personnel exchange programs between universities and industries will be promoted. Technology transfer from personnel experienced in business to students will be enhanced. University staff, on the other hand, will find the real needs of the industry.

(iv) Upgrading of Private Institutes

① Guidelines and/or Regulations for Institutes to Provide Qualified Training (S)

Some private institutes provide their trainees with poor training. Measures should be taken to secure a certain level of quality in private institutes. The government or ACTOS (Association of Private Institutes) is suggested to set up regulations or guidelines to maintain their quality.

② Provision of Concessionary Financing Scheme for Private Institutes (S-M)

Most private institutes are suffering from inadequate textbooks, equipment and shortage of teachers. In order to mitigate such difficulties, concessionary financial support should be extended as far as they follow guidelines or regulations.

(v) Establishment of Re-training System

① Outsourcing of Training (S-M)

Rapid technological progress requires a technical staff to constantly watch technology trends. Since further professionalism and knowledge of management are required, outsourcing of training will be recommendable.

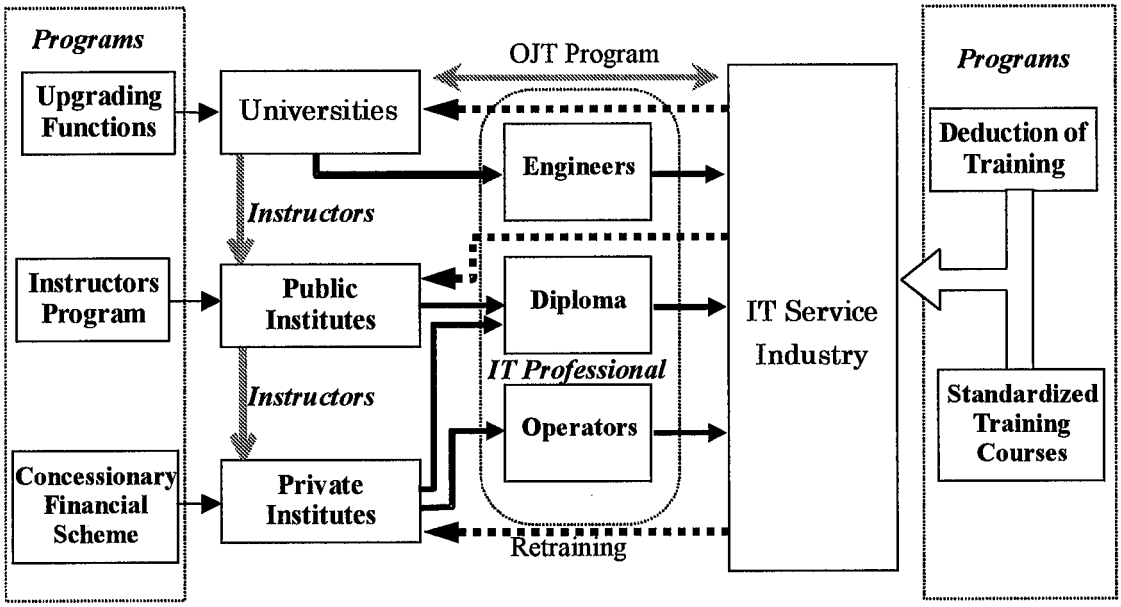
② Standardized Training Courses (S-M)

The systems to ensure certain training quality and to evaluate a trainee's technical level will be required. A training course will be held in the Smart Center in the

proposed e-Park or Technopark.

③ Professional IT Certification System (M)

Certification of professional IT will be adopted to evaluate technical level objectively.



Supply of IT Professionals

5) Strategy 5: Creation of New Business

Most of the strategies proposed above are to arrange the market conditions and to indirectly support the IT service industry. Strategy 5, Creation of New Business, is a direct support to IT service enterprises, especially existing small enterprises and potential entrepreneurs.

(i) Establishment of Software Business Incubator (S-M)

Small seed money makes the establishment of IT service enterprises possible. Individual technology and/or ideas will become a seed of big enterprise. There are several steps from idea to merchandise, development, marketing, and management. In the development stage, technological support might be requested. In this context, incubation support will keep knowledge and/or idea-rich personnel and prevent brain drain. Since incubator will require some experience and know how, Software Business Incubator (SBI) will provide them with an experienced partner. SBI will be located in the proposed e-Park or Technopark.

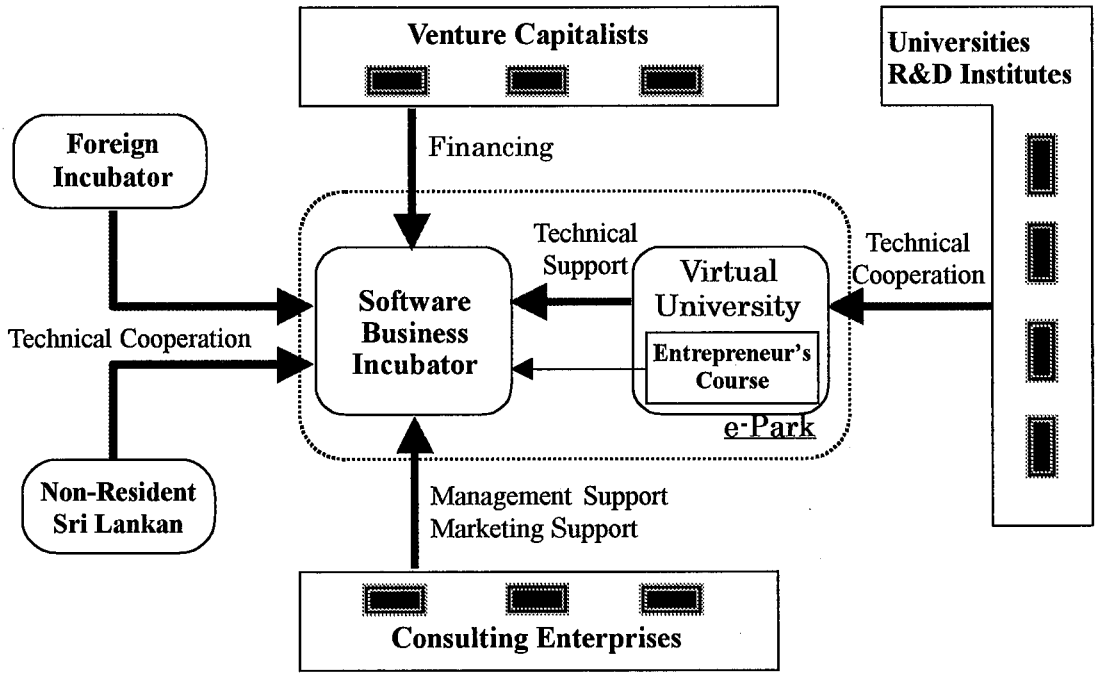
(ii) Supporting System for New Business

① Concessional Loan to Start-up IT Enterprises (S-M)

According to the questionnaire survey, 18 enterprises reported that they were facing financial difficulties. Many small-scaled industries (SSIs) are excluded from BOI incentives. A financial support or concessional loan should be introduced to SSIs during the start-up period.

② Technical Assistant Scheme (S-M)

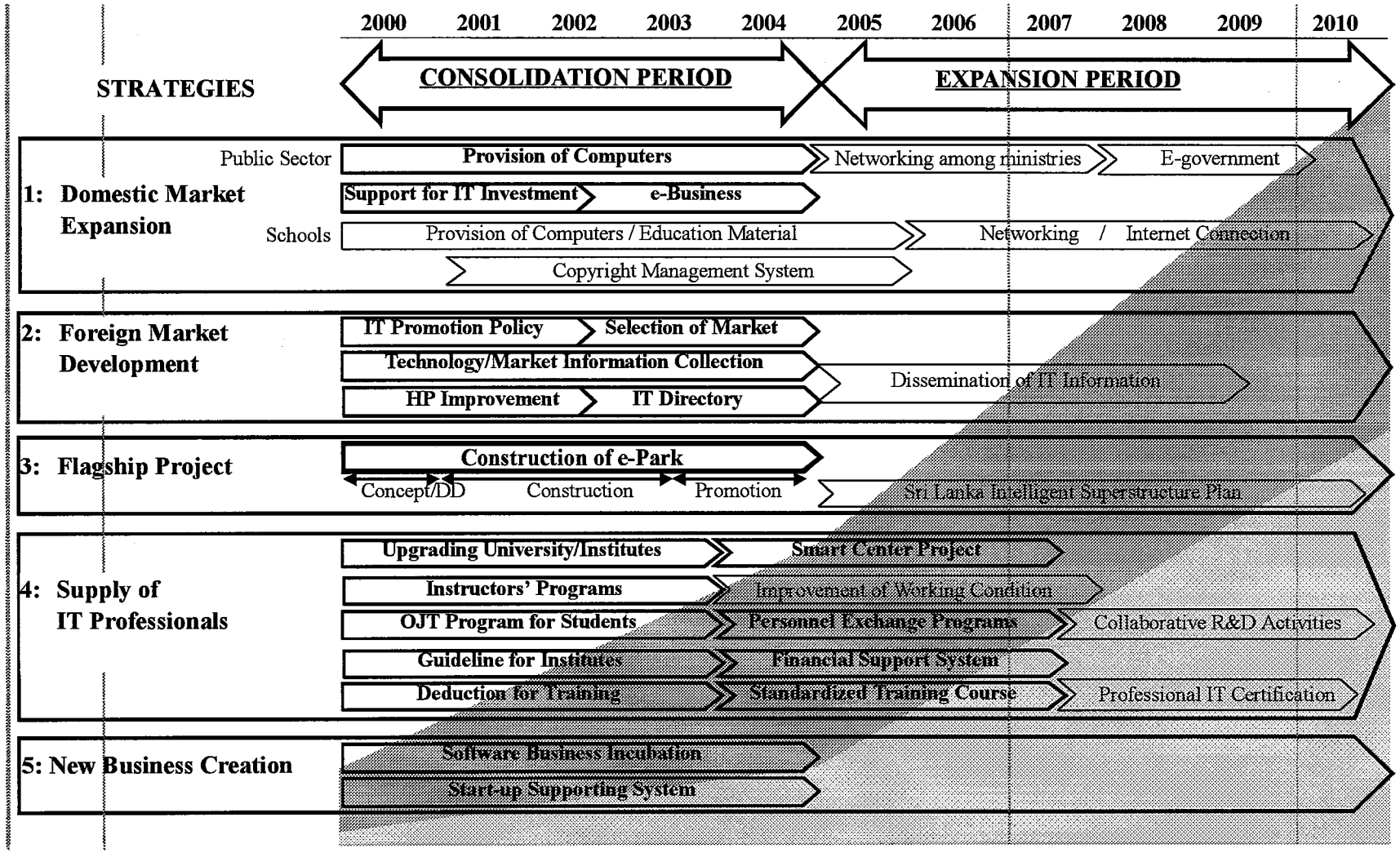
A technical supporting system will be quite useful. SBI in the proposed e-Park or Technopark will offer this function.



Proposed Software Business Incubator (SBI) Scheme

The strategies and development plan proposed for the IT service industry are summarized in the chart on the following page.

IT Service Industry Master Plan



4. ACTION PROGRAM (2000-2004)

The action programs are selected from the strategies and development plans as the priority programs for implementation in the short term (2000-2004). There are two types of programs: the public initiative program and the private initiative programs supported by the public.

1) Domestic Market Expansion Program

① Digitization in Public Sector

As the model case of computerization in the public sector, computerization of MID and IDB is programmed for implementation in combination with the institutional rationalization.

The required actions are:

- Study and collect the existing data and information in MID and IDB,
- Study the method to provide the information services to the public,
- Develop a small scale LAN system with single server and 100 PCs,
- Develop LAN system with multi-servers and 200 –300 PCs, and
- Select platforms and required software under the presumption of C/S system.

The implementation body is the Task Force to be established in the ministry based on the IT Working Group.

	2001	2002	2003	2004
Data & Information Selection	▬			
Decision of providing services & its method	▬			
Study & Build of Network	▬	▬		
Selection of Platform and Software	▬	▬		
Selection of Equipment	▬	▬		
Data Entry	▬	▬		
Computer training for the Officers		▬	▬	▬

Estimated Cost: US$2 million (indicative)

Project type: Public Initiative (MID)

② Computerization of Industrial Sector

This program is initiated by the private sector with the support of the public. It aims at promotion of computer usage in the industrial sector, with incentives granted for

double tax deduction on investments in computerization, especially in SMIs.
The details of the scheme will be studied within the year 2000, by defining:

- Definition of investment in computerization
- Application Form
- Eligibility
- Implementation Body

Project Type: Private Initiative with Public Support

2) Foreign Market Development:

① Promotion of FDIs

To accelerate promotion of FDIs in the IT industry, the current BOI scheme to grant incentives to "computer software" is to be revised and expanded to other IT services. Recruitment of personnel who have a wide range of knowledge on the IT industry should also be implemented.

- Review and expansion of focal services in the IT industry,
- Recruitment of experts in the IT at BOI,
- Export market research in major countries, (e.g., USA, EU, India, ASEAN and Japan)
- Selection of promising markets based on the market research, and
- Complication of Database on the export markets and potential investors.

Project Type: Public Initiative (BOI and EDB)

② Collection of Technology & Market Information

Based on the selection of promising markets, tactics for promotion should be elaborated, including a plan to set up IT center branches. Bangarole and Singapore are candidate locations for such branches. Major activities of the branches are:

- Collection of real time information on IT, e.g. technical, enterprises, products,
- To open channels between Sri Lanka IT service industry and foreign enterprises,
- Dissemination of information to Sri Lanka enterprises, and
- Matching service.

Estimated Cost: US$3 million (for 5 years, two branches)

Project Type: Public Initiative (BOI)

③ Information Disseminations

A homepage (HP) on the Internet is a powerful method to advertise. Further, HP becomes a service providing way in the IT industry in advanced countries. On the basis of the directory of the IT service industry under preparation by the CINTEC and EDB, arrangements to use the matching service with foreign enterprises should be implemented. The directory should include:

- Company Profile and contact person, manpower,
- Major clients and experience,
- Promising field of IT service,
- Technical advantages and equipment, and
- Expected cooperation (contract-base, technical cooperation, J/V, etc.).

Besides the individual HP, a Web site for FDI promotion will be prepared (The National HP is prepared by CINTEC but it is not targeted to FDI promotion). The items to be included in the Web site are:

- Partners' information (e.g. above directory),
- Selected site information (e.g. e-Park or Technopark),
- Incentives and application form of BOI,
- Advantages, and
- Yellow page for IT related HP.

Project Type: Private and Public Initiative

3) Promotion of Flagship Projects

① e-Park or Technopark project

The e-Park or Technopark will be implemented for the following purposes:

- Internationally recognized IT Center in Sri Lanka,
- Efficient provision of services for the IT related industry,
- Solution of bottleneck in infrastructure,
- Core of IT related information,
- Strengthen the linkage between academia and industry, and
- Pool of IT professionals.

The Park will accommodate IT service industry and IT hardware industry. The state-of-the-art infrastructure will be provided at a reasonable price. Major components of the Park are:

- Testing and measurement center for the IT hardware industry,

- Electronics parts center for the electronic industry,
- Public institutes for the IT industry (software and hardware industries),
- Instructors' training and retraining center for IT,
- Software business incubator,
- Virtual University,
- High speed and large capacity telecommunications lines,
- Rental office and site lots for the IT service industry, and
- Factory lots for the IT hardware industry.

The implementation of e-Park or Technopark will be summarized as follows.

	2000	2001	2002	2003	2004
Concept Plan / F/S	▬				
Selection of location	▬				
Financial arrangement	▬	▬			
Detailed design		▬			
Construction			▬	▬	

Project Type: Public Initiative (MID)

4) Supply of IT Professionals

① Supply of Engineers

For the supply of engineers, major players are university and public institutes. The programs of university upgrading and institutes expansion are:

- Selection of target universities for modification of faculties,
- Preparation of modification plan of university,
- Preparation of education materials for university and public institutes, and
- Implementation of expansion plan of public institutes.

The Smart Center is planned as a core facility of e-Park or Technopark. The Center will function as a training and education center. The Center will be equipped for:

- Virtual University
  - Preparation of textbooks of IT and on-line deriver
  - Electronics library
  - Technical forum of IT software and hardware
  - Entrepreneurs' course for the IT service industry
- Re-training center
  - Re-training course for the employees of the IT service industry

Re-training course for the private institutes

Duration: 1 day workshop, 2 weeks, 3 months, 6 months

- Instructors' training center

Project Type: Public Initiative (MOHE, MID, MOST)

② Cultivation of Instructors

Shortage of instructors is serious for the training of IT professionals. As an initial step to cultivate the instructors for IT professionals, the instructors' programs should be prepared for:

- Technical assessment of instructors
- Establishment of the guideline for instructors
- Establishment of the instructors' programs

Project Type: Private Initiative with Public Support

③ Strengthening Linkage between Industry and Academia

The OJT programs with credit provide some merits to students, teachers, and IT enterprises, and this program should be promoted. The merits of OJT programs are:

- For Students:

  To gain experience of practical business of the IT service industry

  To be given the credit
- For Teachers:

  To identify the practical requirement by the business
- For Enterprises:

  To recruit capable students

  To give information of the requirement to the university

Project Type: Private and Academic Cooperation

④ Upgrading of Private Institutes

Guidelines for private institutes for qualified training should be prepared by ACTOS in cooperation with CINTEC and other related organizations. The guideline will include:

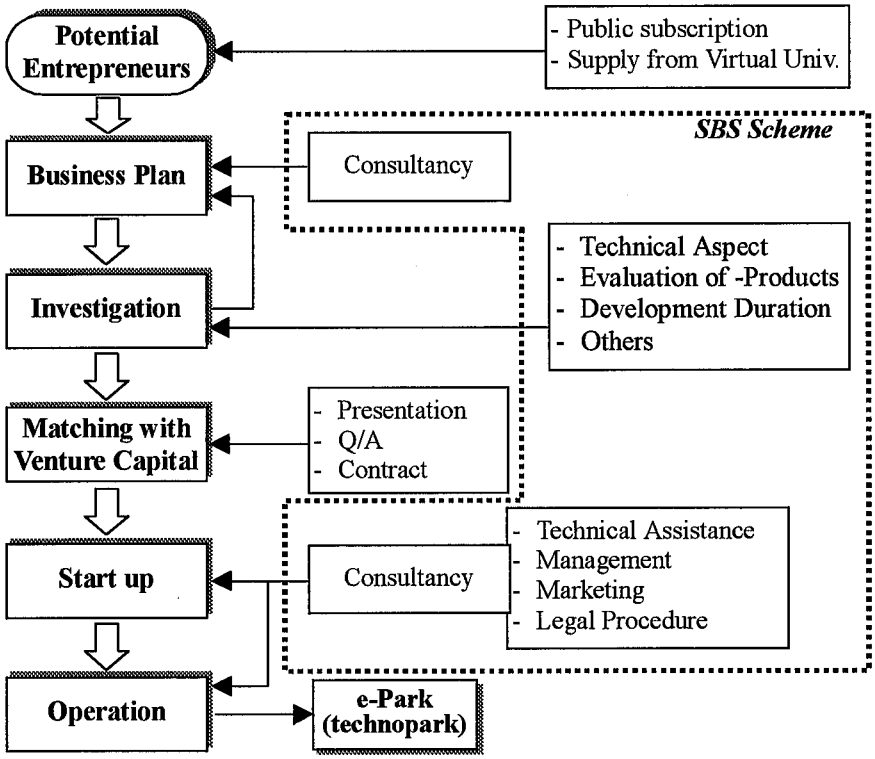
- Number of teachers
- Criteria of the proportion of teachers to the students
- Equipment
- Curricula

Subject to clearance of the guideline, concessional loan may be provided for the private institutes together with incentives of double tax deduction for procurement of equipment.

5) Creation of New Business:

① Establishment of software business incubator

The software business incubator is schematized as follows:



Outsourcing of consultancy service and investigation of the business plan are key factors for success of incubation.

	2001	2002	2003	2004
Formation of Scheme	▬			
Selection of Consultants	▬			
Investigation Procedure		▬		
Funding		▬		
Public Subscription			▬	▬

Project Type: Private Initiative with Public Support

ANNEX

DEVELOPMENT OF TECHNOPARK

ANNEX DEVELOPMENT OF TECHNOPARK

Table of Contents

1. BACKGROUND AND STRATEGY

1.1 Background

The IT service industry is rapidly changing and developing in Asian countries. The "IT Tigers" have emerged in Asian NICs with the image of "4 Dragons". South Korea, Taiwan and Singapore are standard-bearers of the IT Tigers. Their changes have been supported by deregulation for telecommunications, wide use of computers, and buildup in human resource supply system. On the other hand, Thailand and Malaysia are so-called "Digital Divide". In Thailand, science parks were set up (e.g., at the location near the Asian Institute of Technology (AIT) and Tamasart University) in the latter half of the 1990s, with a purpose of attracting research institutes and enterprises in the field of IT and biotechnology. As for IT, however, only 20 enterprises or 10% of about 200 enterprises originally planned for location by 1999 are in operation at present. This delay is partly attributable to the financial crisis since 1997 and partly to a limited supply capacity of IT engineers in Thailand.

It is well known that India's computer software is armed with highly capable, abundant and cheap human resources. An excellent cycle has been developed where IT enterprises are coming from the world, enlarging the industrial scale, generating demands for human resources, and increasing the supply capacity of human resources.

A lesson is learned from the Asian countries and India, that the supply capacity of human resources is the most critical issue for development of the IT service industry. This lesson is to be reflected in formulating a conceptual plan for development of a Technopark in Sri Lanka.

1.2 Strategy for development of Technopark

Technopark has a symbolic role of an industrial accumulation of IT. It will provide a better environment to facilitate a linkage of the industry and academia, as well as to formulate a development base for the IT industry in Sri Lanka. The conceptual plan of the Technopark is to be formulated through a viable approach in consideration of the current status of human resource development (HRD) and IT enterprises in Sri Lanka.

The premises for development of the Technopark are summarized as follows:

- Expectations of the IT service industry are high.
- Capacity of universities for human resource development is still limited.
- The external degree system has been adopted at universities to enlarge the mass in the current scheme of university education.

- Both public and private institutions have a shortage of instructors. Education of teaching staff is urgently required.
- Textbooks are insufficient.
- Development of telecommunications infrastructure and deregulation in telecommunications are lagged.

The above premises will lead to the definement of the development strategy of Technopark in Sri Lanka as follows:

Strategy 1) HRD is to be promoted prior to constuction of Technopark and it should be integrated as a key function of Technopark.

Training of middle class IT engineers has been initiated by the public and private institutions. However, the number of trainees is insufficient and the institutions lack instructors. IT instructors are required to pay continuous attention to the technology trends and they should be retrained to meet the changing demand. In this context, it is proposed to strengthen the function of the existing universities and concentrate resources to some fields of IT in the initial stage. This program will be integrated as a key function of Technopark in the later stage when Technopark is constructed.

Strategy 2) Technopark is to be implemented in partnership with academia.

Since training of human resources is a key function of Technopark and the function of the "Center of Excellence" is integrated into Technopark, it is desirable that Technopark be located near one of the existing universities. The function of a virtual university and electronic library will also be integrated into Technopark when it is constructed.

Strategy 3) Software and hardware are to be integrated in Technopark.

Technopark is to be symbolic in the sense that software and hardware are integrated by means of IT technology. Nowadays, the hardware industry cannot survive without software technology, and software is supported by development of hardware. In this context, Technopark will be designed for development of both software and hardware in Sri Lanka.

To follow the strategies as cited above, it is suggested that Technopark be developed stage-wise. In the initial stage (pre-Technopark stage), training of IT engineers and instructors will be executed at the existing universities by developing the center of excellence in some selected IT technology. Preparatory works for construction of Technopark (e.g. studies, design and construction) will be executed in this stage.

After Technopark is constructed, a network operation unit for a virtual university and electronic library will be established as a gateway for software and hardware development. Technopark will have an electronic technology center (public) and software/hardware enterprises (private).

2. DEVELOPMENT CONCEPT OF TECHNOPARK

Technopark will be developed in two stages: 1) Pre-Technopark Stage, 2) Technopark Operation Stage.

2.1 Pre-Technopark Stage

The major target of this stage is to consolidate training of IT instructors. Programs proposed in this stage will be implemented before construction of Technopark.

1) Concentration of resources to certain fields of IT

IT technologies and products are categorized into three fields; i.e., Platform, Network, and Content. The platform field includes hardware, OS and middleware, and the network field refers to telecommunications and related software. The content field is software. Because of limited resources, particularly manpower resources, it is proposed that resources are concentrated in the following three fields; i.e., multimedia technology (contents), data base management system (DBMS) of middleware technology (platform), and network applied software engineering such as CAD/CAM (contents and platform).

2) Targeting as the Center of Exellence in each field

Three selected universities, i.e., Peradeniya, Colombo, and Moratuwa, will establish the unique Center of Excellence respectively for the selected technology, as proposed below.

Multimedia Design Center in the University of Colombo

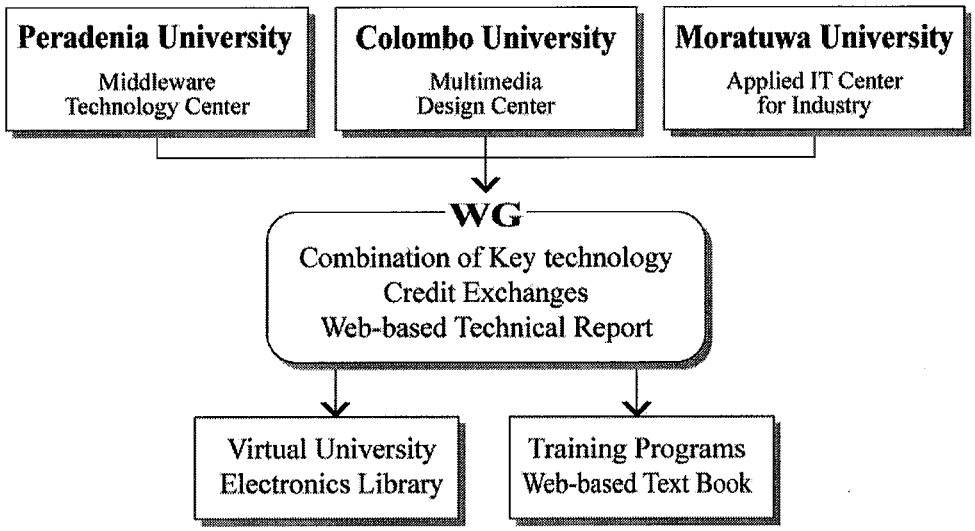
Multimedia technology is a new area of IT. There is a global shortage of engineers for such technology.

Network Technology Center in the University of Peradeniya

Middleware is software between OS and application, and it covers wide areas. The center focuses on the DBMS which will be the basis of business management system such as SCM, ERP, etc.

Applied IT Center for Industry in the University of Moratuwa

There are two faculties in the University of Moratuwa; Faculty of Engineering and Faculty of Architecture. The graduates of these faculties are leading industries in Sri Lanka. The Center of Excellence, therefore, shall be directed to industry-related-software-technology such as CAD/CAM.



3) Supporting Programs

University of Peradeniya

JICA granted equipment was installed in the Computer Department of Peradeniya University. Some of the equipment is old-fashioned, but still useful. Some improvement is expected for the extension of three existing servers and introduction of software. Installation of an optical fiber cable is needed to establish a network for data communication. Further, it is desirable that one or two foreign experts for DBMS or network be dispatched to prepare curricula and textbooks for education/training.

University of Colombo

The recommended program for Colombo University is the provision of faculties and experts for the promotion of a multimedia design center that CICC intends to promote. Installation of an optical fiber cable is needed to establish the network for data communication.

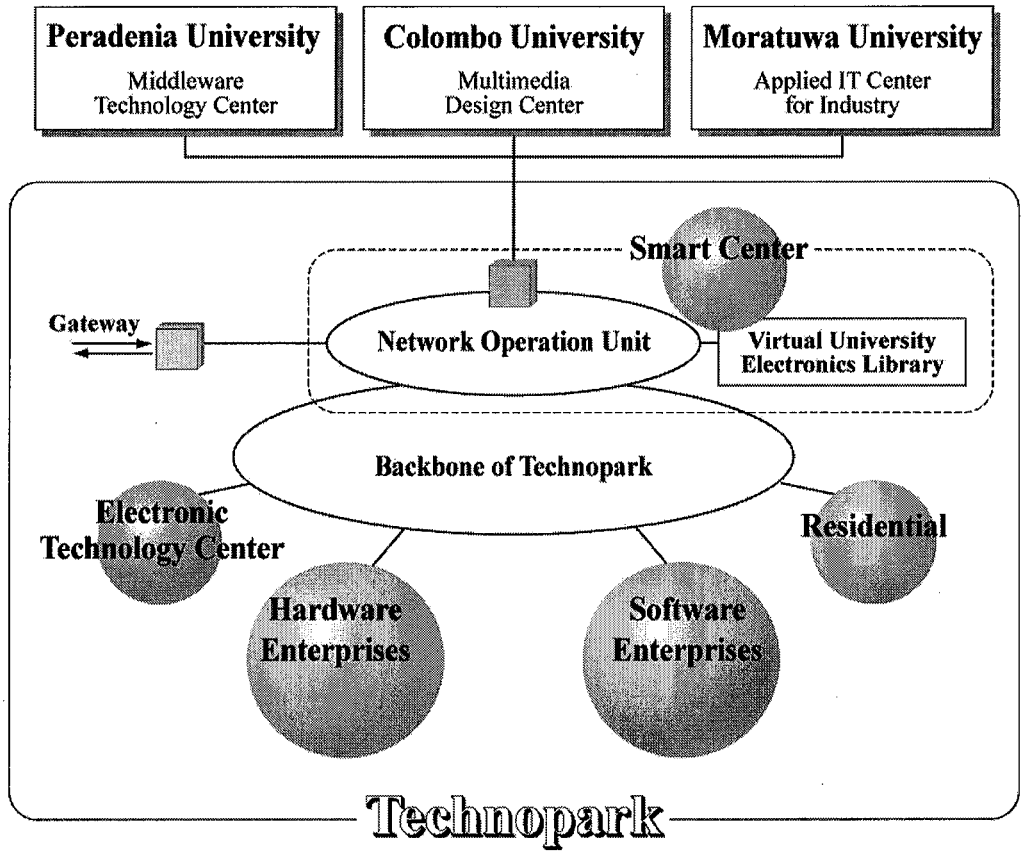
University of Moratuwa

Support for the expansion of the Department of Electronics and Telecommunications of Moratuwa University was once requested in December 1997. The University also has the Department of Computer. It is recommended that support be extended to the Applied IT Center for Industry. Installation of an optical fiber cable is needed from LAN of the University and the SLT station to establish the network for data communications.

The supporting programs as proposed above will be arranged separately so that they are implemented prior to the construction/operation of Technopark.

2.2 Technopark Operation Stage

The functions of Technopark are many, and are illustrated below. An outline of each function is explained on the following pages.

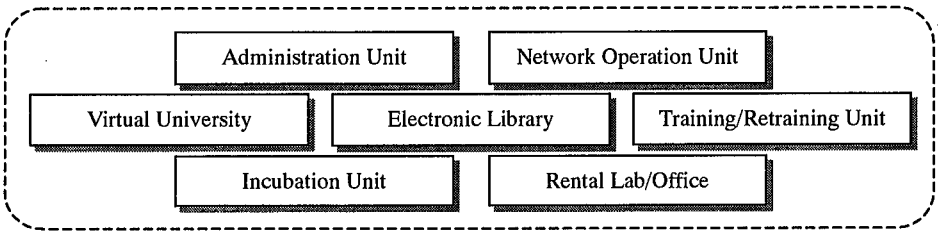


There are five major components in Technopark; i.e., Smart Center, Electronics Technology Center, Software/IT Soft Industry Lot, Electronics Industry Lot, and Residential Lot.

1) Smart Center

The Smart Center has the function of strengthening relations between academia (universities) and industries. The basic functions of the Smart Center are: (i) management and operation of Technopark, (ii) telecommunication hub, (iii) gateway to various centers of university and organizations in the country and overseas; and (iv) support to the IT industry. The following units will be established in the center:

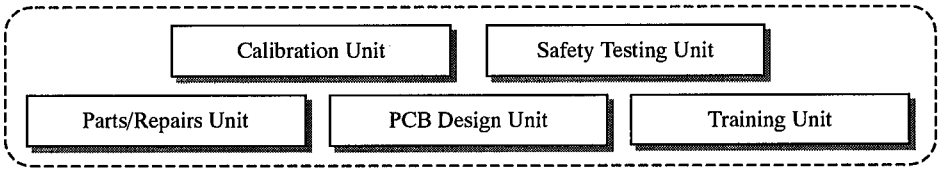
Units of Smart Center



2) Electronics Technology Center

The Electronics Technology Center will support development of the electric and electronic industry in Sri Lanka. Periodical calibration is required for machinery to be used in the electric and electronic industry. The Parts/Repair Unit will be established to get rid of high costs caused by procurement in small lots. It will have the function of a procurement center using the computer network. The PCB Design Unit will enhance the capability of PCB Design utilized in all fields of the electric/electronics industry in cooperation with Moratuwa University, and it will develop PCB commissioned by private enterprises as well. The Training Unit will provide a training program for enterprises.

Units of Electronics Technology Center



3) Software/IT Soft Industry Lot

The enterprises incubated in the Smart Center will be located in the Software/IT Soft Industry Lot. This lot will also receive software enterprises scattered in the Greater Colombo Area and enterprises newly coming to Sri Lanka. It is expected to attract enterprises by high-speed network.

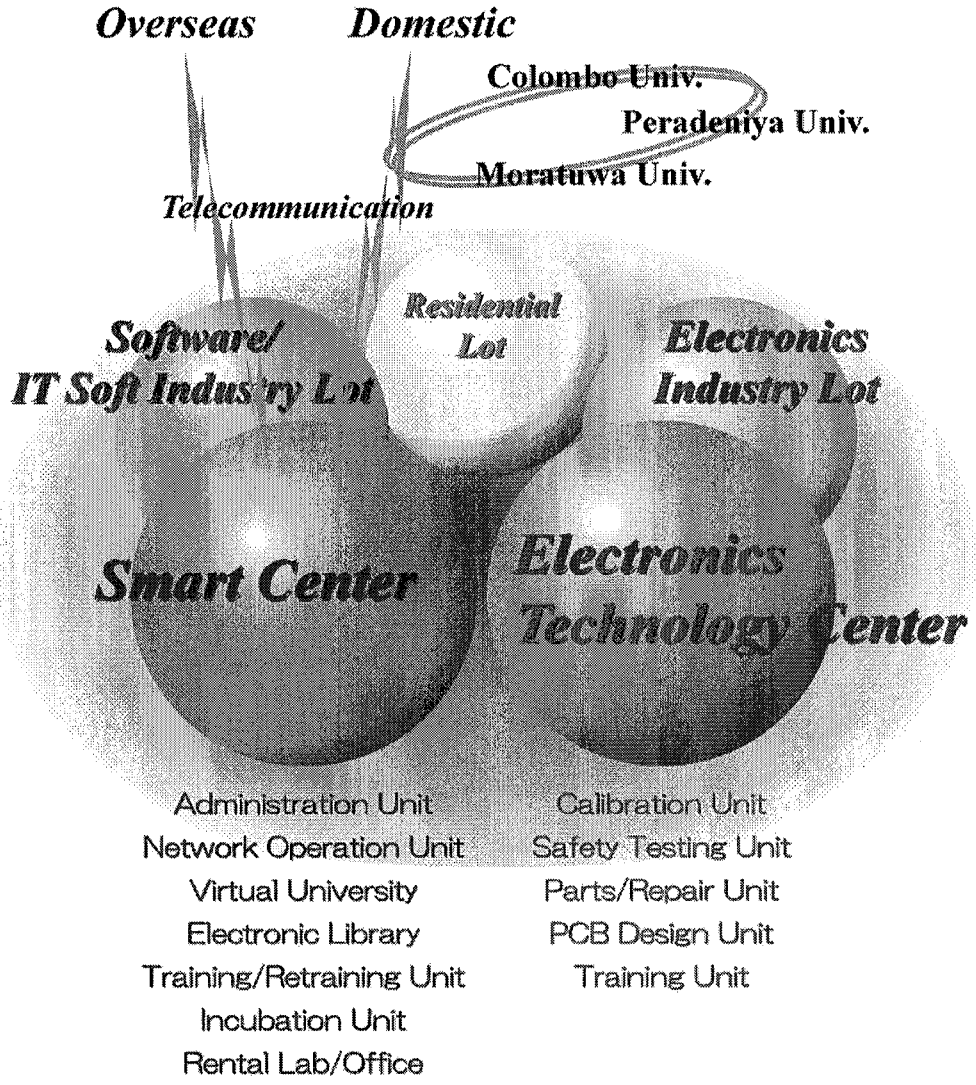
4) Electronics Industry Lot

This is the factory lot for the electric and electronic industry to be installed in Sri Lanka.

5) Residential Lot

A residential lot for employees of enterprises is designed in the component of Technopark. This lot is suitable for other people because of the residential advantage of an ideal location on the water front and the environment surrounding Technopark.

A conceptual image of Technopark is illustrated below.



3. LOCATION OF TECHNOPARK

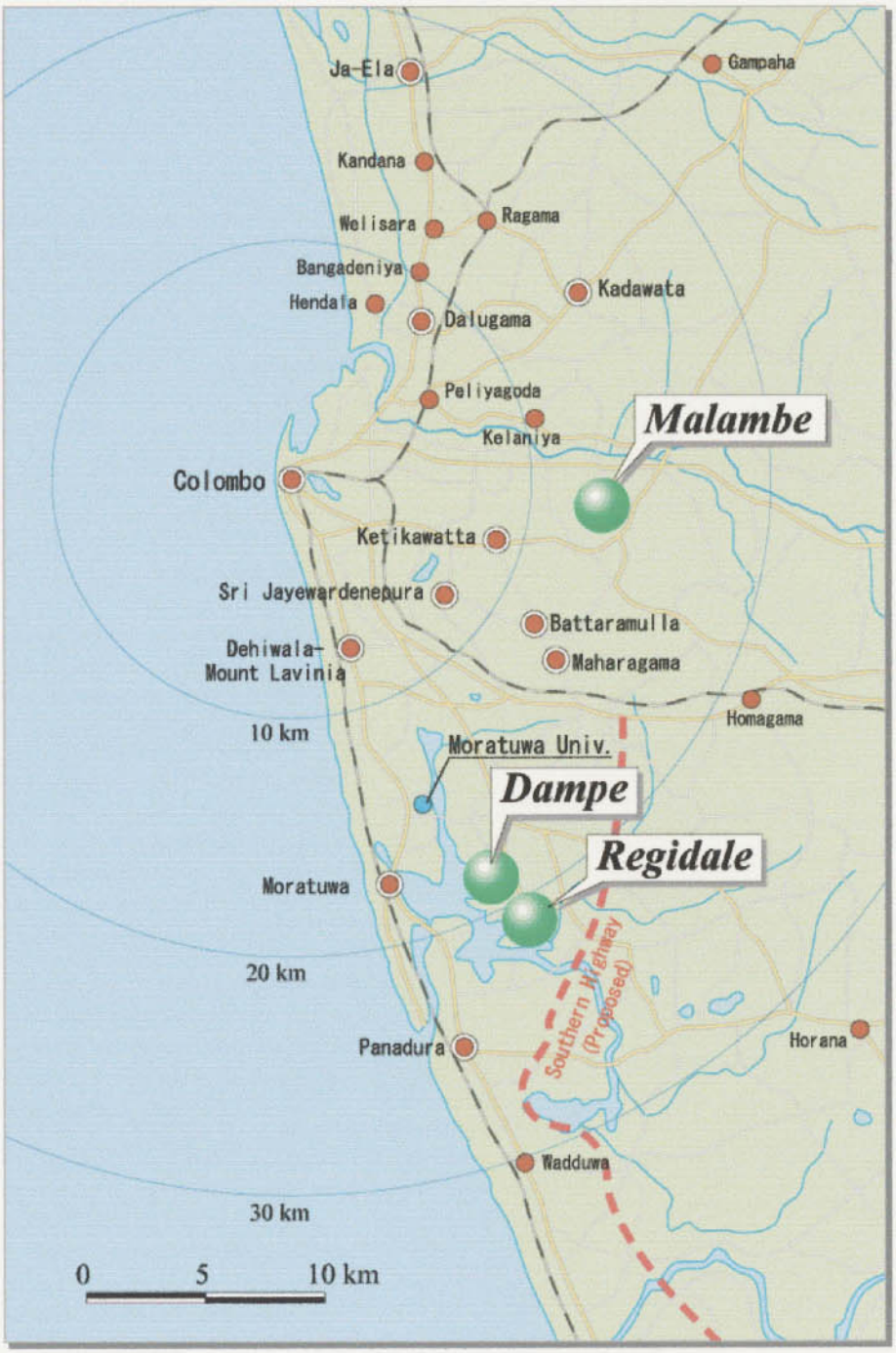
Three candidate sites have been selected by the Urban Development Authority (UDA) for the development of Technopark; (i) Malambe, (ii) Dampe, (iii) Regidale (Hepparawatta). Characteristics of these three sites are summarized below.

Conditions of Three Candidate Sites

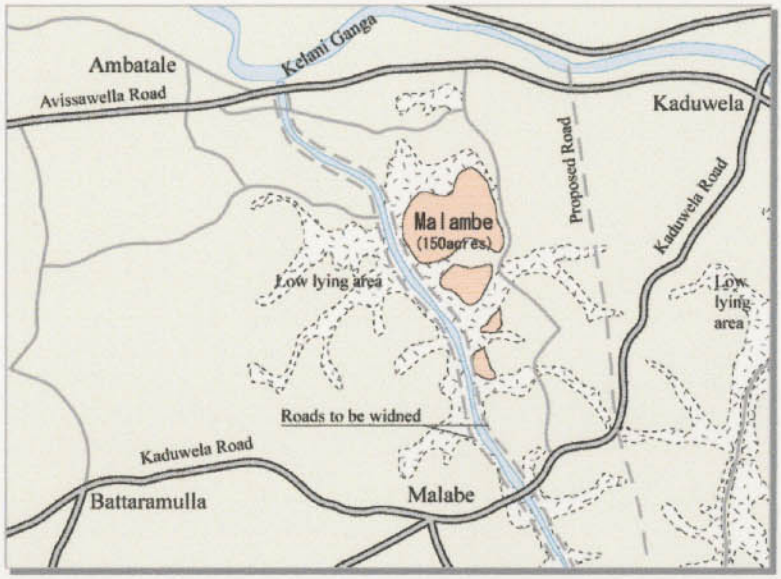
Site	Malambe	Dampe	Regidale
Location	App. 15 km from the center of Colombo	App. 25 km from the center of Colombo	App. 25 km from the center of Colombo
Area	150 acres (60ha)	100 acres (40ha)	80 acres (32ha)
Present land use	Rubber tree estates	Coconut tree estates	Rubber tree estates
Land owner	15 private owners	1 private owner	1 private owner
Development progress	16 acres (6ha) of land was allocated to an IT entrepreneur	None	None
Access	2.5 km from Colombo-Kaduwela Road	4.3 km from Moratuwa-Kesbewa Road or 4.5 km from Morauwa Univ.	2.0 km from Kesbewa-Bandaragama Road or 2.0 km from Dampe site
Infrastructure	· High voltage electric transmission line runs nearby. · Ground water is available	· Low voltage electric line runs nearby. · Enough ground water.	· Low voltage electric line runs nearby. · Enough ground water.
Advantage	· One local software entreprenuer has already decided to settle. · Institute of Information Technology (IIT) is planned next to site. · Estate development is easier thanks to the easy access to the major road.	· Proximity to Moratuwa University. · Waterfront environment can be enjoyed. · Land acquisition is easy.	· Proximity to Moratuwa University. · Waterfront environment can be enjoyed. · Land acquisition is easy.
Disadvantage	· Land acquisition is not easy. · Cooperation with Moratuwa University / Colombo University will be uneasy.	· Access road improvement is not easy because of roadside residents. · Due attention to natural environment of Bolgoda lake is required.	· Due attention to natural environment of Bolgoda lake is required. · Topography is much undulated
Development Direction	Private initiative software estate development	· Public, private joint technopark development	· Same as Dampe (Phase II development as shown below)

Note: Moratuwa University is a leading university in the technical/engineering field in Sri Lanka.

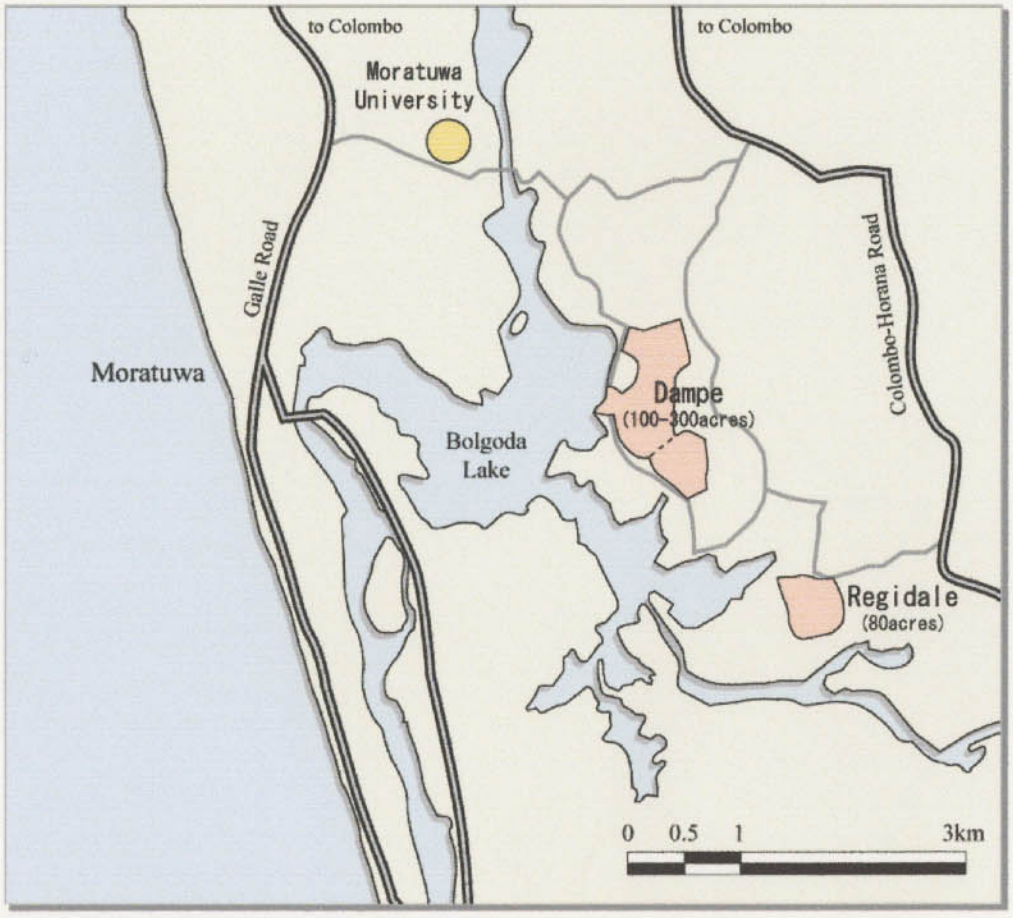
Malambe will be a software-oriented estate in view of the software entrepreneur registered to locate in the estate. Dampe and Regidale will be Technopark including IT and manufacturing. Therefore, Dampe and Regidale are considered to be alternative locations for Technopark.



Location Map of Candidate Sites

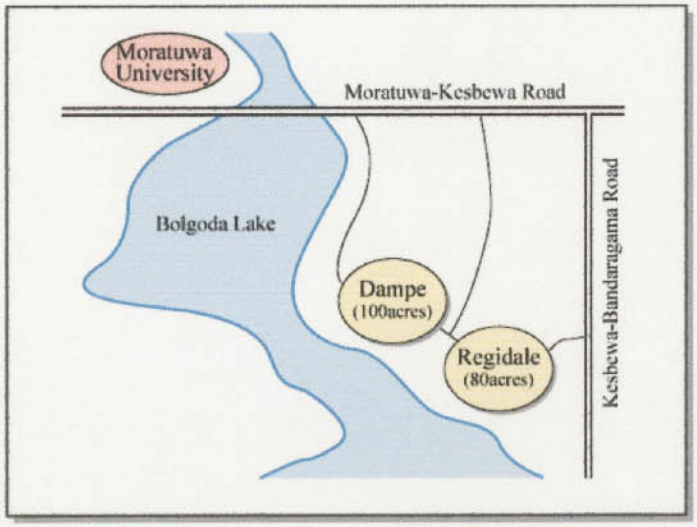


Sites of "Malambe" (no scale)

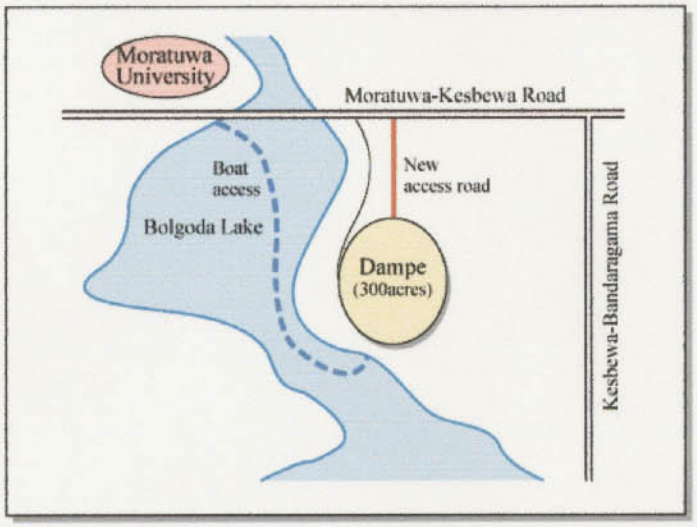


Sites of "Dampe" and "Regidale"

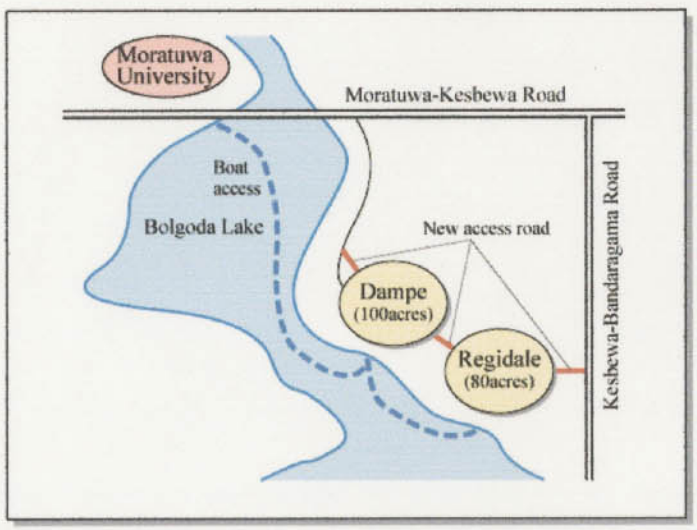
■Present Condition



■Development Plan Alternative[1]



■Development Plan Alternative[2]



Development Alternative of Dampe and Regidale Technopark

4. DEVELOPMENT PLAN OF DAMPE TECHNOPARK

4.1 Land use plan

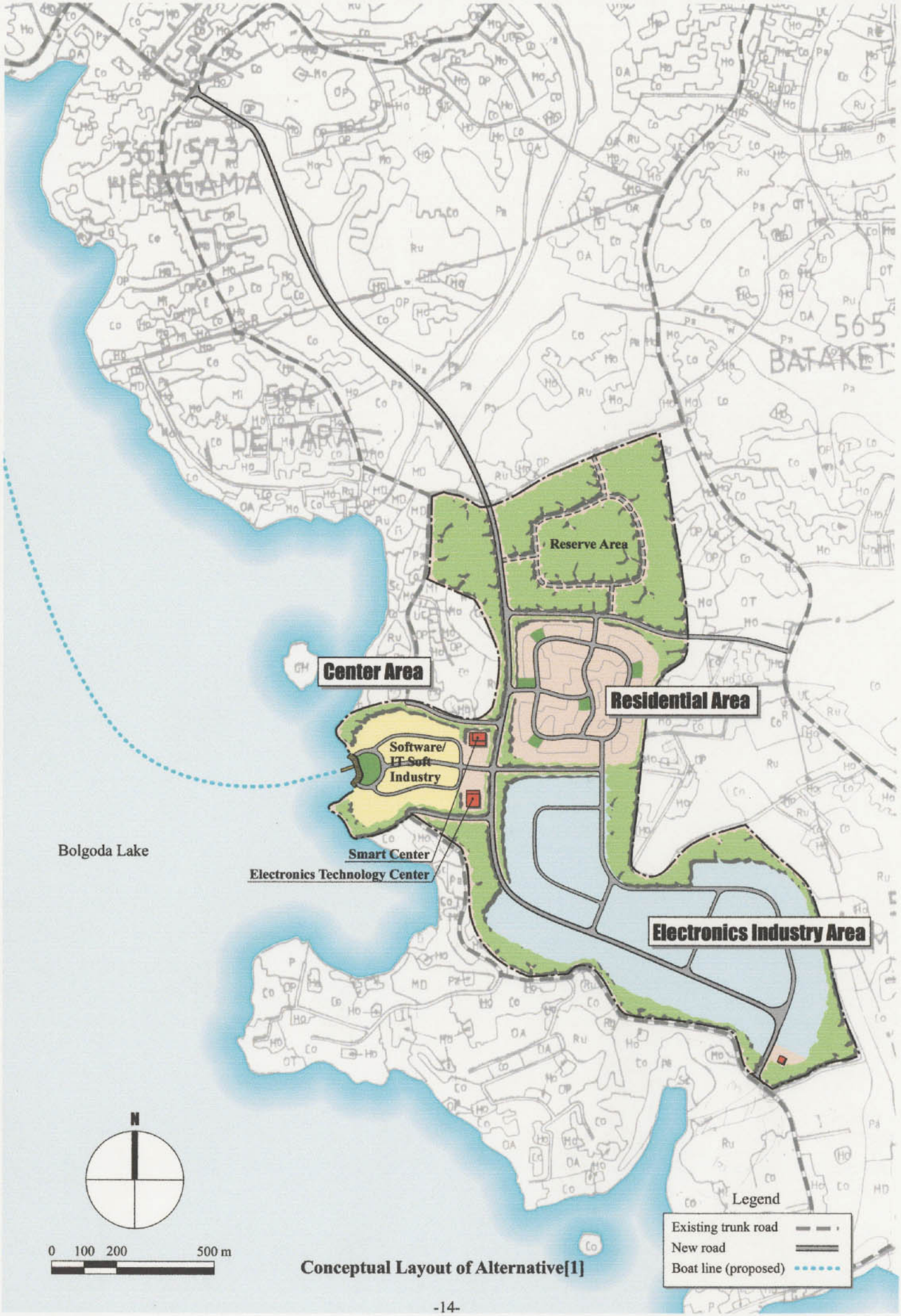
A land use plan is presented in the table below for each alternative plan. A conceptual layout is also illustrated on the following pages.

Land Use Plan of Alternative 1 (300 acres)

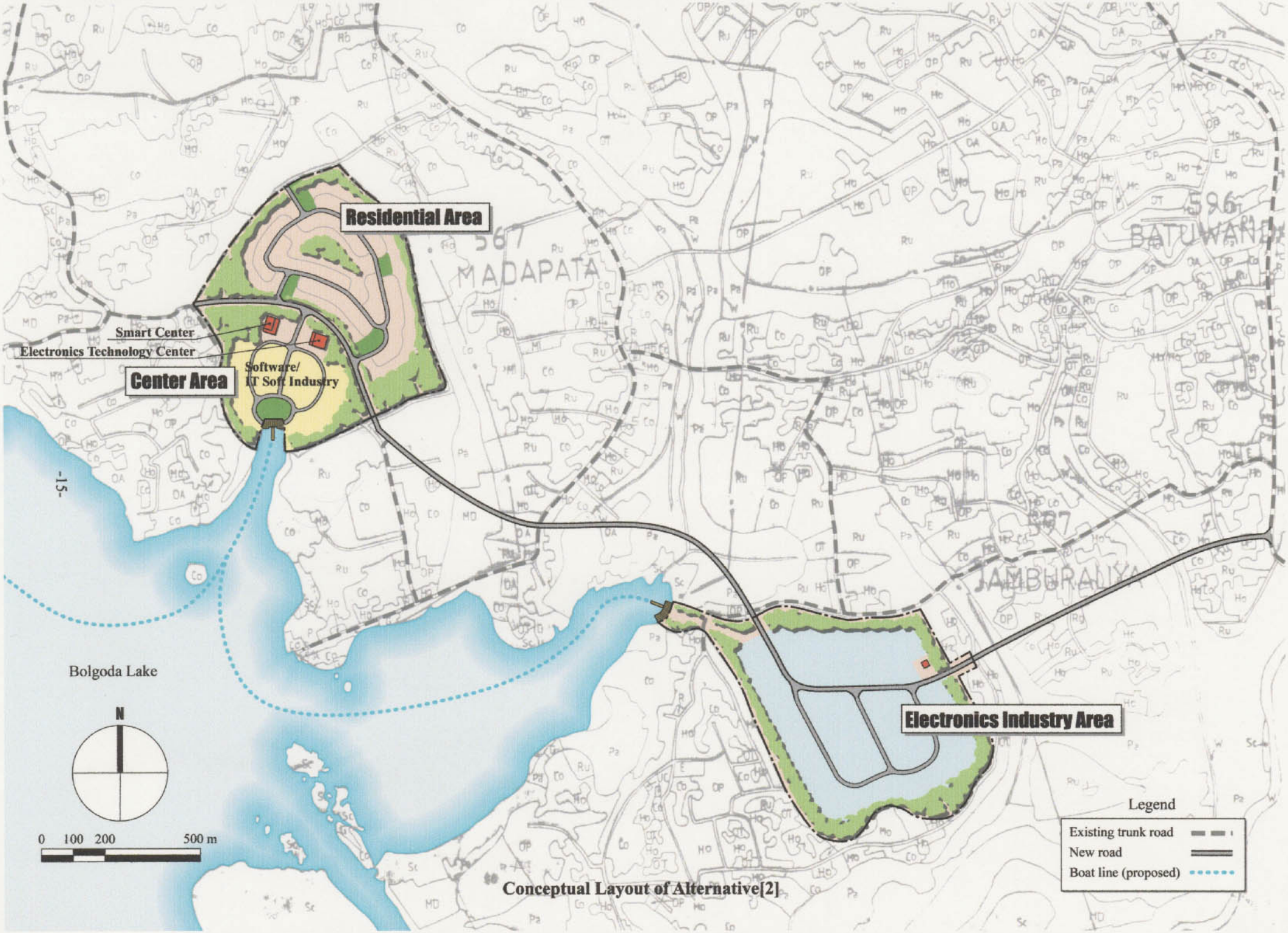
	(acres)	(ha)	(%)	Remarks
I. Center Area	**21.3**	**8.5**	**7.1**	
1 Smart Center and Electronics Technology Center	3.8	1.5	1.3	
2 Software/IT Soft Industry Lot	12.5	5.0	4.2	20 lot x 2,500m^2
3 Road & Others	5.0	2.0	1.7	Road, Park, etc.
II. Electronics Industry Area	**95.0**	**38.0**	**31.7**	
1 Electronics Industry Lot	75.0	30.0	25.0	30 lot x 1ha
2 Roads & Others	20.0	8.0	6.7	Road, Park, etc.
II. Residential Area	**30.0**	**12.00**	**10.0**	
1 Residential lot	15.0	6.0	5.0	200 lot x 300 m^2
2 Roads & Others	15.0	6.0	5.0	Road, Park, etc.
III. Other Area	**153.8**	**61.50**	**51.3**	
1 Reserve area	112.5	45.0	37.5	
2 Buffer and green	41.3	16.5	13.8	
IV. Total	**300.0**	**120.0**	**100.0**	

Land Use Plan of Alternative 2 (180 acres)

	(acres)	(ha)	(%)	Remarks
I. Center Area	**21.3**	**8.5**	**11.8**	
1 Smart Center and Electronics Technology Center	3.8	1.5	2.1	
2 Software/IT Soft Industry Lot	12.5	5.0	6.9	20 lot x 2,500m^2
3 Road & Others	5.0	2.0	2.8	Road, Park, etc.
II. Electronics Industry Area	**70.0**	**28.0**	**38.9**	
1 Electronics Industry Lot	50.0	20.0	27.8	20 lot x 1ha
2 Roads & Others	20.0	8.0	11.1	Road, Park, etc.
II. Residential Area	**30.0**	**12.00**	**16.7**	
1 Residential lot	15.0	6.0	8.3	200 lot x 300 m^2
2 Roads & Others	15.0	6.0	8.3	Road, Park, etc.
III. Other Area	**58.8**	**23.5**	**32.6**	
1 Reserve area	0.0	0.0	0.0	
2 Buffer and green	58.8	23.5	32.6	
IV. Total	**180.0**	**72.0**	**100.0**	



Conceptual Layout of Alternative[1]



Conceptual Layout of Alternative[2]

4.2 Development Plan of Infrastructure and Center Facility

1) Internal and External Infrastructure

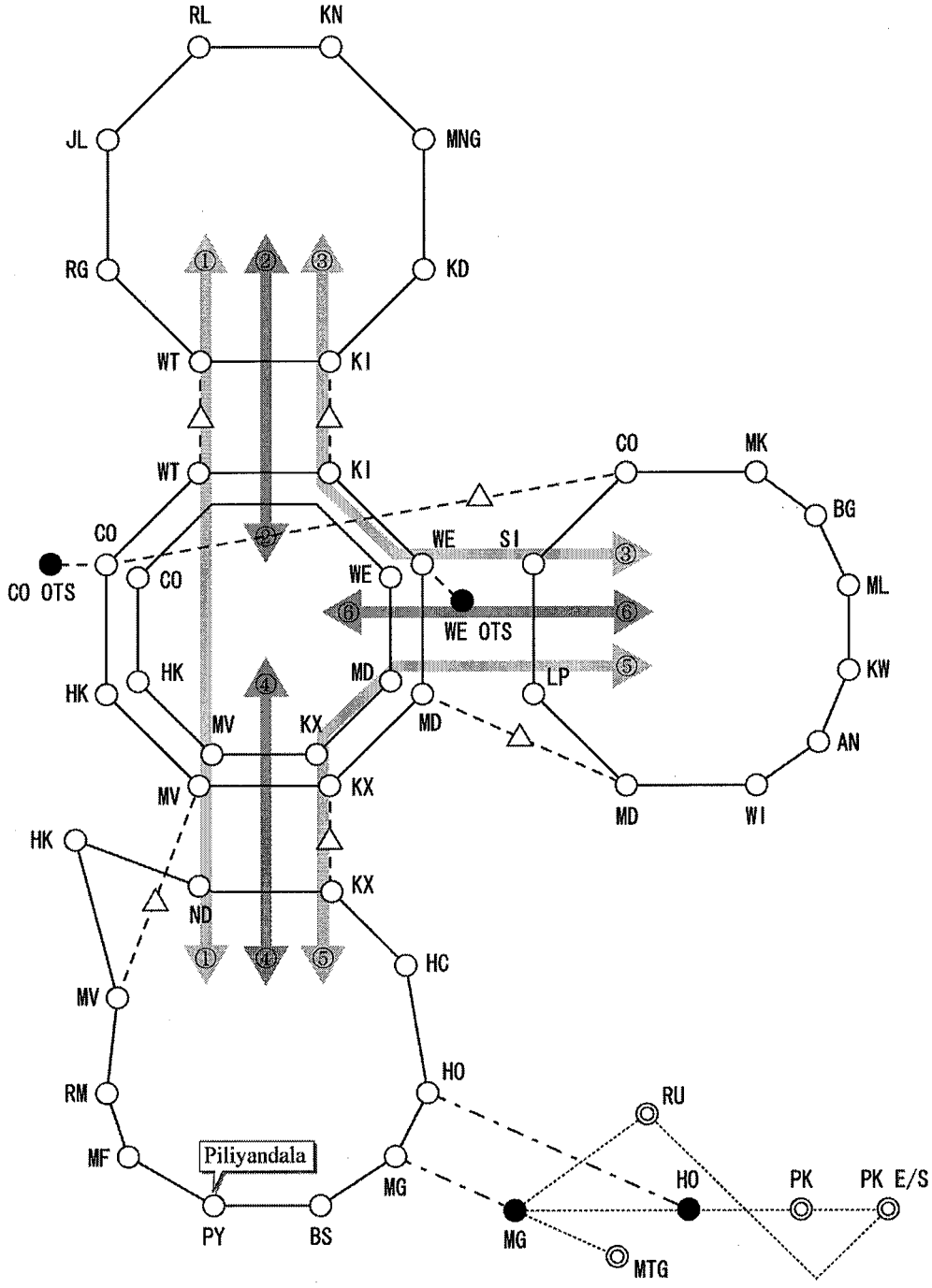
Dampe Technopark will require infrastructures to be improved internally and externally. A critical external infrastructure will include a telecommunications facility and access road as shown in the table below. Sewage treatment will also be important in view of the natural environment of the Bolgoda Lake.

Sri Lanka Telecom (SLT) is developing an Optical Fiber Cable (OFC) network for data telecommunications in the Colombo area. Dampe Technopark can access the Piliyandala (PY) junction of the OFC network as illustrated on the following page.

Necessary Supporting Inrastructure for Dampe Technopark

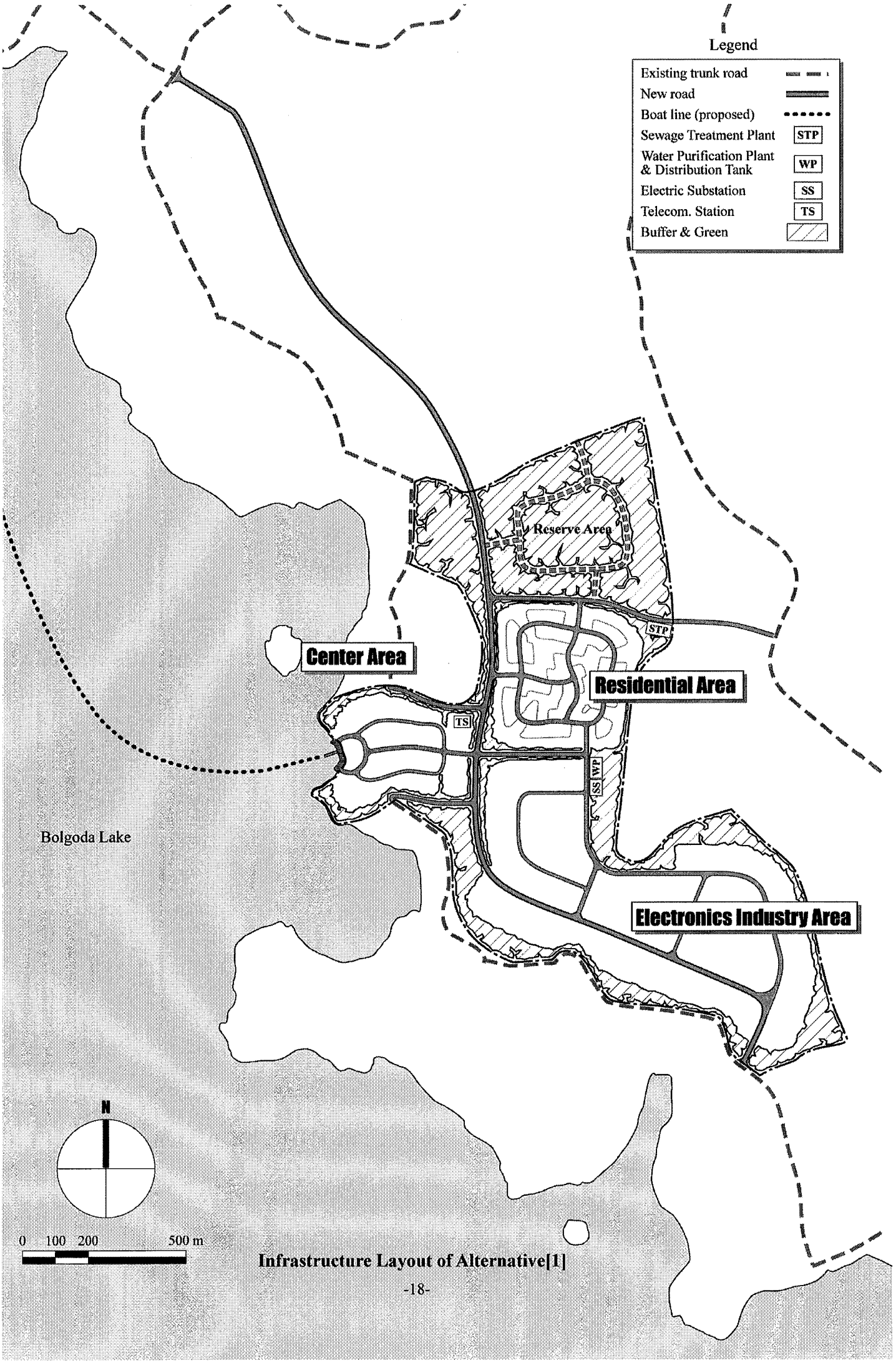
	Infrastructure	Alternative 1 (300 acres)	Alternative 2 (180 acres)	Remarks
Internal infrastructure	1 Telecommunication facility	○	○	
	2 Road	○	○	
	3 Water distribution pipe	○	○	
	4 Power distribution line	○	○	
	5 Sewer	○	○	
	6 Others (solid waste disposal facility, park & green)	○	○	
External infrastructure	Telecommunication facility	5km optical fiber cable from Piliyandala	6.5km optical fiber cable from Piliyandala	SLT shall develop with own budget
	Transportation facility	Access road (2.0km) & a boat pier	Access road (2.5km) & 2 boat piers	
	Water supply facility	Borehole & purification plant	Borehole & purification plant	
	Power supply facility	10km transmission line from Ratmalana & Substation	12km transmission line from Ratmalana & Substation	
	Sewage treatment facility	Sewage treatment plant	Sewage treatment plant	

The layout plan of internal infrastructure development is shown in the following pages, respectively for the land use of alternatives 1 and 2.

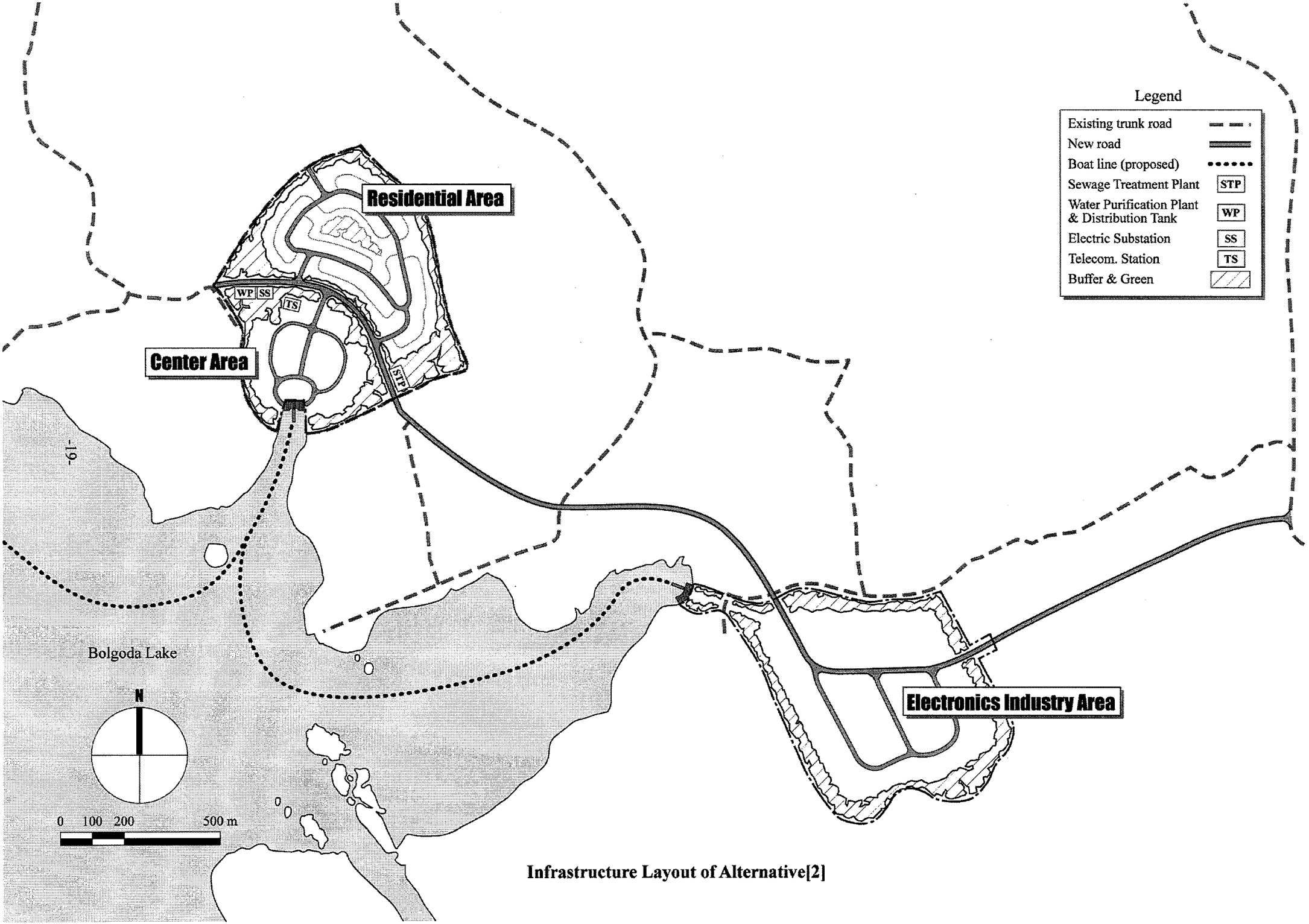


System Configration of Junction OFC Network being developed by SLT

(source: SLT)



Infrastructure Layout of Alternative[1]



Infrastructure Layout of Alternative[2]

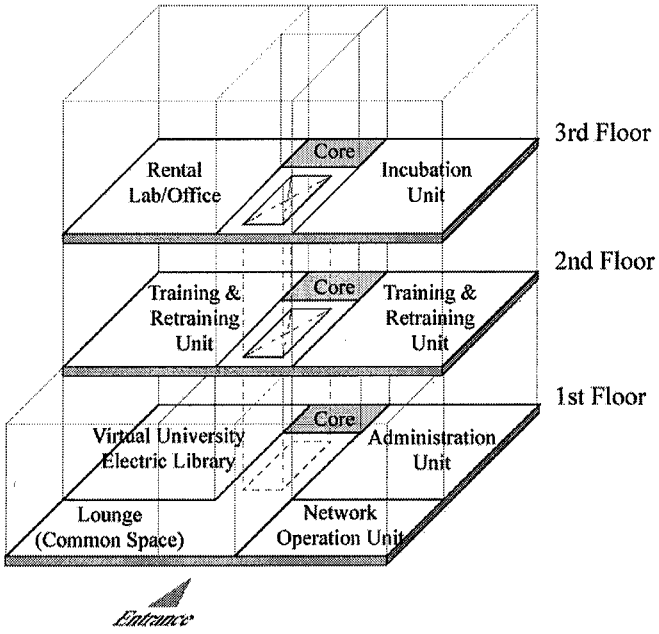
2) Center Facility

Two centers are planned in Technopark; Smart Center and Electronic Technology Center with various kinds of functions as shown in the table below. Floor arrangement images of both centers are also shown on the following page.

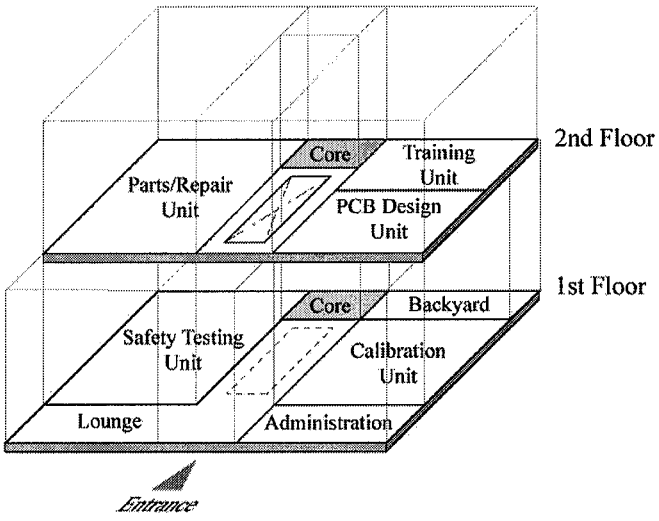
Center Facility Plan

Center	Function	Floor Area
1. Smart Center	Administration unit	500 m^2
	Network Operation Unit	200 m^2
	Virtual University	500 m^2
	Electronic Library	
	Training/Retraining Unit	1,000 m^2
	Incubation Unit	1,000 m^2
	Rental Lab/Office	
	Common Space	800 m^2
	Total	4,000 m^2
		1st floor: 2,000m^2 2nd floor: 1,000 m^2 3rd floor: 1,000 m^2
	Plot area: building ratio 20 %	10,000 m^2
2. Electronic Technology Center	Calibration Unit	3,000 m^2
	Safety Testing Unit	
	Parts/Repair Unit	
	PCB Design Unit	
	Training Unit	
	Common Space	600 m^2
	Total	3,600 m^2
		1st floor: 2,000m^2 2nd floor: 1,600 m^2
	Plot area: building ratio 20 %	10,000 m^2

Smart Center



Electronic Technology Center



Floor Arrangement Image of Smart Center and Electronic Technology Center

4.2 Development Cost

Development cost of Dampe Technopark is estimated to be approximately US$ 30 million as shown below. Internal cost will be US$ 18～21 million, while the external cost will be US$ 11～13 million.

Summary of Development Cost of Dampe Technopark

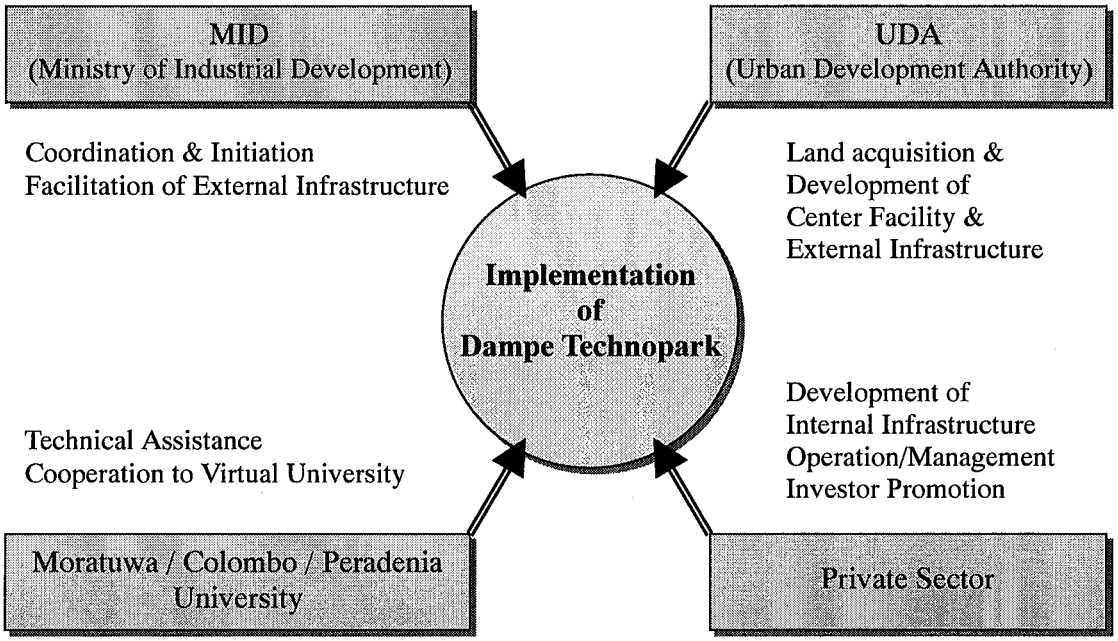
	Item	Alternative 1		Alternative 2		Remarks
		Rs. million	Million US$	Rs. million	million US$	
Internal Cost	1. Construction cost	587	15.7	493	13.2	
	2. Administraion expense	9	0.2	7	0.2	1.5% of construction cost
	3. Engineering service	59	1.6	49	1.3	10% of construction cost
	4. Physical contingency	131	3.5	110	2.9	20% of (1, 2 and 3)
	Subtotal	**785**	**20.9**	**660**	**17.6**	
External Cost	1. Construction cost (External infrastructure)	351	9.4	309	8.2	
	2. Administraion expense	5	0.1	5	0.1	1.5% of construction cost
	3. Engineering service	35	0.9	31	0.8	10% of construction cost
	4. Physical contingency	78	2.1	69	1.8	20% of (1, 2 and 3)
	Subtotal	**469**	**12.5**	**413**	**11.0**	
Total		**1,254**	**33.5**	**1,073**	**28.6**	

Note: /1 Land acquisition, compensation, resettlement cost is not inclusive.
/2 Cost of telecom. devices development is not inclusive assuming that it will be developed by SLT budget.
/3 1 US$ = 37.5 Rs.
/4 Cost of the center facility and equipment is excluded since it will be arranged separately.

5. IMPLEMENTION PLAN OF DAMPE TECHNOPARK

5.1 Organization for Implementation

Dampe Technopark is proposed to be implemented by the private initiative with the public sector cooperation. The implementing organization is schematically proposed as shown below.



Schematic Plan of Implementing System of Dampe Technopark

5.2 Implemention Schedule

The implemention schedule of Dampe Technopark is tentatively proposed as follows.

- Preparatory work stage : 2000 – 2002
- Construction stage : 2003 – 2004
- Commissioning stage : 2004 – 2005

The construction work of Dampe Technopark is scheduled to be completed by the end of 2004 and establishment of software entrepreneur/electronic manufacturer will be expected in 2004 and 2005. A detailed development schedule is shown on the following page.

Item	2000	2001	2002	2003	2004	2005
1 Preparation Stage						
1) FS						
2) Organization of Implementing Participants						
3) Financial Arrangement						
4) Land Acquisition						
2 Construction Stage						
1) Design						
2) Land Development						
3) Internal Infrastructure Development						
4) Development of Center Facility						
5) External Infrastructure Development						
3 Commissioning Stage						
1) Establishment of Software Entrepreneur						
2) Establishment of Electronic Industry						
3) Settlement of Residential Area						

Development Schedule of Dampe Technopark (Proposed)

5.3 Financial Arrangement Plan

Development finance of Dampe Technopark is tentatively assumed as shown below. In principle, the development of the land and internal infrastructure will be carried out by the private initiative, while the external infrastructure and centers be developed by the public with cooperation of foreign aid.

Financial Arrangement for Dampe Technopark

Item	MID	UDA	Private Initiative	Relevant Agency	Foreign Assistance (Loan/Grant)
1. Development Investigation/study	○				○
2. Land acquisition for Technopark and external infrastructure		○			
3. Center building & equipment					○
4. Land grading & internal infrastructure development			○		
5. External infrastructure development				○ (Tel, Elec)	○