

Project implementation by an infrastructure development company (IDC) has been adopted as an instrument soluble for the budget constraints of the Government. IDC is established by two ways: 100% investment by domestic capital, and joint venture with foreign enterprises. Vietnam capital has developed 30% of industrial estates in whole Vietnam. Coordination between various projects will be substantially more effective, if IDC is identified and fixed, since it becomes coordination between the implementators. Planning as a guideline is not enough for IDC to decide to become the project implementator, and therefore the detailed planning should be established.

As for the 21A Urban Corridor from Mieu Mon, Xuan Mai, Hoa Lac to Son Tay, the Government of Vietnam is scheduled to formulate its detailed plan within 1998 at the earliest. The Government of Japan decided to support this scheme, and has started a JICA-sponsored study on a comprehensive regional development plan centering on the Hoa Lac New City. The Government of Vietnam is to establish the Board of Management (BOM) for the development of the New City/21A Urban Corridor. Accordingly, it is expected that IDC will be identified and fixed in the course of the JICA study so as to make the activities of BOM and the coordination between the component projects substantially effective.

3.3 Site Demand for the Hoa Lac High-Tech Park

High-tech factory, software industry, and R&D laboratory are prospective locators in the HHTP site, and their site demand is the most decisive factor in setting up the development scale of HHTP. This section identifies the site demand in the short term based on questionnaire/interview surveys conducted under this Study, and estimates the site demand in the long term in view of the macroeconomy of Vietnam.

3.3.1 Demand Identified by Questionnaire/Interview Survey

The demand identified by questionnaire survey and the like is limited to that in the near future, since an enterprise's management plan in general spans around 5 years. Accordingly, the demand for the HHTP site foreseen in this Study is up to 2005 (start of operation base).

(1) Factory Site Demand

A questionnaire survey to companies was conducted within the scope of this Study, and its detailed results are compiled in Appendix VII. The results on demand for the HHTP site are summarized below:

- Foreign enterprises: There are 23 companies who certainly wish to locate their factory, including the ones possibly to locate. Of the 23, 17 companies indicated that the factory site area needed is 48.7 to 68.1 ha.
- Vietnamese domestic enterprises: There are 3 companies who certainly wish to locate their factory, including the ones possibly to locate. They indicated that the factory site area needed is 3.0 to 5.7 ha.
- The factory site demand of the above 26 companies totals 51.7 to 73.8 ha, which is expandable to around 115 ha by 55 companies/factories. This presumed output is the demand of companies including ones not covered by the questionnaire in the sampling survey, while taking into account the practical investment reliability.

(2) Site Demand of Software Industry

There are 5 Vietnamese companies who wish to locate in the HHTP site, of which 3 companies said they needed a factory site area of 0.6 to 1.0 ha. Among the respondents to the questionnaire survey, there are no foreign companies who wish to locate in the HHTP site.

It is in a sense reasonable that the questionnaire survey could not identify potential foreign investors in the HHTP site, since software enterprises are in general aligned with local enterprises when they do business in foreign countries. In the case of package software, the maker consigns the system/claim solution relevant to the localization of software and manpower training to the local enterprise. This is likely the case of Vietnam. Custom software programming is also consigned to foreign enterprises. This consignment has become popular, as exemplified in Bangalore, India, while utilizing international telecommunications/information system.

In other words, this suggests that wishes of foreign software enterprises to locate in the HHTP site have been reflected in the answers by Vietnamese enterprises to the questionnaire survey. A seminar was held in October 1997 in Vietnam to promote expansion of business and tie-up between software makers in both Vietnam and foreign countries. In addition, incubation of software development is considered to have a high possibility for the following reasons.

- 1) Vietnamese have the good qualities for software development.
- 2) Initial investment costs of software development are much lower than those of manufacturing and R&D activities.

- 3) Investment on software development is encouraged by strong political support.

In the Study, the investment demand for software is considered to be several enterprises with an area of about 10 – 20 ha, taking into consideration that incubation of software development seems to be encouraged in the foreseeable future.

(3) Laboratory Site Demand

1) Site demand for enterprises' laboratories

R&D institutions are classified into national/public institute and enterprise's laboratory in terms of constitution. In terms of establishment, enterprise's laboratory is divided into laboratory attached to headquarters and factory, and independent laboratory. A national/public institute has a headquarters/center, and its divisions/sub-institutes. The results of the questionnaire survey on the demand for the HHTP site are summarized below:

- Foreign enterprises: Of the 23 companies who wish to locate certainly or possibly in the HHTP site, 3 companies responded they needed a site area of around 3 ha for two independent laboratories and one laboratory attached to factory.
- Vietnamese domestic enterprises: Of the 3 companies who wish to locate certainly or possibly in the HHTP site, 2 companies responded they needed a site area of around 1,000 - 2,000 m² for two laboratories attached to factory. No need for location of independent laboratory was expressed.
- Taking into account the practical investment reliability and the like, location of independent laboratory of enterprise (ILE) is not prospective in the short term. Location of laboratory attached to factory is considerable to some extent, but the site demand has been already included in the factory site demand, and therefore there is no site demand for ILE.

As mentioned above, location of ILE is not expected in the HHTP site in the short term. However, high-tech industry and R&D function are inseparable from each other. R&D function indicator (researchers-100 factory workers ratio) in Japan is 12% on average among the 24 categories of high-tech industries selected in the "Master Plan for High-Tech Industrial Policy" (Volume I) to be promoted in Vietnam. This ratio of R&D function is not low, and it might be effective for national/public R&D institutes in Vietnam to support the factories to be located in the HHTP site, so that they can do high-tech production in a real sense. This

support system by national/public R&D institutes will be conducive to investment promotion as an incentive. The next section outlines the site demand of national/public R&D institutes.

2) Demand for state research institutes

(a) Basic philosophy

State research institutes should be moved to HHTP by governmental initiative, since the HHTP Project is a national project. Lots should be prepared so that the Government could locate the state research institutes which are important in terms of high-tech promotion, while for high-tech factories and foreign research institutes lot areas are determined based on the investment demand. Therefore, due consideration should be given to the relocation of state research institutes to HHTP or the establishment of the National High-Tech R&D Center that is proposed in the "Master Plan for High-Tech Industrial Policy" (Volume I), prior to the implementation of the HHTP Project.

(b) Estimation method for lot area of state research institutes in the Study

The required lot area for state research institutes has to be estimated, as there is no plan for their relocation or for the establishment of the National High-Tech R&D Center at this moment. The required lot area is estimated by the method mentioned below.

Firstly, estimation is made on the current number of researchers in the high-tech fields who are working for state research institutes in Hanoi under both the National Center for Science and Technology (NCST) and Ministries.

Secondly, the number of high-tech researchers in Hanoi in the year 2005 is estimated from the above current level. It is assumed that all high-tech researchers in Hanoi move to HHTP in 2005. According to the target of high-tech promotion mentioned in the part concerning policy in this report, the number of researchers per 10,000 labors is assumed to increase from 5 ~ 10 in the year 1995 to 20 in the year 2005. In other words, increase is assumed to be 2 to 4 times during this decade. A 2 times increase, that is the lower limit of the above range, corresponds to an annual growth rate of 7.1%, which is used for estimating the number of researchers in 2005.

Thirdly, the density of researchers per ha is set at 40 persons. The required lot area of state research institutes in HHTP is estimated by dividing the number of researchers by the density.

(c) Estimation of number of high-tech researchers in Hanoi in the year 2005

Researchers belonging to NCST

The number of high-tech researchers of state research institutes belonging to NCST located in Hanoi was derived from the brochure of NCST for 1997. The number in 2005 was calculated from this using the above growth rate. The numbers of researchers in 1997 and 2005 are shown below.

	1997	2005
Information Technology / Electronics	200	346
Mechanics / Mechatronics	120	208
Biotechnology	317	549
New Materials	387	670
Total	1,024	1,773

Researchers of state research institutes under ministries

State research institutes related to high-tech were selected from the paper, "Presentation on the Research - Development Institutions" published by Scientific Activity Review that is the mouthpiece of MOSTE. This publication, which is made up of 3 separate volumes, "Special Issue 95", "Special Issue 95-2", and "Special Issue 96", introduces Vietnamese research institutes. The number of state research institutes introduced in "Special Issue 95", "Special Issue 95-2", and "Special Issue 96" are 61, 63 and 55, respectively and 179 in total.

State research institutes that meet the following conditions at the same time were selected from the above 179 institutes: being related to high-tech at any rate; being located in Hanoi; and being under ministries. As a result, altogether 20 research institutes fulfilled the conditions. For 7 research institutes which responded to the questionnaire survey conducted by the Study Team for all of the 20 institutes, the current numbers of researchers were derived from their responses to the questionnaire. For the remaining 13 research institutes, the current numbers of researchers were derived from the above publication, assuming the number of researchers mentioned in the publication is the same as the current one. The number of researchers altogether is estimated to be 2,239 in 1997 as shown in the table below. The number of researchers really related to high-tech is assumed to be half of them, i.e. 1,120 persons in 1997.

**Number of Researchers of High-Tech Related State
Research Institutes under Ministries**

Research Institutes	Research Field	No. of Researchers in 1997
1	Environmental	31
2	IT/ Electronics	**32
3	Plural	**78
4	Biotechnology	44
5	Biotechnology	110
6	New Material	**40
7	Mechanics/Mechatronics	**39
8	Energy	195
9	Mechanics/Mechatronics	**37
10	Biotechnology	**150
11	Mechanics/Mechatronics	157
12	Biotechnology	502
13	IT/ Electronics	**81
14	IT/ Electronics	**129
15	Mechanics/Mechatronics	**250
16	IT/ Electronics	**40
17	IT/ Electronics	**16
18	Mechanics/Mechatronics	**11
19	Energy	**25
20	Plural	272
Total		2,239

Notes: Figures with ** are based on published data of "Presentation on the research - development institutions", while those without ** are based on the questionnaire survey made by the Study Team.

Furthermore, the number of high-tech related researchers in 2005 was estimated at 1,938 based on the number of 1,120 persons assumed above and the annual growth rate of 7.1 % set in paragraph (b) above.

Number of high-tech related researchers to be moved to HHTP

As estimated above, the number of high-tech related researchers to be moved to HHTP is 1,773 from NCST, 1,938 from state research institutes under ministries, i.e. 3,711 in total.

(d) Assumption of the density of researchers

The density of researchers per ha was assumed to be 40 persons / ha based on the philosophy that research institutes should be located in a large lot to create a better environment for R&D activities. This assumption was made referring to the following examples:

- NCST institutes at Nghia Do in Hanoi (11 institutes): average 195 persons / ha
- Criterion for a research zone in the new campus of Vietnam National University - Hanoi (for planning): 50 persons / ha

- State research institutes in the science and technology field located in Tsukuba, Japan (16 research institutes): average 12 persons / ha

(e) Required lot area of state research institutes

The required lot area of state research institutes was estimated at 92.8 ha by the dividing the number of high-tech related researchers to be moved to HHTP (3,711 persons) by the density of researchers (40 persons / ha).

3.3.2 Site Demand in View of Macroeconomy

In addition to the site demand in the short term as calculated above, the site demand in the long term, excluding the demand of software industry, is estimated in this section.

(1) Site Demand of High-Tech Factory

Site demand of high-tech industry in HHTP amounts to 394 ha up to 2020, based on the considerations shown in Figure 3-3-1.

Site demand for HHTP is estimated not only up to 2020, but also up to 2005 (170 ha), 2010 (237 ha), and 2015 (346 ha) as shown in Table 3-3-1.

Considerations for the estimation are as follows in due order depicted in Figure 3-3-1:

- 1) Vietnam in 2020 is envisioned in reference to other countries; the forerunners in industrialization, Thailand and Malaysia regarding the industrial structure, and Japan for high-tech industry's share of total GDP. This takes into account a definite relationship between the size of GDP and the industrial structure.
- 2) Base year is 1995, and target year is 2020. Per capita GDP, total GDP, and manufacturing VA in 2020 are set, and then their values in every 5 years from 1995 to 2015 are calculated based on their annual average growth rates between 1995 and 2020.
- 3) Population of Vietnam in 2020 is presumed to be 98.43 million by setting its annual growth rate. The population growth rate has decreased in recent years, and it was 1.88% from 1995 to 1996. Assuming further decrease in the rate, the annual average growth rate is set at 1.5% between 1995 and 2000, 1.3% between 2000 and 2005, and 1.0% after 2005.
- 4) Per capita GDP in 2020 is set at 2,500 USD. There is no official target of per capita GDP in 2020, but it has been discussed in Vietnam that the target will be

around 2,000 - 2,500 USD. The target in this Study is set in consideration of a rapid growth of GDP due to high-tech industrialization. In the meantime, this target of 2,500 USD corresponds to around 90% of Thailand's GDP, 2,770 USD in 1995.

- 5) Vietnam's GDP in 2020 will be USD 246.1 billion, which is derived from the population and per capita GDP in 2020 already set above.
- 6) Manufacturing GDP in 2020 is presumed to be USD 78 billion accounting for 30% of the total. This share is set based on the rate of 32% in Thailand (1995) and 33% in Malaysia (1994) as shown below, while considering that Vietnam's per capita GDP in 2020 is smaller than that of these countries in recent years.

Economic Indicators in Thailand and Malaysia

	Thailand		Malaysia		Source
0.1 GDP	in 1995		in 1994		• UN Statistics
GDP Total (mill. USD)	164,541		70,626		
Per Capita GDP (USD)	2,770		3,594		
02. GDP Structure in 1995 (mill. USD)			(mill. USD)		• VN Statistical Yearbook
• Manufacturing	52,944	32%	22,349	33%	1996 (General Statistical Office)
• Other Sectors	111,597	68%	48,277	67%	
	Workers		Workers		
03. Employment	32,845	in 1993	8,060	in 1995	• VN Statistical Yearbook
• Manufacturing	3,961	12%	1,997	25%	1996 (General Statistical Office)
• Other Sectors	28,884	88%	6,063	75%	
04. Labor Productivity	(USD/Person in 1993)		(USD/Person in 1994)		• Ditto
	(Difference)		(Difference)		
• Total/Average	3,819	(100)	9,002	(100)	
• Manufacturing	9,581	(251)	11,900	(132)	
• Other Sectors	3,029	(79)	8,089	(90)	

- 7) The high-tech industry's share of manufacturing total gross value-added is presumed to be 40% in 2020. This high-tech industry comprises the 24 categories selected by the "Master Plan for High-tech Industrial Policy" (Volume I), which are listed in the note of the next table. They had constantly accounted for around 45% of the manufacturing total from 1986 to 1995 in Japan. That is probably because high-tech industrialization had been saturated in Japan, relocation of labor-intensive high-tech industry had become active in foreign countries, and high-tech industrialization had brought about restructuring and curtailment of enterprises through the severe competition while simultaneously causing enterprises to grow or retire from the race. As

such, industrial growth as a whole is not so large, after high-tech industrialization is saturated.

Shares of High-tech Industries to be promoted in Vietnam

Year	Net Value-Added (billion yen)			Labor Productivity (000 yen)				
	Total	High-Tech Industry	High-Tech's Share	(1) Total	(2) High-Tech Industry	(3) Others	(4) High-Tech Industry's Difference (3)= 100	(5) (1)= 100
1986	89,205	40,664	46%	8,190	9,835	7,183	137	120
1987	92,825	42,224	45%	8,645	10,434	7,563	138	121
1988	102,729	47,660	46%	9,415	11,559	8,113	142	123
1989	110,993	51,591	46%	10,124	12,333	8,762	141	122
1990	119,028	56,077	47%	10,653	13,093	9,137	143	123
1991	125,748	58,125	46%	11,078	13,266	9,703	137	120
1992	121,136	54,102	45%	10,857	12,646	9,745	130	116
1993	114,974	50,696	44%	10,562	12,313	9,497	130	117
1994	112,349	49,900	44%	10,786	12,612	9,667	130	117
1995	117,204	53,711	46%	11,356	13,813	9,871	140	122

Note 1: High-tech industry comprises the following 24 categories which are selected by this Study (Volume I) to be promoted in Vietnam.

201 Fertilizers & Inorganic Chemicals	299 Other General Machinery/Equip.
202 Organic Chemicals	301 Industrial Electrical Machinery/Equip.
203 Synthetic Fibers	302 Electrical Home Appliances
204 Detergents, Surfactants, Paints, etc.	303 Telecommunications Equipment
205 Pharmaceuticals	304 Computers, X-Ray Equip. VTR, etc.
209 Other Chemical Products	305 Electronic Parts/Devices, etc.
231 Rubber Tires & Tubes	309 Other Electrical/Electronic Products
251 Glass and Glass Products	311 Motor Vehicles & Parts, etc.
261 Iron & Steel Products	321 Medical Equipment, etc.
291 Metal Processing Machinery/Equip.	322 Optical Equipment & Lenses
292 Special Industrial Machinery	323 Watches/Clocks & Parts
293 Office Equip., Air Conditioners, etc.	329 Other Precision Instruments

Note 2: Data were on establishments with 4 or more workers.

Source: The 1987 Census of Manufactures, Japan (Ministry of International Trade and Industry)

In the meantime, this high-tech industry's share of 40% in 2020 is set based on the consideration that shares of high-tech basic industries such as iron and steel with blast furnace and petrochemicals in Vietnam will be less than those of Japan.

8) Labor productivity of high-tech industry is also different between countries. Such difference is a source of global location of factories seeking competitiveness, and therefore it is not reasonable, for example, to apply the labor productivity of Japan to Vietnam. Consequently, it is set as follows:

- The labor productivity in 2020 is presumed to be 80,000 USD per worker, corresponding to 50% of that of the 24 categories of high-tech industry of Japan in 1995 (gross value-added base).

Yearly 80,000 USD/worker = around 170,000 USD/worker × around 0.5 (level of Vietnam)

Around 170,000 USD/worker = 146,947 USD/worker × 117% (gross value-added/value-added)

146,947 USD/worker = ¥13.813 million / ¥94 per USD (exchange rate)

- The labor productivity in 2000 is presumed to be 20,000 USD per worker, considering labor productivity in Thailand and Malaysia, and assuming that the annual average growth rate up to 2000 will be 6%, and that labor productivity of high-tech industry will 1.5 times that of the manufacturing total.

Yearly around 20,000 USD/worker in 2000 = 10,000 USD/worker × 1.338 × 1.5

1.338 : converted from an annual average growth of 6% of labor productivity from 1995 to 2000 (based on the growth rate of Malaysia in recent years)

1.5 : high-tech industry's difference over the manufacturing total in terms of labor productivity (presumed to be larger than that of Japan)

- The labor productivity in 2005, 2010, and 2020 can be calculated using the annual average growth rates (7.8%) between 2000 and 2020, but this is not adopted. Conclusively, the productivity is presumed to annually increase at 8.4% from 2000 to 2010, during which high-tech production will rapidly expand, and expansion of related industry's production conducive to decrease in import of raw materials will also progress in Vietnam. As a contrast, the growth will slow down to 5.9% per annum from 2010 to 2020.

9) Numbers of workers in the high-tech industry are derived from its VA and the labor productivity mentioned above; 56,570 in 2000, 129,201 in 2010, and 369,120 in 2020.

10) Factory site demand in whole Vietnam is calculated using the land use parameter (150 workers/ha), which is set in consideration of operation of factory by shifts.

- 11) The Red River Delta region is considered to decreasingly share the factory site demand in whole Vietnam toward 2020, from its highest share of 60% in 2000. The region's highest share in 2000 takes into account the development of HHTP, and the 60% is determined considering the location of high-tech factories in other areas including the Ho Chi Minh High-Tech Park. The region's decreasing share reflects a gradual industrial decentralization in the distant future, to rural areas from big city areas including Hanoi/Ha Tay where high-tech industry will agglomerate earlier than rural areas.
- 12) The HHTP's share of the region's total demand and the high-tech factory site demand for HHTP are presumed taking into account the factory location in other IEs as follows:
- The HHTP's share of the site demand in the region is presumed to be 75% in 2005 when there will be no high-tech park other than HHTP, but considering high-tech factory location in other IEs and the land other than IE.
 - The HHTP's share of the site demand in the region will be 50% in 2010 and 40% in 2020, or 237 ha and 394 ha in terms of factory area. This is mainly because in the distant future not only new high-tech parks will be developed in the region, but also development of IEs targeting high-tech factory location will progress.

As a result, the factory site demand for HHTP will account for 45% and 16% of the national total in 2005 and 2020, respectively. This is based on a consideration that high-tech industrialization will expand across whole Vietnam according to the progress of the HHTP development and high-tech factory location in HHTP site. As such, this estimation for the HHTP is relatively moderate, reflecting the objective of the estimation, i.e. to foresee a sort of minimum demand for the HHTP site.

In the meantime, VA of high-tech industry will amount to 29.5 billion USD in 2020 accounting for 12% of the national total. It may be controversial whether this contribution of high-tech industry is large or not. As such, next concern might be the time schedule of targeted per capita GDP of 2,500 USD to be achieved, when setting an annual GDP growth rate of 8% and 9% after 1995, based on an assumption that population of Vietnam will annually grow by 1.0% after 2020 (98.43 people in 2020).

- 8% growth case: This case can reach the target of 2,500 USD from 2029 (2,385 USD) to 2030 (2,511 USD), while per capita GDP in 2020 will be 1,305 USD.

- 9% growth case: This case can reach the target of 2,500 USD from 2025 (2,384 USD) to 2026 (2,572 USD). Per capita GDP in 2020 will be 1,628 USD.

As seen above, high-tech industrialization will positively contribute to 5 to 10 years earlier achievement of the targeted per capita GDP. As a matter of methodological limitation above, all of contribution cannot be attributable to high-tech industrialization, however, it will certainly accelerate the target achievement.

(2) Laboratory Site Demand

The “Master Plan for High-tech Industrial Policy” (Volume I) has set the R&D staff including researchers, engineers, and R&D assistants and technicians at 20 persons per 10,000 workers in 2005, 30 persons per 10,000 workers in 2010, and 50 persons per 10,000 workers in 2020.

Figure 3-3-2 shows considerations to estimate laboratory site demand for the HHTP site, on the basis of the above targets. As a result, the demand is estimated to be 188 ha (128 ha for national/public R&D institutes, and 60 ha for enterprises’ independent laboratories) up to 2020. The demand up to 2005 and 2010 amounts to 115 ha and 150 ha, respectively as shown in the Table 3-3-2. Consideration to reach such results are as follows:

- 1) Population in the future is the one forecast in the previous section (refer to Table 3-3-1). Workers-total population ratio is presumed to be 50% in 2020, increasing gradually from 47.9% in 1995. R&D staff is derived from the workers and the targets, e.g. 246,080 persons in 2020.
- 2) Laboratory site demand is for national/public R&D institutes and enterprises’ laboratories. However, the targeted R&D staff includes that in universities, and it is needed to clarify the number of R&D staff in universities and other organizations. They are estimated to be 49,650 persons in 1995, including 13,650 in universities, as detailed below:
 - Universities: $22,750 \text{ (Teachers in 1995)} \times 0.6 \text{ (natural science's share presumed)} = 13,650$
 - Laboratories (national R&D institutes and SOEs): $45,000 \times 0.8 \text{ (natural science's share presumed)} = 36,000$
 - The natural science’s share is presumed based on the rates in Japan; 0.67 (universities), and 0.9 (national/public R&D institutes), and also considering that the social science’s share in Vietnam is higher.

- Laboratory's share in 1995: $\{ \text{laboratory } 36,000 / (13,650 + 36,000) \} \times 100 = 72.5\%$

- 3) This laboratory's share of the total R&D staff is foreseen to decrease, since the staff in universities will rapidly increase according to increasing student enrollment in line with the growth of Vietnam's economy. As such, the laboratory's share of the total R&D staff is presumed to be 70% in 2005, 67.5% in 2010, and 60% in 2020, assuming the university's share to gradually increase 30% in 2005 from around 28% in 1995, to 32.5% in 2010, and to 40% in 2020, which is almost equal to that in the first half of the 1970s in Japan. Accordingly, the number of R&D staff in laboratories will amount to 52,683 in 2005, 88,418 in 2010, and 147,648 in 2020.
- 4) Of the incremental R&D staff in national/public institutes (NPIs) and enterprises' laboratories (ELs), the number conducive to new laboratory site demand is presumed to be 7,168 in 2005, 65,497 in 2010, and 97,248 in 2020 by deducting 54,000 from the total, on the assumption that the existing laboratory sites as a whole would be able to accommodate 54,000 R&D staff, 1.4 times of 36,000 in 1995.

The allowance of 1.4 times was set with an assumption that no critical problem arises if R&D staff increase from 5 to 6 within the present space of laboratories, but they will feel cramped, if they increase from 5 to 7. On the other hand, the allowance of 1.4 times could be derived from the consideration that the laboratories which are able to accommodate existing R&D staff up to 2 times within the existing site, may account for 70% of the total.

- 5) The number of R&D staff in NPIs and ELs should be clarified to calculate the new site demand. To date, NPIs' R&D staff have been dominant, and they account for nearly 90 - 100% of the total. However, NPIs' share is presumed to rapidly decrease to 15% of the total R&D staff, since that of ELs is assumed to increase to 85% of the total in 2020. This ELs' share is determined not only based on the present share in Japan, but also considering that the future increase in ELs will be conducive mainly to new site demand and new location of laboratories. Consequently, NPIs' staff will amount to 14,587 in 2020 but would number 5,734, accounting for 80% of the total, in 2005 when its share is still quite high. After that, NPIs' staff will rapidly decrease through the NPIs' restructuring and transfer to SOEs, and will number 11,450 in 2010, accounting for 30% of the total.

6) As for ELs, their independent laboratories are expected to be located in HHTP. ELs attached to factories are located within the factory site, of which demand has been already estimated. On the other hand, ELs attached to the headquarters are foreseen to be located in Hanoi. Independent laboratories of ELs are assumed to account for 55% of the total R&D staff of enterprises, which is set based on the data of Japan in 1995 as follows:

- Researchers of ELs attached to the headquarters: 192,495/55.1%
- Researchers of ELs other than those attached to the headquarters: 156,812/44.9%

*Source : The 1995 Results of the Basic Survey of Business Structure and Activity
(Ministry of International Trade and Industry of Japan)*

In addition, the ratio between ELs' independent laboratories and ELs attached to factories in terms of number of establishments is 40 : 60 according to a study conducted by the Housing and Urban Development Public Corporation in Japan. However, the independent laboratories are mostly larger in terms of number of R&D staff, and their share is set at 60% of the enterprise's total R&D staff. As a result, the shares of R&D staff of independent laboratories are as follows:

- ELs attached to factories
and independent: $100\% - \text{ELs headquarters } 55\% = 45\%$
- Independent laboratories: $45\% \times 60\% (\text{attached to factories/independent}) = 27\%$

Finally and wholly, the totals of R&D staff in laboratories other than those in universities are as follows based on the above shares.

	2005	2010	2020
NPIs	80%	30%	15%
ELs	20%	70%	85%
Independent laboratories of ELs	$20\% \times 0.27$ = 5.4%	$70\% \times 0.27$ = 18.9%	$85\% \times 0.27$ = 22.95%

7) The R&D staff of independent laboratories can be calculated by its share and the total number of R&D staff in laboratories excluding universities. The result shows that there will be 387 R&D staff in 2005, 7,185 in 2010, and 22,318 in 2020 across whole Vietnam.

- 8) The laboratory site demand in whole Vietnam can be calculated based on the land use parameters (40 R&D staff/ha for NPIs, and 60 R&D staff/ha for ELs). NPIs with the lower land parameter require the larger site than that of ELs, since NPIs would have more visitors including those who use their facilities than ELs. In either case, an emphasis is put on a good image and environment building by a spatially less-intensive land use.
- 9) Thus, the laboratory site demand in whole Vietnam for NPIs is estimated to be 143 ha up to 2005, 285 ha up to 2010, and 365 ha up to 2020; for ELs, it will be 6 ha, 120 ha, and 372 ha, respectively, rapidly increasing after around 2010.
- 10) The Red River Delta region is considered to decreasingly share the laboratory site demand in whole Vietnam toward 2020, like the factory site already estimated. ELs' share by each year is considered to be the same as that of the factory site, taking into account the development of HHTP.

As for NPIs, the region's share will decrease not as rapidly as that of the factory site demand, and is presumed to be 50% in 2020, considering that public R&D institutes will be established in addition to national R&D institutes. Vietnam has planned to develop high-tech parks across the country following the models of Hanoi and Ho Chi Minh. In this context, such public R&D institutes at the local level are expected to support the enterprises' R&D facilities to be located in high-tech parks. Practically speaking, DOST under MOSTE would be in charge of the said support.

- 11) The HHTP's shares of the region's demand and laboratory site demand for HHTP are presumed as follows:
 - In the case of NPIs, the HHTP's share of site demand in the region is presumed to be 100% of the total demand of 115 ha in 2005, considering NPIs' active participation in the HHTP development as a national project. NPIs site demand for HHTP will be 120 ha up to 2010, and 128 ha up to 2020, assuming the HHTP's share to be 70% after 2010 due to the development of new high-tech parks in other areas and expansion or new location of NPIs in and around Hanoi.
 - In the case of ELs, the HHTP's share of site demand in the region is presumed to be 50% of the total, i.e., 30 ha in 2010 and 40 ha in 2020, i.e. 40% increased, also considering the development of new high-tech parks and the progress of independent laboratory location. There would be no location of ELs in the HHTP site up to 2005, since foreign enterprises

would not locate their laboratories, and laboratories of SOEs and other enterprises would be centered on expansion of the existing sites in and around Hanoi, although a small site demand of 4 ha in the Red River Delta region is estimated.

The laboratory site demand for HHTP has been estimated as mentioned above on the basis of the considerations and processes illustrated in Figure 3-3-2 and Table 3-3-2. Table 3-3-3 may be useful to know the structure of R&D staff by sector in Vietnam as a whole. Between laboratories in universities and other organizations, R&D staff in universities will gradually increase its share, accounting for 40% of the total in 2020. As such, Vietnam's universities, which have been centering on education to date, are expected to play a large role in basic research through strengthening their R&D functions.

R&D staff in NPIs conducive to new site demand will only account for around 6% of the total in 2020. However, they will amount to 64,987 persons or around 26% of the total, together with other staff who are the majority of the staff in all the existing laboratories in Vietnam.

On the other hand, R&D staff in enterprises will amount to 82,661 persons in 2020, accounting for around 34% of the total R&D staff in Vietnam. Many of them, 18.5%, will be working at laboratories attached to headquarters, while 14,879 or 6.1% will be working at laboratories attached to factories, and 22,318 or 9.1% at independent laboratories.

The "Master Plan for High-Tech Industrial Policy" (Volume I) has established a target other than the target of R&D staff per 10,000 workers. The target is R&D expenditure per GDP: 1.5% in 2005, 2.0% in 2010, and 3.0% in 2020. From the presumed amount of 1,244 USD in 1995, R&D expenditure per R&D staff will largely increase, and will be 10,523 USD during 2005, 14,041 USD during 2010, and 30,000 USD during 2020, which can be calculated from GDP in 2020 already set based on the targeted per capita GDP of 2,500 USD and the population in 2020 (refer to Table 3-3-1). Such a large increase in R&D expenditure is expected to substantially strengthen Vietnam's R&D functions and activities

3.3.3 Evaluation of Site Demand

The site demand for factories, software industry, and laboratories in HHTP as estimated so far is summarized in the table below.

Summary Results of Site Demand Estimates for HHTP

	2005	2010	2020
New Site Demand by Questionnaire/Interview Survey	208.4-208.8		
01. Manufacturing Factory	115		
02. Software Industry	0.6-1.0		
03. R&D National Institute	92.8		
New Site Demand by Macroscopic Forecast of Vietnam's Economy	285	387	582
01. Manufacturing Factory	170	237	394
02. R&D Laboratory Total	115	150	188
2-1 National/Public Institute	115	120	128
2-2 Enterprise's Independent Laboratory		30	60

Source: JICA Study Team

The site demand estimated from the viewpoint of macroeconomy is a little bit larger in 2005 than the demand identified by the questionnaire/interview survey. The former is to be used as a basis for the HHTP development planning after 2010, however, such forecast demand will not be materialized without investment promotion and the like led by an appropriate strategy. Additionally, the planning should take into account not only the site demand, but also various planning elements regarding the HHTP site development such as physical conditions and desirable land use of the project site, efficient development related to economic feasibility, and the like.

Table 3-2-1 Outline of the Hanoi Master Plan

Areas/Years	1994	2000	2010	2020	Districts/Existing Facilities/Projects
Total	1,433	1,990	3,017	4,500	
1. Hanoi City Center	1,054	1,500	2,000	2,500	
1-1 Limited Development Area (size of urban area: ha)	912	850	800	800	Ba Dinh/Dong Da/Hoan Kiem/Hai Ba Trung/West lake (City center at present)
1-2 Outskirts/Vicinity Areas	142	650	1,200	1,700	
Right bank of the Red River	(313)	530	830	830	
South Thang Long Bridge	(171)	310	450	450	
(size of urban area: ha)		2,372	4,412	5,600	<ul style="list-style-type: none"> Industrial Zone (IZ): Cau Dien, and South Thang Long Universities, research institutes, embassies, centers of trade/service/sport, Buoi resort, and concentrated residential areas
Southwestern part (size of urban area: ha)	(57)	90	180	180	<ul style="list-style-type: none"> Areas along NH 6, Yen Hoa, and along Ring Road 3 neighboring on Ha Dong in Ha Tay province IZ: Thuong Dinh Me Tri Park, national sport center, and new urban area (Trung Yen/Yen Hoa/North and South Thanh Xuan)
Southern part (size of urban area: ha)	(85)	130	200	200	<ul style="list-style-type: none"> Areas along NH 1 (Dinh Cong/Linh Dam green park), Van Dien town, Cau Buoi, and Mai Dong IZ: Phap Van, Minh Khai-Vinh Tuy New residential areas (Mai Dong/Dinh Cong/Yen So)
Left bank of the Red River	(94)	120	370	870	New Ha Noi Area
North Thang Long Bridge	(20)	100	100	170	Areas including an area around the Van Tri lake
(size of urban area: ha)		600	1,200	3,000	<ul style="list-style-type: none"> Integrated new urban center with IZ, goods distribution center, new town, sport center, tourism/resort spots, etc. IZ: North Thang Long
Eastern part (size of urban area: ha)	(54)	100	160	300	<ul style="list-style-type: none"> Towns: Gia Lam/Sai Dong/Yen Vien IZ: Sai Dong A/B, Duc Giang Gia Lam Airport/Goods distribution center (planned)
NH 3 route (size of urban area: ha)	(20)	50	100	400	<ul style="list-style-type: none"> Towns: Dong Anh/Co Loa/etc. IZ: Dong Anh Historical monument (Co Loa), sport centers, etc.
2. Balancing Urban Groups	85	190	603	1,500	
2-1 NH 18 Urban Center (size of urban area: ha)	31	58	153	500	<ul style="list-style-type: none"> Soc Son/Xuan Hoa/Dai Lai/Phuc Yen EPZ: Soc Son (100 ha-430 ha/expansion) Xuan Hoa (50-70 ha) IZ: Me Linh (100-200 ha) and 400-500 ha (planned)
2-2 Urban Corridor: Mieu Mon-Xuan Mai-Hoa Lac-Son Tay (size of urban area: ha)	54	132	450	1,000	<ul style="list-style-type: none"> IZ (planned): Son Tay (50-100 ha), Xuan Mai (200-300 ha) High-Tech Park (1,600 ha) National University (Hoa Lac: 1,000 ha) International University (Hoa Lac: 200 ha) Vietnamese Cultural Village (830 ha), etc.
		5,770	10,750		
3. Satellites	294	300	414	500	

Note: Number in () is the total population (urban plus rural).

Source: The Hanoi Master Plan (proposal: Hanoi People's Committee and Ministry of Construction)

Table 3-2-2 Water Demand Projection in New Urban Series and Hanoi City

Water demand Areas	Terms			
	Existing (1996)	Short (2005)	Medium (2010)	Long (2020)
1. New Urban Series				
1.1 Son Tay Town				
Population (1000 people)	40	60	80	100
Water demand (m ³ /d)	6,000	10,000	15,000	40,000
1.2 Hoa Lac Town				
Population (1000 people)	44	150	420	670
Water demand (m ³ /d)	6,600	70,000	245,000	480,000
1.3 Xuan Mai Town				
Population (1000 people)	15	60	100	170
Water demand (m ³ /d)	2,250	20,000	45,000	65,000
1.4 Mieu Mon Town				
Population (1000 people)	1	5	10	30
Water demand (m ³ /d)	150	5,000	20,000	40,000
Urban series total demand (m ³ /d)	15,000	105,000	325,000	625,000
2. Hanoi City water demand (m ³ /d)			300,000	300,000
Grand total (m ³ /d)		105,000	625,000	925,000

Data source : Compiled based on the "General Plan of Urban Series/Xuan Mai-Hoa Lac" by MOC in May 1996.

Table 3-2-3 Surface Water Qualities and Drinking Water Quality Criteria

River Name / Categories		Red River	Da River		Water Quality Criteria		
Sampling Points		Son Tay Station	Hoa Binh Station	Trung Ha Station	Environment Standards in Vietnam	Drinking Water Standards	WHO's Guideline
Sampling Period		1994.3 to 12	1994.3 to 12	1994.3 to 12	(Class-A, for raw water for drinking)	Urban in Vietnam	
Sampling Frequency		10	10	10			
Parameters	Unit	Measured Concentration on Average					
pH		7.4	7.2	7.3	6 to 8.5	6.5 to 8.5	-
Nitrate	mg/l	0.9	1.1	0.9	10 as N	10	50 as N
Ammonia	mg/l	0.17	0.18	0.13	0.05 as N	0	1.5
Suspended Solids	mg/l	497	65	143	20	5	-
TDS	mg/l	-	-	-	-	500	1000
BOD	mg/l	2.7	2.6	1.8	4	-	-
Turbidity	mg/l	221	83	144	-	-	-
	NTU	-	-	-	-	-	5
Hardness	mg/l	83	75	80	-	500	-
Alkalinity	mg/l	102	98	102	-	-	-
Total Iron	mg/l	0.24	0.22	0.2	1	0.3	0.3
Zn	mg/l	0	0	0	1	5	3
As	mg/l	0.047	0.027	0.025	0.05	0.05	0.01
Cd	mg/l	<0.001	0	<0.001	0.01	0.005	0.003
Total Cr	mg/l	0.033	0.023	0.021	-	0.05	0.05
III-Cr	mg/l	-	-	-	0.1	-	-
VI-Cr	mg/l	-	-	-	0.05	-	-
Cu	mg/l	0.01	0.01	0.01	0.1	1	1
CN	mg/l	-	-	-	0.01	0.1	0.07
Pb	mg/l	0.034	0.028	0.034	0.05	0.005	0.01
Hg	mg/l	0	0	0	0.001	0.001	0.001
Ni	mg/l	0.02	0.02	0.01	0.1	-	0.02
Mn	mg/l	0.01	0.01	0.01	0.1	0.1	0.1
Phenol	mg/l	0.014	0.006	0.01	0.001	-	-
DDT	mg/l	0.001	0.001	0	0.01	0.001	0.002
Organic Phosphate	mg/l	-	-	-	-	-	-

Source : JICA Study Team

**Table 3-3-1 Summary Results of Estimation of Site Demand of
High-Tech Factories for HHTP**

(in constant 1995 prices)	1995	2000	2005	2010	2015	2020
Population/GDP						
1) Population (000)	73,962	79,678	84,784	89,109	93,654	98,432
• Average growth rate per year		1.5%	1.3%	1.0%	1.0%	1.0%
2) Per Capita GDP (USD)	274	426	663	1,032	1,607	2,500
• Average growth rate per year		9.2%	9.2%	9.3%	9.3%	9.2%
3) GDP (Mill. USD) : 1 * 2	20,258	33,943	56,212	91,960	150,502	246,080
• Average growth rate per year		10.9%	10.6%	10.3%	10.4%	10.3%
4) Manufacturing GVA (Mill. USD)	3,240	6,054	11,314	21,142	39,506	73,824
• Average growth rate per year		13.3%	13.3%	13.3%	13.3%	13.3%
(Shares of GDP total)	(16.0%)	(17.8%)	(20.1%)	(23.0%)	(26.2%)	(30.0%)
High-Tech Industry in Vietnam						
5) High-Tech Industry GVA (Mill. USD)	-	303	1,697	5,814	13,827	29,530
(Percent shares of industry total)	-	(5.0%)	(15.0%)	(27.5%)	(35.0%)	(40.0%)
• Average growth rate per year			41.2%	27.9%	18.9%	16.4%
6) High-Tech Industry Worker		15,135	56,570	129,201	230,452	369,120
(Labor Productivity:USD)		20,000	30,000	45,000	60,000	80,000
• Average growth rate per year			8.4%	8.4%	5.9%	5.9%
7) Land Use Parameter (workers/ha)		150	150	150	150	150
8) Factory Site Demand in Vietnam : 6 / 7		101	377	861	1,536	2,461
High-Tech Industry in the Red River Delta Region (RRDR)						
9) Red River Delta's Shares		(20.0%)	(60.0%)	(50.0%)	(45.0%)	(40.0%)
10) Red River Delta's Factory Site Demand : 8 * 9		20	226	431	691	984
High-Tech Factory Site Demand at Hoa Lac High-Tech Park (HHTP)						
• Factory Site (ha)			170	237	346	394
(Shares of the Red River total)			(75.0%)	(55.0%)	(50.0%)	(40.0%)
• Semi-Gross Area of the Site (ha)			200	279	407	464
- Factory site = 85% of semi-gross area						

Source: JICA Study Team

**Table 3-3-2 Summary Results of Estimation for the Demand of
R&D Institute/Laboratory for HHTP**

	1995	2000	2005	2010	2015	2020
R&D Staff in Vietnam						
1) Population ('000)	73,962	79,678	84,784	89,109	93,654	98,432
• Average growth rate per year		(1.5%)	(1.3%)	(1.0%)	(1.0%)	(1.0%)
2) Total Workers ('000)	35,430	38,245	41,120	43,663	46,359	49,216
(Percents shares of the population total)	(47.9%)	(48.0%)	(48.5%)	(49.0%)	(49.5%)	(50.0%)
3) R&D Staff per 10,000 Workers including ones of Universities	14	19	20	30	40	50
4) R&D Staff Total (2 * 3)	49,650	72,666	82,240	130,990	185,435	246,080
5) R&D Staff at R&D Institutes, and Enterprises (Percents shares of the total [4])	36,000 (72.5%)	52,683 (72.5%)	57,568 (70.0%)	88,418 (67.5%)	115,897 (62.5%)	147,648 (60.0%)
6) Incremental R&D Staff conducive to New Laboratory Site Demand • $50,400 = [5] - 36,000 * 1.4$	-	2,283	7,168	38,018	65,497	97,248
New Lab. Site Demand in Vietnam						
6-1 Percents Shares by Sector						
6-1-1 National/Public Institute		90%	80%	30%	20%	15%
6-1-2 Enterprise's Independent Lab.		2.70%	5.40%	18.90%	21.60%	22.95%
6-2 Number of R&D Staff by Sector						
6-2-1 National/Public Institute		2,055	5,734	11,405	13,099	14,587
6-2-2 Enterprise's Independent Lab.		62	387	7,185	14,147	22,318
6-3 Land Use Parameter (persons/ha)						
6-3-1 National/Public Institute		40	40	40	40	40
6-3-2 Enterprise's Independent Lab.		60	60	60	60	60
6-4 Laboratory Site Demand 6-2 / 6-3						
6-4-1 National/Public Institute		51	143	285	327	365
6-4-2 Enterprise's Independent Lab.		1	6	120	236	372
New Lab. Site Demand in Red River Delta Region						
7) Red River Delta's Shares						
7-1 National/Public Institute		80%	80%	60%	55%	50%
7-2 Enterprise's Independent Lab.		60%	60%	50%	45%	40%
8) Red River Delta's Demand 6-4 * 7						
8-1 National/Public Institute		41	115	171	180	182
8-2 Enterprise's Independent Lab.		1	4	60	106	149
Hoa Lac High-Tech Park						
9) HHTP's Shares						
9-1 National/Public Institute			100%	70%	70%	70%
9-2 Enterprise's Independent Lab.				50%	45%	40%
10) HHTP's Demand 8 * 9						
10-1 National/Public Institute			115	120	126	128
10-2 Enterprise's Independent Lab.				30	48	60

Source: JICA Study Team, [Past data (Statistical Yearbook 1996, Status of Labor-Empolymnt in Vietnam GSO)]

Table 3-3-3 Structure of R&D Staff by Sector

	1995	2000	2005	2010	2015	2020
Total	49,650	72,666	82,240	130,990	185,435	246,080
01. University	13,650	19,983	24,672	42,572	69,538	98,432
02. Other R&D Institute/Lab.	36,000	52,683	57,568	88,418	115,897	147,648
2-1 Number of Staff at Existing Site	36,000	50,400	50,400	50,400	50,400	50,400
2-2 Incremental Staff for New Site		2,283	7,168	38,018	65,497	97,248
2-2-1 National/Public Institute		2,005	5,734	11,405	13,099	14,587
2-2-2 Enterprise		278	1,434	26,613	52,398	82,661
2-2-2-1 Lab. attached to Headquarters		153	789	14,637	28,819	45,464
2-2-2-2 Lab. attached to Factory		50	258	4,790	9,432	14,879
2-2-2-3 Independent Lab.		75	387	7,186	14,147	22,318
* Aggregated Staff at National/ Public Institute (2-1 + 2-2-1)		52,405	56,134	61,805	63,499	64,987
Percent Shares						
	1995	2000	2005	2010	2015	2020
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
01. University	(27.5%)	(27.5%)	(30.0%)	(32.5%)	(37.5%)	(40.0%)
02. Other R&D Institute/Lab.	(72.5%)	(72.5%)	(70.0%)	(67.5%)	(62.5%)	(60.0%)
2-1 Number of Staff at Existing Site	72.5%	69.36%	61.28%	38.48%	27.18%	20.48%
2-2 Incremental Staff for New Site		3.14%	8.72%	29.02%	35.32%	39.52%
2-2-1 National/Public Institute		2.76%	6.97%	8.71%	7.06%	5.93%
2-2-2 Enterprise		0.38%	1.74%	20.32%	28.26%	33.59%
2-2-2-1 Lab. attached to Headquarters		0.21%	0.96%	11.17%	15.54%	18.48%
2-2-2-2 Lab. attached to Factory		0.07%	0.31%	3.66%	5.09%	6.05%
2-2-2-3 Independent Lab.		0.10%	0.47%	5.49%	7.63%	9.07%
* Aggregated Staff at National/ Public Institute (2-1 + 2-2-1)		72.1%	68.3%	47.2%	34.2%	26.4%

Source: JICA Study Team

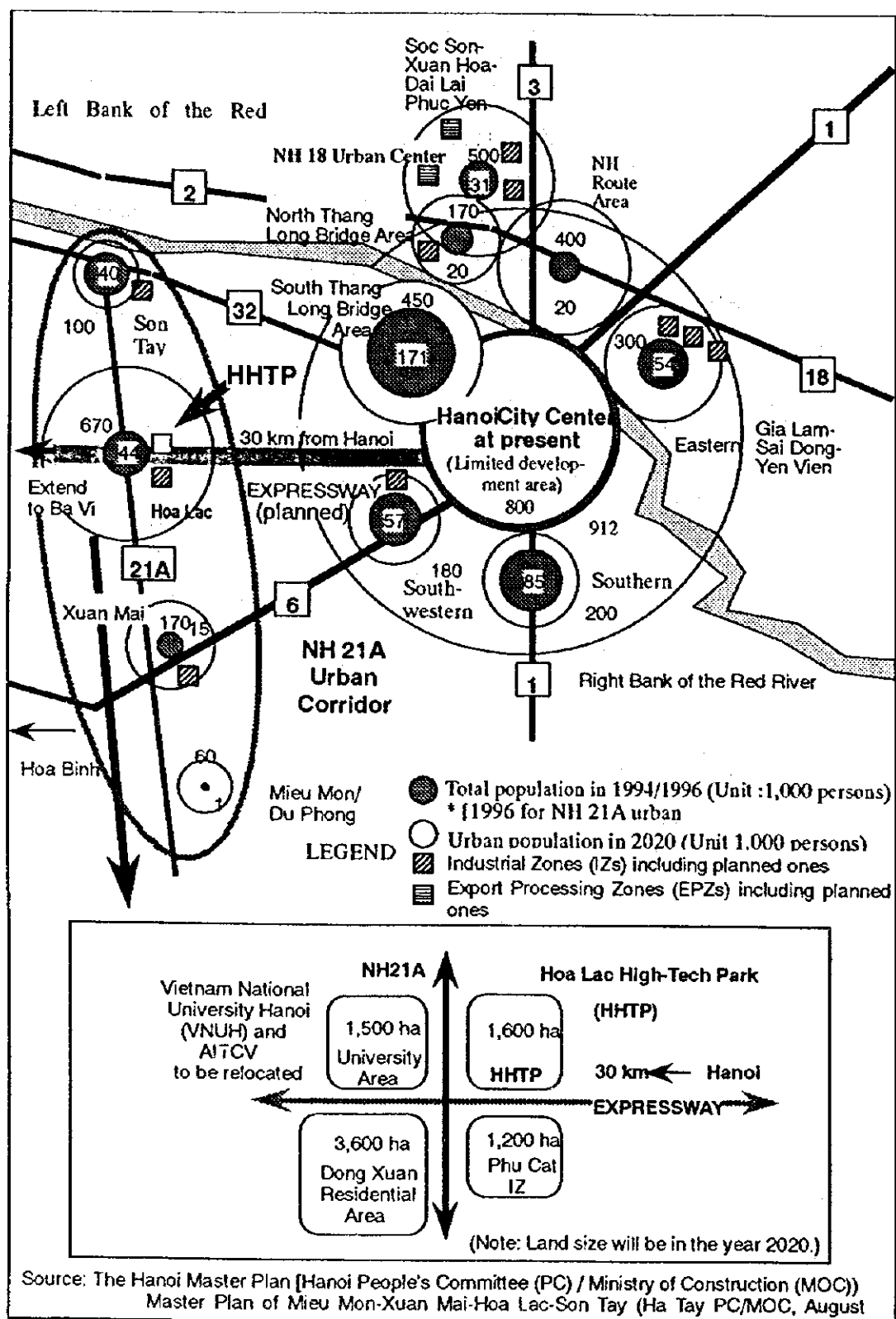
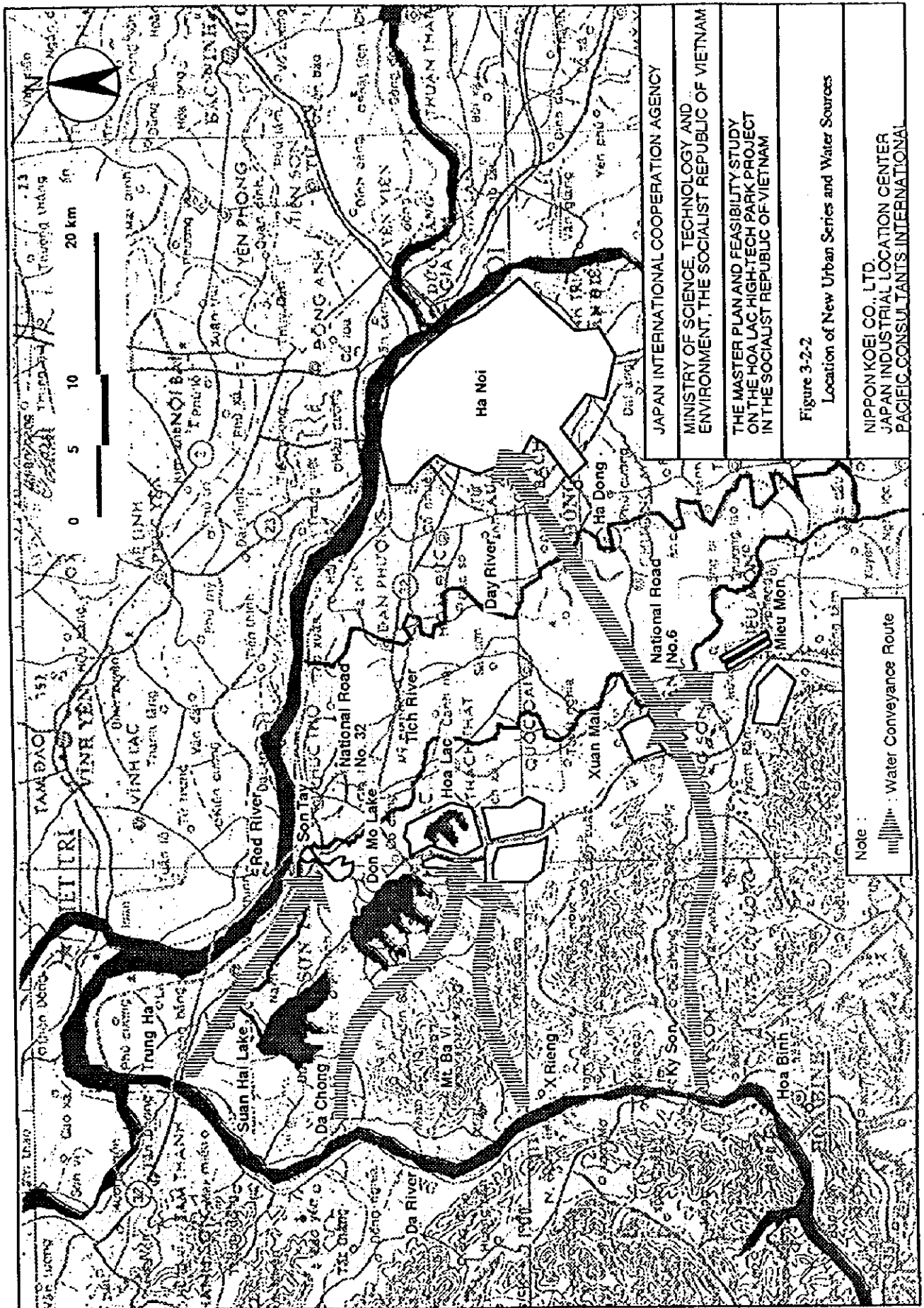


Figure 3-2-1 Spatial Distribution of Urban Population in and around Hanoi City in 2020, and the Location of HHTP



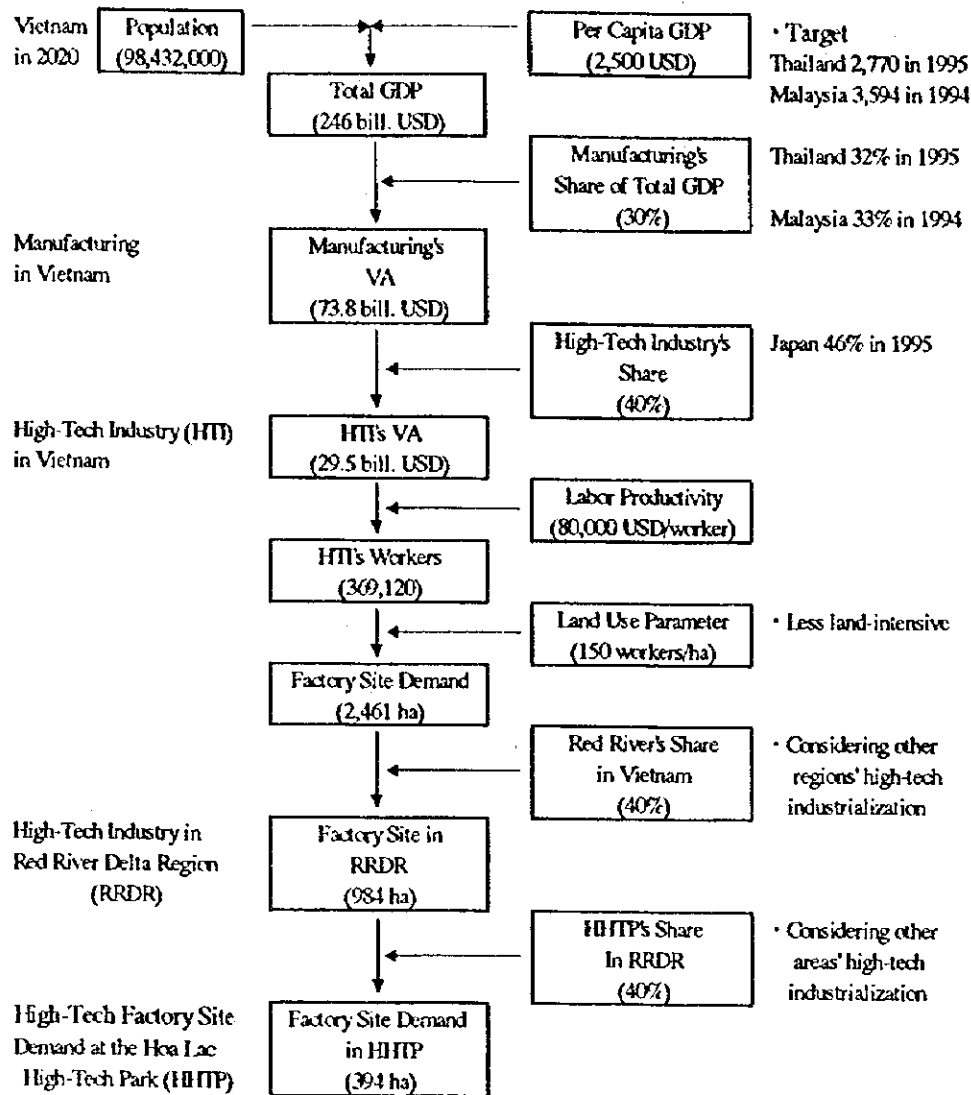


Figure 3-3-1 Process of Estimation for the Demand of High-Tech Factory for HHTP

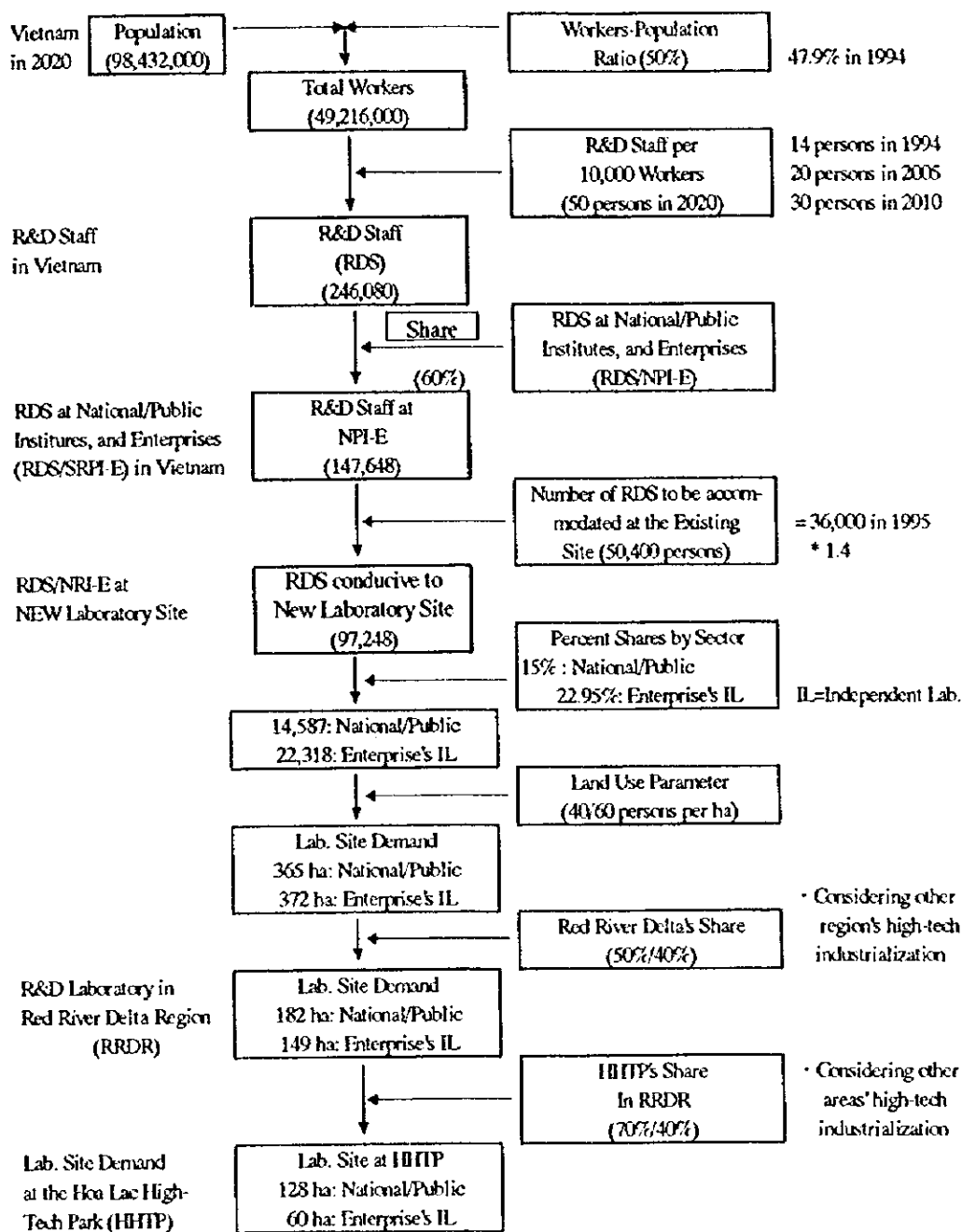


Figure 3-3-2 Process of Estimation for the Demand of R&D Laboratories for HHTP



IV. STRATEGIES AND CONDITIONS FOR SUCCESSFUL HHTP DEVELOPMENT

This chapter clarifies the strategy and conditions for the success of the HHTP development on the basis of its roles and functions.

4.1 Roles and Functions of the Hoa Lac High-Tech Park

4.1.1 Roles of the Hoa Lac High-Tech Park

The envisaged HHTP should play the following main roles in addition to those already mentioned previously:

- 1) To be an industrial core leading high-tech industrialization and a model of high-tech park development in Vietnam: High-tech industries have higher labor productivity (value-added) and a complex production structure with a big growth potential. Recognizing these attributes, the Government of Vietnam is addressing high-tech industrialization. This has been planned to create, keep, and strengthen Vietnam's competitiveness within the globalizing market economy into which Vietnam will be fully integrated, by accelerating industrialization and modernization. The HHTP Project is assigned the task to lead such high-tech industrialization and act as a model to be followed by other high-tech parks in Vietnam.
- 2) To be a deregulation zone for high-tech industrialization: As studied in the "Master Plan for High-Tech Industrial Policy" (Volume I), there have been constraints including limited budget and obstacles accompanied by various regulations in putting forward high-tech industrialization and the market economy in Vietnam, which are closely connected with each other. HHTP, as the leading core or a model for high-tech industrialization, should play the role of a deregulation zone so as to break through such obstacles.
- 3) To be a core project for the formation of the National Center for high-tech industrialization and the Science City in the Hanoi/Ha Tay area: Hanoi city, which is also the S&T capital, could be the National Center for high-tech industrialization. However, it is one of the most critical issues in Vietnam to rectify overconcentration of population and various functions in Hanoi city so that it will be able to soundly grow as the National Capital.

The HHTP project site has been planned to be developed in the Hoa Lac New City, which will be the main component of the national road 21A Urban

Corridor. The site is highly suitable for location of high-tech industries, since it is situated 30 km west of Hanoi to easily utilize Hanoi's existing S&T-related functions and extends over an area of around 1,600 ha with solid ground. Accordingly, the area in and around the HHTP site is expected to be a central cluster comprising high-tech industries and their related industries through the development of HHTP, and thereby will contribute to the sound growth of Hanoi city. In addition, the HHTP development will crucially serve the establishment of the Science City in Hoa Lac playing a part of S&T Capital in the 21st century together with VNHU to be located in a site neighboring on the HHTP site.

- 4) To be a regional project for balanced development between the Northern region, the Central region, and the Southern region: If the HHTP development as mentioned above is successful, the disparity between the Northern region and the Southern region centering on Ho Chi Minh city will be rectified. As such, HHTP will play a critical role in the regionally balanced development of Vietnam.

4.1.2 Functions to be Established in the HHTP Site

HHTP ought to be successful as a national project and in view of the roles mentioned so far. In this context, the following functions should be established within the HHTP site:

- 1) Core functions for high-tech industrialization: The HHTP site should be efficiently developed so as to be competitive as an industrial core and a model leading high-tech industrialization. To this end, high-tech related functions of R&D and production (laboratory and high-tech factory) are to be installed by efficiently utilizing the Vietnam's limited resources, i.e., concentrating on infrastructure development.
- 2) Supporting functions for R&D, production, and business: Large clusters of high-tech industries and laboratories or high-tech parks have been developed in and around the metropolitan areas across the world. As a contrast, there are no urban functions in and around the HHTP project site. Accordingly, in order to effectively promote R&D, production and business in the HHTP site as a new high-tech industrial space, it is essential not only to utilize the urban and R&D-related agglomeration in the mother city of Hanoi, but also to establish such functions as R&D and industrial support and service industry as follows:

R&D and Industrial Support:

- Testing, inspection, measurement, and evaluation including standardization; R&D business
- Information services including processing and data base
- Open laboratory, design and prototype fabrication, and incubation
- Manpower training
- Research study, technology extension, and consultation
- Technology transfer/trade/exchange and joint R&D including R&D-related exchange
- Services such as banking, legal service, rental of meeting room, rental of office room, convention service, hotel, and shopping

Housing and living conditions-related functions including education, culture, recreation, amenity, sports, and amusement for researchers, engineers, and foreign investors

- 3) New institutional arrangements for HHTP as a deregulation zone: In order to create a good business environment, free telecommunications and deregulation on investment should be realized; e.g., long term visa for foreigners, deregulation on foreign workers, liberalization of technology transfer, and bonded business or development of EPZs
- 4) Networking for opening the HHTP site to the world: The HHTP site should not be closed to the outside. Networking with the outside will be essential for the efficient and substantial R&D activities, the access of the products to the world market, and the mobilization of capital, technology, information and manpower from all over the world. Networking of the HHTP site should cover various aspects such as investment promotion, enterprise development, manpower development, R&D, and technology transfer.
- 5) Environmental conservation/creation in HHTP as a new high-tech industrial space competitive across the world: The HHTP site should be developed to a high-tech area through the installation of ISDN/multimedia and the construction of "Intelligent Building." In addition, it is expected to establish functions not only to monitor the environment and guide landscaping, but also to contribute in the long term to the conservation of energy and resources including resource recycling.

4.2 Basic Strategy for HHTP Development

The HHTP development will be successful only if it is implemented with an appropriate strategy. This section sets out the basic strategy for the promotion of R&D and high-tech production. The strategy for regional linkage will be mapped out in the next section.

(1) Strategy for Investment Promotion

As mentioned in Chapter 3, the area demand for HHTP has been estimated at more than 200 ha for high-tech factories and laboratories up to 2005, both of which are the HHTP's core functions. However, this site demand is not automatically ensured and materialized without appropriate development efforts and strategy. In addition, HHTP as a national project will be developed by an infrastructure development company (IDC) established with its own capital or by a joint venture in cooperation with the Government of Vietnam. The role of the Government is to support such development, and therefore the strategy for investment promotion should be seriously established by the Government initiatives, as proposed below:

- 1) Deployment of trigger projects: The initial development is the key for the successful development of HHTP. In order to smoothly start up the HHTP project, a R&D and industrial support system competitive to other ASEAN countries should be established in advance by the Government initiatives. If national R&D institutes fully support the R&D and production activities of enterprises, it will be a strongly effective measure promotional for the investment. In addition, it will be effective to program a joint R&D project sponsored by ODA into the HHTP development so as promote also the location of national R&D institutes.
- 2) Location of "High-Tech Flagship Enterprises": This has been a strategy popular across the world, and is to invite the factories and laboratories of world class enterprises representing specific high-tech fields or multinational companies. The flagship enterprises' location in the HHTP site might lead to further increase in investment in HHTP by other enterprises, since the enterprises have had an influence over other enterprises also in terms of factory location. Factory/laboratory establishment is risky especially in developing countries, and needs a decision making critical for the prospects of enterprises. In this context, enhanced reputation of the HHTP caused by

factory/laboratory location of the "Flagship Enterprises" will be a security or an insurance for the others.

- 3) Networking and strengthening of institutional arrangements for investment promotion: In order to materialize investment in the HHTP site as mentioned above, Vietnam should focus its efforts on strengthening of institutional arrangements for investment promotion including networking with foreign countries and a "Top Sales" system, in addition to special incentives described in Chapter 7.

(2) Strategy for Industrial Clustering and Enterprise Development

High-tech industry is complex in terms of production structure, and high-tech industrial clusters have been formed in specific areas, while "global division of labor between production processes" is popular in recent years. High-tech industrial clusters or "Technopoles" have been developed in and around the metropolitan areas excluding USA and part of Germany. These include Paris-Sud, London-M4 Corridor, Milan, Moscow-Zelenograd in Europe, and Tokyo including Tsukuba, Seoul-Inchon in Asia. Also there are well known "Technopoles" such as Nice-Sophia Antipolis, the Hsinchu Science-Based Industrial Park in Taiwan, and those in Singapore, Shanghai, Sao Paulo, Barcelona, and so on. Such spatial continuity has contributed to the high-tech industrial clustering through the generation of synergy effects between R&D/production of high-tech industries and their supporting industries. It is essential for the HHTP development to internalize or program such logic of industrial clustering, and therefore to strategically address the following:

- 1) Utilization of urban functions in the mother city of Hanoi, i.e. an integrated development of the HHTP with Hanoi: This is already programmed in the development of the expressway between Hoa Lac and Hanoi. The more Hanoi's high order urban and S&T-related functions are strengthened, the more linkages between HHTP and Hanoi will bring about synergy effects, which will be easily conducive to regionwise high-tech industrial clustering.
- 2) Promotion of high-tech SOEs and clustering of high-tech-related industries: This is to promote and agglomerate the supporting industries. It will have an effect of getting two birds with one stone for SOEs to enter the business of supporting industries in line with their restructuring. On the other hand, strategic location should be effectively put forward in such a way that core/assembly industries will be located in the HHTP site, while their related industries will be located in industrial estates around HHTP. In addition,

information and intermediate services for enterprises should be established to promote the clustering of high-tech related industries.

- 3) Clustering of R&D support and software industries through mobilizing resources of national R&D institutes: National R&D institutes should enter the business of R&D support and software industries through the mobilization of their resources including manpower, since they have already been able to establish joint ventures with foreign companies.
- 4) Facilitation of new business enterprise development: High-tech industry is also called "venture business" with an attribute of "high risk-high return." On the other hand, the word of "venture" implies the challenge to new business and the continuous innovation of technology, and there are not a few success stories of researcher/engineer spun off from laboratory/enterprise. "Student venture" is also well known. As such, an incubation function should be established to support the generation of new enterprises.
- 5) Networking for enterprise development: Incubation business has been active particularly in USA, and HHTP should invite the venture capital, while offering measures for reduction of risk in investment, as proposed in the "Master Plan for High-Tech Industrial Policy" (Volume I).

On the other hand, expatriates including the former ones have contributed to the successful development of high-tech parks well exemplified in the Hsinchu Science-Based Industrial Park in Taiwan, and Bangalore in India. Their advantages are English speaking, advanced knowledge and human network, and sometimes sizable resources for starting business. There are not a few scientists and engineers among the overseas Vietnamese. In this context, the HHTP site should be strategically developed to be a stage/place generating new business enterprises through linking and networking with the overseas Vietnamese.

(3) Strategy for Manpower Development

Manpower necessary for high-tech industry, which is highly brain/engineering intensive, comprises various types of researchers, engineers, and skilled workers. Highly skilled workers are essential in particular for prototype fabrication. High-tech manpower should be developed according to the following directions:

- 1) Close linkage with the Vietnam National University-Hanoi (VNUH): VNUH, planned to be relocated in the area adjacent to the HHTP site, has educated and provided highly talented manpower to hold key positions in Vietnam.

VNUH is expected from now on to provide manpower to enterprises and laboratories to be located in the HHTP site. In this context, HHTP should ensure manpower to meet the requirements of high-tech enterprises through a close linkage with VNUH in terms of manpower development and arrangement of curriculum.

- 2) **Fostering of middle level engineers and high level technicians:** VNUH will educate high level engineers and scientists, but other institutions will have to provide middle level engineers and high level technicians badly needed by factories to be located in the HHTP site. In addition, it is also important to foster R&D assistants and high level technicians to fabricate prototypes. A new technical institute should be established for high-tech manpower development, since there are a few secondary technical schools in the Hanoi/Ha Tay area, but they are disadvantageous in terms of education level. In addition, it is necessary to foster manpower for software industry including programmers.
- 3) **Strengthening of on-the-job (OTJ) training also conducive to investment promotion:** In the progress of the globalizing economy, high-tech industry's investment should be more timely than before. Less timely investment might be costly and sometimes ends in failure. To address such a situation, and so that enterprises can save time and money, HHTP should prepare a place to train factory workers prior to the start of factory operation or to retrain them during renewal of production equipment or replacement of old equipment.
- 4) **Networking for manpower development:** High-tech industrialization is a process of a worldwide generalization with global division of labor. Within this context, technological level of engineers working at enterprises should be high or at an international standard. In other words, the same level of technology is a basis for division of labor. As a measure to upgrade technological level, it might be effective to implement manpower development through networking with the outside world. HHTP should strategically promote periodic exchange for manpower training with industrial estates in industrialized countries, utilizing the network of enterprises located in the HHTP site.

(4) **Strategy for R&D and Technology Transfer**

High-tech industrialization in Vietnam, particularly at its initial stage, will be focused on technology transfer from abroad and its localization, since high-tech industry

has not yet been agglomerated. Such assignment is applicable to enterprises and national R&D institutes in Vietnam, and therefore the following should be strategically addressed:

- 1) Restructuring and strengthening of R&D functions of national R&D institutes including those under the Ministries and SOEs toward high-tech industrialization, and their location in the HHTP site; and promotion of and support for R&D activities of enterprises: This includes the establishment of "High-Tech R&D Institutes" proposed in the "Master Plan for High-Tech Industrial Policy" (Volume I) and their location in the HHTP site. Prior location of national R&D institutes in the HHTP site and their full and supplementary support for R&D activities of foreign enterprises will be crucial for smooth start-up of the HHTP development, as mentioned previously. This will enable to achieve not only the cost reduction for foreign enterprises, but also highly effective technology transfer to the Vietnamese. Thus, such R&D support by national R&D institutes should be strategically carried out not only at the initial stage of development, but also after that.

The "Master Plan for High-Tech Industrial Policy" (Volume I) has selected 24 categories of high-tech industries to be promoted in Vietnam, which have attributes as shown below, according to the data from April 1994 to March 1995 compiled in the "Results of the Basic Survey of Business Structure and Activity in Japan" in 1995.

- R&D expenditure-total sales ratio: 4.1% (average total manufacturing: 2.9%)
- R&D staff-factory worker ratio: 11.9% (ditto. : 9.3%)
- R&D staff of branch laboratories other than those attached to headquarters-total R&D staff ratio: 46.5% (ditto.: 44.9%)

Enterprises' laboratories comprise those attached to the headquarters and factories, and those independent. It is a focal point that researchers corresponding to 12% of factory workers support the R&D activities of the above 24 categories of high-tech industries. Such attribute of the high-tech industries, which are not limited to Japanese enterprises, suggests that the high-tech factories mostly need R&D functions but their initial stage of production in developing or less developed countries is risky and without the R&D functions. Some factories might not need R&D functions mainly because they use already proven technologies and, therefore, they are probably

"not high-tech." Other factories might need R&D functions for production technology, product and design development. However, they are unable to use the costly home country's R&D staff in foreign countries on one hand, and on the other hand they realize that it will take a long time to train local staff. In this case of "high-tech factories," Vietnam's support for their R&D activities through national R&D institutes could be very useful and attractive for them, and therefore HHTP should incorporate and organize such a R&D full support system.

- 2) Institutionalization of cooperation in R&D between HHTP and universities such as VNUH, AITCV, and the Hanoi University of Technology: Universities in Vietnam are centering on education, but they will strengthen their R&S functions as exemplified in the future plan of VNHU, which is to be relocated at the site neighboring on the HHTP site. Universities have talented staff in basic science and basic research. In this context, national R&D institutes might specialize in applied research and development, while universities specialize in basic research. Apart from such functional sharing, the enterprises to be located in the HHTP site will in the distant future conduct R&D on the development of products, production technology, and design. In summary, a linear integration will be attained between research, development, prototype fabrication, and production in the Hoa Lac New City, and then it will be a Science City playing a part of S&T Capital based on such an organic linkage between science and technology.
- 3) Promotion of joint R&D through the triad cooperation between the enterprise, the university, and the national R&D institute: This is a strategy effective in the distant future. Foreign enterprises will conduct R&D activities such as product development in the course of industrial location in the HHTP site and correspondingly to the continuous growth of Vietnam's economy. Joint R&D through the triad cooperation between the enterprise, the university, and the national R&D institute should be strategically promoted, since it is very effective for R&D activities on high technologies, which are interdisciplinary between and among different industries.
- 4) Establishment of transactional functions for smooth technology transfer: The "Master Plan for High-Tech Industrial Policy" (Volume I) has proposed the establishment of a technotrade market. In line with this market, it is essential to strategically programme the establishment of functions ensuring appropriate

technology transfer including protection of intellectual rights and promoting technobusiness in the HHTP site.

- 5) International networking for R&D and technology transfer: As already mentioned, an international joint R&D project should be promoted as a trigger/start-up project for HHTP. In addition, interactions between HHTP and universities/laboratories in the world will be programmed through Inter Net. Further, R&D and technology transfer in the HHTP site should be effectively carried out through periodic exchange of manpower and R&D partnership with high-tech parks in countries already industrialized (sister high-tech parks).

(5) Establishment of High-Tech Park Centers (HTPC) for Integrated Promotion of High-Tech Industry

To fulfill the varied objectives of the HHTP Project, coordination among the bodies concerned including the ministries and agencies, Ha Tay People's Committee, State Research Institutes and enterprises and foreign investors is pre-requisite. Centers should be established in HHTP to play the role of the nucleus of coordination. These should be established adequately depending on the main objectives and the ministries in charge of the respective functions. The centers should assume the following functions:

- 1) To provide One-Stop Service for relevant information and application for approval and licenses;
- 2) To collect, accumulate and disseminate information about high-tech development, industrial property rights and patents, market needs for high-tech products, etc.;
- 3) To provide services of measurement, testing, certification of industrial standards, and other basic services needed for the high-tech production;
- 4) To provide the interfaces among the key players in high-tech production: enterprises, state research institutes and universities as well as foreign investors;
- 5) To provide supporting services for the establishment of new business including ventures;
- 6) To provide technical education and OJT for bringing up technicians and skilled labors for high-tech production; and

- 7) To support computer software enterprises by offering office spaces and facilities as well as training opportunities.

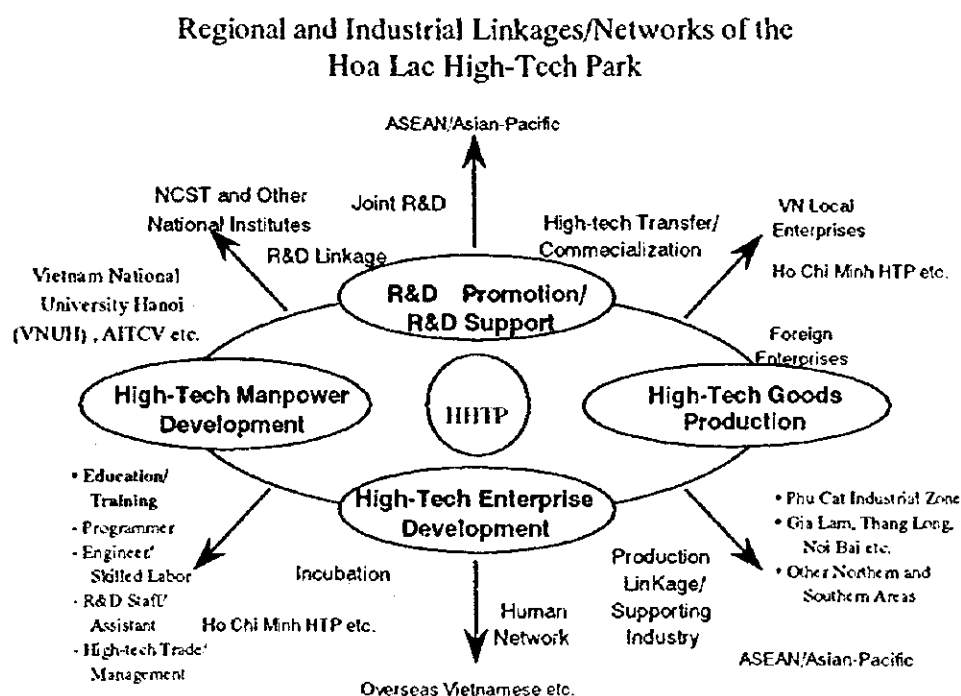
(6) Establishment of the Management Council with VNUH

Close cooperation between the two principal project partners: HHTP and VNUH to be relocated to the west of HHTP in the new satellite city of Hoa Lac, will be the key to the success of the two and the city as a whole. The university would be the supplier of the highly qualified manpower including engineers and managers for HHTP enterprises and research institutes as well as of technical seeds for high-tech products. Meanwhile, HHTP would provide information about the human resource requirements of the high-tech industry, which should be reflected in the curriculum of the university. Between the two partners, cooperative research and development are also expected. Considering these, a standing committee style council should be established, comprising the representatives of the two parties concerned.

4.3 Strategy for Regional Linkages

The regional and industrial linkages/networks of HHTP are shown in the following figure.

The linkages/networks will bring about multiplier effects of the economic development and efficient infrastructure development, and shall be strategically promoted.



4.3.1 Strategy for Regional Linkages

(1) Networking of Regional Development in the Northern Part of Vietnam

The potentialities and regional development role of Hanoi, Hai Phong, and Quang Ninh province, known as the "North Triangle Development Area (Triangle Plan)" have already been recognized. This area possesses the highest potential for industrial development and urbanization in North Vietnam. The Study Team proposes a new industrial development axis (North Industrial Corridor (NIC) & Science Technology Corridor (STC)) adding the Hoa Lac area planned as a new science and technology city onto this existing development axis. By maintaining this trigger axis, an industrial zone can be created as "the Red River Delta Industrial Development Zone (RIZ)". Based on this axis, the Team has studied and organized the direction of development and collaboration of industrial cores in each area with the purpose of developing industry in the Red River Delta Region as follows:

- 1) Hanoi city and surrounding areas \Rightarrow Advancement of industry and industrial supporting functions centering around the Red River Delta Region.

An issue facing the capital of Hanoi and its surroundings is to advance conventional industrial technology. The key is to convert the industrial structure while leading new industries, and creation and development of new technologies in the northern part of Vietnam. The industrial supporting functions (R&D, specialized technology, distribution support, and other functions) that have been available in Hanoi should be updated to more advanced functions to satisfy the domestic needs and the progress of internationalization. Furthermore, advanced urban service functions needed for the capital should be expanded. Namely, production facilities using advanced technologies (electric machinery, machinery and metal product manufacturing, textile and apparel industry, and chemical industry) should be converged. It is necessary to renew, introduce, and nurture urban industries (machinery industries and metal product manufacturing), sundry type industries (furniture, apparel, textile, leather), and printing and publishing. In addition, it is necessary to introduce and nurture related supporting industries.

- 2) Hai phong and Cai Lan area \Rightarrow Basic resource production center

The basis for the North Triangle Plan (Hanoi, Hai Phong, and Cai Lan) is the conurbation of the three cities and areas to bring Hanoi capital, Hai Phong coastal city, and Cai Lan together. This plan calls for the connection of Hanoi capital, its gateway Hai Phong Port, and a new deep-water Cai Lan Port, to reinforce the first

port. The plan aims to link these three cities and areas and coordinate the composed area as the North Triangle Area to achieve general development. Since basic resource type industry requires a large influx of goods from the outside and is labor-intensive, it has a high concentration effect. By advancing the congregation of production facilities for primary resources (steel, non-ferrous metal, chemical industry, and shipbuilding) in the Hai Phong and Cai Lan area, ensuring a unique development program, and linking the capital city of Hanoi and its surroundings by Route 5 and Route 18, this plan aims to disperse the development momentum built up here to the rest of the Red River Delta Region. Based on the above, the North Triangle Plan plays the role of a basic development axis (North Industrial Corridor) of the industrial development in the Red River Delta Region.

3) New satellite city area (Hoa Lac area) \Rightarrow Research and development base for science and next generation technologies

New planned Son Tay, Hoa Lac, Xuan Mai, and Mieu Mon satellite cities are located deep inland in the Red River Delta Region. The planned area is directly linked to the Greater Hanoi Area and is a desolate area nearly to the west of Hanoi. The area is scheduled to become the core of intelligence where science and technology are congregated and it receives the energy of industrial development in the Red River Delta Region. While the Hai Phong and Cai Lan coastal areas are expected to bring together fundamental material industries and device industries, the Hoa Lac area is intended for support of industrial development in the coastal areas in the field of research and development of technology. By connecting the urban functions of Hanoi, the area is anticipated to build up research and development functions for next generation technologies. However, this area has another role. It must spread its success to the rest of the Red River Delta Region. This area must fully support the industrial development in the entire Red River Delta Region by providing science and technology. Hoa Lac, to be connected via a new expressway from Hanoi urban area, must be developed as an urban center with an emphasis on the ease of commuting. High-tech industries invited to the area will choose a city with superior urban functions and broad network functions. To reinforce the regional relations, it is necessary to secure a unique inland production base that can handle the production and technology-related tasks of the existing factories. By locating or transferring VNUH, the National Software Center, etc., the area can serve as an academic and research center based on academic research foundation.

All the above three areas should form a development axis for conurbation based on their unique functions. The key is to reinforce the link and construct "RIZ" that creates and leads industries.

Industrial Development and Urban Conurbation in the Red River Delta Region (Summary)

Industrial Collaboration Axis	City/ Area	Collaboration and Allocation of Functions on Collaboration Axis
1) North Industrial Corridor	◇ Hanoi city and satellite city "Production and technology center"	(1) Due to the future development into satellite city area and improvement in location potential, Hanoi and surroundings will promote exiting factories function. (2) The plan aims to renew, introduce, and nurture urban type industries, and also introduce and nurture supporting industries.
	◇ Hanoi city "Center for advanced urban functions and introduction and nurturing of urban type industries"	(1) Hanoi will promote advancement and improvement of additional value on the production activity based on the existing industrial technologies and the congregation of cities. (2) Through this process, the plan aims to develop new industries and the urban functions of the capital.
	◇ Hai Phong and Cai Lan cities "Basic resource production center"	(1) This area will likely improve location potential. An increasing basic production function from within and outside Vietnam will shift their operations. (2) For advancing and expanding production technologies with the emphasis on being a basic resource production center.
2) Science & Technology Corridor (commuting axis to Hanoi and collaboration axis with industry and city)	◇ Son Tay, Hoa Lac, Xuan Mai, and Mieu Mon satellite city area (Hoa Lac new city) "Center for academics and next generation technologies"	(1) This area will be developed to promote the new city as the intellectual core where science and technology are accumulated. (2) While developing the new city functions, the city will grow as an independent city equipped with superior urban functions and broad network capability. (3) The area and city should be formed an academic and research support center for existing industries and newly introduced industries in Hanoi.
⇒ Formation of "The Red River Delta Industrial Development Zone"		⇒ The industrial production and technology in the Red River Delta Region and the renewal of existing industries will be promoted through a wide collaboration among areas extending from Hanoi city to the Hoa Lac.

(Source) JICA Study Team

(2) Strategy for Regional Linkage with Hoa Lac City

The Hoa Lac City has an important role in the conurbation of Son Tay-Hoa Lac-Xuan Mai-Mieu Mon City as part of the Greater Hanoi Development Plan. In this plan, the cities are connected by one axis with the national road 21A. Each city has a transportation system needed for high-tech industry in the larger area network. The Study Team considers the formation of construction of each city function in the future as follows:

- Hoa Lac City must be constructed as the core "Science and Technology Capital City".
- Xuan Mai City is on the position where the national road 6 and 21A intersect; it should be constructed as a "Commercial City" in coordination with the larger area in the south of the Red River Delta Region.

- Mieu Mon City, must be constructed as an "Airport City" with a second international airport.
- Son Tay City, as a historical old city, is to be constructed and form a "Sightseeing and Commerce City".

This City Development Plan consists of the construction of only one axis emphatically, which differs from the Greater Hanoi Development Plan which aims at the development in all directions.

It is necessary to make enough investment to the new town with the basic transportation means.

Outline of General Construction Plan of Mieu Mon - Xuan Mai - Hoa Lac - Son Tay Urban Areas

New city	Current Population (1996)	Planned Population (2020)	Land Selection and Developing Direction, Functional Division for Each City
A. Hoa Lac City	per. 44,000	per. 670,000	<ul style="list-style-type: none"> - Being the center of politics and administration, trade service, culture, sports tourism of the new urban developing area of Hanoi City - Being the center of training, scientific research, high technology, high technical concentrating industry area of the nation, Southeast Asia and the world... - Being an important national defense location
B. Xuan Mai City	15,000	170,000	<ul style="list-style-type: none"> - Being the center of industry economy, concentrating trade service. - Being an essential national defense area - Being the center of administration, urban culture - Being an open water space, green trees park, sports area
C. Mieu Mon City	10,000	60,000	<ul style="list-style-type: none"> - Being the international airport and the service center for the port (Maintaining of the Mieu Mon International Airport) - Being the service center for airlines, tourism
D. Son Tay City	40,000	100,000	<ul style="list-style-type: none"> - Being the tourist service center and tourist service industry area - Concentration of some industry factories when changing their function into some industry basis of tourist service processing - Arrangement of the urban architectural sight
Urban Area	109,000	1,000,000	17,500ha (2020)

(Source) Master plan of Mieu Mon - Xuan Mai - Hoa Lac - Son Tay (1997.8)(Peoples Committee of Ha Tay province)

4.3.2 Coordinated Strategy of IEs and EPZs

There are seven existing industrial estates (IEs) and export processing zones (EPZs) in the Hanoi metropolitan area; five around Hanoi, one in Ha Tay province, and one in Hai Phong province around the planned HHTP site. Therefore, it is necessary to adjust their functions for industrial location. Some of high-tech enterprises are expected to locate in the existing IEs except HHTP. The development of regional industries is deemed necessary, since high-tech industries are dispersed around regional linkages of the larger region.

HHTP should have a production problem with the industrial areas as a regional issue and supply high-tech service. It is necessary to provide high technologies and related services by upgrading the level of HHTP, accumulating high-tech industries and strengthening the support functions. The contents of the services are as follows.

- Supply of R&D services, material examination, and quality inspection for small and medium-sized enterprises surrounding Hanoi City.
- Supply of technological development service and training for production workers and quality control workers.
- Supply of high-tech market information and technological information, etc.
- Software support and supply to regional industry through the promotion of software industry.
- System support and supply for development and design ability with the telecommunications and information equipment.

4.3.3 Coordinated Strategy with the Ho Chi Minh High-Tech Park

(1) Development Strategy by Utilizing Characteristics

The Ho Chi Minh High-Tech Park is a national project like the Hoa Lac High-Tech Park. Its target of accumulation of high-tech industry is almost similar to that of HHTP. There are concerns about the possibility of competition between two high-tech parks established in the same country and at the same time. However, they are 1000 km or more distant from each other and the climate is also different. Both parties have a different development condition and a different market. For instance, in Hanoi City surroundings engineers and scientists are abundant because there are a lot of national research organizations. It is important to make the best use of the locational conditions and to maintain the functions of high-tech parks according to the characteristics of Hanoi and Ho Chi Minh cities.

(2) Establishment of High-Tech Park Network

To promote and ensure efficient development based on the characteristics of the regions, it is essential to create a high-technology network among the high-tech parks. A lot of high-tech enterprises will face the difficult problems of getting information, expansion of market, technological upgrading, human skills enhancement, etc. These problems would be regional issues rather than the problems of enterprises themselves. Multiplier effects of the economic development are expected to be generated by using information on technologies, markets and manpower through the network of high-tech

parks. With the establishment of the network, an enterprise will be able to locate its basic research facility in HHTP and its production factory in the Ho Chi Minh High-Tech Park at the same time.

4.4 Other Conditions Necessary for Successful HHTP Development

The functions and strategies leading to the success of HHTP development have been determined so far. One criterion to examine its success may be whether it will play the roles assigned for high-tech industrialization in Vietnam or not. On the other hand, there are the following conditions to be cleared in order to secure the success of the Project, in addition to the condition that HHTP be a core project in the national road 21A Urban Corridor/Hoa Lac New City development:

- 1) HHTP should be a profitable zone for the locators and the infrastructure development companies (IECs): This is a matter of course, since there is no business without profit. Not only provision of cheap labors, but also low cost as a whole are a precondition for profitability.
- 2) HHTP should be so developed as to attain a positive balance in terms of "cost-benefit" ratio from a national viewpoint: This means that economic benefit should be estimated not only for individual components of HHTP, but also for the HHTP Project as a whole, including economic effects of HHTP as a regional development project.
- 3) HHTP should be developed along with efficient infrastructure development, in synchronization with relevant projects in the national road 21A Urban Corridor/Hoa Lac New City development: In line with this, an integrated development of several projects or a combined development of different projects is essential.
- 4) HHTP development should be consistent with relevant plans: This means planning consistency, including appropriate solution if any individual project against the plans of Hoa Lac New City and HHTP is proposed. Without such a consistency, any plan would not be reliable, and would bring about confusion among investors.
- 5) HHTP should be developed with orderly planned land use.
- 6) HHTP development should not cause problems including environment pollution.
- 7) HHTP should satisfy the wishes of the existing residents in the planned site and people working there

- 8) HHTP should provide useful manpower and realize common ownership of information, both of which are the foundation for future growth and development in Vietnam: In other words, the real objective of modernization and high-tech industrialization in Vietnam is laid on them, in line with the generation of high-tech enterprises and technology transfer.
- 9) HHTP should be highly evaluated not only within Vietnam, but also across the world: This is very important today within the globalizing economy and informational society.

Among the conditions mentioned above, some represent only the "issues." The specific conditions to be cleared are detailed below:

- 1) Low cost could be attained by provision of land at reasonable prices, e.g. through the provision of the HHTP site to the infrastructure development companies (IDC) at low prices, duty free import of construction materials, and keeping the construction cost at the domestic project level/abolition of dual prices. These are expected to be realized with a daring decision by the Government.
- 2) Economic benefit of the HHTP development will be first of all attained by industrial location in the HHTP site. High-tech industrialization would allow to attain the targeted per capita GDP of 2,500 USD several to ten years earlier than that of an annual average growth rate of 8% to 9%, as already discussed in section 3.3.2 Site Demand in View of Macroeconomy. Economic feasibility is evaluated differently for individual components of HHTP and the HHTP Project as a whole. HHTP will be developed with different functional zones, therefore there are at least two cases of project implementation; one is that one infrastructure development company (IDC) will develop HHTP as a whole, the other is that several functional zones will be independently developed by different IDCs. In relation to this, Chapter 7 will study an appropriate system of project implementation including a feasibility study.
- 3) On how to develop the HHTP site, the planning by the Government of Vietnam has well recognized and incorporated the importance of efficient infrastructure development, development consistent with relevant plans and projects, and combined development of different projects. The consistent development plans are expected to be prepared under the "Master Plan for Hoa Lac – Xuan Mai Regional Development", which is scheduled to commence in January 1998.

- 4) Consistency within the HHTP development plan will be ensured by the Board of Management (BOM) of HHTP to be established. It is expected for the BOM to be appropriately operated.
- 5) As for the orderly planned land use of HHTP site, regulations should be enforced in accordance with the master plan. Land transaction within the HHTP project site has been prohibited by the Government of Vietnam, since August 6, 1997 at the announcement ceremony of the Master Plan for the national road 21A Urban Corridor development. Additionally, individual component projects of HHTP will be officially permitted through a strict check in accordance with the land use plan.
- 6) To prevent environmental pollution, the HHTP site should be equipped with functions for environment protection and creation of a new attractive environment, as already mentioned. Details of this will be discussed in Chapter 7.
- 7) In order to ensure satisfaction of existing residents in the planned site, various measures should be prepared, such as: compensation for relocators based on right regulations, in addition to avoidance of land development in existing residential clusters as much as possible; preparation of a resettlement area, housing, job training for livelihood restructuring; and provision of business opportunities (shops, parking and guardsman service to be invested by the relocators).
- 8) As the foundation of future growth and development, teaching of popular foreign languages such as English could be done within the HHTP site together with technical training for smooth technology transfer and fostering of high-tech manpower. It is pointed out that if trainers and trainees use different languages in technology transfer, the trainees' technological level will mostly stay at the ordinary level. In this context, trainees who master the mother language of a foreign enterprise will be the manpower contributing to the enterprise's future growth and development.

"Common ownership of information" between researchers and engineers, and between laboratories and enterprises might, in a sense, contradict the severe competition in high-tech industries. However, it is essential for basic research and the field to be distant from the factory in terms of technology development sequence. Regarding this, it is already well known that the most advanced information is disseminated from the meetings for academic

exchange and joint partnership for R&D, many of which have been held across the world. As exemplified in the Silicon Valley, exchange of information at the places with an atmosphere of a salon after working hours, i.e. common ownership of information, is a strong driving force for new technology and new product development. It can be said in general that agriculture-based societies including Vietnam are the societies of common ownership of information, due mainly to the dependence on common foundations such as nature and weather. In the meantime, information, which is different from goods, is not exclusively and physically transferred, and still kept in transferor's hands. It should be noted that such shared information would be less valued but is an origin of further competition and innovation. Accordingly, HHTP is expected to contribute to the formation of a "high-tech community" through housing projects for researchers and engineers working within the HHTP site, while holding seminars and salons for common ownership of information.

- 9) A worldwide high evaluation of the HHTP development will depend on the degrees of appeal not only to Vietnam but to the world. To this end, the HHTP site should be developed with infrastructure/facilities meeting the international standard, and should generate many success stories. Vietnam's open market policy and integration into market economy might be a basis for foreigners' evaluation, although they have different sense of value. In addition, a development vision of HHTP should be set up while intensively incorporating the objectives of the HHTP development as well as high-tech industrialization in Vietnam.

Other than those mentioned above, conditions critically necessary for successful HHTP development are summarized below:

- 1) Strong state initiatives for the HHTP development: HHTP is a national project under MOSTE's direct management. High-tech parks have been developed over the world by various implementation bodies including universities, chambers of commerce and industry, private developers, local governments, and national governments. However, they are in common the strong-minded promoters, the implementation bodies with a long term vision, and the capable managers among the successful high-tech park projects. The state initiatives have been essential for the success of high-tech park development, as exemplified in the Sophia Antipolis in France, the Tsukuba Science City in Japan, and the Hsinchu Science-Based Industrial Park in Taiwan. Within

this context, HHTP is expected to be developed by the state initiatives centering on MOSTE.

- 2) State assistance to R&D: While some countries regard high-tech as a part of the national security, it costs a huge amount of investment for high-tech development. In addition, the market for new high-tech and new high-tech products is sometimes premature and not developed. With respect to such situations, some American and European countries have borne more than 20% of R&D expenditure in the industrial sector. S&T promotion, for which the Government of Vietnam allocated some 3% of the budget, is one of the first priority policies, while there are exactly no available data on the government budget allotments to SOEs' R&D activities.

In this regard, the Government has concentrated its efforts in realizing the HHTP Project. Such stance is expected to be thoroughly kept while mobilizing every resource, and to further enhance its capability in policy making and implementation.



V. CONCEPTUAL PLAN OF THE HOA LAC HIGH-TECH PARK

This chapter clarifies the conceptual plan or grand design of obtained HHTP for the target year 2020, on the basis of the study results obtained so far.

5.1 Zoning and Options for HHTP Development

HHTP is planned by the Government of Vietnam to be developed in an area of around 1,600 ha in Hoa Lac. According to the concept paper prepared by MOSTE, HHTP will be divided into six zones: R&D Zone, High-Tech Industrial Zone, Central Business Zone, Training Zone, Recreation Zone, and Housing Zone. This zoning is reasonable for such an integrated project creating a new and attractive high-tech space, as far as HHTP will be a comprehensively designed new town to be developed based on the two core functions of laboratory and high-tech factory.

HHTP is also a component of the Hoa Lac area development, which is likewise an integrated regional development project containing the university area centering on VNUH, the Phu Cat Industrial Zone, the Dong Xuan Residential area, and the Dong Mo Resort with a total population of 670,000 in 2020. As such, the Hoa Lac area will be literally a "New City." According to a plan formulated by NIURP-MOC, housing development has been considered within the HHTP site with a total area of 1,800 ha, in order to accommodate 22,000 people in 2005, 35,000 in 2010, and 45,000 in 2020.

In the meantime, there could be several options for HHTP's development and land use. One of the options might be based on the following considerations:

- 1) The development area of HHTP is 1,650 ha after deducting the large residential areas from the total area of 1,800 ha. The HHTP site (1,650 ha) contains the lands that are not easy to develop for the specific use, such as the Tan Xa Lake, small valleys, and the land for roads. Excluding the area of these lands from the total area of 1,650 ha, the usable land area is around 880 ha, accounting for 53% of the total.
- 2) The site demand for HHTP has been presumed to be 582 ha in total (188 ha for laboratories and 394 ha for high-tech factories) in 2020, according to an estimate based on the macroeconomy as discussed in sub-section 3.3.2.
- 3) The above 582 ha (site demand base) is converted to 630 ha (development base), taking into account an allowance of some 20% to keep a good

environment for R&D and production. Excluding this 630 ha from the usable land area of 880 ha, there remains 250 ha.

- 4) The remaining 250 ha could not accommodate all the four zones (Urban/Business Zone, Center Area, High Grade Residential Zone, and New Town Zone) other than the R&D and High-Tech Industrial Zones. It would be possible to accommodate 45,000 people within 250 ha, but the population density of 180 people per ha ($45,000/250$) is high and not acceptable. Even if it is acceptable, there would be no room to develop zones other than the housing zone. It is also possible to increase usable lands by developing the valleys and/or by relocating the existing residents to other areas. However, such land development would be costly and not desirable in terms of creation of a good environment.
- 5) Accordingly, it is considered that the HHTP site will be developed so as to accommodate only the four zones of R&D, high-tech industry, business and training, while the HHTP-related housing area will be developed within the Dong Xuan Residential area.
- 6) As such, this option has the following advantages:
 - Economic feasibility of the HHTP Project may become better due to focusing on the land development to accommodate all the estimated site demand for laboratory and high-tech factory, even though high-tech factory site development is more profitable than that of laboratory in general. In addition, such HHTP development will be attractive for the infrastructure development company (IDC), if it could enjoy the economies of scale from a large scale land development.
 - Without housing development in the HHTP site, an efficiency or merit in cost performance is expected in terms of social infrastructure development, which is to be done by the People's Committee, if schools, water supply/drainage and the like would be intensively and concentratedly developed in the Dong Xuan Residential area. Further, the existing golf courses in the Dong Mo Resort and those planned in the Dong Xuan Residential area might be more profitable, if a golf course could not be developed within the HHTP site.

However, this option would have the following disadvantages.

- 1) One of the necessary conditions for successful development of high-tech park is the "formation of high-tech community." As already mentioned, the development of new technology and new products has necessitated the common ownership of information across the world, of which foundation is the formation of community by researchers and engineers. However, the HHTP development without housing will make them difficult to form a community within the same place and with the same identity.
- 2) Prior location of national R&D institutes is strategically important for the HHTP development. However, the development without housing may discourage the researchers residing now in Hanoi who want to move and live in houses located very close to their institutes. As a result, such discouragement will give a negative impact on the location of national R&D institutes in the HHTP site.
- 3) Foreign or foreign affiliated companies are the target to be invited in the HHTP site with an aim to import and transfer high technologies. Foreign managers and engineers will commute from Hanoi or live in the Dong Xuan Residential area, if housing is not developed within the HHTP site. Commuting between Hanoi and HHTP will be possible by using the expressway to be completed, but it needs time and cost. One solution for this may be to develop housing especially for foreigners within the Dong Xuan Residential area. However, there will remain a problem in terms of security and control. Accordingly, foreign managers and engineers will unavoidably have some inconvenience in either case.

As mentioned above, the option of not developing the housing and recreation zones within the HHTP site cannot satisfy the conditions necessary for the HHTP's successful development. And it also cannot meet the needs of the user side of HHTP, since it prioritizes the logic of the supplier side. Additionally, such logic or the HHTP development without the housing and recreation zone, lacks integration as a project consisting of the six zones with different profitability, and is not expected to increase profitability of the HHTP Project as a whole. Further, it might be against the HHTP's development concept that HHTP ought to be an attractive and highly valued place. Accordingly, this Study determines that the HHTP development with the six zones is desirable in accordance with the concept paper prepared by MOSTE. However, the Training Zone could not be an independent zone, since the land area required for training facilities will be very small, and therefore the training facilities are to be located in the Center Area.

The recreation facilities are planned to be located in the Central Park outside the functional zones, because the demand for the recreation zone is not enough for establishing an independent zone.

Meanwhile, the development options for HHTP are compiled along with their development framework and planning elements, where the option adopted in this Study is called "Basic Plan", and "Alternative Plan" is the case to minimize housing development and not to develop a golf course within the HHTP site.

5.2 Development Vision and Phasing

HHTP is a national project, and MOSTE has been mandated for its direct national management. For the successful development of HHTP, it would be effective to establish an ambitious and highly appealing vision, which is expected to be shared not only between Vietnamese people, but also between foreign investors or other concerned people so as to be a sort of consensus. Based on such a consideration, the vision could be established as follows:

(1) Development Vision

Vision 1: HHTP as the most advanced growth center and as a core zone of S&T Capital in Vietnam

The HHTP site will be developed to be the most advanced growth center leading the high-tech industrialization in Vietnam, and to be a core zone along with VNUH in the development of the Hoa Lac New City/the national road 21A Urban Corridor project while playing a part in S&T Capital in Vietnam. This vision will contribute to the mobilization of various resources not only from inside of Vietnam, but also from foreign countries.

Vision 2: HHTP as a "Technopole" in the Asian-Pacific region

The HHTP site will be developed to be a "Technopole" up to the year 2020, competitive to other high-tech parks and high-tech clusters in the Asian Pacific region, i.e. a high-tech industrial space with a device or mechanism well prepared for an integrated promotion of high-tech industries while installing an internationally high standard infrastructure. As such, the HHTP site should serve as a place for a continuous innovation to be realized through linkages between high-tech enterprises, national high-tech R&D institutes, and VNUH neighboring on the HHTP site as well as linkages or networking with high-tech parks in the Asian-Pacific region. In other words, the HHTP site should be a vital center where people, goods, capital, information and technology will

be interactive, and new technological seeds and high technologies will be created and developed to be commercialized. This vision will contribute to the generation of worldwide attention not only to the HHTP development as a major project in the Asian-Pacific region, but also to Vietnam which is seriously addressing high-tech industrialization and its potential. Such an attention will also give a positive impact on investment promotion.

- (2) Development Phasing: Phase 1 up to 2005, Phase 2 from 2006 to 2010, and Phase 3 from 2011 to 2020

The aforementioned vision of the HHTP development is expected to be materialized step by step on the basis of the progress of Vietnam's integration into the globalizing market economy and its development efforts. In this context, the HHTP site will be developed over the three phases toward the year 2020. The time schedule of HHTP should be set to lead the way as a front-runner of high-tech industry in whole Vietnam.

Phase 1 is set for a duration up to 2005, since it is the period for start-up of HHTP, which will need around five years on account of time schedule to commence the development of HHTP site. Considering less agglomeration of high-tech industries, prior location of national R&D institutes will be strongly promoted during Phase 1 so that their location could be an incentive for location of high-tech factories and software industry. In addition to this, during Phase 1, HHTP will be the localization hub of the imported and transferred high technologies in Vietnam through foreign companies to be located.

Phase 2 is the duration for five years from 2006 to 2010 where high-tech industrialization will progress across whole Vietnam on the basis of achievements during Phase 1. During Phase 2, an emphasis will be put on HHTP's internal enrichment more than inducement of new laboratories and high-tech factories so that HHTP will be able to become a national center for improved technologies, self-development and the generation of new high technologies based on the imported and transferred high technologies. As such, Phase 2 is the period to expand not in quantity but in quality

Phase 3 is expected to be over a longer term than that of Phase 2, i.e. 10 years from 2011 to 2020, since it is the period where HHTP will achieve the development of original technologies and innovative technologies and become a "Technopole" in the Asian-Pacific region. During this Phase, the HHTP site will be transformed into a "Center of Excellence" in the Asian-Pacific region from a national center in Vietnam to generate new high technologies. This will be materialized through the formation of

complementary and equitable give-and-take relations between HHTP and foreign countries, while strengthening and substantiating partnership or linkages with other high-tech parks/clusters in the west coast of the USA like Silicon Valley as well as Tokyo-Tsukuba, Seoul-Inchon, Taipei-Hshichu, Singapore, Malaysia-Crim, and Shanghai. On the other hand, a rapid growth of HHTP and IZs/EPZs in its surroundings will be conducive to the formation of the Hanoi Metropolitan area in an orderly manner. In addition, the areas along the national road 21A centering on the Hoa Lac New City will be a central "Growth Corridor" in Vietnam led by high-tech R&D and production activities.

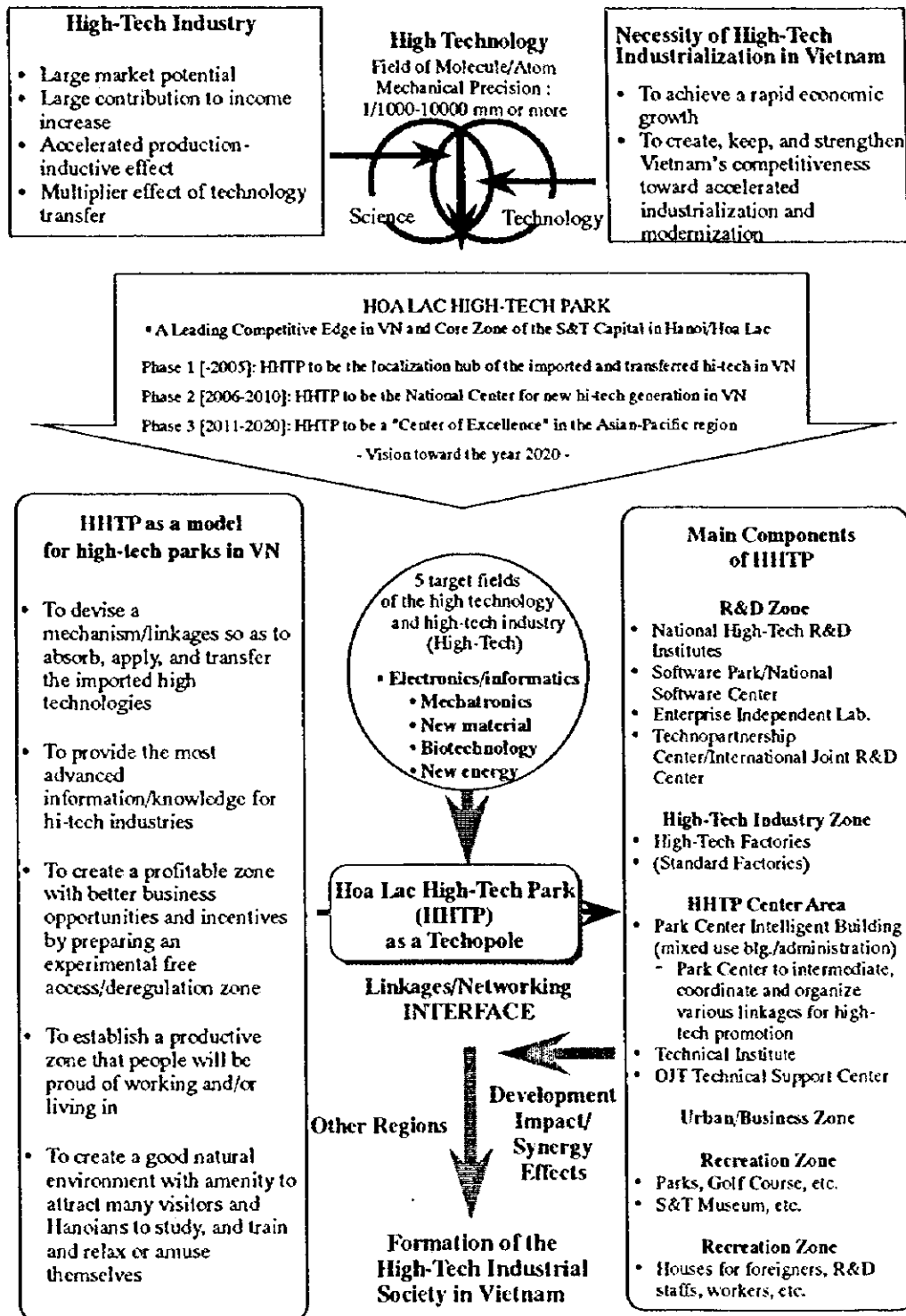
5.3 Major Components/Functions and Development Scenario by Phase

The HHTP site to be developed by the target year 2020 covers an of around 1,600 ha in Hoa Lac. It ought to be developed as a model of high-tech parks in Vietnam according to the following directions, closely reflecting the HHTP's vision and development strategy:

- HHTP to devise a mechanism/linkages so as to absorb, apply, and transfer the imported high technologies;
- HHTP to provide the most advanced information and knowledge;
- HHTP to create a profitable zone with better business opportunities and incentives by preparing an experimental free access/deregulation zone;
- HHTP to establish a productive zone that people will be proud of working and/or living in; and
- HHTP to keep a good natural environment with amenity to attract many visitors and Hanoians to study, train, and relax or amuse themselves

The following figure illustrates the perspective of the HHTP development, and the following table shows a matrix between the major components and the functions to be installed in the HHTP site, and their development phasing. A development scenario will be described below.

Perspective and Major Components of HHTP Development



Major Components and Functions of HHTP by Development Phase

FUNCTIONS/SERVICES	R&D Zone	IZ /EPZ	Center Facilities						Other Zones and Areas
			Park Center	Techo- Partnership	Q/T Technical Support	Technical Institute	National Software Center	S&T Museum	
1. R&D									
1-1 Basic Research	1								
1-2 Applied Research	1	2							
1-3 Production Technology	1	1							
1-4 Product Development	1	2							
1-5 Design Development	1	2							
1-6 Joint R&D	1	1		1			1		
2. Software Production	1						1		
3. High Tech Goods Production									
3-1 Core Industry		1							
3-2 Supporting/Related Ids.		1							1
4. Enterprise Development									
4-1 Incubation				1					
4-2 Financing/Marketing			(1)	1					
4-3 Open Laboratory				1					
5. Manpower Training									
5-1 Engineer					1	1			
5-2 R&D Staff	1								
5-3 Programmer							1		
5-4 System Engineer							1		
5-5 Quality Management					1				
5-6 Pollution Control					1				
6. Manpower Education									
6-1 Middle Engineer						1			
6-2 Higher Technician						1			
7. Technology Transfer									
7-1 Technotrade				1					
7-2 Intellectual Property Protection				1					
7-3 Technology Extension				1	1	1	1		
8. Industrial R&D Support									
8-1 Testing/Masurement/Evaluation/Analysis				1					
8-2 Engineering Service			(1)	1					
8-3 Survey/Consulting			(1)						
8-4 Prototype Fabrication				1					
8-5 Information/Data Base etc.			(1)	1			1	2	
8-6 Open Laboratory				1					
8-7 Standard Factory		1							
8-8 Manpower Provider			(1)						
8-9 Investment Promotion		1	(1)						
9. Intermediation Service			1						
10. Housing									1
11. Other Services									
- Business/Legal Service			(1)						
- One-Stop Investment Service			(1)						
- Rental Office/Meeting Room			(1)						1
- Equipment Leasing			(1)						2
- Bank			(1)						2
- Government Offices			(1)						
- Hotel/Convention Service			(1)						2
- Shopping Restaurant			(1)						1
- Amusement									2
- Recreation									1
- Culture								2	
- School/Hospital			(1)						1
- Basic Public Services			(1)						1

Note: Numbers signify "These" of starting operation. () = Activities/function to be done at the High-Tech Park Center building.

Phase 1 (-2005)

Phase 1 is the period of start-up of HHTP, during which HHTP will promote import and transfer of technologies and be the localization hub of high technologies in Vietnam.

In the R&D Zone, prior location of national high-tech R&D institutes will be implemented by the State initiatives at an earlier stage of HHTP development, either by new establishment or by relocation through integration of the exiting institutes. In addition, international joint R&D projects will be implemented for the start-up of HHTP with foreign assistance or in cooperation with foreign countries to conduct researches in high-tech fields such as informatics, biotechnology and new materials. Further, a National Software Center will be established as the common service facility in the Software Park to be developed in the R&D Zone, so that software enterprises can make use of high-performance computer, train manpower such as programmers, and jointly develop a sizable number of software.

In the High-Tech Industrial Zone, world class enterprises will locate their factories centering on the R&D type or "knowledge oriented" manufacturing industries, since they might well recognize the HHTP's advantages to IZs and EPZs in its surroundings and Hanoi, and in particular highly evaluate the HHTP's full support system by national institutes for their R&D activities. Such "High-Tech Flagship Enterprises" in HHTP are expected to contribute to further increase investment in HHTP. In order to accommodate small scale factories and started-up enterprises, standard factories will be developed in the High-Tech Industrial Zone.

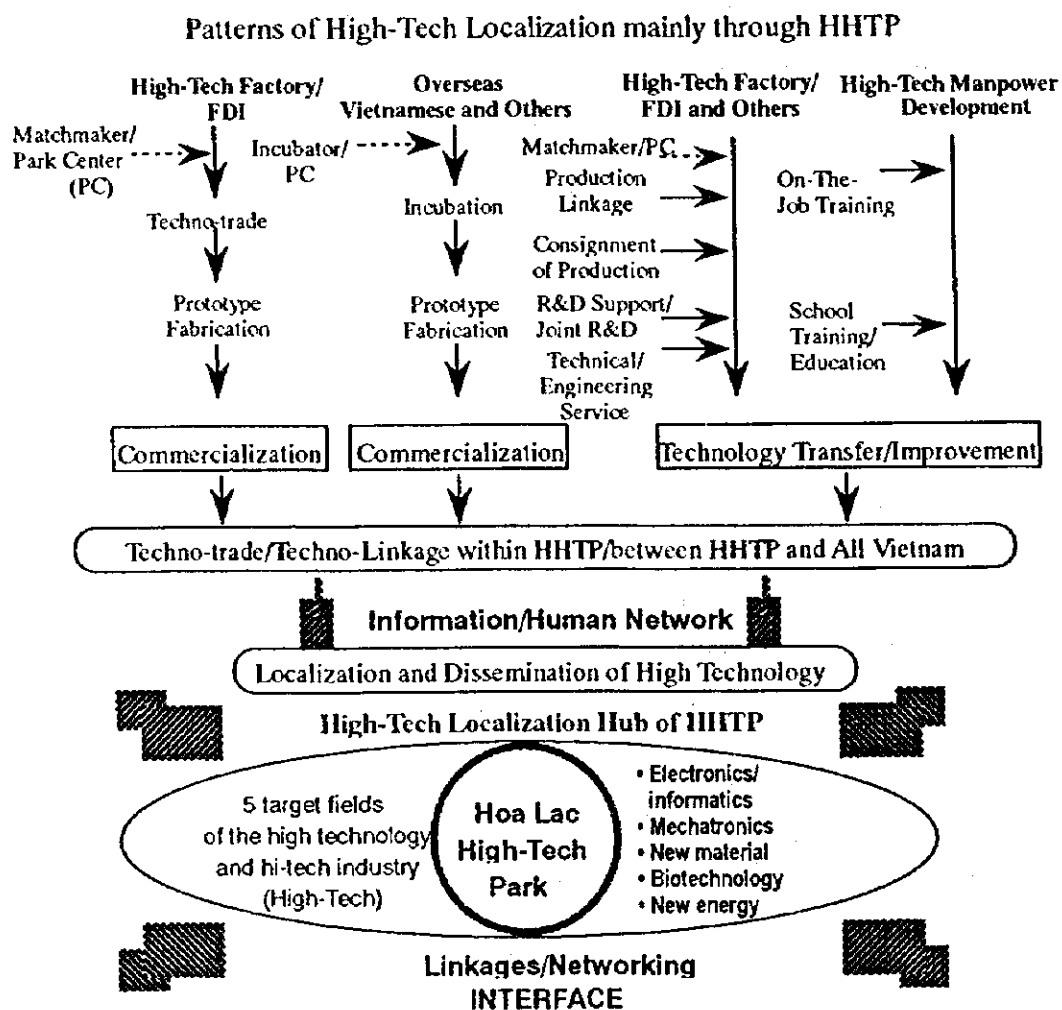
In the Center Area, Technopartnership Center (TPC) will start operation. An incubation program by TPC will start, targeting mainly overseas Vietnamese, and small and medium enterprises in Vietnam. On the other hand, some incubation business companies or venture capital/fund enterprises might open business within the HHTP site, on the basis of institutional arrangements such as stock market and tax reduction on the capital gain. In addition, TPC will play the central role supportive of high-tech production and R&D in the HHTP site, undertaking activities related to technology transfer such as technotrade, technology extension, testing/measurement, engineering services, and provision of open laboratory.

In the Center Area, a Park Center Intelligent Building (PCIB) with ISDN will be constructed to accommodate the Board of Management of HHTP, concerned government agencies, and other various service industries and will provide One-Stop Services.

Also in the Park Center Area, an OJT Technical Support Center will undertake training prior to the start of factory operation as an incentive for investment promotion, and the training to foster middle engineers and hi-level technicians will be carried out in a Technical Institute site.

Such activities during the initial development stage will promote investment not only in HHTP, but also in IZs and EPZs around Hanoi city as well as the Phu Cat Industrial Zone neighboring on the HHTP site beyond the new expressway. Such investment will cover the HHTP enterprise-related industries including supporting industries.

During Phase 1, various activities mentioned above are expected, and the localization of high technologies to be substantially coordinated and promoted by the Technopartnership Center will be implemented in such patterns as shown in the following figure.



In the High Grade Residential Zone, a nine-hole golf course will start operation, and housing will be developed to accommodate foreign businessmen including managers/executives, researchers and engineers of high-tech factories as well as researchers of national high-tech R&D institutes.

Phase 2 (2006-2010)

Phase 2 is the period where HHTP will grow to become the National Center for new high technology generation, and more emphasis will be put on HHTP's internal enrichment in quality than expansion in quantity. As such, there will be no new laboratory location, and the location of high-tech factories will be limited during Phase 2.

In the R&D Zone, the National High-Tech R&D Center and National Software Center will be functionally strengthened through increase of researchers and expansion of equipment, and young researchers coming back from abroad might take leadership in the R&D activities.

In the High-Tech Industrial Zone, factories located during Phase 2 will expand their production, and new factory location will progress to a limited extent. R&D activities of enterprises in the HHTP site will be substantially strengthened, since it could be considered that some of these factories will conduct R&D not only on production technology, but also on applied research and product development.

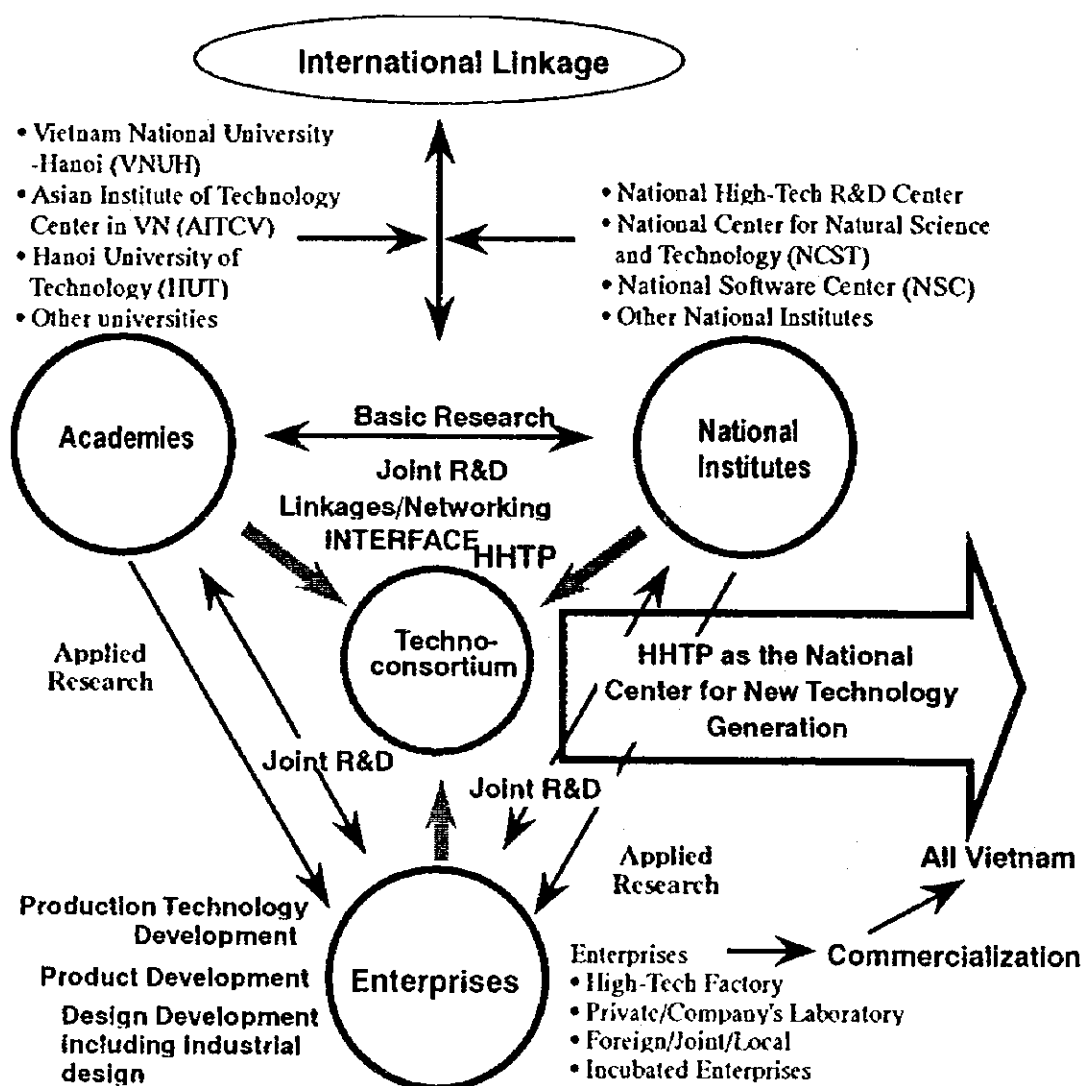
Based on the positive conditions mentioned above, HHTP will become the National Center for new technology generation through the establishment of a R&D Triangle as shown in the following figure, to develop and produce highly qualified products. This Triangle is a sort of joint R&D system for new technology generation through the formation of complementary linkages and network between the enterprises to develop production technology, products and design, universities such as VNUH and national high-tech R&D institutes, both of which will be engaged in basic and applied research. Such a triad linkage will be more effective with a "Technoconsortium", which is a joint venture/conference of industry-university-government, to be formulated by the Technopartnership Center as a coordinator or matchmaker with interface functions.

HHTP as the National Center for new technology generation will be more attractive than that in Phase 1, and will accelerate factory location in the Phu Cat Industrial Zone and other IZs in the Hanoi area. Simultaneously, new industrialists fostered by the incubation business including overseas Vietnamese, new graduates from VNUH and people spun-off from enterprises/factories might establish factories or laboratories for experimental production in the HHTP site.

During Phase 2, success stories originated from HHTP will attract more investments from both abroad and Vietnam. The name of HHTP would be already well known throughout the world.

The Technology Museum to be constructed during Phase 2 will collect many students for excursion and young people. In the High Grade Residential Zone, a golf course with nine holes will start operation, and high grade residences will be developed for foreign businessmen, researchers, high-level technicians.

R&D Triangle for Creation of New Technologies in the HHTP Site



Phase 3 (2011-2020)

Phase 3 is the period where HHTP will become a "Technopole" in the Asian-Pacific region while strengthening and substantiating partnership or linkages with other high-tech parks/clusters in foreign countries.

Phase 3 would be also the period where HHTP could contribute to the outside world. HHTP would have been already a "Technopole" in the Asian-Pacific region through mobilizing capital, manpower, technology, information and the like from all over the world, and thereby would be a "Center of Excellence" in the region in some specific fields. As a result, there would be two flows of technology transfer, one from abroad to Vietnam, and the other from Vietnam to foreign countries.

Many scientists, researchers, and engineers would come to HHTP, and some of them would reside within and around the HHTP site for R&D activities. Large or small private independent laboratories and international institutes would be located in the HHTP. As such, HHTP would be a trendsetter in specific fields leading S&T development in the world. High-tech products manufactured by new technologies to be developed in HHTP would be highly evaluated and dominant in the world market.

On the basis of the development of HHTP and its synergistic development effects, Vietnam in 2020 will be one of the industrial societies with international competitiveness supported by high technologies.



VI. MASTER PLAN FOR THE DEVELOPMENT OF THE HOA LAC HIGH-TECH PARK

This chapter formulates a master plan to implement the HHTP Project.

6.1 Development Framework

The development framework of HHTP consists of the factors cited below, while the target year for the framework is each final year during the three development phases, namely 2005, 2010, and 2020:

- * Setting up the development scale of the R&D Zone and High-Tech Industrial Zone, both of which are the core functional zones, based on the categories of industry to be located there and their site demand;
- * Formulating a plan to construct the “Center Facilities”; and
- * Setting up the development framework for the total area of HHTP including the land use plan based on the above.

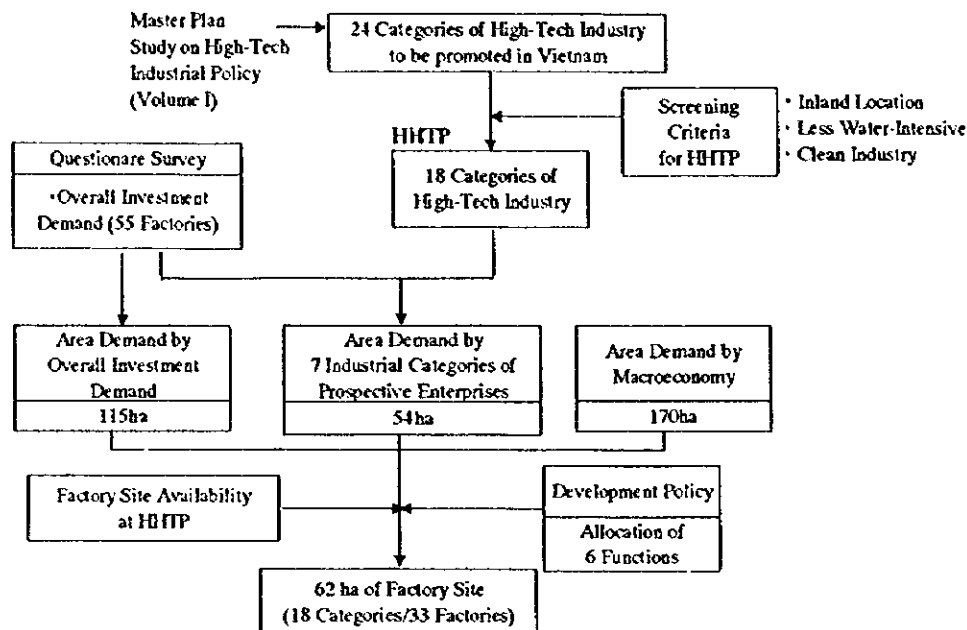
6.1.1 Development Framework of High-Tech Industrial Zone (HTIZ)

Factory site demands for HTIZ in HHTP have been estimated on the basis of the macroscopic projection of the Vietnamese economy as well as the results of the questionnaire survey conducted by the Study Team as described in Section 3.3. While taking into account these site demands, this subsection deals with the selection of the categories of high-tech industry to be located in HHTP, setting up of the land development scale of HTIZ, and estimate of the relevant employment and GDP to be generated as well as the demand for utilities.

(1) Site Demand and Development Framework in 2005

The development framework for factory site is determined on the basis of the following figure.

**Projection Flow of Development Framework for Factory Site
(up to the year 2005)**



This is to screen 24 categories of high-tech industry selected to be promoted in Vietnam in the “Master Plan for High-Tech Industrial Policy” (Volume I). Of the 24 categories, industries which are oriented to inland location, less water-intensive, and clean with less possibility of environment pollution, are screened to be located in HHTP, since HHTP is situated in the inland area with a small capacity of groundwater supply, and it should be developed to be an industrial estate with a clean image. Accordingly, 18 categories of high-tech industry are selected as shown in Table 6-1-1.

Factory site demands for HHTP estimated in Section 3.3 are 115 ha by 55 enterprises according to the questionnaire survey, and 170 ha in view of the macroeconomy.

Taking the factory site demands into consideration, the development framework for factory site is estimated based on factory site availability as well as the development policy that HHTP contains all of the six functions of R&D, high-tech industrial production, urban/business, education and training, high grade residential, and new town.

As a result of estimation, the land area suitable for factory site is 71 ha and the net area of factory lots (33 factories with 18 industries) is around 62 ha out of the HHTP's total area of about 800 ha to be developed during Phase 1. The selection of categories

of industries to be located in HTIZ (18 industries) is as mentioned in Sub-section 7.3.3 (1).

On the basis of the location of the 33 factories, relevant employment, VA (Value Added) to be generated, demands for utilities, etc. are presumed as follows:

- * Factory site area per worker is assumed based on the Census of Manufacturers in Japan (Report on Industrial Land and Water), taking into account the operation of factory by shifts (two shifts on average).
- * VA is calculated by the gross value-added per worker, which has been set out in Section 3.3 (factory site demand in view of the macroeconomy): the gross value-added per worker by category of industry is calculated based on the differentials between industries by using the data in the Census of Manufacturers in Japan.
- * Water demand is calculated on the basis of water consumption per factory by using the data in the Census of Manufacturers in Japan.
- * Electric power demand is calculated on the basis of electricity consumption per factory by using the data in the Structural Survey of Energy Consumption in Japan.
- * Out-flow of cargoes is calculated based on the weight of products per value-added, which is presumed from statistics on exports of Thailand and the value-added ratio.

The results from the above considerations and calculations are shown in the following table. In HTIZ of HHTP, some 8,600 workers (yearly average) will work at factories generating around USD 400 million through the consumption of around 6,700 m³/day of water, around 57 million kWh/year of electricity, and about 160,000 tons/year of cargo outflow in 2005.

Development Framework of HTIZ in 2005

High-Tech Level/ Productive Power- Intensiveness	(in 1995 Constant Prices)	No. of Factory	Factory Site (ha)	Emp- loy- ment (prs.)	VA (MUSD/y)	Water Consum- ption (m ³ /d)	Elec- tricity 1,000 (kWh/y)	Cargo (Out flow) (ton/y)
Level-1/ Brain- Intensive	Pharmaceuticals	1	4.62	338	81	820	2,544	15,476
	Medical Equipment, etc.	2	2.96	495	22	436	1,856	2,728
	Detergents, Surfactants, Paints, etc.	1	2.95	204	25	578	2,108	10,729
	Sub-total		10.53	1,037	128	1,834	6,508	28,933
Level-2/ Engineering- Intensive	Office Equip., Air Conditioners, etc.	2	3.54	546	31	206	1,816	5,818
	Sub-total		3.54	546	31	206	1,816	5,818
Level-3/ Skilled Labor- Intensive	Communication Equipment/CD-ROM	4	5.04	1,182	47	420	2,776	11,635
	Industrial Electrical Machinery/Equip.	1	1.54	248	8	90	978	1,849
	Other Electrical/Electronic Products	4	8.56	1,068	33	1,392	12,012	8,101
	Other Precision Instruments	1	1.12	225	9	72	514	1,631
	Electronic Parts/Devices, etc.	3	2.88	684	11	438	3,210	4,187
	Optical Equipment & Lenses	1	1.26	276	5	125	725	1,472
	Watches/Clocks & Parts	1	1.2	266	5	119	889	380
	Sub-total		21.6	3,949	118	2,656	21,104	29,255
Level-3/ engineering- Intensive	Computers, X Ray Equip. VTR, etc.	2	2.86	660	42	204	2,574	9,134
	Electrical Home Appliance	1	1.74	311	11	186	1,482	16,500
	Motor Vehicles & Parts, etc.	2	5.82	654	15	420	7,736	20,295
	Special Industrial Machinery	2	4.24	390	15	192	1,350	8,044
	Other General Machinery/Equip.	1	1.46	188	5	91	1,580	2,846
	Metal Processing Machinery/Equip.	3	6.12	621	17	246	3,570	7,167
	Glass and Glass Products	1	3.69	278	12	722	9,511	35,333
	Sub-total		25.93	3,102	117	2,061	27,803	99,319
TOTAL		33	61.6	8,634	394	6,757	57,231	163,325

Source: JICA Study Team

Average labor productivity or VA per worker for the 18 high-tech industries in the HHTP site is estimated at 45,600 USD/year, which is around 50% higher than that of 30,000 USD/year estimated in Section 3.3 (factory site demand in view of macroeconomy). This higher labor productivity in the HHTP site might reflect the fact that it is generally higher in the metropolitan area, and specifically very high in pharmaceuticals factory.

(2) Development Framework in 2010 and 2020

The factory site demand in HHTP is estimated at 237 ha up to 2010 and 394 ha up to 2020 in view of the macroeconomy of Vietnam. On the other hand, the High-Tech Industrial Zone will require 79 ha (development base: 93 ha) up to 2010 and 179 ha (development base: 210 ha) up to 2020 in accordance with the total land use plan, both of which are less than those of the factory site demand estimated in view of the macroeconomy. However, it is not necessarily the best option for the HHTP site to meet all the factory site demand estimated. In other words, a selective invitation of factories is a better option for the HHTP development.

The 18 categories of high-tech industry will be located in the HHTP site not only up to 2005, but also after 2005. However, products to be produced there will change in

response to the progress of high-tech industrialization in Vietnam, and also according to the enterprises' management strategy, while the products will be higher in terms of value-added and more innovative. In the meantime, it could be more important for the HHTP to induce enterprises with abundant management resources including R&D capability, even though industries categorized by industrial classification have a significance.

In the development framework for 2010 and 2020, it is assumed that the number of factory workers will increase correspondingly to the increase in factory site, and that the volume of water, electricity and out-flow cargoes will be proportional to the increase in number of factory workers. This consideration is adopted to avoid a sort of "overestimate" when assuming that such items will increase correspondingly to the high-tech industry's VA expansion.

With regard to high-tech industry's VA, labor productivity set up in Section 3.3 (Factory site demand in view of macroeconomy) is used to estimate it in 2010 and 2020 as shown below:

Consequently, the development framework of HHTP in 2010 and 2020 is estimated as follows:

Development Framework of HHTP in 2010 and 2020

	2005	2010	2020
Factory Site Area (ha)	62	79	179
Employment (persons)	8,600	11,200	25,200
VA/year (USD million)	394	766	3,054
Water Consumption (m ³ /day)	6,700	8,700	19,600
Electricity (kWh/year)	57.2 million	74.4 million	167.6 million
Cargo Outflow (tons/year)	163,300	212,600	478,500

Labor productivity set up for estimating factory site demand in view of the macroeconomy and its increase rate: [] in 2010 or 2020

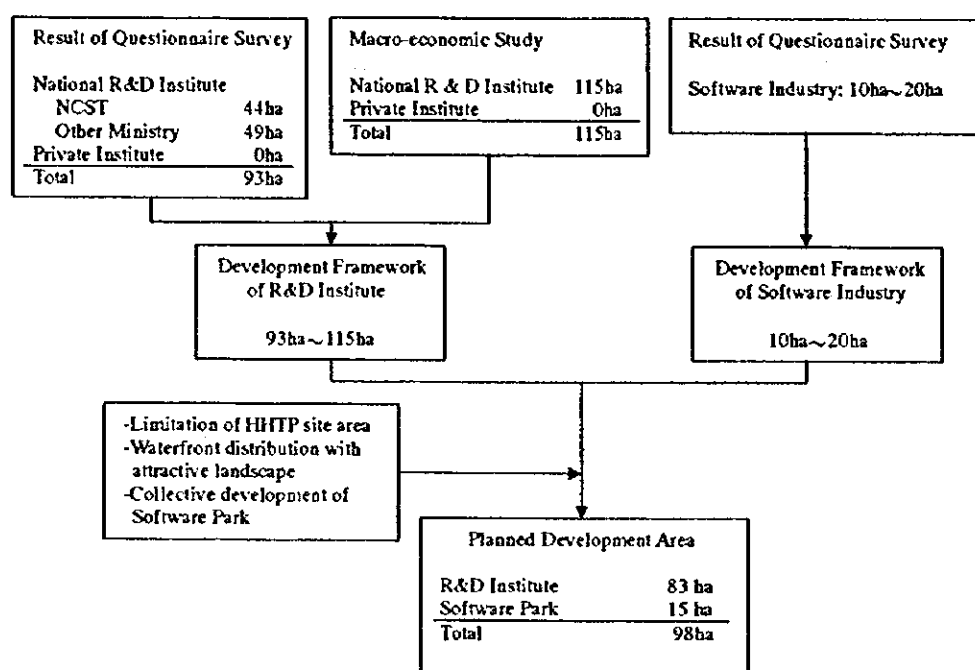
- * Labor productivity in 2005: 45,600 USD/year
- * Labor productivity in 2010: 68,400 USD/year = 45,600 USD/year x 1.5 ([45,000]/30,000)
- * Labor productivity in 2020: 121,200 USD/year = 45,600 USD/year x 2.66 ([80,000]/30,000)

6.1.2 Development Framework of R&D and Software Industry

Development demand of R&D and the software industry in HHTP was discussed on the basis of the results of the questionnaire survey and the macro-economic study as

shown in Chapter 3, 3.3. In this section, the development framework of R&D and the software industry in HHTP will be studied in consideration of the development demand and the characteristics of HHTP site in consideration of the study flow as shown below.

Study Flow of R&D and Software Industry Development Framework in 2005



(1) Development Framework of R&D and Software Industry in 2005

Investment demand of private R&D institute is estimated at almost null in accordance to the results of the questionnaire survey. National R&D institute, on the contrary, is expected to relocate to HHTP. Relocation demand of R&D institutes belonging to NCST and other ministries are estimated at approximately 44 ha and 49 ha respectively.

NCST officially announced its participation in the HHTP development through the establishment of new laboratories in response to the HHTP's development needs, and/or the relocation of some existing sub-institutes/laboratories into the HHTP site, while depending on its necessity. In addition, NCST is keen to participate not only in the activities of the National Software Center to be established in the HHTP site, but also in solution of environmental problems on the HHTP development as well as in human resources development for high-tech manpower.

On the basis of the macro-economic study, development demand of the national R&D institute in HHTP is projected to be approximately 115 ha in the year of 2005, though the private R&D institute investment will be negligible in HHTP.

In consideration of the survey and the study mentioned above, 93 ha ~ 115 ha is set as the development framework of R&D institute in HHTP at 2005.

In order to satisfy the development framework, the available land for R&D institute is planned by the study of the characteristics of the HHTP site. Considering that the extent of the HHTP site and availability of the waterfront area with the advantageous landscape are limited, 83 ha net area is planned as the R&D zone.

The investment demand of software industry is estimated at 10 ha ~ 20 ha based on the results of the questionnaire survey, on the other hand. 15 ha software park is planned to be established at the advantageous location in HHTP where the collective software park could be developed at the waterfront area with the attractive landscape.

(2) Development Framework of R&D and Software Industry in 2010 and 2020

Development demand of R&D and the software industry in HHTP in 2010 and 2020 is projected to be 150 ha and 188 ha respectively on the basis of the macro economic study. Demand increment will be 35 ha and 38 ha in 2010 and 2020 as shown below.

	Development Demand (ha)			Increment (ha)	
	2005	2010	2020	2005 ~ 2010	2010 ~ 2020
National R&D	115	120	128	5	8
Private R&D	0	30	60	30	30
Total	115	150	188	35	38

Suitable land with attractive landscape for the R&D institute is unavailable in Phase 2 of HHTP, while 50 ha in semi-gross or 38 in net is planned in Phase 3 as shown below.

	Development Area in HHTP (ha)			
	Phase 1 2005	Phase 2 2010	Phase 3 2020	Total
R&D Zone	118 (98)	0 (0)	47 (38)	165 (136)

Note: () means net area in ha.

As described above, the area of R&D zone in HHTP will be 165 ha in net in 2020.

6.1.3 Center Facilities

In order to fulfill the multiple objectives of HHTP, center facilities are proposed to be established as nuclei for the development. Considering the interrelation and interdependence among the centers, it is proposed that they should be erected next to each other in the same functional zone in the Center Area. Considering their functions, the centers should be located adjoining the R&D Zone and High-Tech Industrial Zone. They should also have good access to the National University of Hanoi campus through the northern regional trunk road to be constructed in HHTP which leads to the national road 21A. The centers, thus, are proposed to be constructed in the north-western part of HHTP.

The roles and functions to be assumed by the proposed centers are explained below:

(1) Roles and Functions of Center Facilities

The center facilities will have the following seven roles for systematic and industrial promotion.

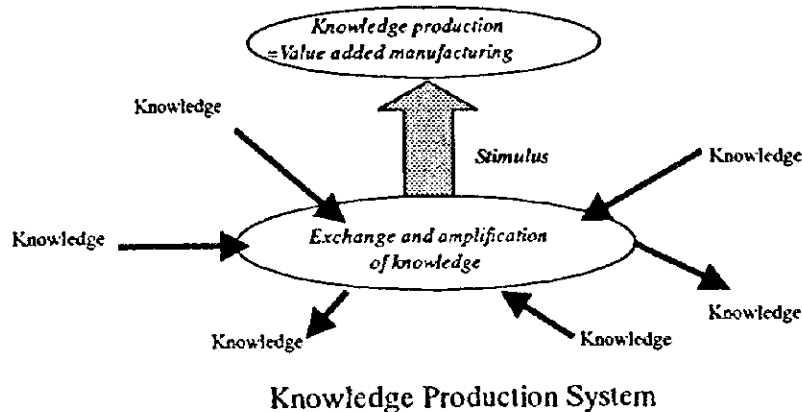
Role of regional core for deepening and consistency of industrial development

When the Study Team looks at advantages of the Vietnamese local industrial agglomeration, i.e. an industrial estate, economy of scale, and scope and labor pooling generated by having the manufacturing entities related to the same kind of industry, it is HTPC's mandate to further promote industrial deepening and consistency of industrial development. The creation of the regional manufacturing network should extend beyond the confines of HTPC and so does the clientele of HTPC. The justification of extended territory arises from both demand and supply. There will be manufacturers from outside of HTPC seeking for the highly specialized services by HTPC. The exchanges with these outside enterprises will contribute to the creation of a large network of manufacturing know-how. On the supply side, HTPC needs to expand its revenue base to financially justify the facilities and services for the manufacturing concentrations such as in Hai Phong, Ha Noi, and any other industrial areas in Vietnam.

Role of exchange and amplification center of knowledge

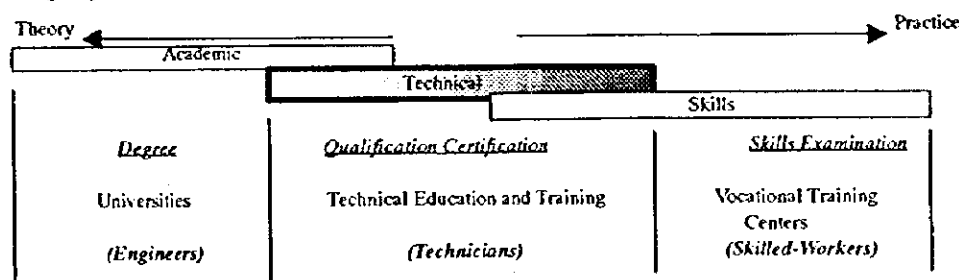
Secondly, value added manufacturing is almost equal to knowledge production. The base for the knowledge production relies on a sound foundation of knowledge

exchange and amplification environment. Exchange and amplification of knowledge stimulate trial and errors in simulation, combination, and replacement of elements of knowledge production. These intellectual activities eventually lead to improvement and innovations. This core for exchange and amplification of knowledge should be built in HHTP.



Roles of high-tech skill labor development with education and training system

The human resources are the serious issue for industrial deepening and value-added production in Vietnam. The Ha Tay Province and Ha Noi City have several plans for new training institutions. In addition, the new education and training function of HHTP should be examined carefully for the purpose of high-tech skill labor development. It is desirable to have a high-tech training institute to cater for more specific needs. Steady supply of technicians and engineers should be assured by the system. The following figure shows three objects of human skill development.



Spectrum of Technical Education and Training

The skilled labor in most insufficient supply in Vietnam at present is technicians who support high-tech industrial production, therefore the strengthening of this class is the most important training and education course. It is very difficult to set up the training and educational curricula for the technicians and engineers to be suited for various high-tech and local enterprises. The curricula should have some universal applicability to the

majority of firms. The training and educational course to be offered should correspond to the specific needs to assist the high-tech industries in HHTP.

Roles of investment promotion center

The centers to be established in HHTP should also assume the role of the nucleus for attracting enterprises to set up their offices, factories or laboratories for high-tech production or business activities. In collaboration with BOM, HHTP-IDC and other ministries or agencies concerned and other organizations to be stationed within the center, these centers should provide one-stop services to investors and enterprises, including obtaining investment licenses, construction approval, preferential treatment for investment, labor employment, and other administrative services.

Roles of testing and certification center

The centers should also provide the basic services required for production of high-tech products, including testing, measurement, and certification of products. They should also promote the industrial standards and support the quality control management of enterprises. Offices of the governmental agencies concerned should be stationed for this purpose.

Role of new enterprises establishment center with incubation system

The Hsinchu Industrial Park currently conducts incubation of new ventures. It plans to move into a newly constructed industrial park in Hsinchu and plans to accommodate 150 new ventures. A lot of electronic enterprises located in this park have supported high-tech industrial products in Taiwan in recent years. These enterprises have been established by overseas Taiwanese who studied abroad and returned to this country. When they undertook the establishment, they used the incubation system in this park. In 1993 there were 1,004 overseas Taiwanese in this park and some of them established 73 companies among the total of 150 companies founded by applying this incubation system. Thus, such a system in a high-tech park is very effective for the establishment of companies. In view of the contemplated objective of building indigenous manufacturing capabilities, there should be some incubation functions in HTPC.

Roles of services center for manufacturing communication and information

Even a well-established factory cannot ensure good manufacturing function alone without an efficient communication and information system which must be serviced collectively. HTPC can simply provide a liaison service for the service providers. Data communication is now becoming increasingly important within the manufacturing and

institutional sectors. The Internet system allows its users to be connected with world-wide manufacturing and R&D organizations in the world. Currently a Vietnamese service provider named "Vietnam Data-Communication Company (VDC)" is offering Internet services in this country. A data communication system such as an Internet node should be established within the center and function at a relatively inexpensive service charge. With this node linkages should be established with other major high-tech hubs such as the Ho Chi Minh High-Tech Park, Hsinchu Industrial Park, Silicon Valley, Tsukuba, Massachusetts, together with the provision of advisory groups and a roster of experts to assist enterprises.

(2) Plural Centers

With the single function alone HHTP is not able to cope with and solve the technical problems and various service needs of high-tech manufacturers and the research and development sector. Therefore, to create an overall environmental atmosphere for these knowledge activities, plural collaboration centers and buildings are necessary and should be maintained in HHTP. It is proposed to create the following 5 types of plural centers and buildings:

- * *"Technical Institute"* for human skill development program
- * *"OJT Technical Support Center"* for labor skill development program
- * *"High-Tech Park Center (HTPC)"* for location of public administration and private sector's offices for applying the various service programs and investment promotion.
- * *"Technopartnership Center"* by applying the technical transfer system among the various institutions and collaboration for R&D
- * *"National Software Center"* for establishment of software enterprise production and nourishment and supply of software engineers by applying the incubation program.

Thus, the above 5 center functions and facilities should be planned to satisfy the specialized high technical needs. These will promote the establishment of strong manufacturing and institutional communities by integrating all the research institutions, state and private enterprises by serving as promotion bodies. It is necessary to avoid unnecessary duplications, but instead to build complementary relations among these institutions to create symbiotic effects in the Vietnamese manufacturing and research working system.

Figure 6-1-1 shows the roles, functions, services and cooperation of plural center facilities in HHTP.

6.1.4 Land Development Plan

(1) Development Constraints

The topography of the HHTP site with an area of approximately 1,600 ha is characterized by undulated farmland and groves. 5 - 10m deep valleys are observed in the southeast part of 400 ha. Land grading by simple flat plate is rather difficult due to the valley depth and, therefore, cluster development of the hilly land is recommended.

Villages are scattered in the northern and eastern areas of the HHTP site. The area of villages is estimated at approximately 150 ha in total, accounting for 6% of the total area of HHTP. The largest village has a population of approximately 500 grouping in 100 families, and the smallest village has a population of 15 in 3 families. Most villages are developed along the existing inter-village roads. In consideration of the difficulties of relocation, it is recommendable that the existing villages be ultimately reserved.

The rivers, reservoirs, and groves would also be reserved. Two upper streams of the Tich River are running in the HHTP site: The Linh So River with a 50 m width running in the northwest corner of the site and the small stream with a 10 m width in the south part of the site. In order to save the development cost of the park, these two streams should be reserved without any relocation or improvement. R&D, high-tech industrial parks, etc. will be located in the elevated area of hilly land and be free from floods even if river improvement is not implemented.

The two agricultural reservoirs being operated at the center and north edge of the HHTP site should be reserved to supply agricultural water to the paddy field in the downstream area. The two reserved reservoirs are proposed to be designated as the R&D development area to utilize the supreme landscape of the waterfront.

The groves scattered in the HHTP site, where eucalyptus tree plantation is dominant, are recommended to be reserved to create green landscape in the planned parks and administration building area.

Full attention should be paid to the preservation and/or compensation of existing inter-village roads.

The distribution of land development constraints is presented in Figure 6-1-2.

(2) Land Development Principles

Following principles are proposed to direct the land development plan:

- 1) High-tech manufacturing industry will be developed in the area adjacent to the Hanoi-Hoa Lac Highway to promote investment. The site along the highway is considered to be most suitable for the development of high-tech manufacturing industry.
- 2) R&D and education/training facilities will be distributed in the central and north edge areas around the existing reservoirs to utilize the waterfront landscape.
- 3) The downtown of HHTP, business and commercial zone will be located along the national road 21A for easy access from the park and from outside. Namely the business and commercial zone will be intensively developed around the junctions of the national road 21A and main road of the park. Thus, not only the R&D facilities, New Town, and High-Tech Industrial Zone in HHTP but also the universities to be relocated in the west of the park and Xuan Mai/Hoa Lac new city could enjoy the services of the Urban/Business Zone in the park.
- 4) Middle-rise residences will be developed in the New Town adjacently to the Urban/Business Zone, and high-rise residences will be built next to the middle-rise residences in the New Town.
- 5) The park should be developed efficiently and effectively (the park area target is planned to be 10 m² per resident). The park and reserved green area will create an attractive green landscape suitable for a high-tech park.
- 6) A new interchange of the Hanoi-Hoa Lac Highway is proposed to be constructed to connect the road of HHTP directly to the highway and the Phu Cat Industrial Estate planned in the south of HHTP. The road skeleton will be developed utilizing the existing road alignment.

Two alternatives of land use concept for HHTP are proposed in Figures 6-1-3 and 6-1-4 on the basis of the development principles mentioned above.

(3) Land Use Plan

A comparison of two land use alternatives is shown below and alternative 1 is recommended by the Study Team.

	Alternative 1	Alternative 2
Basic Idea of Plan	The high-tech industrial zone is planned to be developed in the south area of the site, along the highway, and in the north area in order to avoid mixture with residential land use.	The high-tech industrial zone is planned to be developed in the south and central areas of the site in order to have convenient access to the interchange of the highway.
Comparison	This alternative is preferable in consideration of the unmixed development of residential and industrial land.	In case the existing villages could be relocated, alternative 2 will be better choice. However, under practical consideration, alternative 2 is evaluated as the second.

The detailed land use plan was elaborated on the basis of alternative 1, as summarized below and presented in Figure 6-1-5 and Table 6-1-2. The infrastructure development plan described in the subsequent section was formulated on the basis of this detailed land use plan.

Land Use Plan of HHTP

	Phase 1		Phase 2		Phase 3		Total	
	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	Ratio(%)	Area (ha)	(%)
1. R & D Zone	118	14.8	0	0.0	47	8.8	165	10.0
2. Center Area	16	2.0	0	0.0	32	6.0	48	2.9
3. High-Tech Industrial Zone	71	8.9	22	6.9	117	21.8	210	12.7
4. Urban/Business Zone	26	3.2	8	2.5	47	8.8	81	4.9
5. High Grade Residential Zone	76	9.5	56	17.7	0	0.0	132	8.0
6. New Town Zone	74	9.3	23	7.3	150	27.9	247	15.0
7. Infrastructure	142	17.8	18	5.7	108	20.1	268	16.2
8. Tan Xa lake	120	15.1	180	56.8	0	0.0	300	18.2
9. Green River, Reserve Area	153	19.2	10	3.2	36	6.7	199	12.1
10. Total	796	100.0	317	100.0	537	100.0	1,650	100.0

6.1.5 Development Framework of Other Zones

(1) Employment and Population Framework

The number of workers expected in the Education/Training zone, Center/Business zone, etc. is projected as tabulated below.

Number of Workers in HHTP

Land Use	Number (Cumulative)			Increment		
	2005	2010	2020	~2005	2005~2010	2010~2020
1. R&D Zone	3,900	3,900	5,400	3,900	0	1,500
2. Center Area	300	300	900	300	0	600
1) Technical institute	50	50	150	50	0	100
2) High-Tech park center	130	130	450	130	0	320
3) OIT technical support center	20	20	100	20	0	80
4) Technopartnership center	100	100	200	100	0	100
3. High-Tech Industrial Zone	8,600	11,200	25,200	8,600	2,600	14,000
4. Urban/Business Zone	1,300	1,900	5,400	1,300	600	3,500
5. High Grade Residential Zone (commercial function)	100	200	200	100	100	0
6. New Town Zone (commercial function)	100	100	200	100	0	100
7. Total	14,300	17,600	37,300	14,300	3,300	19,700

Population increase induced by HHTP development is estimated at approximately 89,000 as shown below.

Population Increase by HHTP Development

	Factory Worker and R&D Staff (FWRD) (person)	Population (PP) (person)
The end of Phase 1 (2005)	14,300	28,600
The end of Phase 2 (2010)	17,600	35,200
The end of Phase 3 (2020)	37,300	74,600

Note: Population/worker = 2.0

About 40 % of the increased population will reside in the Hoa Lac High-Tech Park and the remaining will reside and commute from outside, Dong Xuan Residential Area and Hanoi City as well as the area in the vicinity of HHTP as shown below.

	Population		
	2005	2010	2020
1) Population induced by the development	28,600	35,200	74,600
2) Population in HHTP	12,800 (45%)	15,000 (43%)	31,000 (42%)
3) Difference (commuters from outside)	15,800 (55%)	20,200 (57%)	43,600 (58%)

Infrastructure and utility demands for the development of HHTP are summarized below.

	Water Demand (m ³ /day)	Electricity Demand (MW)	Telecommunication Demand (lines)
Phase 1 (2005)	13,000	48	8,800
Phase 2 (2010)	17,000	61	10,300
Phase 3 (2020)	37,000	135	20,900

Note: Cumulative number