

**Report to the
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**Environmental and Social Aspects of
Taiwanese and U.S. Companies in the
Hsinchu Science-Based Industrial Park**

prepared by

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The first phase of the project focused on two sectors—oil and high tech—with a high degree of business activity in California. In addition to Taiwan, field investigations of the high tech sector were conducted in India, Thailand and Malaysia. Field investigations of the oil sector were conducted in Ecuador, the Caspian region, and Nigeria. A Public Policy Report and a handbook for educators and activists will be available in September, 2001 (<http://www.nautilus.org/cap/>). We are grateful to the Richard and Rhoda Goldman Foundation, the Ford Foundation, and the MacArthur Foundation for financial support of the CAP project.

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All our members of the Taiwan Environment Action Network (TEAN), a grassroots organization of scholars and students which works to increase Taiwan's involvement in global environmental issues. TEAN focuses on collecting first-hand information to help promote sustainable development in Taiwan and worldwide. Through international collaboration, the mission of TEAN is to cultivate international friendship and wisdom in order to create a just, and peaceful world (<http://tean.formosa.org/>).

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A Study of the Environmental and Social Aspects of Taiwanese and U.S. Companies in the Hsinchu Science-based Industrial Park

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Executive Summary

This report identifies the most pressing environmental and social impacts associated with hardware firms in the information technology (IT)¹ sector in Taiwan, in particular, the Hsinchu Science-Based Industrial Park (HSIP). The leading environmental problem is the widespread toxic pollution of water, including water used for agricultural production and for local drinking supplies. There may also be a significant problem of worker exposure to health risks. Little research has been done on occupational health and safety and data are scarce.

The report also explores the regulatory context in Taiwan and the extent to which company voluntary/non-regulatory approaches to improve environmental performance may be successfully developed and applied in Taiwan. The report focuses on Taiwan-based semiconductor firms with close ties to Silicon Valley firms, primarily as suppliers. The findings are based on interviews with industry, government officials, IT personnel, representatives from non-governmental organizations, and local residents². This report also draws from reviews from recent science and public policy literature, and news clips.

The advent of Information Technology (IT) has radically transformed the structure of the global economy, the global spatial division of labor, and the global distribution of environmental resources. Taiwan has played a significant role in the global IT industry since the 1970s, when it became an original equipment manufacturer (OEM) for leading US personal computer companies. In the 1990s, a host of Taiwanese IT firms emerged, covering design, manufacture, assembly, packaging and testing of semiconductors. Given these economic and environmental developments, to what extent may the sector's social and environmental performance be improved in Taiwan? In order to address this question, this report is organized into the following four sections:

Section 1: How do multinational semiconductor coalitions influence the IT industry in HSIP? What is the socio-spatial structure of the HSIP and the science-based industrial park policy (SIP policy)? What are the environmental protection systems in Taiwan? What are the existing gaps in the implementation of the environmental laws in the HSIP?

¹ Mazurek, J. 1999. *Making Microchips: Policy, Restructuring, and Globalization in the Semiconductor Industry*. Cambridge, MA: MIT Press. This report follows the same definition of Information Technology as the Silicon Valley report, *From Pilots to Program* (2000): Information Technology, as the general usage in most professional media elsewhere, it refers to all related industries which provide technology, products and serve to facilitate information process. It covers all electronic firms that provide and produce computer related products and technology. Due to the diversity of industry, firms, and products that comprise the IT sector and the heterogeneity of environmental problems associated with the sector, the focus of this report primarily is on the semiconductor industry.

² However, it is very difficult to interview local residents and IT employees regarding the public health and the occupational health issues. According to our survey, IT employees have to sign an agreement with their employers. Under the agreement, IT employees cannot discuss any work related issues with the third party outside their working environment. Anyone violates this rule will be fired. Therefore, we suggest that a government supported systematic research regarding public and occupational health issues has to be conducted immediately.

Section 2: What are the environmental and public health implications of the IT industry in the Hsinchu region? What are the major issues of environmental management systems in the IT companies and the HSIP?

Section 3: To what extent do IT economic developments decrease the quality of life at community level? How have global cooperatives, the emerging IT elite and transnational politics impacted local government autonomy and the transformations of the NGOs' environmental protection patterns?

Section 4: What are the next steps to promote environmental accountability in the industry, with attention to the role that the global cooperatives and the transnational NGOs networking can play?

The report finds that:

Section 1: Advances and applications in the IT industry have become important indicators for evaluating the economic competitiveness of a country in the global economy. The challenge of implementing Taiwanese environmental laws in the HSIP has been attributed to two major factors. First, due to the rapid growth of the IT industry – its short product cycles and intensive chemical use, there is an inability to develop comprehensive toxic inventories which play a substantial role in controlling and monitoring toxic release. Second, local environmental authorities have been unable to force the implementation of law due to a lack of labor, technology, and financial support. Long-term pro-economic development policy and lack of local autonomy under the 50-year KMT one party rule have crippled the environmental practice of local governments.

Section 2: The vertical division of manufacturing creates market advantage for IT sectors, but brings environmental management disadvantage to the region. The environmental and public health effects of the IT industry in the Hsinchu region have been revealed in six issues: (1) coastal pollution, (2) water consumption, (3) ground water pollution, (4) waste water treatment discharge, (5) public health crisis, and (6) occupational health and safety issues. However, due to the lack of environmental assessment of total capacity control in the HSIP development permit system, IT firms carry out passive management practice.

Section 3 The economic force created by the IT sector has intertwined with social and political forces and impacts local communities as well as Taiwanese society as a whole. Local communities have suffered a declining quality of life, while the new IT elite is the up-coming class in Taiwanese society. The emerging IT elite influence policymaking processes in the new Taiwanese government regarding IT industrial development and Chinese-Taiwanese economic relations. This political transformation challenges the local environmental NGOs' practice. Due to the lack of domestic resources, global environmental accountability and transnational NGO networking play critical roles for local NGO re-formation.

Section 4 Global environmental accountability and transnational NGO networks are critical for the improvement of social and environmental performances in Taiwan. Six steps should be taken:

- (1) Environmental / labor laws should be improved.
- (2) Information should be internationally and easily accessible to the public.

- (3) The HSIP and Hsinchu city government should build up and maintain a good partnership.
- (4) International expertise on investigating and monitoring high-tech operation processes should be introduced and shared in Taiwan.
- (5) International NGO action networks should be promoted to help the transformation of Taiwan's NGOs.
- (6) Company–community partnership should be promoted to encourage high-tech corporation involvement at a local level.

I. The Context

The advent of Information Technology (IT)¹ has radically transformed the structure of the global economy, the spatial global division of labor, and the global distribution of environmental resources. Advances and applications in the IT industry have become important indicators for evaluating a country's overall economic competitiveness in the global economy.

Since the 1970s, Taiwan has played a significant role in the transformation of the IT sector. This section discusses IT development in Taiwan from three angles. Section 1-1 describes the history and development of the IT industry in Taiwan. It focuses on the role of multinational semiconductor corporations in determining the character of IT industry in the Hsinchu Science-Based Industrial Park (HSIP) (Table 1-1). Section 1-2 explains the socio-spatial structure of the HSIP (Figure 1-1) and the science-based industrial park policy (SIP policy). It clarifies how the SIP policy and the proposed spatial plans affect Hsinchu and Taiwan. Section 1-3 describes the environmental protection system in Taiwan and elucidates the gap between the HSIP and the rest of Taiwan in terms of environmental governance.

Year	Multinational corporation	Initiative	Technology
1976	RCA	ERSO pilot plant	IC fabrication (LSI)
1986	Philips	TSMC	VLSI IC fabrication
1989-91	TI	TI-Acer	DRAMs
1994	Oki	Mosel-Vitelic	DRAM fabrication
1994	MEMC	TEM	Silicon wafers
1994	HP	Winbond	RISC processor
1994	MIPS (Sun)	MXIC	RISC processor
1994	IBM, Motorola	NewPC consortium	PowerPC processor
1995	SEH	SEHT	Silicon wafers
1995	Kanematsu	TKEM (NanYa)	Silicon wafers
1995	Oki	NanYa	DRAMs
1995	Mitsubishi	Powerchip	DRAMs
1995	Toshiba	Winbond	4M DRAMs

Table 1-1:
Multinational Linkages: Taiwan semiconductor industry

Adopted from Mathews & Cho, 2000:189.

¹ Information Technology, as the general usage in most professional media elsewhere, it refers to all related industries which provide technology, products and serve to facilitate information process. It covers all electronic firms that provide and produce computer related products and technology.

1–1. The Introduction of IT Industries in Taiwan

The era of IT industry in Taiwan dawned in the early 1970s. Since then, Taiwan's industrial structure has undergone a number of significant changes². According to the *Taiwan Institute of Economic Research Statistics*, high tech products accounted for about 36% of total exports in 1990, rising to 46% in 1995 and to 55% in 1997. This rapid growth was the result of government industry policy. Taiwan concentrated on becoming a greater exporter of technology and capital-intensive products, deliberately reducing its dependence on traditional labor-intensive exports. The policy was successful: the value of total IT products increased from US\$20 billion in 1986 to US\$141.56 billion in 1995, and US\$198 billion in 1997, making Taiwan's information product output one of the fastest growing IT industries in the world.

1-1.1 The Business Relationship Between Taiwanese and International IT Firms

Strategic coalitions, technological innovation alliances, and multinational leverage are the fundamental business relationships critical to the competitiveness of Taiwanese IT firms. Taiwanese IT industries are built on OEMs (original equipment manufacturers). In order to maintain competitiveness in the global semiconductor market, the interdependent business relationships among Taiwanese IT industries and multinational firms have changed frequently. Table 1–1 and Figure 1–1 present a snapshot of the role of multinational activities in the 1990s. Table 1–1 overviews the multinational links in Taiwan's semiconductor industry from 1976 to 1995. Figure 1–1 shows the technology alliances of UMC, Windbond, TSMC, MIXC, and Powerchip that took place in the 1990s (Mathews and Cho, 2000: 182).

In his probing study, *The Information Technology Industry*, Wang states that Compaq is the Taiwanese IT industry's number one procurement company and has established the closest business relationships with Taiwanese IT firms.³ Wang declares that Compaq spent more than US\$4 billion in procuring Taiwanese IT products in 1997, rising to US\$5.6 billion in 1998—which accounted for one third of IT hardware production value—and to more than US\$7 billion in 1999. IBM spent US\$1.4 billion in procuring Taiwanese IT products in 1997, US\$2.24 billion in 1998 and US\$3 billion in 1999. Besides Compaq and IBM, Dell and Hewlett Packard (HP) are also important procurers of Taiwanese IT products. In particular, HP is deeply rooted in the Taiwanese market. In 1998, 50% of HP personal computers were manufactured and assembled in Taiwan.

² In 1961, the percentage of GDP constituted by agriculture, industry and the service sector stood at 27.45%, 26.57%, and 45.98, respectively. But by 1997, the proportions had changed to 2.7%, 34.9%, and 62.4%, respectively. The primary goal of economic development in Taiwan is the attainment of a fully industrialized nation status by the year 2000. By the end of 2000, per-capita income is expected to be US\$15,000, while the proportion of manufacturing production value in GDP will remain above 30%. (Data from “1998 Development of Industries in Taiwan, Republic of China”, Ministry of Economic Affairs.)

³ Data in this section are cited from Wang, Cheng-Feng's “The Information Technology Industry” published in 1999.

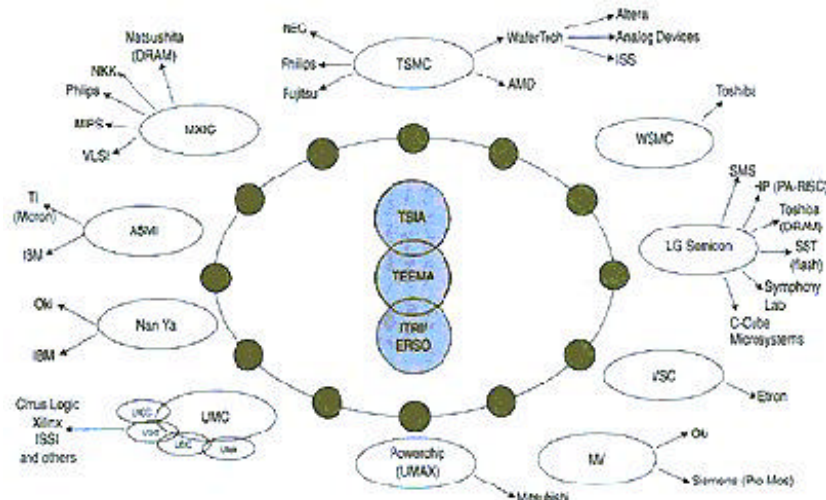


Fig. 1-1 Taiwan's strategic alliances. Adopted from Mathews & Cho, 2000:182

1-1.2 Structural Characteristics of Taiwan's Semiconductor Industry

The multinational business links of semiconductor industries in Taiwan have two key structural features: 1) a vertical division of labor in the organization of production, and 2) global market niches of the foundry service. Both features constitute a vital base in the competitive position of Taiwan's semiconductor industry in the global economy. We explain how the SIP policy influences these structures in Section 1-1.3 below.

(i) Industrial Structure – Vertical Division of Labor

A vertical division of labor rather than vertical integration in the organization of production characterizes the industrial structure of Taiwan's semiconductor industry (Fig. 1-3). Vertical design manufacturing means that Taiwan IC makers focus only on one particular segment of the overall IC manufacturing process. Firms specialize in either design, manufacture, assembly, packaging or testing. In contrast, many IC makers in the US, Japan, and Korea have adopted integrated design manufacturing, which means that they design, manufacture, assemble, and test within the firm.

Taiwan's particular split type of industrial structure stems from Taiwan's unique business structure and also differences in cost and technology development conditions among IC designing, manufacturing, assembly, packaging and testing processes. The business structure of small and medium size enterprises, with its flexibility in technology adjustment and technology restructuring, has been the main force driving Taiwan's economic growth overall. In the IT sector, by 1998, Taiwan had 83 design houses, three wafer material suppliers, five mask making companies, 20 wafer fabricating manufacturers, 13 lead frame manufacturers, 23 packaging companies, and 16 testing companies.

Maintaining a structure of small and medium sized firms has helped the Taiwanese IT industry to reduce and manage market uncertainty in the technology-intensive and highly competitive global semiconductor industry. The small and medium size structure, however, poses a unique set of issues for environmental management in Taiwan's semiconductor industry.

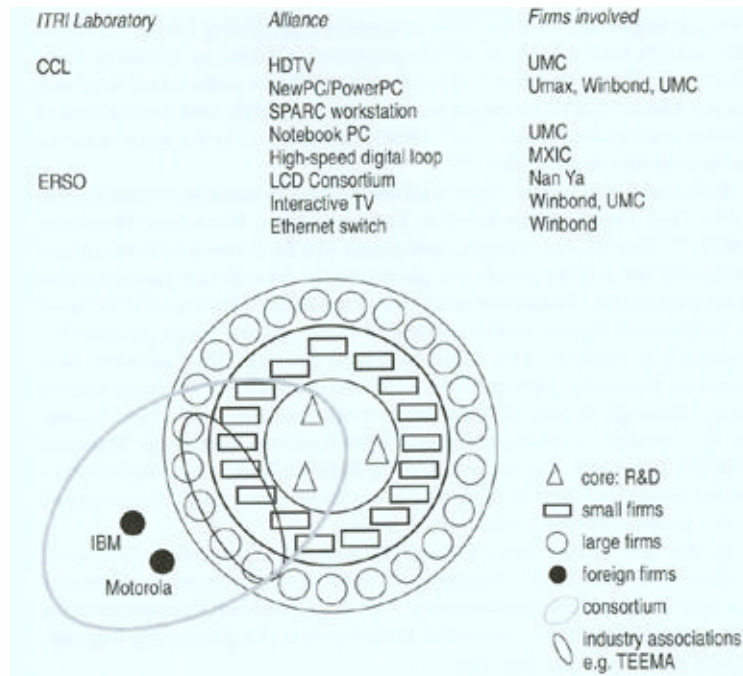


Fig. 1-2. Technology innovation alliances organized by ITRI: 1990. Adopted from Mathews & Cho, 2000:185.

(ii) Market Niche – Foundry Service

While many US, Japanese, and Korean integrated design manufacturing IC firms manufacture their own chips, Taiwanese firms create a foundry company for wafer fabrication selling their own products. Moreover, the core competence of Taiwan’s semiconductor industry lies in the foundry niche in the global economy. Figure 1–4 is the United Microelectronics Co. (UMC) case which occurred in 1995–1996. In Deng’s book, *Legends of Silicon Valley*, she identifies the UMC case as a watershed coalition for Taiwan–Silicon Valley foundry niches (Deng, 1998, 236), and the CEO of UMC, Robert Tsao, was honored by California Governor Pete Wilson.

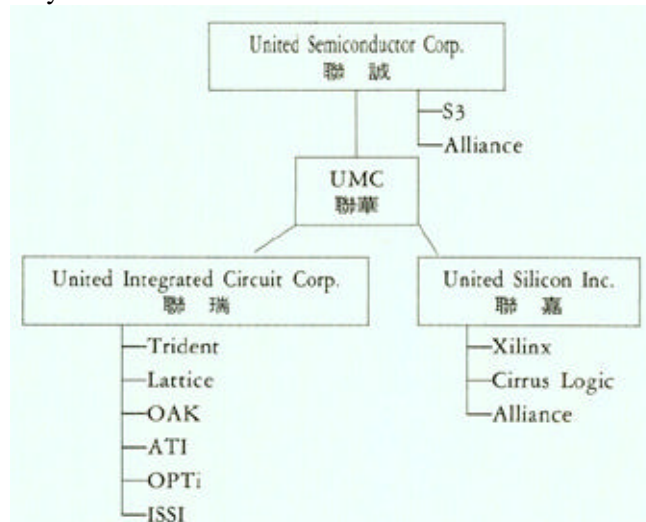


Fig. 1-3. 1995 – 1996 UMC Taiwan-Silicon Valley coalition. Adapted from Deng, 1998: 236.

1-1.3 The Development of the Semiconductor Industry in Taiwan

Taiwan's creation of a semiconductor industry took place in four developmental stages (Mathews, 1997). The first stage, before 1976, was a preparatory stage: Taiwanese electronic firms were OEMs (original equipment manufacturers) to international IT firms. In the second, 'seeding' stage, 1976–1979, technology transfer for semiconductor fabrication was initiated. During the third 'technology diffusion' stage, 1980–1988, increasing numbers of companies entered the industry and institutional structures in Taiwan were established to facilitate the rapid transmission of technological capability. During the fourth phase, 1989–1998, the industry expanded and developed the institutional, technical and financial sources of support through a broad range of firms involved, the breadth of products and processes employed, the depth of expertise developed and the internationalization of its activities.

(i) Semiconductor Industry in Taiwan's Economic Structure

In terms of market dynamics and industrial transformation, the semiconductor industry is one of the most strategic and important sectors in Taiwan's IT industry. In 1998, the value of semiconductor industry totaled \$US8.47 billion.⁴ In 1998, the value of semiconductor manufacturing alone climbed to US\$5.07 billion.⁵ Taiwan is presently the world's fourth largest producer of semiconductor products, taking 7.4% of global IC market share in 1998.⁶

The decisive economic impact of the semiconductor industry on Taiwan's economic structure can be illustrated by Taiwan's recent survey of the 100 most competitive technology companies⁷. According to the survey, the semiconductor industry enjoyed a revenue growth rate of 272% in 1999, the highest of all Taiwanese industries. One fourth of Taiwan's most competitive technology companies were semiconductor firms.

(ii) The State and the Creation of the Semiconductor Industry

Government involvement is vital for the development and the success of semiconductor industries. The US military played a critical role in providing funding and market for US semiconductors. In Japan, government laboratories took the first step in semiconductor R&D in the early 1950s⁸ and later continually played a major role in the development of semiconductor technology in Japan (Mathews and Cho, 2000). Likewise, Taiwan's state has played a critical role in the development of Taiwan's semiconductor industry.

Taiwan first started semiconductor production when the American semiconductor industry was tied up with strong competition from Japanese firms. In order to be competitive and have an advanced development focus, American firms looked for low labor cost regions to handle the low-technical element of semiconductor production. In the mid-1960s, Taiwan began to be part of international semiconductor production's

⁴ Data resources: Ministry of Economic Affairs (MOEA).

⁵ Data resources: Ministry of Economic Affairs (MOEA).

⁶ Data resources: Ministry of Economic Affairs (MOEA).

⁷ The survey was conducted by Common Wealth Magazine, published in Aug 2000 issue (in Chinese). The ranking of 100 technology companies was based on the indicators of a company's revenue, revenue growth, return on equity, and profits.

⁸ The development of semiconductor industries in Japan took place within two research institutes, one affiliated with Nippon Telegraph and Telephone Corporation, and the other with the Ministry of International Trade and Industry.

division of labor when American semiconductor firms looked for overseas production (Hong, 1997). However, Taiwan merely served the global semiconductor industry as a low labor cost location for assembly of semiconductor devices for foreign firms. No advanced technology transfer took place at the time. The Taiwanese state's effort to develop the semiconductor industry began in 1974. When the economy went into a serious recession in the early 1970s, Taiwan government officials attempted to upgrade industrial structure, and the electronics industry was selected as one of the strategic sectors.

Taiwan State involvement can be seen as a milestone in the development of the Taiwanese semiconductor industry. Since the semiconductor industry requires intensive capital investment in research and development stages, private capital investment was hard to attract at the developmental stage. Major private firms such as UMC and the Taiwan Semiconductor Manufacturing Co. (TSMC) were created directly under the state's sponsorship. The state provided virtually everything needed for the formation of major semiconductor manufacturing firms, including investment capital, technologies, management support and human capital (Mathews and Cho, 2000).

In 1999, the IC industry was comprised of 118 companies, represented US \$11.3 billion in sales and an incredible annual growth rate of 63%. Wafer foundry and DRAM production technology had reached 0.25 μm at the beginning of 1999, and is now approaching 0.18 μm with some of the products already using the copper interconnection process, aided by 6-inch wafer plants that are now also developing analog and high-voltage processes (Bipolar, BiCMOS, BCD).

The significant involvement of the state in developing IT industries in Taiwan is manifested in several government motivated institutional changes.

(1) The Creation of the Industrial Technology Research Institute and the Electronic Research Service Organization

In 1974, the Industrial Technology Research Institute⁹(ITRI) and the Electronic Research Service Organization (ERSO) combined to become the critical leading body in developing the semiconductor industry by providing technological support for the industry (Mathews and Cho 2000, 157 – 202).

(2) Implementation of National Economic Development Plan

A government commitment to developing IT industries has been institutionalized in the National Economic Development Plan (NEDP) since the 1970s. In September 1982, the NEDP affirmed the strategic importance of developing high-tech industries, among which the information industry was chosen as strategic sector in upgrading Taiwan's industrial structure. As a result, the state subsequently directed public investment funds to IT development.

In 1991, the strategic importance of developing IT was reiterated in the NEDP, based on the six-year National Development Plan. Ten emerging high-tech industries, including

⁹ The mission of ITRI is to scan the global technological horizon for developments of interest to Taiwan industry and then takes on the steps required to import technologies to Taiwan firms.

semiconductors, communications, pollution control and treatment industries, were selected as goals for the next phase of Taiwan's development. With this renewed institution, IT's importance in Taiwan's economic structure has been re-affirmed, and social and politic support for the IT development has been legitimized.

(3) Establishment of Hsinchu Science-based Industrial Park and Green Silicon Island

In 1980, the state established the Hsinchu Science-based Industrial Park (HSIP). Administered by the National Science Council, HSIP was to provide an infrastructure that would facilitate and accelerate the processes of technological diffusion, and localize the vertical division of labor in the semiconductor firms.

Due to the success of the HSIP, many agricultural-based counties are seeking to establish science-based industrial parks (SIPs) in their jurisdictions. During his 2000 presidential campaign, President Chen promoted the idea of the Green Silicon Plan. He promised not only to extend the Tainan SIP, but also to develop new SIPs in central and southern Taiwan. Two new SIPs are proposed: 1) the Taichung SIP for central Taiwan, 2) the Luchu SIP for southern Taiwan. The location of Taichung SIP integrates five cities and county jurisdictions including Taichung City, Taichuan County, Miaoli County, Changhwa County, and Nantou County. The Louchu SIP, as a satellite SIP of Tainan SIP, will be located in Kaoshoun County. Meanwhile, I-lan County, in the eastern coastal region of Taiwan, is also under consideration for the establishment of a SIP that specializes in software and Internet industries.

1-2. Hsinchu Science-Based Industrial Park

The establishment of the Hsinchu Science-based Industrial Park was a key component of the government's policy to develop the IT sector in Taiwan. This section introduces the HSIP from three socio-spatial aspects: (1) the background of IT employees and industries in the HSIP; (2) the review of Science-based Industrial Park (SIP) Policy; (3) the spatial development of the HSIP in the Hsinchu region.

HSIP, the first science-based industrial park in Taiwan, was established on December 15, 1980, as part of the state's strategic plan for promoting high-tech industries. From 1980 to 1997, the Taiwanese government has invested about US\$60 billion in the HSIP, building the necessary infrastructure for providing high-tech industries with an incubator environment. The success of the HSIP has been demonstrated in the increasing numbers of high-tech start-ups moving into the HSIP.

1-2.1 Background of IT employees and Industries in HSIP

(i) Employees in HSIP

Table 1-3 shows the rapid growth rate of employees in HSIP during the past 15 years. There were 8,275 workers in 1986. By the end of 1999, there were 82,778 workers employed by 292 companies¹⁰. The most prominent characteristics among HSIP employees are their high level of educational qualifications and their age, providing both a challenging and a competitive outcome. According to Chang's recent research (2000, 28), higher position employees, i.e., engineers, managers, and CEOs, mostly are new comers with a Ph.D. degree or a Masters degree from the US. The majority of lower position operators and engineers are local residents who have a Bachelor degree or Junior College qualification. The relative breakdown of employees is depicted in Fig. 1-5. In terms of the household, an estimate gained from the 1999 Hsinchu City Annual Statistic Report, reveals that on average one person in every 4.2 households in Hsinchu is an HSIP employee. Section 2-1 details the relationship between local residents and the HSIP in detail.



Table 1-2. The rate of growth of HSIP employees 1986-2000

Source: SIPA, (http://www.sipa.gov.tw/guide/1999c/HSIP99_C.HTML 9,22, 2000)

¹⁰ In 1998, among 272 companies, there were 222 domestic firms, 6 European firms, 34 American firms, and 10 firms from other Asian countries.

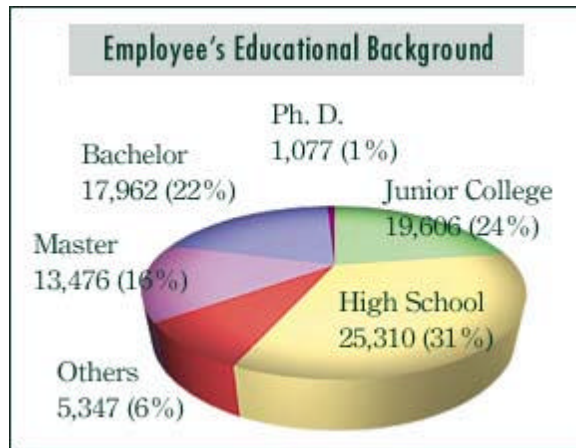


Fig. 1-4. HSIP Employee's educational background. (Source: Ibid.)

(ii) Industries in HSIP

Companies in the HSIP are primarily focused on designing, manufacturing, and researching and developing high-tech products. The major industries within the HSIP can be categorized into six basic groups: integrated circuits, computers and peripherals, telecommunications, opt-electronics, precision machinery, and biotechnology (Table 1-4). So far, integrated circuits, computers, and peripherals have been the areas showing the greatest performance and they hold a pivotal position in the international market. The total sales volume for 1997 (US\$13 billion) shows an increase of 25.6 % when compared to the previous year.

Industry	No. of companies	No. of workers	Sales (US\$ million)	Growth rate of sales(%)
Semiconductor	118	48,284	11,300	63%
Computers and Peripherals	51	16,529	6,292	31%
Telecommunications	47	5,299	1,015	28%
Optoelectronics	48	11,066	1,609	58%
Precision Machinery	13	1,165	150	49%
Biotechnology	15	435	21	22%
Total	292	82,778	20,387	49%

Table 1-3 Six groups of IT industries in HSIP
(Source: Ibid.)

The increasing numbers of companies joining the HSIP have been responsible for the rapid expansion of HSIP. The HSIP is currently undergoing Stage IV of development: 112 hectares in Chunan and 400 hectares in Tunglo. By 2006, it is expected that the number of manufacturers and employees within the HSIP will double and that production value will reach US\$45 billion.

Established in 1980, the Science-based Industrial Park Administrative (SIPA) oversees operations and management of the science-based industrial parks. The SIPA is the body

that not only provides market space within the HSIP to new manufacturers but also provides one-stop services for all the administrative needs of Park residents in an effort to provide an attractive environment for investment in high-tech industries creating a competitive position for those who take advantage of its facilities.

In 1999, 34 companies joined the HSIP, raising the total number of companies in the park to 292. Gross sales reached US\$20.4 billion, an increase of 49% over the previous year. Aggregate investment was US\$20.4 billion of which 243 companies (83% of all companies) were domestically owned, compared to 49 foreign owned companies (17%). Domestic sources accounted for 92% and foreign sources for 8% of investment capital. Forty-seven of the Park's companies were listed on the stock market.

1-2.2 Review of Science-Based Industrial Park (SIP) Policy

The Science-based Industrial Park Policy operates under a three-part policy that includes: (1) a special administration district under the State; (2) a special tax deduction policy; and (3) a one-step application system plus high standard. The success behind HSIP's three-part policy lies in the fact that it is controlled by a well-planned organization, the Science-based Industrial Park committee, which works under the control of the State central government. The infrastructure is described below:

(i) Special Administration District under the State / Central Government

HSIP is a special district under the jurisdiction of the National Science Council of the Executive Yuan (the Cabinet). There is a Science-based Industrial Park committee (SIP committee) organized by the 13 deputy chairs from different Ministries of the Cabinet and five scholars.¹¹ The IT companies' development application and permit are reviewed by the SIP committee. Local Hsinchu governments can only review and monitor the environmental management system of each individual application.

In addition to the SIP committee, there is a section of SIP Law that regulates every action that IT companies undertake inside HSIP territory. There are one hundred sets of regulations categorized into 15 types. The 15 types of regulation are: (1) SIP standard regulations, (2) investment regulations, (3) land management and construction regulations, (4) business regulations, (5) storage and tax regulations, (6) information administration regulations, (7) R & D regulations, (8) environment & labor safety regulations, (9) public health regulations, (10) bilingual high school application regulations, (11) security regulations, (12) service and administration regulations, (13) fire and safety regulations, (14) space rental regulations, and (15) industrial organization regulations. Appendix A lists one hundred regulations under the 15 categories.

The SIP committee and SIP regulations provide IT companies with the best investment environments in Taiwan, while creating the political link between central and local government. More importantly, they separate IT companies and local communities into two worlds. Section 2 will address these issues in details.

¹¹ The Ministries include: Domestic Affairs, Military, Finance, Education, Economic, Transportation, and the Council of Economic Planning Development. The chair and deputy chair of the National Science Council are the default members of the committee. Mayor and Deputy Mayor of Hsinchu City Municipal Government and Hsinchu County Governor can not participate in the SIP committee.

(ii) A Duty-free Policy

Among all regulations, the IT Duty-free Law and the Land Rental Regulation benefit the IT companies the most. First, every new IT company investing in HSIP has a five-year duty-free period. After its first-time investment, the company can receive an extra four-year duty-free period for an additional investment. There are also various policies that benefit the whole production line, from importing raw materials to exporting final products, as well as consideration of the stockholders' investment. According to a report carried out by the Commonwealth Magazine (May 2000), from 1990 to 1994, IT companies in HSIP only paid 1.57% of their sales profit to the Department of Finance. In contrast, the top 100 manufacturing industries paid 15.29% on average. The small business sector, during the same period, turned in 20% of their sales profit as tax.

Cheap rent for land development is another important benefit for IT companies investing in HSIP. In order to provide Taiwanese IT companies a competitive edge in a global market, the State central government controls the land price in the HSIP. IT companies can rent space at a relatively low price, US\$1.27 Sq feet / year. Appendix C shows the land sale price of the 18 largest industrial parks under the jurisdiction of the Industrial Development Bureau. The sale price per sq. feet is between US\$19.00 and US\$57.00.

(iii) One-step application system plus high-standard infrastructure

The one-step application system aids efficient IT companies to compete in a global market. As mentioned earlier, the HSIP committee handles the application process of IT investment in the HSIP. The application is reviewed and IT companies are authorized to start work in a span of two months, which is unusual for any other industrial start-ups in Taiwan.

According to HSIP Administration, there are 298 individuals who are responsible for basic facility planning, operations and implementing various services (1999, HSIP). Appendix D elaborates the fees, the schedule and the departments that are in charge of the processes. The only step controlled by local government is the environmental assessment review. The Hsinchu EPA has the authority to reject applications. It actually creates an environmental battle between local governments, HSIP, and IT companies. We will address this issue in Section 2.

In terms of the high-standard infrastructure, HSIP is a "self-sustaining community" (Chang, 2000:133). It contains well-planned road systems, public facilities, low-density housing, large-scale open spaces, wide road systems, banks, a post office, a customs office, medical clinics and custom brokerages. More importantly, it has also established the National Experimental High School, offering high school, junior high school, primary school, and kindergarten curricula, as well as a bilingual section, to provide educational opportunities for the children of employees (Science-based Industrial Park, 1999, 6).

1–3. Environmental Protection Systems in Taiwan¹²

Driven by post-martial law environmental movements after 1987, environmental acts were established in Taiwan in the 1990s. Stemming from environmental awareness at grassroots level, most environmental acts are not only progressive in spirit, but also integrate modern environmental control mechanisms. However, few of the laws and mechanisms have been implemented in the HSIP.

The difficulties in implementing Taiwanese environmental laws in the HSIP have been attributed to two major factors. First, due to the rapid growth of high-tech industries – with short product cycles and intensive chemical use – it is impossible to develop comprehensive toxic inventories, which play a substantial role in controlling and monitoring toxic release. Second, the local environmental authority has been unable to force implementation of law due to a lack of labor, technology, and financial support. The long-term pro-economic development policy and lack of local autonomy under the 50-year KMT one party rule have crippled the environmental practice of local governments.

The shortcomings of the HSIP system of environmental protection became evident in the Shengli incident, which occurred in July 2000 (see Section 2-3 for a detailed description). Illegal toxic dumping severely polluted the water supply of Kaoshiung and caused the city to be without any usable water supply for two days. The Shengli incident showcased Taiwan's troubled waste treatment management. Shengli was one of the few private companies licensed to handle organic chemical toxic waste and had signed contracts with 80% of IC companies in the HSIP to handle these high-tech firms' waste solvents. It is estimated that IC companies in the HSIP produced 1,000 tons of waste solvents per month (Liberty Times, 7/19/2000, China Times, 7/20/2000).

For the first time, the Cabinet's Research, Development, and Evaluation Commission concurred that mismanagement of hazardous waste was a problem and caused the Shengli incident. The loopholes of toxic waste management include low capacity, which leads to widespread illegal dumping of waste; incapability of local agencies to monitor firms' waste management, facilitating companies in skirting rules; and the inadequacy of the monitoring process. Licensed treatment firms often commission illegal entities to dump waste hazariously (Taiwan News, 8/17/2000, China Times, 7/19/2000).

The April, 2000 United Microelectronics Corporation Environmental Impact Assessment incident (UMC EIA incident) is a good example of how the powerful industrial sector challenged the Hsinchu city government as well as the implementation of the EIA act. It was the first time that the corporation was forced to stop operations because of violation of the EIA act by not carrying out an EIA before development. It was also the first time that both city government and corporation publicly accused each other in the media (press conference and newspaper advertisements).

Although the Hsinchu city government got much support from local people, the central government, the media, and even the general public stood behind UMC. The incident resulted in the quick passing of UMC EIA within ten days and a public apology by

¹² For more information, please check <http://www.epa.gov.tw/english/LAWS/>

Hsinchu city government to UMC. The UMC EIA incident presents the power struggles among different agents, and how environmental laws may be sacrificed when applied to top high-tech corporations.

1-3.1 Environmental Impact Assessment Act

Taiwan has a number of strong and innovative environmental laws. The Environmental Impact Assessment (EIA) Act, approved in December 1994, prevents and mitigates adverse impacts of development activities to attain the goal of environmental protection (article 1). It provides for an environmental management plan, public explanation and review through scientific, objective and comprehensive surveys, predictions, analyses and evaluations conducted in advance of project implementation to identify the potential impact of development activities or government policies on the environment (including both natural and social environments), as well as on the economy, culture and ecology. The EIA process includes Phase I and Phase II EIAs, reviews and follow-up, performance monitoring, etc.

The EIA Act has forced developers to consider environmental impacts before undertaking construction or development activities. In the UMC Fab-8F wafer plant, the EPA claimed Lien-Dien's development permit invalid under Article 14 of the EIA Act, which requires the completion of EIA review before the issue of any development permits (EPA news, 4/20/2000).

1-3.2 Hazardous waste: 'Cheng Bao'

In the main, disposal of hazardous waste produced in the HSIP is contracted out to professional waste treatment companies. However, this contract system, so called "Cheng-Bao", creates a loophole, since the HSIP hardly keeps track of the process of waste treatment. In the case of the Shengli illegal dumping issue, Shengli, a legal holder of the license for toxic waste treatment, is responsible for any of their drivers carrying out illegal dumping. There are two laws regarding hazardous waste control:

The purpose of the *Waste Disposal Act*, last revised in March 1997, is to effectively clear away and dispose of the wastes, improve sanitation and protect the health of the people. It regulates wastes including hazardous industrial wastes, which are generated by industrial enterprises containing toxic or dangerous substances in a sufficient concentration or quantity, to endanger human beings or pollute the environment, and general industrial wastes that are generated by industrial enterprises.

The *Soil and Groundwater Pollution Remediation Act*, promulgated in February 2000, is enacted 1) to prevent and remedy soil and groundwater pollution, 2) to ensure sustainable use of the land and groundwater resource, 3) to improve the living environment, and 4) to enhance public health.

The environmental authorities at the local level are responsible for regularly monitoring the soil and groundwater quality status in their jurisdiction. It requires that the environmental agencies at local level should promptly investigate any site where the soil or the groundwater is likely to have been polluted. If any discharge, leakage, infusion or disposal of pollutants in violation of any applicable requirement is found, the environmental authorities shall first control the sources of pollution pursuant to relevant

environmental laws and regulations, and then investigate the environmental pollution status.

Once the site has been assessed as presenting a potential danger to national health or the living environment, it should report to local Authorities and request the EPA to appraise and declare the site as soil pollution or groundwater pollution remediation site (hereinafter, "Remediation Site").

This act required the establishment of a Soil Pollution and Groundwater Pollution Remediation Fund to remedy pollution problems. Any violator of this act may be subjected to life imprisonment and a criminal fine if any death results. It is viewed as an important act in the regulation of illegal toxic waste dumping and contaminated sites.

1-3.3 Air pollution

The *Air Pollution Control Act (APCA)*, last revised in February 1992, laid down its main objectives as the prevention and control of air pollution, safeguarding public health and the living environment and improving the quality of life. It regulates activities such as industrial development, emissions of air pollutants, using or storing organic solvents or any other volatile materials generating malodors, and any other activity that may contribute to air pollution.

Violation of the APCA is punishable by an administrative penalty of between five thousand and one hundred thousand NTD, which is considered a very light penalty for effectively stopping harmful activities.

1-3.4 Water pollution

As wastewater discharge is one of the major concerns of neighborhood communities, the HSIP management bureau promised to enhance the monitoring system, improve the facility, and make information accessible to the public. There are two laws regarding water pollution control:

The purpose of the *Water Pollution Control Act*, effective May 1991, is to prevent and control water pollution, ensure the cleanliness of water resources in order to protect ecological systems and improve the living environment and human health. It requires the responsible agency at local level to issue permits or to approve permit information changes for industrial wastewater discharge. It also authorizes the agency to order suspension of business operations if waste discharges from factories or sewage systems cause serious harm to human health, agricultural or fishery production, or to the safety of drinking water. Although the act imposes continuous daily administrative penalties and authorizes the responsible agencies to suspend business operation if violation occurs, the act is regarded as less effective for water pollution control because of its light punishment (imprisonment of up to 3 years, or fine of up to \$1,000).

The purpose of the *Drinking Water Management Act*, amended May 1997, is to safeguard and improve drinking water quality, and to protect public health. Under this act, no activity that may pollute water sources and water quality such as the establishment of a polluting factory plant, and any dumping of garbage, sludge, waste chemicals, or other materials which may pollute water source quality, is allowed within a tap water source quality protection area or an area within a certain distance from a water-intake point.

Those persons violating these provisions shall be punished by imprisonment of no more than one-year or detention, with the possible addition of a fine of no more than \$200.

1-3.5 Toxic chemical waste

The *Toxic Chemical Substances Control Act*, last revised in November 1997, is enacted for the purpose of preventing toxic chemical substances from polluting the environment or harming human health. It regulates the use of toxic chemicals and provides a legal base for punishment if persons are found to cause serious physical harm to humans (punishable by imprisonment of between three and 10 years, with the possible addition of a fine of up to five million NTD) or to endanger human health and cause disease (punishable by imprisonment of up to three years, with the possible addition of a fine of up to four million NTD).

II. Environmental Impacts of IT Companies in Hsinchu

This chapter is in four parts. Section 1 describes the problem of toxic water pollution, the most visible of environmental impacts of the IT industry in the Hsinchu region.

Section 2 analyzes environmental management systems in IT companies and emphasizes four issues: (1) the challenge of environmental issues in the IT industry, (2) environmental risk and disadvantage to environmental management embedded in the vertical industrial structure of IT industries; (3) supervision of environmental management system: SIPA, EPA, HSIP industries association and environmental management supervision committee, and (4) the contract between a proactive approach in voluntary environmental management practice and a passive approach to regulatory environmental management.

Section 3 describes the pivotal Shengli toxic water dumping incident in detail. Section 4 examines the HSIP environmental operation process. It introduces the HSIP pollution water quality examination items and chemicals used in manufacturing processes in the HSIP. It emphasizes two problems in the operating system: (1) problems in the development permit system, and (2) problems in total capacity control.

2-1. Toxic Water Pollution

The most visible environmental problem generated by the IT industry in the Hsinchu Region is toxic water pollution, including the degradation of watersheds. While air pollution, noise pollution and other hazard factors are also problems, they have received less attention from local residents and the general public.¹

In 1997, however, the public received a rude awakening following a fire incident of United Integrated Circuits, a semiconductor company located in HSIP (see Figure 2-2). According to our interviews, the leader of the fire team did not know how toxic the air inside the factory was. After the fire, he walked into the factory without wearing a mask. He fainted, was sent to the emergency room, and was then hospitalized for a week. The toxic air pollution created by the UMC fire was the first shock needed for Hsinchu residents to realize how toxic the IT industry is. Before the fire, local residents perceived the IT industry as a low-pollution, clean industry, the so-called “no chimney” industry.

¹ Since there is no data archive for researchers to investigate, personal experiences and residents' interviews become the main sources for our research. Therefore, this survey does not include other types of pollution. However, we do interview and survey some four residents who have been suffered by the noise pollution. We do not include their cases in our report, because the SIPA argues that they provided relocation plan for these residents. These residents did not want to move. Due to the limitation of our filed survey, we cannot clarify the situation. We decide only to add this information, after we have updated study.



Fig. 2-1 The United Integrated Circuit's fire incident in 1997. Photo from Wu, Ching-ji.

This section focuses on six types of issues related to toxic water pollution: (1) coastal pollution, (2) water consumption, (3) ground water pollution, (4) wastewater treatment discharge, (5) public health crisis, and (6) occupational health and safety issues. In addition to the UMC fire, a number of incidents related to the dumping and discharge of toxic water and discharging were revealed in 1997, significantly increasing public awareness about IT pollution in the Hsinchu region. After newspapers explored the evidence of the polluted water in Ker-ya Creek and the toxic water discharge in Ke-yuan District, local residents began to report more and more pollution cases to the Hsinchu EPA and SIPA. However, according to our interviews, improvements have been marginal.

2-1.1 Coastal Pollution

The Hsin-Chu coastal area is polluted by TBT and other metals, and oysters and spiral shells are heavily affected. The pollution is caused by the 75,000 tons of wastewater discharged from the HSIP. Researchers found that the Ke-yin conches changed their sex after they were in contact with polluted oysters for too long (China Times, 7/21/2000).



Fig. 2-2. Coastal pollution in the Hsinchu region. (China Times, 7/21, 2000)

2-1.2. Water Consumption

The IT industry consumes large amounts of water as a part of product manufacture. According to the China Times, daily water consumption of the Hsinchu region is 3.5 million tons of which 1.1 million tons, 31% of the total, is used by the IT companies in HSIP (China Times, 6/20/2000). Although HSIP reports 65% of the water used by IT companies is currently recycled and reused, they estimate that total water demand will grow to 1.4 million tons in October 2000 (China Times, 8/1/2000).

In order to meet the water demand from both IT companies and the eight hundred thousand people in the Hsinchu region, four dams have been built in Hsinchu County.² The fifth dam, Bou-shan II Dam, will be completed by 2007 and will support 0.19 million tons water daily. Meanwhile, starting from 2001, the recently constructed Long-en Drainage will support 0.1 million tons water during the rainy season.

The construction of dam projects has seriously threatened the regional ecosystem. No well-documented EIA was carried out before the construction projects started. One of the most recent examples is the case of dead fish found in the riverbank of the Ker-ya Creek (Fig. 2-4). Researchers found a new riverbank built in Ker-ya Creek directing water to HSIP. The riverbank is too high for fish to jump up and swim toward the upper stream, providing unfavorable living conditions for many fish and thus yielding high fish mortality rates. According to a survey conducted at the bank area by Professor Tsen and

² They are: Fei-tsei Dam, Shih-man Dam, Bou-shan I Dam, and Yuan-he-shan Dam.

her student Chen during the peak period, 80 fish hit the bank and die per minute (China Times, 07/11/2000).



Fig. 2-3. Dead fish Found at the Ker-ya Creek. Photo taken by Wen-ling Tu.

Professor Tsen claimed that all these dead fish were a rare species in Taiwan. The riverbank fish incident might cause some species to be endangered. Therefore, Prof. Tsen proposed a fund raising plan to collect approximately US\$17,000 to construct a new step low enough for fish to jump up and swim toward the upper stream.

2-1.3 Ground Water Pollution

NGOs claim that toxic water is discharged from the HSIP. According to their investigation, 60,000 tons of toxic water are drained into the toxic treatment plant every day. However, according to the HSIP document, only 20,000 tons of wastewater is treated. Therefore, they suspect that the remaining 40,000 tons are dumped in the watershed and polluted neighboring villages (Interview, July 2000). Evidence of ground water pollution was first reported and identified at a nursery at Poshan Rd. adjacent to the HSIP in 1997. After the local nursery owner had watered his plants with groundwater as he always did, he found numerous white dots dried on the leaves of his plants in 1997. Since then, he has stopped using groundwater to irrigate his plants (Interview, 7/15/2000). SIPA disregarded his report and no improvement has been made since then.

In the same year, heavy water pollution was found in Da-Chi village. The residents said many bamboo plants died and no egrets ever returned (China Times, 9/24/1997). In addition, wastewater and construction soil were dumped in Pao-Shang village. Serious landslide problems and hazards stopped the new development projects. The incident left the residents in the affected areas with huge property losses. One of the major impacts was the effect on drinking water. The drinking water after the incident had a strange odor and sour, spicy taste in the Paoshan village. After the incident, residents of the village were afraid to use the groundwater anymore (Chiu, Common Wealth, May 2000).

2-1. 4 Waste Water Treatment Discharge

Most wastewater is discharged into the drains from semiconductor factories. These drains connect to the irrigation systems for thousands of acres of rice fields (Fig. 2-5). Worse still, their overflow water sometimes serves as drinking water for one quarter of the population in Hsinchu (Chen, 1998). Black and yellow wastewater was found in Ker-ya Creek (China Times, 2/20/1998). In response to the Ker-ya Creek pollution enquiry conducted by a nationwide environmental NGO, “Green Peace Taiwan”, the EPA and SIPA claim that the discharged polluted water constituted illegal dumping (Report from SIPA, 11/3/1997). However, newspapers explored more serious pollution issues surrounding the HSIP; i.e., construction soil dumping and wastewater pollution. Worse still, newspapers revealed that there had been no toxic water treatment plants in the HSIP for the past 16 years (China Times, 10/30/1997).

This report seriously damaged the public image of the global IT companies and the HSIP. In order to express its concerns, the SIPA finally collaborated with the environmental NGOs to investigate the toxic water discharge incident. The environmental NGOs groups included *Hsinchu Anti-Pollution Association*, *Hsinchu Cultural Association*, *Wild Bird Association*, and *Green Peace Taiwan*. During the investigation, the team claimed that 10 out of the total 20 biochemical-treatment plates were out of order. This seriously reduced water filtering function in the toxic water treatment plant (China Times, 11/7/1997).



Fig. 2-4 Toxic water discharge to local agricultural villages through drainages. (China times, 1997/11/1). photo taken by Chen Chuan-hsin

According to our interviews, each company only pays a \$NT45,000 toxic water treatment fee for toxic water produced by four factories. Water flow monitoring systems from wastewater treatment plants have been broken ever since installation. The SIPA also admitted some companies made a mistake by discharging wastewater into other channels.

They claimed that they would improve the wastewater treatment plant and enforce regular investigations (China Times, 10/30/1997).

On the other hand, according to our field survey, there are also serious toxic water discharge problems happening in the inner city high-density area. HSIP toxic water has been discharged through an underground pipe into the Ker-ya Creek at Nan-da Road near the Hsinchu Normal College Faculty Community. Residents complain that they saw black and yellow polluted water with a strong burning-sugarcane smell early in the morning and around midnight, especially during rainy periods. They claim that they have lived in this place for more than 40 years, but they have only seen this phenomenon after the HSIP was established in the early 1980s (Interview, local residents, 7/16/2000). Appendix E is the field survey carried out by us. We observed the site every morning around 5:30 am to 6 am for five days. We found similar evidence as per the residents' description.

2-1.5 *Public Health Crisis*

Pungent smells and polluted water have been evidenced in the Jordan River at the Bible College since 1997 (Fig. 2-6). A sister (teacher) at the Bible College fainted because of the smell. The Department of Health in Hsinchu City did an epidemic test for the students of the Bible College and residents in Kao-fong-li District and Sing-kuan-li District (Interview 7/15/2000, 7/19/2000; China Times, 6/15/2000). Epidemic report: among 255 people in Kao Fong Li, and Sing Kuan Li, 56% show abnormalities in blood tests. 41% show abnormalities in urine tests. Furthermore, records showed complaints of eye problems, asthma, tiredness, headache, chest pain, dizziness, and muscle pain (China Times, 6/15/2000). However, there was no official feedback from SIPA regarding this report during our field work period.



Fig 2-5. A view toward the Jordan River at Bible College. The local NGO leader identifies that the white bubbles are the heavy metal pollutants discharged from HSIP. Photo taken by Shenglin Chang, July 2000.

2-1.6 ‘Occupational Health and Safety’ and ‘Environmental Issues’

Occupational health and safety (OHS) and environmental issues are sensitive issues among HSIP employees. Most employees who are non-OHS and environmental professionals are reluctant to learn about the issues and are unwilling to discuss them, even though these issues are a potential threat. This phenomenon may be explained from the perspective of industrial relations. There are no labor union organizations in the HSIP and there are no attempts by employees to form one. The only labor organizations formed are the welfare committees. The relationship between employers and employees has been cohesive, since employees are also the shareholders of the company. Concerns about protecting a company’s public image are widespread among employees at all levels.

Moreover, work in HSIP IT firms is highly regarded by society for its social and economic rewards. Rapid growth of the IT industry has brought high profit returns to employees through high salaries and stock options. Employees consider IT industry work as higher social status work and is generally preferred by workers due to its clean appearance, in contrast with manufacturing firms in other industries. Our interviews revealed a popular belief that a janitor in TSM can earn as much as US\$33,000 annually.

OHS professionals indicated in interviews that no significant occupation-related health issue have been identified in IC employees' health examination. However HSIP employees do have a major concern about gout, which is a general concern among the Taiwanese population. OHS professionals have different interpretations: some have claimed this to be an occupation related disease, some said this is due to the life style of the high-tech elite; some said this is no different from the rest of Taiwan's population. Whether gout or other diseases are epidemic in the HSIP requires further investigation.

2-2. Company Environmental Management Systems

In order to understand the sources of the IT pollution, it is necessary to examine environmental management systems at both the company and the HSIP levels. We will study the IT company systems in this section and the HSIP system in next section.

Company Code	Industry Type	Number of Employees	Capital (US\$million)	Major Products
IT1	Integrated circuits	3900	930.4	Personal computer and peripheral IC. Memory IC. Consumer IC. Digital Video/Audio IC Foundry Service
IT2	Integrated circuits	5858	2434.99	ULSI and VLSI wafer manufacturing Wafer probing Assembly and testing. Mask production ASIC Manufacturing
IT3	Integrated circuits	2677	2118.44	ULSI wafer manufacturing Turn key service.
IT4	Integrated circuits	1541	451.94	1.0.25 UM 64b DRAM
IT5	Computer peripherals &	3500	1242.34	PC PC notebook Server Multimedia PC ASPC Mother board Consumer electronics.

Table 2-1. Company profile of our interviewees.

In brief, our qualitative data indicate that semiconductor companies are the major pollution sources. However, individual companies might believe their internal pollution

hazard management systems are well operated. The major issue is the overall control of HSIP development. In addition, we are also concerned about the effectiveness of the ISO 14001 certification system. Although all of the companies we interviewed were ISO 14001 certified, they differed with respect to environmental performance. In Section 3, we will address the impact on the community.

2-2.1 Environmental Challenges for IT Companies

High-tech industries are distinguished from traditional industries by their intensity of technology, capital, production value, and labor, as well as the consumption of energy and natural resources. Due to high-tech innovations, short production cycles and under the condition of maximum utilization of the most advanced technologies, high-tech industries create complex by-products and pollutants from production procedures that differ from traditional industries. The challenges high-tech industries face in terms of environmental impact include water pollution, air pollution, wastes handling, toxic chemical-waste handling and energy consumption.

Environmental problems within the scope of the semiconductor industry in Taiwan were not documented properly in the past. There was no environmental dispute involving the Hsinchu Science-based Industrial Park reported in a comprehensive survey of anti-pollution protests between 1980 and 1996 (Hsiao, 1997). Likewise, the issues concerning the human and environmental health effects of the manufacture of semiconductors have rarely been brought to the public's attention.

The high-tech industry has built a clean and non-polluting image that is free from environmental and occupational hazards. However, as we mentioned in the beginning of Section 2-1, the UMC fire hazard that took place in 1997 at United Integrated Circuits, a semiconductor company located in the HSIP, revealed for the first time the safety and environmental concerns about the Taiwanese semiconductor industry (Yang and Lin, 2000), and its significant impact on both property and humankind. The estimated losses amounted to more than NT\$10 billion and it was suspected that the incident released a huge amount of chemicals and toxic materials into the air that are dangerous for humans.

2-2.2 Environmental Risk Embedded in IT Industrial Structure

IT industries face pressing environmental issues not just concerning pollution of the environment and depletion of resources, but also concerning health risk to workers and nearby residents. It is not widely known that the semiconductor industry uses a variety of highly toxic materials in all processes of production from cutting, polishing, dicing and packaging. However, due to the fact that product cycles in IT industries are short, the rapid changes to its production processes and the chemicals used has resulted in a failure to fully understand the potential risks of chemical toxicity before their application.

Interviews of health and safety staff and production engineers in the HSIP revealed suspicions that some of the production procedures were applied before the potential toxic risk was fully understood. Although firms routinely check safety issues with new chemical uses, the sophistication of the chemical formulae makes the potential risks unlikely to be discovered in the short term. Moreover, some of the unknown interactions among those chemical components might go beyond chemical engineers' current knowledge. Being a latecomer to the global semiconductor industry, Taiwan has the

advantage of following countries more advanced in semiconductor production and in health and safety practices to avoid known risks. However, when Taiwanese firms advance their own semiconductor technology and exceed the knowledge of their counterparts in other countries, Taiwanese semiconductor firms' capabilities in handling health and safety issues in newly adopted production processes need to be seriously addressed.

The handling of new production processes involving new formulae of chemical compounds is more complicated in Taiwanese IT industrial firms than in IT firms in other countries. As we explained in Section 1-1, the manufacturing process is divided among firms, from the production process supplier, to factories, to other down-stream production firms; each manufacturing firm possessing partial knowledge of the chemical uses. This knowledge gap was created in applying chemical compounds in different stages of semiconductor production procedures, which is the result of Taiwanese IT firms' unique industrial structure. Therefore, the question of how suppliers to equipment companies and to the semiconductor industry are manufacturing material, also of how manufacturing firms, testing firms, packaging firms and waste management firms are sharing environmental and safety information becomes a critical issue in the management of the knowledge gap in environmental management.³

According to the interview with one company environmental manager, the lack of cooperation and sharing in environmental and safety issues is evidenced by the fact that even within the industrial association, the sharing of environmental and safety information is limited by trade secret concerns. In other words, within the HSIP, a cooperative production network connects semiconductor firms in different stages of production. Designing firms, manufacturing firms, packaging firms, testing firms create economic success in Taiwan but produce environmental and safety challenges in environmental management.

Another environmental management issue that has emerged in the HSIP is that most IT firms in the HSIP depend on contracting waste management companies to handle organic chemical toxic waste. However, there is no effective method that can be applied to monitor the process of how this sub-contracted organic chemical toxic waste is being processed and handled in waste management firms. As we mentioned in Section 1-3, the Shengli incident revealed the loophole of handling organic chemical toxic waste⁴. Shengli was by far one of the very few private companies licensed by the Taiwanese government to handle organic chemical toxic waste. Shengli had contracted with 80% of IC companies (44 companies) in the HSIP. Almost all IC companies contract Shengli to deal with solvent waste. Every IC factory, on average, produces 250 to 300 gallons of solvent waste per day. It is estimated 1,000 tons per month (Liberty Times, 7/9/2000, China Times, 7/20/2000). Shengli's monopoly and IC firms' inability to monitor the toxic waste handling process have created an opportunity for Shengli to skirt rules to handle toxic waste beyond their technical capacity.

³ Top 10 global IC production equipment and material supplier companies are Applied Materials, Tokyo Electron LTD, Nikon, Canon, Lam Research, Varian, Screen Mfg. Co., Silicon Valley Group, ASM Inc., Hitachi (semiconductor).

⁴ Seng-Li Chemical Company, a licensed treatment firm, transported waste from Eternal Chemical Co. legally but then commissioned others to dump it in Kaoping River. It was uncovered on July 2000.

2-2.3 Supervision of Environmental Management System

In response to the environmental crisis, grassroots protest, and public image concerns, the Taiwanese government established the Supervision of Environmental Management System (SEMS) in January 2000. We will outline the SEMS structure here, but we need further information and longer observation to evaluate outcomes from the SEMS.

The environmental management system for companies in the HSIP involves four entities. First, companies in HSIP's environmental management are subject to the supervision of SIPA's environmental regulations/contracts, specific to HSIP firms, and of the Taiwanese EPA's environmental regulations, general to all industrial firms in Taiwan. In addition to these two government organizations, the Taiwan Science-based Industrial Park Industrial Association has been an important entity in influencing IT company's environmental management practice. All the firms that reside in the HSIP formed this association. Within this association, the Environmental Protection Committee and the Water and Electricity Supply Committee were established to manage the environmental issues and energy resources collectively. They are responsible for education, system support, monitoring, research, communication and negotiation.

Furthermore, a cooperative entity, "Environmental Management Supervision Committee", formed by academic researchers, government agents, business managers, local community leaders and environmental activists, was created to improve HSIP environmental management. Due to the increasing number of HSIP environmental management issues exposed in the past few years, the local environmental NGOs have been pressing HSIP Management Bureau to responsibly supervise IT companies. This resulted in an "Environmental Management Supervision Committee" being organized in 1999, which consists of four environmental experts, three local government agents, one HSIP Management Bureau manager, two local county officers, one local environmental NGO member, and one IT firm manager.⁵ The mission of this committee is to improve supervision over HSIP IT firms' environmental performance.

2-2.4 Environmental Management: Proactive Voluntary vs Passive Regulatory

Recent ecological modernization research done in Taiwan (Yang and Lin 2000) indicated that many companies have begun to invest in cleaner production. The Taiwanese EPA, the IDB and the Industrial Technology Research Institute (ITRI) have been conducting programs to assist companies in establishing environmental management systems, for example like ISO 14001, eco-labeling, eco-efficiency, and life cycle analysis. Amendments were made to the Statute for Encouragement of Investment, tax credits and investment incentives offered to industry for improving pollution control, energy efficiency and conservation, recycling, and waste reduction.

For example, manufacturers would be eligible for a 5 to 20 percent company tax credit for expenditure on environmental protection equipment or energy conservation technology, thus encouraging environmental safety. Many other benefits, such as low-interest loans, are provided for anti-pollution investment plans or construction projects, thus encouraging and enhancing the opportunity for research in the field. An Industrial Pollution Prevention Technology Advisory Task Force was also established by the IDB to assist industries to reduce pollution and minimize waste in the most cost-effective manner.

⁵ Reference from interview with Professor Hwang, Tea-Yuang.

In terms of voluntary environmental management systems, IT companies in the HSIP have been actively and enthusiastically participating, showing a way for improvements in that field. For both economic and industry safety concerns, many of the semiconductor companies in the HSIP are making efforts to address environmental issues. It is estimated that more than 50 percent of the companies in the HSIP have been ISO 14001 certified, including the leading semiconductor companies in Taiwan, United Microelectronics Corporation (UMC), Taiwan Semiconductor Manufacturing Company, and Winbond Electronics. For UMC alone, its investment in pollution control equipment exceeded NT\$50 million in 1999. It was estimated that, through environmental practices and resource conservation, the companies acquired economic benefits of NT\$537 million (UMC, 2000).

It has been noted that HSIP high-tech firms were enthusiastic about the implementation of voluntary environment management system/state-assisted environmental management systems, such as ISO 14001 (Yang and Lin, 2000). However, it was noted that the level of managers involved in these implementations was still not up to the expected standards.⁶ Such projects are mostly initiated and implemented by the 'Environmental, Health and Safety' (EHS) department, and these often lack the participation of higher-level decision makers. In other words, the pretty high rate of use of ISO 14001 does not signify any major commitment to environmental issues when we consider real time practice.

The worst example is that the companies involved in the Shengli toxic waste disasters were ISO 14001-certified companies. Most environmental management strategies in HSIP high-tech firms are considered marginal issues in the companies' strategic business planning. Secondly, the EHS professions are the main force behind the environmental and safety issues in high-tech firms. Thirdly, large firms in the HSIP are paying more attention to environmental management and being more proactive in implementing environmental management systems than smaller firms. Fourth, the need to establish a shared information network among high-tech firms regarding environmental and safety issues is to be highlighted globally.

2-3. The Shengli Toxic Dumping Incident

For Taiwanese society, the Shengli Toxic Dumping Incident (Shengli Incident) is the single most dramatic waste disaster that has happened on this island in the past decades. The dumped toxic waste polluted two major water systems (Fig. 2-7). The highly polluted river in southern Taiwan is the reservoir for the second largest city in Taiwan⁷. For the IT companies, the incident was the most dramatic situation they have faced since first operating in the HSIP. They have difficulty finding storage places for their chemical waste. Worse still, the metal containers used for storing chemical waste are in seriously short supply. For the local governments and local communities, the incident creates a new opportunity for negotiations with SIPA and IT companies for better environmental

⁶ The usage of 'state-assisted environmental management systems' is adopted from Yang and Lin's research on Taiwan's ecological modernization efforts (Yang and Lin 2000, page 16)

⁷ Trichloroethylene was found on the riverbed of Tungkung River. The dumpsite was around 0.2 hectares in size and about 2 kilometers away from a drinking water station. It was also detected in drinking water in Kaoshung by Kaoshung Medical School, but Water Company and local environmental bureau claims this is unlikely. (Mingsheng, 2000/7/21) Residents in Kaoshung claimed that the water was tasted only 2 days ago, but we received the news and know the water was polluted by toxic solvent from the newspaper 2 days later (China Times, 2000/7/21).

protection systems. However, we do not have solid evidence to demonstrate any improvements after the incident.

What is the incident? Why is it so critical? The story was uncovered on the July 18. Kaoping River was found to contain illegally dumped toxic waste. More toxic dumps were found in several creeks in northern, central and southern Taiwan (China Times, 7/18/2000). The Shengli Chemical Company transported waste from Eternal Chemical Co. legally, but then commissioned others to dump it in Kaoping River. Shengli got the license for toxic waste treatment in 1996, and was also approved by ISO 14001. Due to the illegal dumping, EPA decided to cancel Shengli's license. 52,000 tons of toxic solvent and 78,000 tons of non-toxic solvent are produced a year. Shengli handled 20% of solvent produced, which included the waste from 84 companies.

The real issue for the SIPA and IT companies is thus that Shengli was by far the largest one of only five companies licensed by the Taiwanese government to handle organic chemical toxic waste. Shengli had contracted with 80% of IC companies (84 companies) in the HSIP⁸. Almost all IT companies contract Shengli to deal with solvent waste. Every IT factory, on average, produces 250 to 300 gallons of solvent waste per day. It is estimated 1,000 tons per month (Liberty Times, 7/19/2000, China Times, 7/20/2000). As we mentioned in Section 1-3 and earlier in this section, the Shengli incident revealed the loophole of handling organic chemical toxic waste. Sheng-Li's monopoly and IT firms' inability to monitor the toxic waste handling process have created an opportunity for Sheng-Li to skirt rules to handle toxic waste beyond their technical capacity.

In order to resolve the waste disaster, the Cabinet conducted a study and finalized a report. According to the report presented on August 17, 2000 (Taiwan News, 8/17/2000):

- 1) Taiwan's waste treatment capacity is too low to deal with the amount of poisonous industrial waste produced. The long-term failure of environmental protection and industry regulation bodies to solve this problem has led to widespread illegal dumping of waste.
- 2) Companies were able to skirt rules because environmental protection agencies at local levels do not make realistic assessments of what types of waste are actually being produced and in what quantities.
- 3) The Environmental Protection Administration is monitoring the system for controlling and measuring poisonous waste treatment and described it as inadequate. The EPA's supervisory team in southern Taiwan was also indirectly linked because of its monitoring of investigations by local environmental protection agencies that was not able to get to shortcomings.
- 4) According to a criminal investigation launched following the pollution of the Kaoping River, Shengli Chemical Company, a licensed treatment firm, transported waste

⁸ All semiconductor companies in Taiwan produce more than 1,000 tons of waste solvent (China Times 2000/7/19). The HSIP is producing 70,000 tons of wastewater and 700,000 tons of silt waste per day. The management bureau will assist semiconductor industries to deal with the waste by building the silt incinerator for recycling and power generation (Liberty Times, 2000/7/19).

from Eternal Chemical Co. legally but then commissioned others to dump it. Environmental Protection bodies at all levels should have been able to prevent this.

5) The Water Conservation Agency, part of the Ministry of Economic Affairs, was also blamed for carrying out insufficient river inspections.

Meanwhile, different measurements and numbers were reported by different government agencies. As the major supervising agency of toxic waste disposal, the Industrial Bureau reported that current industrial waste (general) is 16,740,000 tons, and toxic waste is about 1,470,000 tons. Nevertheless, the SIPA admitted that there was a lack of toxic waste treatment and all toxic wastes were contracted out to private businesses. The loopholes of toxic waste management are:

- 1) Toxic waste treatment reporting is a paper-work process. Government agencies seldom supervise and monitor the reports.
- 2) The supervising responsibilities among government agencies are not clear, i.e., the EPA, the local EPA, the Industrial Bureau, and the SIPA. Interestingly enough, the responsible agency now is the Industrial Bureau. Therefore, the local EPA seldom track the waste treatment situations (Mingsheng, 7/21/2000)!
- 3) The environmental agencies did not actively examine the treatment. The subcontracting system has created the loophole. Typically, it is the licensed company which signs the contract with toxic waste producers, but then sub-contracts to non-licensed companies. The market price for toxic waste treatment is NT\$400 to NT\$500 a ton, but Shengli offers NT\$140 per ton (China Times, 7/19/2000).

2-4. HSIP Environmental Management System

The Shengli Incident revealed the intertwined problems among all the IT companies, government agencies and environmental laws. In this section, we take a close look at the shortcomings of the HSIP environmental management systems. We conclude that the main problems are generated by the Development Permit System and the lack of Total Capacity Control.

2-4.1 Problems in the Development Permit System

In accordance with the law, (Table 2-2), environmental permits in the HSIP are issued by environmental bureaus of local governments. However, Shengli's permit showed the shortcomings of this regulation. In reality, the data about total amount of industrial waste production and its treatment has not been collected. The sharing of information between central and local environmental agencies, or among local environmental agencies, is very limited. Furthermore, the total contract amount of waste treatment is not monitored if the contract amount is beyond the capacity of waste treatment companies in handling industrial waste. As a result, even though the environmental permit is controlled by the local environmental agencies, there is no guarantee that industrial waste will be properly treated.

2-4.2 Problems in Total Capacity Control

According to the HSIP Investment Guideline, the overall impact assessment by the HSIP Management Bureau only includes the size of land for development, electric voltage, water use, and wastewater discharge. This only relates to the land use, water supply, power supply, and total amount of wastewater treatment in the HSIP. The total amount of toxic and non-toxic waste, the assessment of capacity of Ker-Ya Creek, and public infrastructure and services (e.g., transportation and education) are not included in the management and services of the HSIP Management Bureau. Therefore, the control of total amount of waste release and its impact is not in the item of assessment for issuing permits. However, these are the most apparent and difficult tasks for the HSIP in facing overall environmental impacts.

Process	Exam Item	Legal Base	Response Agency
Application	HSIP Pollution Prevention Plan	HSIP Pollution Prevention Exam Guideline	SIPA
Construction and Operation	Water Pollution	Water Pollution Prevention Act. (13)	Local EPA
	Clean Industrial Waste Plan	Clean & Store Industrial Waste: Method and Facility Standard (4)	Local EPA
	AirPollution	Air Pollution Prevention Act (14)	Local EPA
	Environmental Impact Report	Environmental Impact Assessment (6)	EPA
	Pollution Prevention Exam	HSIP Management Guideline (7)	SIPA

Table 2-2: Permit issue in the HSIP, legal base and responsible agency

2-4.3 HSIP Wastewater Treatment

The HSIP wastewater treatment plant was constructed after January 2000 and cost nearly US\$1 billion. The facility handles 120,000 tons of wastewater with an estimated environmental treatment facility investment about \$0.2 billion, around 2% of total capital of semiconductor and optic electronic industries (30 companies in 1997).⁹ According to the Water Pollution Prevention Act, companies would be requested to stop operation if they caused heavy pollution (China Times, 2/22/1998). Table 2-3 and Table 2-4 show the timing and subject of water quality investigations.

⁹ HSIP Management Bureau, *HSIP Environmental Report*, 1997/12/5

Examining Time	Context
License Issue	Exam waste water and rain water drain pipes
Start Operation Exam	Exam water quality and pre waste water treatment facility
Monthly Sample Collection	Exam water quality of waste water discharge drain pipe

Table 2-3: Schedule and context for water quality examination¹⁰

Item Exam for Water Pollution in the HSIP
BOD, COD, SS, Benzene, Silver, Arsenide, Cadmium, Copper, Iron, Mercury, Nickel, Lead, Zinc, Organic Mercury, Chromium, Manganese, Cyanogens, Urine, Borax, Sulfide

Table 2-4: Water pollutant exam item¹¹

(3) Chemicals used in manufacturing process in HSIP:

Operation		Chemical use
Cleaning	particle	NH ₄ OH/H ₂ O ₂ / H ₂ O
	Metal impure	H ₂ SO ₄ /H ₂ O ₂ , HCl/H ₂ O ₂ /H ₂ O, NO ₃ /HF/H ₂ O
	organic	H ₂ SO ₄ /H ₂ O ₂ , NH ₄ OH/H ₂ O ₂ /H ₂ O
		HF/H ₂ O, HF/NH ₄ F/H ₂ O
Micrometer		IPA
	Exposure	Photo resister (g-line, I-line, Deep UV photo resistance)
Etching	Develop	Developer
	SiO ₂	HF ₁ HF/NH ₄ N (BHF)
	Si,	HF/HNO ₃ /CH ₃ COO H
	Si ₃ N ₄	H ₃ PO ₄
	Al	H ₃ PO ₄ /HNO ₃ / CH ₃ COOH
	Dielectric Precursor	TEOS, TMPI, TMB, TMDC, TAETD, TDEAT, TDMAT
	Metal Precursor	Cu, Al, Ti Precursor
	Dielectric Film	SiO ₂ slurry, PU Pad, carrier film
	Metal film	Al ₂ O ₃ slurry, PU Pad, carrier film

Table 2-5. Chemicals used in manufacturing process in HSIP

Source: Industrial Research Institute IT IS project (1995), copy from *Silicon Gold Island-2010*

¹⁰ HSIP Management Bureau, *HSIP Environmental Report*, 1997/12/5, p.2

¹¹ HSIP Management Bureau, *HSIP Environmental Report*, 1997/12/5, p.3

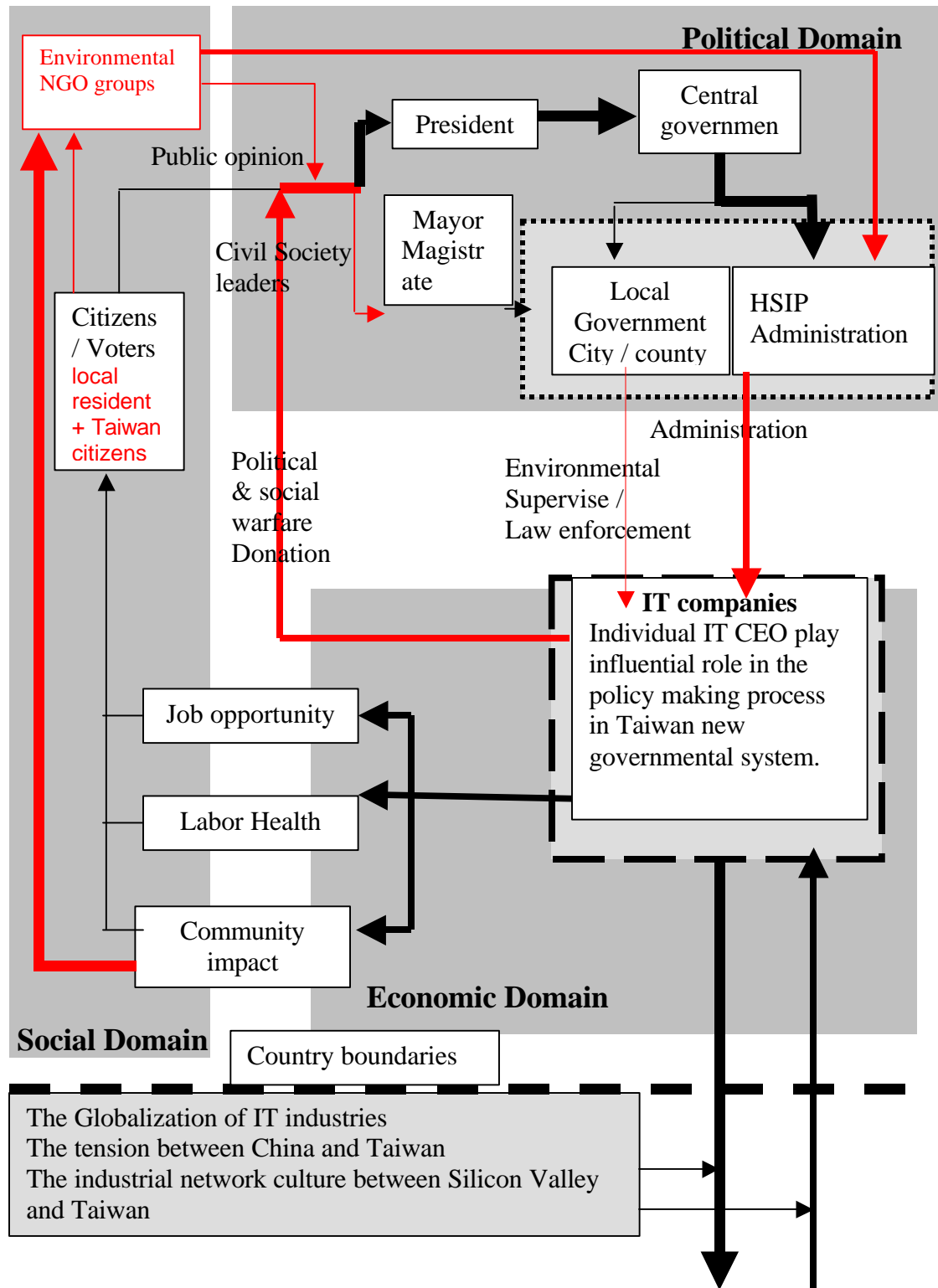
3. Socio-Community Impact of IT Industry in the Hsinchu region

IT industries have been the economic driving forces in Taiwan since the early 1990s. The economic forces created by the IT industry have not only generating widespread environmental impacts. They have deeply intertwined with social and political forces and had broad impacts on local communities as well as Taiwanese society. This section examines social impacts of the IT industry on Taiwanese communities. Figure 3–1 illustrates the social, political and economic context of IT companies in Taiwanese society.

Section 3–1 sketches the socio-political context of the IT industries in Hsinchu and Taiwan. The political domain encompasses the role of global production networks in rule-making processes in Taiwan; the relationship between Taiwan and China, and local government autonomy. The social domain focuses on the transformation of local environmental NGOs and examines (1) the relationship between the new Taiwanese government and local environmental NGOs, and (2) the decline of environmental protest and the emergence of alternative lawsuit strategies.

Section 3–2 examines social impacts of IT growth on the Hsinchu local communities and the economic impact on Taiwanese society and examines the decreasing quality of life in local communities; the booming real estate development in surrounding suburbs; and the emerging IT class in Taiwanese society.

Fig. 3-1 The social, political and economic relationships among the IT industry, NGOs and governmental agencies in Taiwan



3–1. The Socio-Political Context of IT companies in Taiwan

The advent of IT industries had a remarkable impact on structural transformations in the global economy. Strong performance in the global economy has affected power relationships among global IT cooperatives and different levels of governments in domestic social and political domains. The most significant impact in Taiwan is that the role of the Hsinchu local governments has been disregarded and excluded in most policy-making processes related to science park developments. Instead, the Taiwan-based global IT cooperatives, Taiwan home team (i.e., UMC, TSMC, PCS, Windbond, etc.), and the Taiwan government have formulated intimate but delicate partnerships. The phenomena create many limitations for local governments, but lead to some opportunities for global NGOs. We analyze them based on our interviews, news clips and information from insiders.

3-1.1 Political Domain: Global Production Networks, China-Taiwan, and Local Autonomy

Economic and technological developments have given rise to transnational IT networks. The globalization of production networks has influenced the character and scope of government regulation and law-making. In the case of Taiwan, as we mentioned in Section 1–2, the ruling laws, *Science-based Industrial Park policy and SIP Investigation Acts*, were prepared for Taiwanese IT companies to increase their compatibility in the global market and to attract global IT cooperatives to invest in the HSIP. Therefore, enforcement of the environmental protection system has proven to be a problem for local government. However, the IT Taiwan home team is concerned with its cooperative image and public relationships globally. It might thus open a door for international pressure, especially from Silicon Valley, to enhance the enforcement of environmental law.

Due to the threat from the One-China Policy instigated by the Chinese government, the Taiwanese government established censorious regulations that forbid Taiwanese home-based leading IT companies, i.e., TSMC, UMC, and Powerchip, to conduct or exchange R&D with China. However, the successful development of the IT industry needs the support of a global based technological environment and labor market. The growing demands and global competition for the market in China are also prime concerns for the leading Taiwanese IT companies. Driven by lower cost of manufacturing, many IT companies in the computers and peripherals sector have already moved their production lines to the industrial parks in coastal China, especially Shenjiun, Shanghai, and Shouchou.

On the other hand, companies in the semiconductor sector have still been restricted to transferring their investment, production lines and R&D to China. From the government point of view, the semiconductor IT industries are the economic foundation for Taiwan. More importantly, the unemployment rate has increased since the 2000 Presidential election. The new Taiwanese government proposed the Green Silicon Island Policy as a guideline of new economy development. This dialectic situation is converted into political and economic bargaining power for Taiwan-based IT companies. In order to prevent the semiconductor IT companies relocating to China, the new Taiwanese government has to create more incentives for leading companies. During the bargaining

processes, issues relating to environmental quality, public health, occupational health and safety are likely to be strategically sacrificed.

The SIP policy separates the SIP Administration (SIPA) and the local Hsinchu governments. The lack of negotiation mechanism between SIPA and local governments has created serious political issues regarding local autonomy. From local government's point of view, the most critical one is that the sales profit tax was handled by central government leaving the socio-environmental problems to the powerless local governments.

As we mentioned in Section 1–2, the SIPA committee reviews the IT applications. The administrative staffs of the SIPA determine the development permits and other applications for the IT companies. Local governments do not participate in any of these procedures. In the past two decades, the rapid HSIP development has resulted in an increase in the urban growth rate of both the city as well as the county governments. The local governments neither had a role in forecasting or managing the investment of the public facility, nor had the budget to upgrade the infrastructure in supporting the HSIP development. Meanwhile the SIPA did not have any mechanisms to evaluate the effect of HSIP's rapid development impacts on the local communities in the past two decades.

The HSIP Policy has been functioning as a glass wall separating IT Companies and local communities. The law not only provides the IT companies with an efficient investment process, but also protects them from the environmental censorship of the local governments and environmental NGOs. Two important aspects should be addressed. First, our interviews reveal the fact that the IT staffs in the environment & health departments of the IT companies only consider that the SIPA has the censorship of their toxic waste management. Any environmental law enforcement from the local governments incur the political commission that the local governments request from the high-profit IT companies. The China Times in May 15, 2000, states that, according to the EPA, the Hsinchu Municipal has no right to supervise IT companies within the HSIP.¹

Second, in terms of infrastructure, the HSIP Center for Toxic Water Treatment collects wastewater from all IT companies inside the HSIP, leaving the local environmental NGOs with no right to investigate the wastewater generated by each individual IT company. Only SIPA can renew and manage the toxic water treatment center. This tightens the rope, making it hard for the environmental NGOs to identify IT companies responsible for the illegal discharge of toxic water into the wastewater center. With the above prevailing authorities, NGOs can only investigate the HSIP center as a whole, targeting the HSIP for their protests. Although the EPA of the Hsinchu Municipality has the censorship of individual IT companies, they do not have enough staff for all. The Hsinchu EPA has released water quality data of the Ker-ya Creek in their website <http://www.hcceptb.gov.tw/>. However, the official web sites still do not provide public access to the information regarding the wastewater disposal of the individual IT companies. Although the HSIP website has published wastewater data since August, it has never been accessible to the public.

¹ “UMC is located in HSIP and under the jurisdiction of the HSIP Law...According to the HSIP Law, EIA reviews only apply to a new Fab development project covers an area larger than five hectares. Therefore, the UMC's Fab-8 project should not go through the EIA process. Although, the UMC's Fab-8 case conflicts with the EIA Law established by the EPA, UMC should be protected by the HSIP Law.”

3-1.2 The New Taiwan Government and Local Environmental NGOs

In July 2000, a new government came to power in Taiwan, the DDP. In the wake of the elections, a number of political transformations have decreased the power base of environmental NGOs. Social pressure groups that have long-term alignments with the DDP and drove social reform are alienated from the DDP since the DDP straddles both local and central government and gradually follows the mainstream attitude of society. Especially after the DDP dismantled central political rights in 2000, some people even suggested, "The DDP has already come to power, we don't need social pressure!"

In the reorganization of the central clan of the DDP, Chain-hsin Coa, the only legislator with relevant expertise and who was reappointed for eight years, was assigned financial administrator of the central clan. As the financial administrator is responsible for the money matters, the objective must be high-tech industries. This appointment is an obvious indicator of the political-economic relationship between the DDP and high-tech industries in the future.

Traditional environmental protests cannot monitor IT pollution. The decrease of local activists in the anti-HSIP toxic water movement is the critical issue. Among the environmental activists of the anti-HSIP toxic water movement, five of them represent the movement transformations in the past years: C1, R1, N2, N3, and N4. Having been a radical environmental activist for years, N4 declares, "now, I take the environmental IT wars as my hobby. I do it in my leisure time."

First, C1, the ex-block Chief of Chin-Shan-Mian District could not succeed in his second run in 1998.² He has been the one of the most radical leaders of the anti-HSIP toxic water movement since 1997. He also operates the Chin-shan-min local cultural community studio. He recalled that the 1998 block leader election was a very confrontational one. The HSIP and the ruling party, KMT, mobilized other candidates to divide his power base and he lost the game. He also tried to run for the city council, but failed again. Without any elected title, he could not represent local communities for accessing government resources and joining the negotiation processes among the HSIP, the local and central governments. Currently, he manages his family rice shop business.

Second, R1 is a reporter for the China Times. He has won one of the most important journalism awards in Taiwan. His series of articles first revealed the HSIP toxic water incident in 1997 and shocked Taiwanese society. It indeed provoked great tension between the IT companies and the China Times. All IT companies boycotted the China Times by banning advertisements for one month. They did not stop Mr. Wu's activist approach. Mr. Chen first published the epidemiological survey that we mentioned in Section 2, on June 15, 2000. This time, Mr. Chen was forced to transfer from the HSIP section to the Hsinchu government section. Similar to Mr. Wu, Mr. Chen also tried the city council election and failed.

² Chin-shan-min District is the location of the HSIP. In order to build HSIP, the local Ha-ka communities had been relocated to the area out side the HSIP zone. C1 always claims that the Chin-shan-min communities sacrificed all the quality of life to support the HSIP development. However, what the Chin-shan-min residents received from the HSIP is nothing but pollution.

Third, N2, teaching in the Ching-hwa University, is the founder of the Anti-environmental Pollution Association (AEPA).³ He carries the legendary glamour of being the leader of the Lee-chang-ron Chemistry Incident since 1986. Instead of playing the watch dog for local communities, he decided to establish the partnership with the HSIP. He points out that, without the collaboration of the SIPA, it would be impossible for local environmental NGOs to monitor the IT companies. As we explained in Section 2, all the IT companies discharged their toxic water into the HSIP treatment plant. Only SIPA staff can access individual companies. Therefore, he initiated the Supervision of Environment Management System that we address in Section 2. He is also a member of the Environmental Management Supervision Committee (EMSC). In addition, he is currently elected to the national assembly of commissaries.

Fourth, N3(P1), a former Congresswoman, currently served as the Principal of the AEPA. She states that lack of resources is the main problem for the local environmental NGOs. More importantly, local NGOs cannot get environmental technical support for professional anatomizations for the pollution of the ecosystem. She argued that most Hsinchu residents, as the general public, are also workers in the HSIP and running businesses related to the HSIP operation. There is a love-hate relationship between the general public and the HSIP. Although the decline of the quality of life upsets the public, they still will not support radical movements. In addition, she points out that press releases and media coverage can only raise public awareness, but not improve environmental quality. She has decided to join the EMSC.

Finally, N4, Administrator of Hsinchu Culture and Education Foundation, operates a high-tech company himself. He is also an ex-administrator in the AEPA. He modulated his attitude on environmental issues as a leisure activity. He emphasizes the public accessibility of toxic water treatment. He intends to develop a website that releases data collected by the public. Meanwhile, he is developing alternative lawsuit strategies aimed at the IT industry and the HSIP. In summary, the stories of these selected environmentalists in local communities imply a lack of ability to mobilize resources and a failure to adequately contest their counterparts. They are struggling to adapt to challenge the sustainability of the IT industry in the context of the new global new economy. It is the critical moment for the international NGOs to network with them. We will address some possibilities in our conclusion. Next, we will introduce the alternative lawsuit strategies.

3-1.3 *The Alternative Lawsuit Strategies*

Filing lawsuits and monitoring law-enforcement agencies are alternative ways for environmental NGOs to press for better environmental performance in the HSIP and beyond. Based on our interviews, the idea of enforcing international environmental laws is a very important step for local NGOs.

Inspired by N4, the environmental NGOs in the Hsinchu are gradually transforming their radical approach into moderate lawsuit-filing strategies. They file environmental lawsuits or monitor environmental protection laws to supervise IT companies and SIPA. According to our interviews, prosecution is an affordable and effective option for resource-poor local NGOs, because the defendants (mostly governments) need to reply

³ AEPA is a NGO with more than one hundred members. Most members are professionals and academic people.

via official document. Therefore, the process will be recorded, and defendants will handle the processes with great care. There are distinct procedures for environmental NGOs to follow. According to our interviews, local NGOs filed a lawsuit against the local government in the waste soil dumping incident that occurred in the Tao-chin Riverbank in 1998. Local NGOs claim that they successfully compelled the local government to improve the situation.

To sum up, local NGOs have undergone a transformation and filing lawsuits is their new strategy. Although we do not have enough cases to evaluate the effectiveness of the method, we believe the new method has opened up possibilities for international environmental law and NGOs to supervise the local environmental impact of global IT cooperatives.

3–2. Community Impacts in the Hsinchu region and Taiwan Society

After reviewing the socio-political impact of the IT industries, we will now analyze the socio-economic impacts on the Hsinchu local communities and Taiwanese society in this section. Among various impacts, we emphasize three phenomena: (1) the declining quality of life in local communities; (2) the booming real estate development in surrounding suburbs; (3) the emerging IT class in Taiwanese society.

3-2.1 *The Impact on Quality of Life in Community Level*

The rapid development of IT industries has created tremendous job opportunities for the local Hsinchu region, while it has seriously decreased the quality of community life. Three issues are considered critical: traffic and transportation problems, lack of public schools, and the issue of dumping toxic waste in local villages.

(i) Traffic and Transportation (*Appendix H*)

Similar to Silicon Valley, traffic jams are the single worst nightmare in everyone's daily life in the Hsinchu region. According to our interviews and field survey, it might take one hour to exit the highway and drive into the HSIP during peak time. Appendix G illustrates traffic flow during peak hours. Traffic speed on many major roads is lower than 12 to 18 miles per hour. The poor quality of road service in the Hsinchu region has given the region its island-wide infamous reputation.



Fig. 3-2. Traffic congestion and the high demand for parking space. (Location: Hsinchu City. Photo by Shenglin Chang) (Chang, 2000, 175)

(ii) Public Schools

The lack of public schools is another problem for local residents caused by the IT proliferation phenomenon. At the end of 1999, there were 82,778 IT employees working in the HSIP. Although it is estimated that one quarter of the personnel are local population, there are still large numbers of new comers who have moved into this area within the past decade. These new comers are mostly young couples with elementary-age children. Their in-flow into the Hsinchu region, especially the communities adjacent to the HSIP, creates unexpected educational problems for local governments.

Three major issues should be addressed. First, the IT families tend to move into a few newly-constructed communities, rapidly creating the need for facilities and teachers in certain school districts. Second, as these children from IT families are mostly of the same age group, it creates uneven development problems for school administration and management, because the students from IT families cluster in one or two grades. Schools have to extend the classes in those grades. However, there are few students in other grades. This leads to administration problems for schools. Third, as we mentioned in Section 1–2, there are very good bilingual experimental schools, from kindergarten to senior high, inside the HSIP. All the IT families living in the HSIP are by default in this school district. This creates a huge gap between local residents and IT families who live in the HSIP. Most local residents are upset that their children do not have a better chance of getting into the prestigious HSIP experimental school system, and at the same time they have to endure the lower quality of life created by the HSIP.

(iii) Dumping Toxic waste to Local Villages: the Cases of Boushan Township and Da-chi Village

As we explained in Section 2, toxic water discharge is a serious problem for the neighboring villages of the HSIP. Local NGOs claimed that toxic water was discharged from the HSIP. According to their investigations, 60,000 tons of toxic water were drained into the toxic treatment plant every day. However, according to the HSIP recorder, only 20,000 tons of wastewater was treated. Therefore, they suspected that the remaining

40,000 tons were dumped into the water system and polluted neighborhood villages (Interview, July 2000). The Boushan Township and Da-chi Village cases became known in 1997. Heavy water pollution was found in Da-Chi village. The residents said many bamboo plants died and no egrets ever returned (China Times, 9/24/1997). In addition, wastewater and construction soil were dumped in Pao-Shang village. Serious landslide problems and hazards stopped the new development projects. In addition, toxic water pollution discharged into agricultural drainage has caused a farmer's leg to fester (China Times, 11/1/1997). Local governments investigated both cases. However, no official report has been released after the investigations.

3-2.2 Real Estate Development

According to Chang's research, since 1990, more than two-dozen quasi-American subdivisions in the surrounding area of the HSIP have been proposed (Chang, 2000, 78–79). Half of the proposals have already passed government review; others are in the process. According to the Taiwanese central and local governments' annual reports,⁴ over 700 ha. of land will be developed (Leu 1997; Yang 1998). More striking were the number of houses to be built.⁵ The reports predict that by the beginning of the next century, more than fifty thousands quasi-American suburban houses would stand on the hillside of the Hsinchu region to welcome the arrival of the information age in Taiwan. In Fig. 3-4, all the black dots are the built and proposed new development projects that happened from 1993 to 1998.

Since the early 1990s, developers proposed and marketed two types of residential projects. Driven by high-tech companies, one transplants American suburban images (Fig. 3-5). Driven by real estate developers it's easy to see that high-tech companies or personal huge donate can help high-tech industries get good social impresses, the other modifies a Taiwanese skyward house into a quasi-American suburban image. While the former introduces the symbolic forms of home environments in exclusive enclaves, the latter dominates the quantity of local housing market. Together, they superimpose the image of suburban Silicon Valley to the hillsides surrounding HSIP.

(ii) Mega-scale New Development Proposals and Urban Renewal Projects

As we saw in previous sections, local government has been a lack of authority on the HSIP development since the start of its construction in 1979. Currently, both the Hsinchu city and county municipalities are trying alternative ways to secure development authority. Two strategies were undertaken in 2000.

First, the Hsinchu County Municipality tried to establish partnerships with major national universities. National Taiwan University is planning to set up a branch in Hsinchu. The proposed area is about 100 acres. Taipei Technology University also proposed to establish its 74-acre second campus in Hsinchu County. Universities and governments

⁴ 1996 Annual Report, the Ministry of Interior; 1993 Annual Report, the Housing Authority of Provincial Government (Leu 1997, Yang 1998).

⁵ My field interviews revealed that some of the initiative developers had financial crises and end up going bankrupt. Those projects may be sold and transformed to other investors hoping to make a profit. However, these second investors may declare bankruptcy and sell the projects to get a third agent. The process can go on and on and certain developments may end up not being built at all.

expect to develop a Silicon Valley community model (China Times, 7/21/2000). Meanwhile, Hsinchu County Municipality

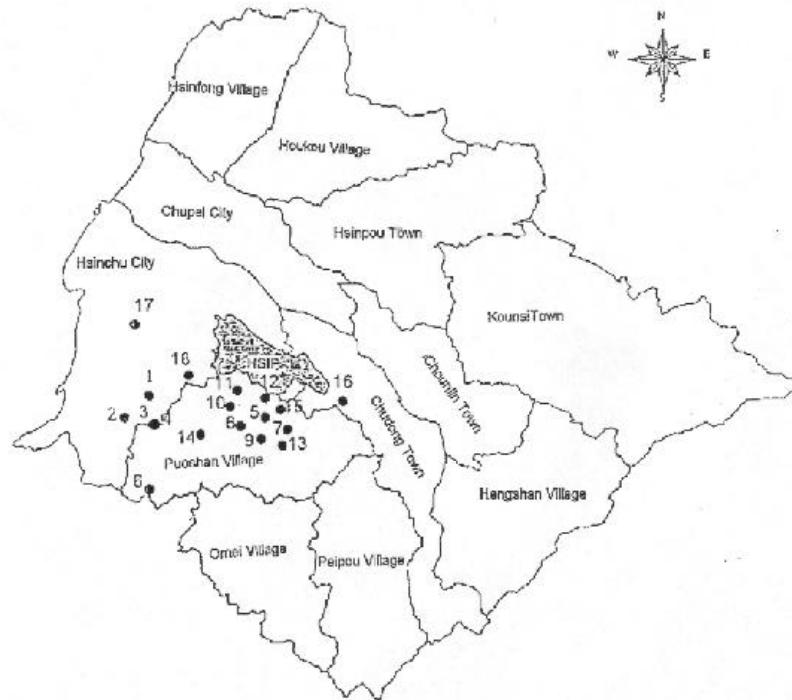


Fig. 3-3. The geographical scope of the Hsinchu region. The black dots represent the new suburban developments around the HSIP/Park, from 1990 to 1995. Reprinted from C.-s. Leu, *The Debate of Science Park Impact on Local Developments and Taiwan's Evidence*, (Taichong, 1997), p. 76. (Chang, 2000, 112)



Fig. 3-4. Home building: Exterior forms for Windbond Sweet Home project, Hsinchu, Taiwan. Reprinted from Chang-chen International Planning and Construction Consultant Company, *Illustration for Sweet Home Community*, (Taiwan, 1990). (Chang, 2000, 113)

proposed the 3,458-acre Puo-yuh development plan in Chon-lin township. Under this proposal, Chiao-tong University will get 247-acres of free land to extend its campus to Hsinchu County and stimulate high quality housing projects for high-tech engineering families. The projects have just been initiated and are still in the planning stage. We need more data and information for further evaluation.

Secondly, the Hsinchu City Municipality proposed the City/Park partnership to the HSIP and central government. Based on our interview with the Hsinchu Mayor, Deputy Mayor and the Chair of the department of Urban Development, Hsinchu City Municipality has proposed an 800-acre second HSIP plan and a light rail system to solve problems of traffic, crowding, lack of public education facilities, and density. However, according to our interview with the Chief of SIPA, the HSIP Administration Board does not appreciate the planning efforts made by the Municipal government. Instead, HSIP is ignoring all the planning steps local government has taken. Worse still, some land included in the Municipal government's proposal has already been transferred to the National Military Ministry (Interview, July 2000).

More importantly, the Cabinet recently announced the renewed HSIP Law. It gives even more authority to the SIPA and IT companies. The Cabinet claimed that, based on their evaluations, the idea of Park/City partnership might decrease the economic competitiveness of the IT companies in the global market. Therefore, they decided to withdraw their policy support for the future City/Park proposal (China Times, January 4, 2001).

(iii) New Market for Prestigious Housing in Suburban Taipei

As in any other society, Taiwan's IT industries have already created a new prestigious elite with extremely high annual income. In order to attract these prestigious consumers in the housing market, real estate developers have advertised a new product: prestigious single-detached houses in suburban Taipei. The building cost is US\$1,000 per sq. foot on average. All the leading-edge remote control technology is to be applied in the so-called prestige houses. The materials used for construction are security approved. In terms of leisure landscape, there are personal 180-meter golf courses close by.

According to Corcoran's 2000 Report, the price of these prestigious Taipei houses is ranked as the fourth highest in the world. The top three in order are: Tokyo prestige houses (US\$1,333 per sq. foot), Singapore houses (US\$1,240 per sq. foot), and London houses (US\$1,142 per sq. foot).

3-2.3 *The Impact of the Emerging IT Class*

Disregarding the socio-environmental impact of the HSIP, the IT industries have created a great economic opportunity for local people. As mentioned in Section 1-2, there is an average of one person in every 4.2 households of Hsinchu who is a HSIP employee. The statistics show that there are more than two thousand companies that function in support of HSIP development.⁶ They include real estate development companies, environmental waste treatment companies, recreation related companies, office supply companies, nurseries, restaurants, food markets, cleaning companies, etc. In other words, the HSIP has been the driving engine of the economic network in the Hsinchu region.

⁶ Interview John Ke.



Fig. 3-5. The quality of life in the HSIP/Park. The HSIP/Park contains the best living environment and the highest quality of life (by American standard to Taiwanese) in Taiwan. Local Chin-Shan-Mian residents identify it as an American colonial town. (Location: the Bamboo Village, Hsinchu. Photo by Shenglin Chang) (Chang, 2000, 171)



Fig. 3-6. The quality of life outside the HSIP/Park. Outside the American colonized town, Chin-Shan-Mian residents have been relocated in the high-density urban neighborhoods adjacent to the HSIP/Park. Although the HSIP/Park was their community before 1980s, the surrounding wall has divided the place into two worlds. (Location: Hsinchu city. Photo by Shenglin Chang) (Chang, 2000, 171)

More importantly, the young generation considers it a privilege to work in IT companies. The employees, both engineers and operation workers, are stockholders of the companies. Their incomes and the profits of the IT industries are relatively high when compared to other industries. This unique system provides the IT employees not only with the economic incentives to engage in the company's production line, but also creates a partnership between the IT employees and their companies. In this way, as we discussed in Section 2, the welfare and health issues of the IT employees were undermined by the advantage provided by partnership in the companies.

In addition to high income, the HSIP community provides a high quality life style that is comparable to that of an American IT professional. According to Chang, the physical planning of the HSIP is based on the Stanford Research Park in Silicon Valley. The Bamboo Village located in the HSIP creates an American suburban image. Many newly developed gated communities for young IT families emphasize the American quality of life they provide (Chang, 2000).

(i) The emerging IT nobles of Taiwan's civil society

Taiwan's IT industries have developed rapidly in the past decade. The rapid growth of the IT sector has created an elite group, the so-called "IT nobles." They shape the new mainstream values that dominate civil society. More importantly, The CEOs of the Taiwan IT home team play a key role in shaping policy matters. For example, Morris Chang (the CEO of TSMC) and Robert Tsao (the CEO of UMC) are both board members of the Presidential Advisory Committee. The CEOs become opinion leaders in Taiwan's civil society. This leads to the social impact that we have discussed in previous sections.

While the IT companies ignore the environmental and social impacts in the local Hsinchu region, they are actively involved fund raising events at national level. In order to establish positive publicity, these companies prefer to donate to events related to art, religion, and education. For example, TSMC currently donate \$NT50 million for the most important dancing group – Uen-man dancing group. The founder of Si-toan tech and Hua-tai electricity, Gin-ueng Tu, donated \$NT2,800 million to Tzu-chi which is the biggest organization with the most social influence in Taiwan between 1998 and 1999. In terms of education, TSMC donated \$NT150 million to Chin-hua University to set up its Tech-management Department in August 2000.

On the local level, these high-tech industries also support Hsinchu parks and supply fire engines to local government. The press release, "The IT Colonist City: the Sorrow of being Hsinchu Citizens", issued by the Hsinchu Mayor, expresses the deep tension between the IT companies, the HSIP and local residents. During our interviews with government officials, NGOs, and local residents, it was pointed out that IT companies donate money for local activities. For example, Acer adopted a public park in Hsinchu city for \$NT500,000 dollars. They all claim that the major issue is the distribution of the sales tax of the IT companies. From their point of view, even if IT companies donate huge amounts of money for urban development, this cannot guarantee to make good the uneven development. They believe that local governments have to be able to control a certain portion of the development tax from the IT sales tax collected by central government. By doing so, local governments can annually allocate their budget for improving infrastructure, renewing public facilities, and upgrading public service.

(ii) New Target for Social Crime in Taiwan

The development of HSIP in Hsinchu has had some negative effects. For instance, the high quality and roomy living environment inside the HSIP forms a strong contrast with the crowded local communities only a boundary wall away. Therefore Hsinchu citizens call the HSIP a "colonized zone". Some social phenomena recently upset local people and surprised Taiwanese society. While the HSIP has increased the income gap between local society and Hsinchu, citizens also suffer the high price of products and houses; and the IT elite supports erotic commercial redevelopment, such as exotic bars.

In addition, the IT elite living in its high-class communities becomes a new target for kidnappings. A recent kidnapping involving Mr. Chou, kidnap case. one of the most important stockholders of the Ya-shi Electronic Company, shocked the public. He was rescued by police after being kidnapped by a Mr. Tsai and held for more than 20 days. Even more terrifying is the revelation that Mr. Tsai previously worked in Mr. Chou's company.

IV. Policy Recommendations

This report has examined environmental and social impacts of IT industries in the Hsinchu Science-Based Industrial Park in Taiwan. It has revealed that the rapid growth of the IT sector has been accompanied by widespread and toxic pollution of water in the Hsinchu region, including water used in agriculture and in local water supplies. There may also be a significant issue of workplace exposure to toxic chemicals. The report has also found that the substantial economic benefits of rapid IT development have widened the socio-economic gap between high tech workers and the local community and nurtured a high tech elite which lives behind the walls of the HSIP.

Most important, the Report has documented the inadequacy of existing environmental regulation in the HSIP, stemming largely from the insulation of the Park from local environmental authorities. On the other hand, there seems to be a large and growing interest by companies in adopting voluntary measures to improve environmental performance. Environmental NGOs are increasingly moving beyond protest to playing a direct role in monitoring company performance and in pressing for more enforcement of environmental laws in the HSIP via lawsuits.

We conclude this Report with a set of five policy recommendations.

1) Environmental and Labor Laws Should Be Improved and Strengthened

National environmental and industrial safety-related laws are the key to monitoring and improving toxic waste management in the high-tech industry. Laws could be improved and strengthened in the following ways:

(1) Environmental management in the HSIP should include the concept of lifecycle monitoring of high-tech products. Official regulatory bodies should monitor the practices used by waste treatment companies in disposing of waste. The process of waste treatment should be regulated in detail, with the implementation of the life cycle concept of waste management.

(2) New environmental laws, especially regulations related to EIA, should be created or modified from the present ones. The EIA should measure the environmental impacts on the HSIP as a whole based on the overall environmental capacity of the HSIP site, instead of considering individual cases. Furthermore, laws such as the clean water act, which deals with the complexity of environmental quality, should be legislated to enforce environmental protection.

(3) A certain amount of the national government budget should be used exclusively for high-tech pollution management and R & D. The results should be proposed in industrial and environmental policies or mandated in laws in order to improve environmental preservation, protection, and management.

(4) Legal assistance and consulting should be given importance and suggestions should be reflected in environmental affairs and public health. For local NGOs, legal action has become an effective strategy with little cost to monitor and track the HSIP and companies on their performance.

2) Disclosure: Information Should Be Made Available Internationally and Be Easily Accessible to the Public

Given the globalization of IT production, there is an urgent need to share related information on high-tech toxic treatment processes with the global community. Through global information sharing and monitoring, consumer awareness and choice can help to reduce toxic use and exposure. We suggest:

(1) An information disclosure system should be established that could be further incorporated into laws and policies. This will aid high-tech companies to follow the law and make related information accessible to the public in order to gain a good reputation domestically and internationally. It further encourages community involvement and helps public organizations like NGOs, the general public, and the media to keep regular track of high-tech toxic use.

(2) Information disclosure should include labor health and safety issues. This would help clarify when issues of employee health are generic and require a public policy response, rather than remain privatized at an individual level.

(3) The HSIP and Hsinchu City Government Should Work in Partnership

In the current policy separating City from Park, high-tech industries have been insulated from local authorities and report directly to the central government directly through the HSIP Administration. The local Hsinchu government, which is in charge of management and public service of the city, has no authority to interfere in HSIP management. As a result, the needs and concerns of the local community have been ignored, thus creating a communications gap between the inside and the outside of the HSIP in terms of increased quality of life. As Taiwan is continuing its high-tech expansion to more local counties, policies should be reconsidered and modified. Therefore, we suggest:

(1) The role of the local authority (city government) should be strengthened in the management of the HSIP. This will force the high-tech industry to consult with local communities and local government regarding the environment or city planning issues. This would also encourage the high-tech industry to take on social responsibilities along with local bodies in order to provide a sustainable vision for the local environment.

(2) The City/Park partnership should be established and well maintained. Social-spatial programs including social welfare projects and physical planning projects should be developed to reshape the social environment in the Hsinchu region. The partnership could be taken several forms. For example, the HSIP committee board should involve local government in tax systems, land use issues, planning, infrastructure, and other public issues concerning local planning and development. As the saying goes: “*Two heads are better than one, unless one is the best*”. Mutual cooperation between would result in improved public welfare of the local community.

(4) International Expertise On Investigating and Monitoring High-Tech Operational Processes Should Be Shared Globally

Labor, environmental, health and safety issues in the high tech industry are not widely discussed in Taiwan and capture little public attention. Moreover, there is a shortage of

expertise needed to investigate and monitor high-tech operational and manufacturing processes. We suggest the following measures to raise public awareness of the labor and environmental impacts of the high-tech industry and to improve the investigation and monitoring process:

- (1) International experience with investigating and monitoring should be mutually shared with Taiwan in order to stimulate public awareness of high-tech labor health and safety issues.
- (2) High-tech companies should be encouraged to form partnerships with public agencies and NGOs to promote environmental monitoring and investigation. A standardized monitoring and reporting framework would help to promote and verify high-tech environmental management.
- (3) International NGOs, especially California-based NGOs, can play a critical role in pressuring California-based high-tech companies to insist that their contracted OEM adopt a universal environmental standard and environmental monitoring system that would have the data for manufacturing chemicals, solvents, toxics, wastewater discharge, survey of groundwater, and epidemiology.
- (4) International NGO Action Network Should Be Promoted to Help the Transformation of Taiwan's NGOs

Taiwan's NGOs are in transition, influenced by democratization in the past 10 years. NGOs became even weaker when the DPP won several political campaigns and took over positions at both local and central levels, and many environmental activists have now been recruited in to government agencies. On the other hand, local NGOs have little power to raise environmental awareness about the negative impacts caused by high-tech expansion, as the high-tech industry is influential in the economic and political arenas. Evidence was given in Section 2 that anti-high-tech pollution activism has received little local support in political voting and press forums. Besides, a lack of financial and professional resources has weakened the development of local organizations. As NGO advocacy plays an important role in transforming high-tech practice, suggested below are some steps that would support the NGOs:

- (1) Taiwan NGOs should be part of a global corporate advocacy network. The global community could assist in making a progressive change towards clean production and sustainable community. The collaboration of Taiwan civil forces with the international arena, on high-tech production, would be a major landmark, providing enhancements in economic community and environmental sustainable development. The international network should contribute to information sharing, supporting campaigns, and marketing initiatives (such as ISO 14000). If this international corporate accountability campaign does work, the OEM companies in Taiwan would be motivated and take more social responsibility for improving their production processes with regard for environment and labor.
- (2) A comprehensive plan should be developed to further share information about the environmental impact of high-tech expansion that takes into consideration the issues of labor and community health. The best procedures thereby obtained by mutual exchange between global NGOs would help local NGOs to monitor the high-tech operation efficiently. It's then possible for NGOs to make further partnerships with

corporate and public agencies for moving the industry towards environmental and social sustainability.

(5) Social Responsibility: Promote Company–Community Partnership

National economic interests provide the high-tech industry with a unique position in Taiwan's industrial structure. As a result, high-tech leaders, as civil society leaders, can make powerful political impacts on policy making and civil society in Taiwan. Global and civil leadership, on the other hand, require more social responsibility from high-tech corporations. However, high-tech companies in the HSIP rarely get involved in community affairs and make small donations locally compared to the contribution at national level. It is necessary to build up social mechanisms to enhance high-tech company involvement in the community and therefore increase interaction between high-tech companies and local community. Suggestions for partnerships include:

(1) Water system management via public participation could benefit from local public/private partnership. Companies, central agencies, local governments, and citizen groups can work together to develop a database for the watershed of the Ker-ya River.

(2) The eco-NGOs (ecologically-oriented NGOs, i.e., Crab Club or Friends of Calling-tide Crab) can be introduced to recruit high-tech engineer families that would support local environmental improvement. Ecological recreation/education oriented NGOs should be responsible for bringing high-tech people to local natural landscapes and connecting high-tech people with local issues instead of conducting direct anti-pollution meetings. For example the Shang-shan Beach is home for one billion Calling-tide crabs, which may call for public support to preserve the habitat.

(3) High-tech companies should provide more resources to local universities and institutes with environmental engineering and biotechnology departments and encourage them to carry out research in high-tech waste and pollution. The support of local education and research institutes would also build up good relationships with local communities.

(4) High-tech companies can link to local communities by making contributions to local education, conservation, and recreation projects. As high-tech industry absorbs more population, especially young workers, the local elementary schools and recreational areas have been inundated with new comers. Thus, high-tech company support for local education and the environment would benefit not only company employees but also local communities.

Appendix A. HSIP Manhole System

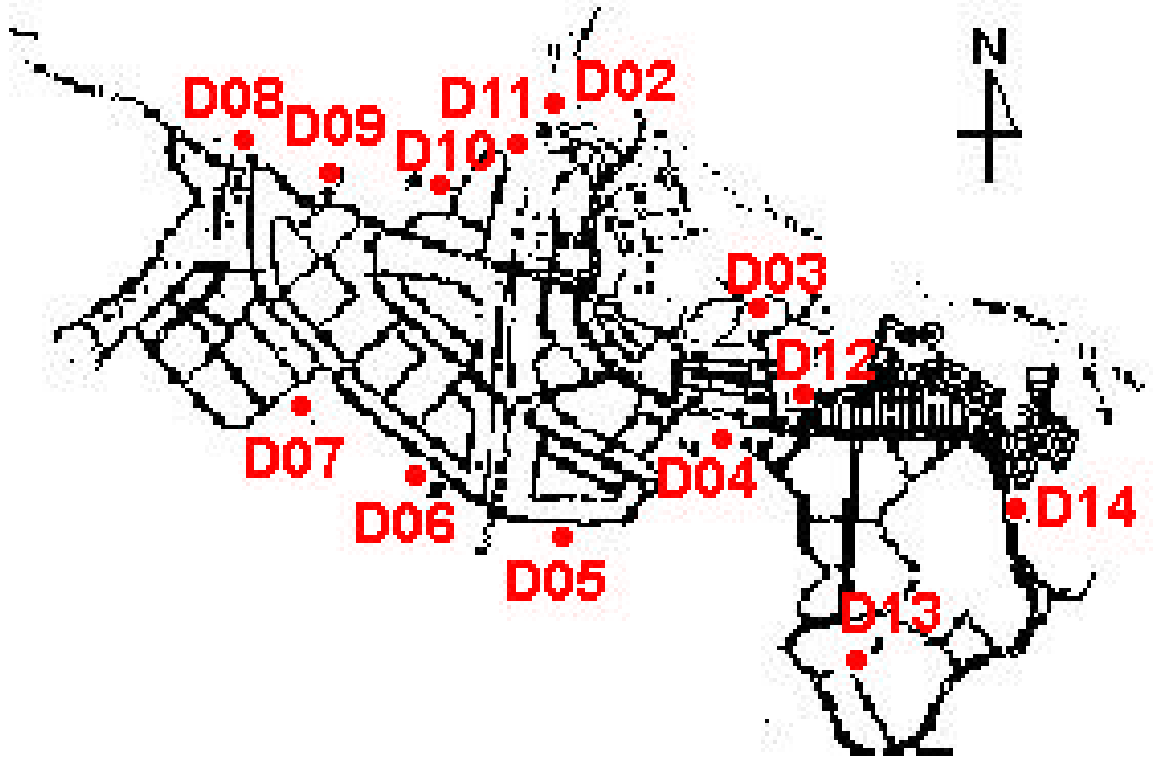
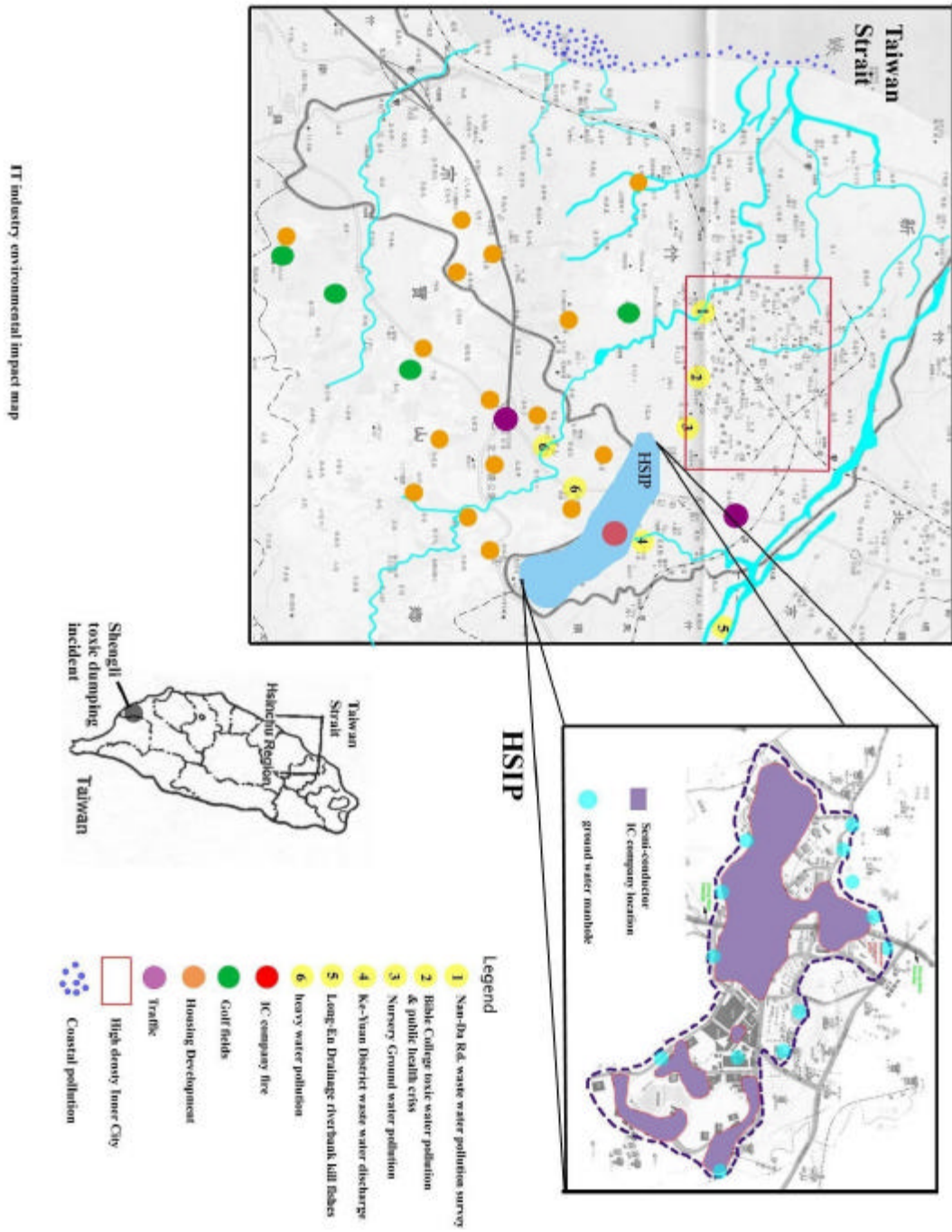


Fig. 3-2. The map for the HSIP manhole system

- D02 – The HSIP Center for Waste Water Treatment
 - D03 – HSIP Lake
 - D04 – HSIP Bilingual Experimental High School
 - D08 & D09 – 2 meter below
 - D09 – the Center for the Radio Lab
 - D10 – University of Jiao-tong
 - D11 – The People’s Computer Co.
 - D12 – The Philips Co.
 - D13 – TSMC Fab-3
 - D14 – the Windbond Fab- 4
 - D05, D06, are D07 under the jurisdiction of the Hsinchu County
- EPA TEL: 080-066666

Appendix B. Map of Hsinchu Region



References

Chang, Shenglin. 2000. Real Life at Virtual Home: The Silicon Landscape Construction in Response to the Transcultural Home Identities. Dissertation. Department of Landscape Architecture and Environmental Planning, University of California, Berkeley, Berkeley.

Chou, Hwa-mei. 2000. Environmental Crisis Seizes the IT Industry's Throat. Common Wealth Magazine. May, 2000. Taipei, Taiwan.

Deng, Hay-ju. 1998. *Legends of Silicon Valley I and II*. 2 vols. Vol. I and II. Taipei, Taiwan: Yuan-shen Press.

Ding-han Consultant Company. 1998. The Hsinchu Comprehensive Plan (the first draft). Taipei, Taiwan: Ding-han Consultant Company.

Global News and Analysis of EMS Developments from Cutter Information Corp. Taiwan Companies Stripped of ISO 14001 after Toxic Scandal. Business and the Environments. Vol. VI, No 11. November 2000.

Hong, Sung Gul 1997, *The Political Economy of Industrial Policy in East Asia: The Semiconductor Industry in Taiwan and South*. UK, Cheltenham: Edward Elgar.

Hsiao, Hsin-huang Michael. 1997. *Local Environmental Protest Movements in Taiwan: 1991-1996*. Taipei Taiwan: Environmental Protection Administration. (in Chinese)

Hsinchu Municipal. Hsinchu Wind. Vol. 9. Hsinchu, Taiwan: Hsinchu Municipal.

Hsu, Jinn-yuh. 1997. A Late-industrial District? Learning Network in the Hsinchu Science-based Industrial Park, Taiwan. Dissertation, Department of Geography, University of California, Berkeley, Berkeley.

Lee, Ding-zan et al. 1997. *Community History of Chin-shan-main*. Hsinchu City, Taiwan: Hsinchu City Culture Center. (in Chinese)

Leu, Ching-song. 1997. The Debate of Science Park Impact on Local Developments and Taiwan's Evidence: A Case Study of Science Base Industrial Park in Shin Chu. Master's Thesis, Graduate Institute of Urban Planning, National Chong-sing University, Taichong. (in Chinese)

Lian, Li-chuan. 2000. Who Wines the Future? The top 100 IT Companies in Taiwan. Common Wealth Magazine. August 2000. Taipei, Taiwan. (in Chinese)

Mazurek, Jan. 1999. *Making Microchips: Policy, Restructuring, and Globalization in the Semiconductor Industry*. Cambridge, MA: MIT Press.

Mathews, John A.; Cho, Dong-Sung. 2000. *Tiger technology : the creation of a semiconductor industry in East Asia*. Cambridge: Cambridge University Press

Mathews, John A. 1995. *High technology industrialization in East Asia : the case of the semiconductor industry in Taiwan and Korea*. Taiwan, Taipei: Chung-Hua Institution for Economic Research.

Ministry of Economic Affairs. 1997. Ministry of Economic Affairs Annual Report. Taipei, Taiwan.

Ministry of Economic Affairs. 1999. Ministry of Economic Affairs Annual Report. Taipei, Taiwan.

Saxenian, Annalee. 1997. Transnational Entrepreneurs and Regional Industrialization: The Silicon Valley-Hsinchu Connection. Paper read at Conference on Social Structure and Social Change: International Perspectives on Business Firms and Economic Life, at Taipei.

Science-based Industrial Park Administration. 1997. HSIP Environmental Report, December 5th, 1997. Hsinchu Taiwan: SIPA.

United Microelectronics Corp. 2000. The EIA Report for the Proposed Fab-8F. UMD

Wang, Chen-feng 1999 " Information Technology Industry". Taipei, Taiwan: Financial Information Publication.

Yang, Li-fang; Lin, Tze-luen. 2000. The State, High-tech Industries, and Environmental Reforms in Taiwan: An Ecological Modernization Perspective. The Sixth Annual Conference of the North American Taiwan Studies Association, June 16-19. Harvard University, Cambridge,

Yang, Yeou-Ren. 1998. Hsinchu to Tainan: The Political Economy of Science Park, New Industry and Local Development. Master's Thesis, Graduate Institute of Building and Planning, National Taiwan University, Taipei.

Field work and News Clips:

Chang, Shenglin et al. 2000. Fieldwork Notes & Interviews in Hsinchu (July – August, 2000). (Unpublished in Chinese)

Chang, Shenglin. 2000. News Clips for the Shengli Toxic Dumping Incident: July to August 2000. (unpublished in Chinese)

Wu, Ching-jie ed. 1997. The Special News Collections for the Chin-shan-main District: September 25th, 1994 to September 14th, 1997. (unpublished in Chinese)

Wu, Ching-jie ed. 1997. The Special News Collections for the HSIP Illegal Discharging Toxic Water Incident: October 29th, 1997 to December 3rd, 1997. (unpublished in Chinese)

Wu, Ching-jie ed. 2000. The Special News Collections for the Ke-tze-lake Creek Environmental Impacts. (unpublished in Chinese)

Web Sites:

<http://www.sipa.gov.tw>

<http://www.epa.gov.tw>

<http://www.hccep.gov.tw>

<http://ibd.management.org.tw>

<http://andywant.chinatimes.com.tw/scripts/chinatimes/iscstext.exe>