Challenges of environmental governance in the face of IT industrial dominance: a study of Hsinchu Science-based Industrial Park in Taiwan

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Abstract: The technology explosion of the 1980s coupled with the economic boom of the 1990s, led to the rapid worldwide expansion of the Information Technology (IT) industry. In Taiwan, the Hsinchu Science-based Industrial Park (HSIP) has been viewed as a successful model to promote the high-tech development that led to profitable production and world-wide marketing of high-tech products. The high-tech development, with its 'smokestack free' image, R&D emphasis, and high-profit margins, is often regarded as a 'golden egg' in the region. However, economically successful high-tech parks have had negative environmental impacts on the host communities. The essay explores the dark side of high-tech development. I argue that success of high-tech development has contributed to a unique 'information technology (IT) dominant' structure. In such a structure, the State is in favour of IT promotion while the environmental and health concerns are often overlooked.

Keywords: IT industrial dominance; high-tech development; environmental governance; Taiwan; Hsinchu Science-based Industrial Park.

Reference to this paper should be made as follows: Tu, W-L. (2005) 'Challenges of environmental governance in the face of IT industrial dominance: a study of Hsinchu Science-based Industrial Park in Taiwan', *Int. J. Environment and Sustainable Development*, Vol. 4, No. 3, pp.290–309.

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1 Introduction

The information technology (IT) industry has been viewed as the world's most dominant industrial sector with its intensive capital and technological advantages. The globalisation of the IT industry, along with its actual and potential environmental impacts, has rapidly influenced the economies of many developing or newly industrial regions, such as India, China, Singapore, Malaysia, and Taiwan. While many have discussed and celebrated the success of IT industrial development, this paper explores the dark side of the industry. Using a case study approach, it examines high-tech development and its environmental consequences in Taiwan. The paper argues that characteristics of IT development – its network-based specialised production, regional competitiveness, and quickly changing nature, which create unique economic advantages – are posing great challenges to current environmental systems. In Taiwan, these challenges are further amplified: the IT sector is nurtured by a political and economic scheme which adds to its dominant power.

This paper will first review the industrial characteristics of IT and its environmental implication. It will then give a brief overview of the success of Hsinchu Science-based Industrial Park (HSIP) in Taiwan, and discuss how the formation of IT's industrial dominance has changed social and political dynamics. Environmental consequences resulting from high-tech development are identified in the following sections. My argument stresses that the challenges to environmental planning and governance are rooted in the IT-dominant structure according to which the State is in favor of IT promotion, and the capacity to govern the environment is consequently weakened. In addition, there has been a lack of regional environmental capacity control in response to rapid high-tech expansion, while active public participation in environmental issues is not encouraged, for fear that this might impede the rapid tempo of development. The research focuses on what follows high-tech economic success, as well as the environmental constraints associated with it. It gives a glimpse of pivotal environmental processes in high-tech dominant contexts, and may contribute to a more sophisticated and detailed understanding of the pitfalls of environmental planning and management in a high-tech political economic context.

2 Literature review: characteristics of the IT industry and their environmental implication

The global IT economy is one of the major forces transforming the world social order. It includes the phenomenal growth of the internet, large volumes of cross-border information flows, and the wireless revolution. The dynamic nature of the IT industry delivers substantial economic benefits not only to IT manufacturers and software companies that design products based on computers, but also to general users of those computers. In many developing countries, the IT industry has provided the opportunity for national industrial upgrading and gives global competitive advantages; it has become the backbone of the industrialisation process. As Jussawalla (2003, p.4) describes it, the influential power of the IT industry drives the processes and cuts across all sectors and impacts virtually all human and societal activities. In addition, the industry also reshapes the international division of labour, generates new growth patterns, and in the process, spawns new products, jobs, and livelihoods.

2.1 Industrial characteristics of information technology

Speed

Industrial IT development is different from other manufacturing industries in terms of its speed and scope. The speed at which new products and technologies are introduced is the key that drives the fierce competition for market share. The IT firms work hard to gain market share and earn monopoly-like profits by being 'first movers', that is, releasing products several months ahead of competitors. Moore's Law, which decrees smaller and faster chips, indicates that the pace of IT product innovation would double about every eighteen months. Speed matters, as it relates to the industry's unique innovative characteristics. Speed also matters for firms to be able to compete and survive. Time pressure accelerates product cycles. Rapid technological innovation and just-in-time manufacturing shorten the production cycle as well as the life-span of IT products. Brief production cycles and fierce competition in a highly uncertain market impel a unique mode of industrial organisation that is structured by a network of flexible specialisation.

Flexible specialisation, illustrated by industry analysts, best characterises the uniqueness of the high-tech industrial structure (Mazurek, 1999; Saxenian, 1996; Luthje, 2002). Because the product cycles are too short, and technology changes too quickly for large integrated firms to respond effectively, flexible firms based on a decentralised network of manufacturing are best suited to such market swings. Given the demand for just-in-time manufacturing and rapid product turnover, flexibility is an imperative in the IT industry. Manufacturing takes less centralised forms than integrated mass production under the same roof of a plant. Flexible specialisation aims not only at the flexibility to switch product lines in response to changing demand, but also at the assurance of quality of output with adaptive process capability for specialised IT products. Economic geographers contend that flexible specialisation creates tremendous economic advantages for driving continuous innovation and production.

Scope

The scope of IT development is reflected in its cluster phenomenon, broad industrial interrelations, and increasing global expansion. It has been widely observed by regional planning theorists that the spatial arrangement of IT development often follows the structure of an agglomeration or cluster (Saxenian 1996; Hall, 1998; Wheeler et al., 2000). Regional planning theorists use transactional cost analysis to explain the incentives for high-tech firms to agglomerate, because proximity creates positive externalities by reducing some direct costs and some less tangible costs. The region cultivates industry growth by creating an available set of inputs including a skilled workforce, institutions, and waste disposal facilities that further attract investment and development in the region. A successful IT industrial cluster also generates upstream linkages to local suppliers, driving regional industrial development.

The IT sector, as defined by the standard industrial codes manual, includes hardware, software, and communications (CAP, 2002, p.90). Interdependence among software firms and computer manufacturers spans the production of semiconductors, disk drives, circuit boards, and video display equipment. The development of IT products has also spawned thousands of businesses in related industrial sectors, such as the manufacture of chemicals and materials used in IT production.

Unprecedented globalisation has seen acceleration in the size and scale of the IT industry. The industry's flexible specialisation drives global expansion in order to lower labour costs, diversify risks, or come closer to markets. Its widespread reliance on strategic alliance for production, marketing, and even waste treatment, in the form of outsourcing and subcontracting, creates long and complex supply webs that span many countries around the world. Today IT components are being manufactured, assembled, and used around the world. While the higher-tech and most research-intensive facilities are located in the USA, Japan, and some countries in Western Europe, IT manufacturing has expanded to many countries throughout Europe, Asia, Central and South America in the hierarchical tiers of the IT industry (Mazurek, 1999)[1].

2.2 The environmental implication of IT's industrial characteristics

Economic advantage, environmental disadvantage

While economists and regional planners celebrate the great mobility of the capital, the flexible organisation of specialisation networks, speedy development, and the cluster structure that contribute to economic advantage in the global economic restructuring process, economic advantages may become environmental disadvantages when planning and policy initiatives fail to address the environmental challenges of these new industrial characteristics. Emerging environmental constraints can only be understood through a broader analysis of industrial characteristics and environmental challenges associated with the industry.

Speed drives rapid growth for the IT industry, but also poses new challenges for planners and policy makers. On the one hand, the industry makes intensive use of chemical compounds, many of which are unknown quantities in terms of their potential risks to the environment and health. Mazurek (1999, p.27), in her analysis of microchip production, maintains that there is no preset formula for making successive generations of microchips. Each new chip generation is achieved through continual experimentation and refinement, or 'learning'. Roughly one-third of all new microchips require chemistry and equipment that are completely different from those used to make their predecessors. While production processes change continually, risk assessment takes years of trials. On the other hand, in a rapidly changing industry where profit margins are razor-thin, the firms are unwilling to divulge internal data for fear of that information being passed on to competitors. This in turn hinders scientific understanding of the risks to community and environmental health. These factors combined mean that policy makers and planners have been far behind in identifying the potential problems of IT production and have failed to assess and identify risks in time.

In addition, accelerated product cycles and rapid changes in technology have resulted in short life-spans for IT products, which create tremendous waste problems. An estimated 12.75 million computers were recycled in 2002, and most of the old computers were exported to developing countries such as China, India, and Pakistan for disassembly, according to the report 'Exporting harm: the high tech trashing of Asia' (BAN, 2002). As computers contain substances such as lead, cadmium, chromium, mercury, and plastics, it is difficult to dispose of them safely in a landfill or by incineration. This creates tremendous environmental justice concerns because many developing countries lack the capacity and regulations (or, usually, the political will) to implement sound environmental practices.

The issue is one of increasing concern due to the rapid global expansion and cluster nature of the industry. Success in high-tech development often contributes to rapid expansion that requires more resource support from the region. While clustering fosters idea sharing and social network building that further benefit continuous tech innovation and rapid industrial growth (Saxenian, 1991, 1996), the overall environmental capacity, and water and energy supplies to support the expansion of cluster are often not taken considered. To satisfy the needs of the IT industry and gain regional advantage, regions often make promises and offers beyond their capacities and means.

Flexible specialisation drives tiered outsourcing and subcontracting, creating difficulties in tracing environmental responsibilities, measuring performance, and preventing problems. Subcontractors tend to be small or medium-sized firms, with thin profit margins and less capacity to dedicate to monitoring environmental and social concerns. Cooperation through information and technology sharing in streamline production for best environmental practice is hindered due to the quick-changing and trade-secretive nature of the industry. Driven as it is by trade initiatives and high-tech company expansion, the globalised scope of the electronics economy and its great mobility of capital allow firms to escape environmental and labour restrictions through choice of locality. Global IT operating standards for community, labour, and environmental health protection often counter the downward pressure of international competition. The IT industry's great transnational mobility further grants more bargaining power to the industry in negotiations with governments. As governments aim to promote the competitiveness of the industry and earmark their resources for IT use, there is a general lack of environmental perspective in terms of addressing the negative impacts of IT development. As the IT industry continues to revolutionise societies across political borders, it becomes more difficult adequately to regulate and manage its environmental and social problems.

IT success overshadows environmental disadvantages

The industry's environmental disadvantages are obviously surpassed by the appearance of economic success; it has the ability to create tremendous wealth and job opportunities. The glitzy image of IT development is further reinforced by its clean and knowledge-based outward look. Unlike traditional industry, associated with images of smoke and undesirable factory buildings, IT industrial parks are often located in picturesque surroundings with green open spaces and park-like landscaping. They are often described as being 'smokestack free', with an R&D emphasis and high-profit margins, as well as many jobs that are highly paid and highly skilled, especially relative to other market regions in many developing areas.

With all this anticipation for IT development, the development of IT high-tech parks becomes an opportunity for leapfrogging, particularly as many governments are placing greater emphasis on the industry to propel their regional economies (Jussawalla, 2003). High-tech IT parks, featuring technological research, investment, and production, are aimed at bringing together all dynamic network externalities for incremental development. The 'high-tech recipe', originally from silicon valley, which 'combines such ingredients as a research university, a science park, and venture capital in an environment free of government regulation or labour unions' (Saxenian, 1991, p.38) has been followed globally in many regions in the form of IT parks to promote regional economy and development. The development vision to create high-tech centres such as Silicon Island in Taiwan, Silicon Glen in Scotland, and Silicon Mesa in Mexico reflects

the desirability of the 'silicon' blueprint in terms of the wealth and prosperity that rapid and extensive IT development brings about.

The erection and expansion of high-tech parks, with their aforementioned economic importance and social image, have often remained unchallenged. In such a political-economic context, viable alternatives can hardly be based on public concerns about industrial competitiveness and national security. Rational planning cannot be implemented because of the powerful influence IT has on public policy, which often overrides the environmental and social concerns addressed in the planning and policy making processes. Although IT development in many regions was originally initiated and developed by governmental agencies with various kinds of subsidies and support, the desire for more rapid economic development has further propelled the industry into the global production network (Evans, 1997; Gopalan, 2000; Wangel, 2001; Foran, 2001). The powerful image and operation of the industry in social, economic, and political domains has further led to a gravitational pull of resources that has reshaped the social and political dynamics between the industry, governmental agencies, and communities.

The study of HSIP demonstrates that the downsides of high-tech development are little addressed on the policy level. Complex environmental issues associated with broad social patterns of production, consumption, and habitation generally fall outside the purview of environmental planning and management.

3 HSIP success and IT industrial dominance

Hsinchu Science-based Industrial Park of Taiwan is frequently cited as a 'miracle' of the information technology era (Saxenian, 1999). HSIP, the first science-based industrial park in Taiwan, has been known for its success in nurturing high-tech industries since it was opened on 15th December 1980. The overall performance of HSIP in the past two decades has been impressive. In 2001, the most dismal year on record for global info-tech industries, the enterprises in the park contributed to a total revenue of US $19,618 million, representing an annual decline of 34%.

As the birthplace of Taiwan high-tech industry, HSIP has propelled the country into the competitive position of global high-tech landscape. To date, Taiwan's high-tech companies produce the majority of the world's notebook computers, motherboards and monitors, and a range of other electronic-related products.[2] Its production of notebooks, LCD monitors, and pocket PCs accounts for more than 50% of global output. The overall productivity rate of the IT industry in Taiwan is the third highest in the world, behind the USA and Japan. The high-tech industry has been a strong contributor to domestic economics and the transformation of Taiwan's industrial structure. It is viewed as the driving force behind the country's economic growth.

The success of the Hsinchu model has been widely discussed. The dominant accounts in the literature focus on active government policy, such as support from the Industrial Technology and Research Institute (ITRI), a publicly funded R&D organisation (Mathews, 1997), or public subsidy, such as tax incentives and loans (Chen, 1990). Scholars also attribute successes in IT-related industries to a concentrated, highly-skilled labour supply, a network of ancillary companies, and a potential market (Castells and Hall, 1994). Moreover, the social and professional networks of an international technical community, advice from overseas Chinese engineers, and the advantage of cluster development are commonly recognised factors in Taiwan's industrial IT success

(Saxenian, 2001). In recent years, Taiwan's interdependence on the silicon valley economy and its particular split type of industrial structure have been increasingly discussed (Saxenian, 1999). For example, Saxenian (2001) argues that the adaptive capacity of Taiwan's IT sector derives from the decentralisation of the industrial system and its close economic connections with silicon valley.

The literature reveals the fact that, given the nature of volatile, uncertain, globalised high-tech development, Taiwan has succeeded in gaining a comparatively advantageous position in the international division of labour in the high-tech economy. The State and the high-tech sector have been the two key players in creating Taiwan's high-tech landscape. The State's influence stems from its well-designed planning and policy promotion, whereas the high-tech sector's impact results from its growing network and global economic expansion.

State-industrial coalition for IT promotion

The emergence of the dominant industrial IT structure in Taiwan has been shaped by the State's unparalleled IT promotion policies and internationalised IT growth and competitiveness. The Science-based Industrial Park (SIP) Policy provides IT firms with the best investment environment in Taiwan, featuring tax breaks, one-stop services, and cheap rents for high-tech firms (Kao, 1995; Chien, 1997; Chang et al., 2001).[3] The high-tech park is a special district directly managed by the central authority that leverages the park as it enjoys more preferential treatment. The privilege of the HSIP is presented in the spatial form of well-planned road systems, public facilities, low-density housing, large-scale open spaces, and its own school system (Chang, 2000).[4] On the planning and policy level, the government further promotes expansion of the industry with assurance of resources for IT use, to pursue the national policy objective of transforming Taiwan into a 'Green silicon island'.

The IT promotion policies boost the importance of the IT sector's role in reshaping Taiwan's economics. My research in HSIP indicates that the success of HSIP creates high-tech illusions that further contribute to the IT dominance structure. In such a context, the IT industrial processes shape the mobility of people and capital, drive business–political coalescence, and dominate the allocation of resources. The industrial sector possesses tremendous power and resources in social, economic, and epistemological areas, which prompt central and local authorities to gravitate toward it. It is especially powerful when the industry is embedded in a global network of production that results in great flexibility of capital movement. The globalisation of capital has minimised the role of the nation-state in the decision-making realm. In the case of Taiwan, the state plays a comparatively small part in controlling and directing the development of high-tech industry because it fears capital flight. To encourage the firms to stay and keep the industry vigorous, government has little option but to continue or expand its favourable treatment of high-tech firms.

IT dominance poses unprecedented challenges to an already weak system of environmental government in a developing State such as Taiwan. As discussed in the following section, policy circles have suffered from a lack of environmental perspective and failed to address the negative impacts of the industrial IT development. Public interests in environmental, community, and occupational health issues are often left out of the coalition policy in the IT-dominant context. With many jobs at stake, many IT workers who are also community members keep silent about their concerns on health issues, while IT's socially glitzy image and fear of capital flight further reinforce the

trend. With its power over resources and sophisticated organisation, IT's hegemonic power presents unprecedented constraints for environmental mobilisation to challenge and change its imperative dominance.

4 Environmental impacts of high-tech development

4.1 Toxic release

Hundreds of chemicals, including several highly toxic substances, are used daily by HSIP firms; it is no wonder that HSIP has been suspected as the primary source of pollution in the Hsinchu region. According to Ku (2002), inadequate treatment of wastewater discharge by HSIP has resulted in substantial land and air pollution. Wastewater generated by HSIP firms includes heavy metal wastewater, organic solvent wastewater, and acid/ alkaline waste liquid. Vaporous releases of volatile organic compounds (VOCs) and emissions of other toxic gases from high-tech production processes and wastewater discharge are major sources of air pollution in the Hsinchu region.

Pollution problems were not publicly revealed until 1997, when wastewater from HSIP was found to be illegally discharged into a local irrigation ditch and creek. Moreover, a fire at United Microelectronics Corp. (UMC) in HSIP also shocked the Hsinchu residents with its toxic gas release.[5] Local communities began to question the once widely held myth of the high-tech industry as a 'clean' form of economic development. While most information about levels of pollutant emission and their impact is not available, several environmental catastrophes, such as pungent smells from the Kerya River, unnatural sex changes in Ke-Yin conches, numerous fire incidents, abnormal blood test results in community members, and repetitive dead fish incidents in Kerya River after 1997, suggest environmental degradation.

Pollution problems are generated from high-tech production processes. Various types of pollution commingle, which then result in broad, adverse impacts on the region's environment and its community's health. Several local papers have reported that residents shut windows and close doors in order to resist the pungent odours that result in nausea; sometimes they seek treatment from local doctors. Individual complaints have been filed in community for a generally not attended by high-tech firms. Local and national government agencies have found environmental management and regulation extremely challenging in the face of the rapid growth of high-tech production.

The environmental catastrophes reflect the insufficiency of current environmental control systems in the face of rapid development in the high-tech sector. Wastewater discharge by HSIP increased four-fold between 1997 and 2000 (Liu et al., 2001; SIPA, 1997).[6] According to Science-based Industrial Park Administration (SIPA), water flow in the Kerya River (upstream of HSIP) is 106,000 cubic meters daily (cmd), but HSIP alone would discharge 185,000 cmd wastewater that could become a serious environmental burden for the Kerya River (SIPA, 2002). SIPA has tried to expand and improve wastewater treatment facilities in response to the rapid growth of IT production.[7] However, wastewater treatment plants can only treat some chemicals and monitor suspended solids (S.S), chemical oxygen demand (COD), and biochemical oxygen demand (BOD), without examining volatile organic compounds (VOC), which are the major negative byproducts of IC (integrated circuit) production (Chiu, 2000, p.114).[8] As an analyst in the Industrial Technology and Research Institute (ITRI) pointed out,

> "IC production uses many toxic chemicals, and because of patent right, even the importers do not know what ingredients are inside. The use of chemical keeps changing, [and] that results in complex environmental consequences. Even discharged wastewater is qualified in terms of environmental standards; it may still be toxic." (Chiu, 2000, p.115)

The pollution incidents also showcased defects of environmental governing capacity in HSIP as well as in environmental systems in Taiwan. SIPA's reputation in handling pollution control was damaged when half (10 out of 20) the biochemical treatment plants were discovered to be out of order, with seriously reduced water filtering function in the water treatment plants.[9] According to investigation by Chang et al., water flow monitoring systems from wastewater treatment plants have been broken ever since installation (Chang et al., 2001, p.20). The Shengli incident further implicated the consequence of mismanagement of hazardous waste.[10] According to the cabinet's Research, Development, and Evaluation Commission, the loopholes of toxic waste management include low capacity for waste treatment, which has led to widespread illegal dumping of waste; the inability of local agencies to monitor firms' waste management thus enabling companies to skirt rules; and inadequacy of monitoring processes – licensed treatment firms often commission illegal entities to dump waste haphazardly (SIPA, 2002).

In the environmental controversies, SIPA and related responsible agencies were acting as defenders for the HSIP firms, seeking solutions by improving public facilities for pollution treatment instead of requiring companies to prevent pollution. It is evident that, in terms of environmental management, SIPA is a service provider rather than a manager for companies in HSIP. Related public agencies also tried to accommodate the needs of the high-tech sector, particularly when the firms complained that the tightening of environmental regulations would raise costs, forcing them to seek more affordable investments outside of Taiwan. No politician who has ever confronted HSIP has succeeded in seeking election or re-election at the local level.[11] On the issue of wastewater discharge, no individual company was ever held responsible for the catastrophic events, while SIPA bore all the blame, leaving the firms unscathed.

Although a series of environmental catastrophes and public health concerns in Hsinchu has awakened local residents from the myth of a green, clean high-tech development, the problems have not been made known nationwide. Media coverage shows a bias toward HSIP that tends to describe its brighter side. Lin, in his analysis of news reports on HSIP, found that environmental issues only occupied an average of 15% of the total HSIP news coverage from 1991 to March, 2002. Reports on two-thirds of incidents involving HSIP environmental disputes never make the national headlines. Rather, these stories appear only in local Hsinchu newspapers (Lin, 2002, p.106). In fact, during the Shengli incident, news reports made no effort to investigate solvent treatment at HSIP.[12] Instead, the high-tech companies in HSIP were legitimised as victims of the incident rather than waste solvent suppliers. On the issue of coastal pollution, the news reports focus on how the research report caused huge losses to oyster farmers. There were no inquiries into the nature of the pollution or who the polluters are. When political figures ate raw oysters to show support for oyster farmers, the research was discredited for exaggerating the health hazards associated with coastal pollution.

The image of 'high-tech equals low pollution' is still widely accepted by the public. Unbalanced media coverage reflects not only this social tolerance toward the rapid-growing IC industries, but also the influences of the social-politically powerful high-tech sector. Some environmental activists have felt extremely frustrated that high-tech pollution problems were downplayed or ignored by the national press. Even after several catastrophic events had occurred, the high-tech firms still claimed that companies in HSIP were the environmental role models of 'high profit with zero pollution'.[13] The powerful influence of the high-tech sector was particularly evident when the illegal discharge of wastewater was revealed in 1997. A reporter from the China Times wrote a series of papers to question water pollution from HSIP. China Times was then boycotted and could not receive any advertisement from companies affiliated with HSIP for a month.[14] As a result, the high-level managers of China Times visited HSIP in person and apologised to the HSIP firms' representatives.[15] The reporter was forced to change his news route to avoid continually uncovering negative impacts of the HSIP.[16]

4.2 Land use

All resource allocation proposed by local and national governments has promoted high-tech development, as the IC sector is viewed as the 'locomotive of economic transformation'. Cluster land development, driven by the economic success of HSIP, has been at the forefront of local strategies to promote local growth. Such development has dramatically changed the landscape from agricultural use to the industrial zone in Hsinchu area. The capital has rapidly expanded as the industry is increasingly embedded in the global production network. The land has been rapidly developed in response to global market demand, and the State has provided land and public infrastructure to satisfy the needs of industries. National land-use planning and other policies are encouraging industrial development in the name of high-tech cluster for regional competitiveness. In periods of economic downturn, the nation provides more subsidies and economic incentives to stimulate development projects. 'Fighting for economic development', promoting high-tech in particular, has been the most important task for the Democratic Progressive Party (DPP) government in winning its ruling legitimacy and recognition.[17] In a newborn democratic nation such as Taiwan, economic growth is the main driver of all developmental policies, often at the expense of social reforms.

It is clear that site selection for the industry is not being based on sustainable land use or regional environmental objectives. The environmental agencies have been powerless to stop inappropriate land development in water protected areas or hillside land. In the Quanta Environmental Impact Assessment (EIA) incident,[18] the President stated that higher local EIA standards would hinder business development.[19] The result was that some rules in the EIA process were changed.[20] The incident showcased the power of the high-tech sector related to its commitment to investment,[21] and how environmental laws can be set aside to accommodate the demands of business.[22] Like the UMC EIA incident, violation of the EIA law has never become the major concern in the public domain or in policy-making processes. Instead, how to mitigate the loss to companies as a result of the implementation of EIA was the focus issue. The EIA has taken a back seat as the State has relaxed land-use controls (e.g. on hillside land use), released national lands for large areas of high-tech park development (e.g. Taiwan sugar lands), simplified the permit application process, and lowered land rents to encourage industrial investment, echoing the policy principle of 'keeping industry rooted in Taiwan'.

4.3 Water planning and allocation

The issue of water shortage has recurred every winter and spring since 1995 (Chen, 2002).[23] In 1999, the problems of water shortage have led to complaints from HSIP firms, which spent a hundred million New Taiwan Dollars (NTD) on trucking water in.[24] The situation was getting worse in 2002. In spring, the Ministry of Economic Affairs (MOEA) implemented emergency measures in response to the drought, to transport water from farms to HSIP. Around 15,000 hectares of Hsinchu farmland were left fallow, but high-tech firms such as IC manufacturers were exempted from restricted measures.[25] At the end of 2002, the Cabinet ordered 3,000 hectares of farmland to be left fallow in order to reserve water supplies for industrial and residential uses. MOEA further decided to leave 28,000 hectares of agricultural land in the north, unseeded, at a total cost of 1.5 billion NTD as compensation for affected farmers, to ensure enough water for the economically important HSIP.

Industrial expansion has demanded more water and electricity and that has resulted in further resource scarcity.[26] Worsening water fights in Hsinchu are indicative of a rapid growth in high-tech industries that require increasing resource investment to meet the demands of rapid global market expansion. According to SIPA, 70–80% of water is mainly supplied for IC manufacturing in HSIP, as it requires ample ultra-pure water for its manufacturing processes. Since 1994, a number of 8-inch wafer manufacturing plants have started operation.[27] Investment in 12-inch wafer manufacturing plants became popular after 1998. Water demand increased 140% between 1996 and 2000. According to the CEO of UMC, water demand for HSIP would increase to 2,230,000 cmd and would require 700 million cubic meters of water a year to satisfy the demand of HSIP.[28]

In the face of water shortages, the firms complained that unstable water and electricity supplies have impeded their investment in Taiwan. They blamed the government's inability to provide production elements, comparing it to its competitor states such as China and Singapore.[29] Fearing that drought would hit high-tech production and result in a further loss of 'international economic competitiveness' and 'economic prosperity', the government took two measures to ensure water supply for the high-tech sectors.[30]

First, it shifted water from agricultural use to HSIP use. According to the Water Resource Act, agricultural water supplies should be prioritised over industrial supplies (Articles 18 and 20) when there is a conflict for water usage.[31] However, the policy was altered when high-tech came into consideration. According to the Council for Economic Planning and Development, the agricultural sector uses around 70–80% of the nation's water but accounts for less than 3% of GDP. There would not be much concern about cutting its water supply. On the other hand, high production value industries such as IC and thin-film transit-liquid crystal display (TFT-LCD) were exempt from the restriction in order to guarantee Taiwan's international competitiveness. The policy echoed the claims of the IT sector that high-tech should be given first priority for resources because of its higher production value.[32]

Second, to accommodate the rapid expansion of high-tech, the government keeps investing in water resource infrastructure. In 1994, the government proposed to HSIP short-term, mid-term, and long-term plans to expand water supply projects, at an estimated cost of 17.2 billion NTD. In 2002, proposed plans for increasing water supplies included overland water shipping, fallow project, dam construction,[33] and desalinator construction to ensure ample water supplies to HSIP. The increasing development of the

water supply infrastructure raised environmental concerns in the communities as three existing and proposed dams are located in Baoshan village, the neighbouring village to HSIP.

The State, again, is the service provider for the IT firms as they are the most economically important sector for the country's competitiveness. Water supply controversies show the favouritism given to the high-tech industry.[34] The high-tech sector has been given first priority for scarce resources and the support of public infrastructure, policies, and opinion. The State used its authority to solve the HSIP water crisis. Besides farmers' protests and requests to increase compensation, little effort has been made to challenge the unjust water allocation and environmental impacts. Environmental and social interests are marginalised while economic interests dominate national development.

5 Challenges to environmental governance

The issues of environmental and resource use controversies associated with HSIP to challenge its glitzy images of 'low pollution and low energy consumption'. They also reflect ineffective environmental governance in relation to HSIP. This section analyses and summarises the problems of the State's environmental systems in the face of HSIP. I argue that the challenges of environmental governance are rooted in IT-dominant structures that result in the setting aside of environmental regulation, planning, and implementation. The problems are examined in the politico-economic context of Taiwan to illustrate the social forces that have crippled environmental governance.

5.1 Setting aside environmental standards in the face of high-tech development

In the face of public inquiries on environmental catastrophes, the HSIP's high-tech firms and SIPA kept claiming, 'everything is in accordance with laws'. However, 'complying with the laws' does not guarantee a safe environment; rather, it means a lack of standards to regulate certain pollutants. In terms of water pollution control, the laws only regulate S.S, COD, BOD, acids/alkalines, and thirty-three other heavy metals. Many chemical compounds were not included in the examining list (Chiu, 2000). In the case of air pollution control, major points of air quality monitoring include SO_2, NO_2, CO, and O_3, which are different from pollutants emitted by HSIP. As Ku observes, there is no comprehensive planning for chemical use management, largely because the regulatory control is often far behind industrial application, and the health impacts of the toxic substances are not well known. In the face of the short production cycles and intensive toxic use that characterise high-tech development, the environmental system has failed to develop comprehensive toxin inventories for monitoring and controlling toxic release (Ku, 2002).

Laws and regulations are the baseline for the companies to follow. However, firms often complain that tightening of environmental regulations would raise costs, forcing them to seek more affordable investments outside of Taiwan. Law making and policy implementation have been thoroughly interfered with by the industrial sectors and their political allies as they are major stakeholders in setting and changing environmental standards. For example, in terms of the effluent standard, the VOCs have not been listed as examined items because of the disagreement from firms.[35] Being one of the major

stakeholders, the industrial representatives from HSIP double as the setter of the 'IC Industrial Air Pollution Control Standard', the 'Overall Environmental Carrying Capacity Control on Air Pollution of HSIP', and the governing authority for issuing permits, while no environmental groups have been consulted.[36]

Even when there is a law to stipulate developmental action or pollution problems, the environmental law is set aside. Developmental activities in HSIP are often protected by developmental policies such as SIP laws or the consensus of the Economic Development Advisory Conference (EDAC), and are exempted from environmental statutes. Although there are many environmental acts that could have regulated the firms in HSIP, few of them have been effectively implemented there. As discussed earlier in relation to the UMC EIA controversies, the violation of the EIA law did not cause the high-tech firm to suffer any penal action. Instead, the controversies often end up with quick passes of EIA review in order to mitigate business loss.

It is evident that the practices of the environmental authorities are marginalised by the SIP policy and further diminished by a crippled local autonomy. Although the local environmental agencies are authorised to investigate environmental practices in HSIP, they have been constrained by their governing capacity and uncoordinated institutional arrangement.[37] According to the head of the Environmental Bureau of Hsinchu local authorities, there are only 48 and 28 environmental personnel in Hsinchu city and county respectively. The staff is in charge not only of the environmental investigation work in the HSIP, but also of all environmental work in the Hsinchu region (Kuo, 2001; Liu et al., 2001). The disputes over the UMC 8-F EIA incident and the Quanta EIA incident further present the powerlessness of local authorities under the current institutional structure. A planning commissioner comments:

> "the companies can directly reach the Ministry of Economic Affairs (MOEA) and the President … As a member of the local Urban Planning Committee, I find it difficult to raise opposition and everything seemed to be signed and passed. Although authority over land use has been transferred to the local government after the downsizing of the Taiwan Provincial Government, it's rarely implemented …"[38]

5.2 The challenge of environmental carrying capacity control

Although the EIA law regulates development activities that aim at preventing and mitigating adverse impacts on the environment, the review of the EIA report is project-specific rather than a programmatic assessment that evaluates overall development activities in a region. There is no constant revision to assess the project's competing relationship with other development activities in the region, nor effective monitoring of implementation of EIA. According to Lu et al. (2002) the EIA system in Taiwan cannot accurately evaluate the impacts of an individual project on site due to insufficient data for comprehensive assessment of environmental carrying capacity in the region.[39] There is no programmatic and legislative EIA to assess long-term impacts of government policies.

Such an EIA system has failed to prevent or mitigate environmental impacts when facing rapid, agglomerated development driven by high-tech electronic industry. The environmental objective is set not on the basis of regional environmental carrying capacity, but on the basis of existing levels of pollution. For example, to manage the air quality, HSIP set the air pollution overall carrying capacity control standard to regulate

the emission of air pollutants in the park. According to SIPA, a 'suitable' level was set, based on current pollutant emissions, for maximum emissions of air pollutants.[40] While the industry complained that the standard was not reasonable from the perspective of increasing production, the environmental community condemned the standard because it fails to address the problem of environmental carrying capacity, not to mention that community residents were not involved in the decision making processes.

The environmental communities have criticised the newly set standard as 'drawing a bull's eye after shooting an arrow' It takes up all quotas of allowable emission without considering other point or non-point sources of pollution in the region. It is also worth noting that the overall carrying capacity control is limited to air pollutants, and does not apply to water pollution, land use development, and water supply.[41] The policies, which promote industrial development, relax land use control, and prevent interference of environmental assessment and investigation to accommodate rapid IT development, conflict with long-term planning that seeks development and preservation of a sound environment.

5.3 A lack of active citizen participation in environmental processes

Participation of citizens and environmental groups has increasingly been included in the major portions of environmental law passed since 1993. The Public Nuisance Dispute Resolution Act of 1992 partially incorporates citizens into the environmental decision making process. The Wildlife Conservation Act grants environmental groups a legal standing in participating in wildlife conservation affairs. The Environmental Impact Assessment Act includes more participatory procedures for citizens and environmental groups (Arrigo et al., 1996). The latest environmental legislation, the Environmental Protection Fundamental Act (2002) further grants citizens and interested groups the legal standing to sue the responsible agencies if the agencies fail to protect environment.

Although channels for public participation and formal access for the public to obtain governmental information are increasing, citizen participation in the environmental planning of pollution control and EIA review of development projects in HSIP has been limited. On the one hand, there is limited access for public participation in the planning and monitoring processes of HSIP. The formation of Environmental Monitoring Groups (EMG), in response to increasing grassroots demand for environmental investigation, provides a formal channel to involve environmental professionals, residents, and NGOs. However, participation in the EMG is confined to its invited committees rather than being open to the general public.[42] On the other hand, there is no significant organised force to demand more public participation from HSIP. Inactive citizen participation on social agendas is shaped by IT development characteristics, its economic driving force and the changes it effects in social demographic features. IT workers, who are also community members, are closely attached to the industry. Sharing a common interest with IT firms, they have kept silent on the environmental and health concerns associated with IT development, in the fear that a negative tone may undermine IT success and its glitzy image (Chang et al., 2004).

6 Conclusion

The failure of environmental practices is fully entrenched in political and economic power struggles. The State intervenes in political negotiations whenever there is a competitive use of resources that affects high-tech production. Enactment of many environmental laws and important amendments of older laws in the late 1990s does not guarantee sound environmental practice. The setting aside of environmental legislation, regulation, and implementation is evident in the face of high-tech development and the pro-growth principle of 'keeping industry rooted in Taiwan'. The constraints of law enforcement are further embedded in the poorly designed institutional arrangement whereby local authorities and environmental agencies are not able to confront well-designed high-tech promotion policies. Two factors, weak environmental practices and strong State-led high-tech development strategies, act as firewalls to shield the high-tech sector from being environmentally responsible, and the governing entities from being politically responsible. Long-term national planning built upon the sustainable vision of resource use, land development, and industrial selection strategies yields short-term rapid economic gain. The biggest restraints occur when community participation in environmental processes is not encouraged and mobilised for fear of retarding the industrial IT processes.

Nowadays, high-tech components are being built, assembled, used, and dumped around the world. The industry's unparalleled globalisation has widely spread its economic influences, and many developing regions strive for and depend on the IT sector as it is viewed as an opportunity for leapfrogging. Taiwan's lesson demonstrates that as the IT industry grows, its toxic legacy and unquenchable demands for natural resources may pose unprecedented challenges to the existing environmental system. The power of IT dominance has also confined the opposition forces that aim at correcting its unsustainable developmental model.

The struggles in Taiwan present the pitfalls of existing environmental systems and changes in power dynamics that have contributed to the environmental outcomes. Yet Taiwan is not the only case. Many of the same problems are emerging in other global high-tech communities as similar stories in Scotland, India, Thailand, Japan, and China are revealed (SVTC and ICRT, 2002). There is a need to peel away high-tech fantasies, to examine and adjust governmental policies in favour of the high-tech sector through vast public investment and subsidy. Such retrospection and policy reform could not occur without vital grassroots movements that demand that the corporate be accountable and the government be responsible, for the sake of social justice and a safe, clean environment. As the governance of high-tech economy is still under construction, active campaigns in pursuing sustainable high-tech development have the potential to influence the shape of construction. The emergence of a transnational environmental justice network that aims to correct unsustainable models of IT development and campaigns for clean production, corporate social accountability, and effective civic engagement may offer a new venue to address the issues at the root.

References

Arrigo, L., Tze-Luen, L. and Yvonne, M.L. (1996) 'Environmental conditions and environmental law in Taiwan', in Capria, A. *et al.* (Eds.): *A World Survey of Environmental Law*, pp.765–777, Gluffre Editore, Milano, Italy.

BAN (Basel Action Network) (2002) *Exporting Harm. The High-tech Trashing of Asia*, http://www.svtc.org/cleancc/pubs/technotrash.pdf.

CAP (Corporate Accountability Project) (2002) *Beyond Good Deeds: Case Studies and a New Policy Agenda for Corporate Accountability*, Nautilus Institute, California, Chapter 3, http://www.nautilus.org/cap/BeyondGoodDeedsCSRReportNautilusInstitute.pdf.

Castells, M. and Hall, P. (1994) *Technopoles of the World: The Making of 21st Century Industrial Complexes*, Routledge, NY.

Chang, S. (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 at Berkeley, Berkeley.

Chang, S., Chiu, H-M. and Tu, W-L. (2004) 'The silence of silicon lambs: speaking out health and environmental impacts within taiwan's hsinchu science-based industrial park', *Proceedings of 2004 IEEE ISEE Symposium/Summit*.

Chang, S., Tu, W-L., Yang, W. and Yang, L-F. (2001) *A Study of the Environmental and Social Aspects of Taiwanese and US Companies in the Hsinchu Science-based Industrial Park*, Working paper for Nautilus Institute for Security and Sustainable Development.

Chen, H-M. (2002) *De-construction of the Environmental Myth on HSIP and High-tech Industries*, Masters thesis, Journalism Graduate School, National Chengchi University, Taipei, Taiwan.

Chen, K-F. (1990) 'Dependent development and spatial structure of Taiwan high-tech industries: a case study of HSIP', *Taiwan: A Radical Quarterly in Social Studies*, Vol. 3, No. 1, pp.113–149.

Chien, S-S. (1997) *State, Development Policy, and Planning on Special Zone: A Case Study of Development and Transformation of Taiwan Exporting Zone*, Masters thesis, Building and Planning Graduate School, National Taiwan University, Taipei, Taiwan.

Chiu, H-M. (2000) 'Environmental crisis seizes the IT industry's throat', *Common Wealth Magazine*, Vol. 228, pp.112–120.

Evans, P. (1997) 'The eclipse of the state?', *World Politics*, Vol. 50, No. 1, pp.62–87.

Foran, T. (2001) *Corporate Social Responsibility at Nice Multinational Electronics Firms in Thailand: A Preliminary Analysis*, Working paper for Nautilus Institute for Security and Sustainable Development, Report to the California Global Corporate Accountability Project.

Gopalan, R. (2000) *A Study on the Performance of the Indian IT Sector*, Working paper for Nautilus Institute for Security and Sustainable Development, Report to the California Global Corporate Accountability Project.

Hall, P. (1998) *Cities in Civilization: Culture, Innovation, and Urban Order*, Orion Books, Phoenix, AZ, Chapter 14.

Hsia, C-W. (2000) 'How many science parks are needed in taiwan?', *Common Wealth Magazine*, Vol. 228, pp.103–111.

Jussawalla, M. (2003) 'Bridging the global divide', in Jussawalla, M. and Taylor, R. (Eds.): *Information Technology Parks of the Asia Pacific*, M.E. Sharpe, Armonk, NY.

Kao, D-J. (1995) *A Comparative Study of Development Experiences of Taiwan Exporting Zone and HSIP*, Masters thesis, Building and Planning Graduate School, National Taiwan University, Taipei, Taiwan.

Ku, Y. (2002) 'Environmental consideration and management strategies for high-technology parks', *Proceedings of the Conference of the Hsinchu City Sustainable Development Model Plan: Green Silicon Island International Environmental Protection Technology Exchange*, 6 May, Hsinchu, Taiwan.

Kuo, K-M. (2001) 'Environmental protection in Hsinchu county: current situation and constraints', *HSIP Environmental Monitoring Group Annual Report*, Hsinchu, Taiwan.

Lin, S-K. (2002) *News Analysis on Taiwan's Industries and Environmental Protection: A Case Study of News Report on HSIP*, Masters thesis, National Chengchi University, Taipei, Taiwan.

Liu, C-C, Liu, K-W. and Liu, Y-F. (2001) 'HSIP current situation and future direction for environmental control: report from environmental bureau of Hsinchu city', in *HSIP Environmental Monitoring Group Annual Report*, Hsinchu, Taiwan.

Lu, K-S., Weita, F. and Li, S. (2002) 'Discussion on direction of EIA system development in Taiwan', *National Policy Foundation Report*, Taipei, Taiwan.

Luthje, B. (2002) 'The detroit of the new economy: the changing workplace, manufacturing workers and the labor movement in silicon valley', Paper presented at the *Annual Convention of the American Historical Association*, 6 January, San Francisco, CA.

Mathews, J.A. (1997) 'A silicon valley of the east: creating Taiwan's semiconductor industry', *California Management Review*, Vol. 39, No. 4, Summer, pp.26–54.

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

Saxenian, A.L. (1991) 'Institutions and the growth of silicon valley', *Berkeley Planning Journal*, Vol. 6, pp.36–57.

Saxenian, A.L. (1996) *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Harvard University Press, Cambridge, MA.

Saxenian, A.L. (1999) *The Silicon Valley–Hsinchu Connection: Technical Communities and Industrial Upgrading*, SIEPR Discussion Paper No. 99–10, September, Stanford Institute for Economic Policy Research.

Saxenian, A.L. (2001) *Taiwan's Hsinchu Region: Imitator and Partner for Silicon Valley*, SIEPR Discussion Paper Series reports, Stanford University.

SIPA (1997) *Report on the Issues of Media Inquiry on HSIP Wastewater Pollution*, 11 March.

SIPA (2002) *Hsinchu Science-based Industrial Park Environmental Impact Assessment Report: Investigation Analysis and Strategies*, Hsinchu, Taiwan.

SVTC and ICRT (2002) *Conference Report: Workshop on Global Strategies for a Sustainable High-Tech Industry*, 14–17 November, San Jose, CA.

Wangel, A. (2001) *Manufacturing Growth and Social Deficits: Environmental and Labor Issues in the High Tech Industry of Penang, Malaysia*, Working paper for Nautilus Institute for Security and Sustainable Development, Report to the California Global Corporate Accountability Project.

Wheeler, J.O., Yuko A. and Barney, W. (Eds.) (2000) *Cities in the Telecommunications Ages: The Fracturing of Geographies*, Routledge, New York, NY.

Notes

[1]Countries include, for example, Ireland, Italy, Spain, the Czech Republic, Hungary, China, Malaysia, Korea, Singapore, Taiwan, Thailand, Israel, Costa Rica, Mexico, Brazil, etc.

[2]Chris Hall, http://www.eb-asia.com/EBA/issues/0203/0203Spot.htm.

[3]Industries in general enjoy the 'Encouraging investment statute' and the 'Statute for promoting industrial upgrade'. In addition to these two statutes, firms in the park also benefit from the IT Duty-free Law and Land Rental Regulation (Kao, 1995; Chien, 1997). The IT Duty Free Law gives every new firm investing in SIP a five-year tax break followed by a maximum tax rate of 22%. After its first-time investment, the company can receive an extra four-year tax break for its additional investment. The whole production line from importing raw materials, production machines, to exporting final products, benefits from tax break policies. From 1990 to 1994, HSIP's firms paid 1.57% of their sales profits to the Ministry of Finance compared to 15.29% on average by the top 100 manufacturing industries, and 20% by the small business sector (Hsia, 2000). The Land Rental Regulation provides cheap rental for high-tech firms with about US $1.27 sq. feet per year (Chang *et al*., 2001).

[4]The National Experimental High School, established in 1983, provides education for the children of employees working in the Park and nearby research institutes. The school is divided into a high school, a junior high school, a primary school, and a kindergarten, as well as a bilingual section (Chang, 2000).

[5]The UMC fire took place at the end of July 1997. An interview with a firefighter revealed the serious pollution problem of toxic release as he explained, "a week after the fire, I walked into the factory without wearing a mask. I fainted and was sent to the emergency room and hospitalized for a week" Chang *et al*., 2001.

[6]Effluent from HSIP was 105,960 cubic meters daily (cmd) in 2001, while the original capacity of the wastewater treatment plant was 18,000 cmd (Liu *et al*., 2001; SIPA, 1997).

[7]According to the Environmental Impact Analysis and Response Report, the second phase in the expansion of the wastewater treatment plant was completed by 1998 to handle 110,000 cmd. The third phase of the expansion project increases treatment capacity up to 55,000 cmd, and another wastewater treatment plant is being built in the third phase of the development of HSIP that handles 20,000 cmd. A total 185,000 cmd capacity will meet the long-term need for wastewater treatment (SIPA, 2002).

[8]According to EPA, industrial wastewater discharge was examined in relation to 36 substances. The HSIP's wastewater treatment plant only handles COD, BOD, and S.S, while control of the other 33 substances should be carried out by each individual plant. Among these 36 substances, there is no control on VOC and no guarantee that there is no VOC in the water (Chiu 2000, p.114).

[9]Minutes of public hearing held by Hsinchu City Government and Pollution Prevention Association on 18th February 1998.

[10]An illegal toxic dumping caused Kaoshiung city to be without any usable water supply for two days. As Shengli had signed contracts with 80% of IT companies in HSIP to deal with high-tech firms' waste solvents, all waste solvent (1,500 metric tons per month) was temporarily stored in HSIP after the incident and shipped to sludge farms in South Taiwan. SIPA then planned to build an incinerator for drying sludge and reusing the waste solvent as fuel.

[11]The city government's tension with HSIP is generally believed to be one of the causes of the defeat of Mayor Tsai when seeking re-election. In addition, Wu and Chen, who revealed HSIP wastewater discharge records, failed when running for election as local aldermen.

[12]In 22nd July 2000 Kulao column it states that "when the HSIP got impaired, all media and all governmental officials rushed to seek solutions for HSIP's waste solvent. They seemed to dismiss common sense. They didn't even ask where those waste solvents that HSIP companies contract to Shengli went …".

[13]On May 15 2000, the CEO of UMC wrote a public letter of accusation to the Hsinchu city government on major newspapers. It stated that companies in the HSIP are all pro-environment and that to develop zero pollution, high-profit industries (IT production) not only contribute to economic growth, but also help the environment recover.

[14]The HSIP industrial association held a committee meeting and decided that the

> "China Times denied the contribution of HSIP toward national tech development and made negative reports without covering the truth. It is meaningless for the members of HSIP to buy advertising from China Times. Therefore, we call for our members to withdraw or ban the advertisement contract with China Times." – from Announcement of the Taiwan SIP Science Industrial Association (18 December 1997)

[15]Proclamation from the SIP Industrial Association on 18th December 1997.

[16]The journalist originally focused on reporting social and environmental issues in Hsinchu. After reporting the wastewater issue, he was assigned to report city government affairs.

[17]The DPP became the ruling party in 2000 after KMT's 50-year one-party rule. It was the first political power transition at the national level in Taiwan.

[18]Quanta is one of the major thin-film transit-liquid crystal display (TFT-LCD) producers in Taiwan.

[19]The President stated that this stone (which was slowing down the EIA process) should be removed and that he could kneel down for that (major newspapers, 16–17 August 2001).

[20]According to the conclusion of the nine-person consulting committee of the Presidential Hall, in order to get rid of the obstacles to business investment, the consensus votes in the EIA process would be changed into majority votes; the new project in industrial parks, science-based industrial parks, or exporting zones would not need EIA review if proposed pollutant emission did not exceed the parks' overall pollution capacity control standard; and if local government would not coordinate central policy to improve the efficiency of EIA review, their local environmental subsidies would be cut off by central government

[21]According to the Ministry of Economic Affairs, Quanta Display Inc. invests 200 billion New Taiwan Dollars (NTD) and is the important investment case in these five years.

[22]The statement published on August 16 2001 represents the view of industrial sector which claimed that the EIA review is not reasonable.

> "The permit should be issued if everything complies with national standard, and they should not require higher standards that could bother the business. It should be one certain standard in a democratic country, therefore, we suggest the EIA review should be modified. Speed is the key for business survival and there should be a fast and reasonable process for EIA review."

[23]According to HSIP, the scarcity of land, water, and electricity may hamper investment. The news about water shortage HSIP first appeared in the national section. According to Chen (2002), water shortage became an issue in HSIP after 1996.

[24]The industry argues that unstable water supplies will prevent it from 'keeping its roots in Taiwan'. It appeals to the government to take action because inadequate water supplies will cost it 200 million NTD per day.

[25]The related news was covered in the major newspapers from February 2002 to April 2002.

[26]Chen, the journalist who revealed the wastewater discharge issue, comments on China Times, March 1st 2002 that

> "many people complained about the delay in the construction of the second Baoshan dam, some complained about the drought, and others complained about farmers fighting for water. However, the real problem is that all water supply systems for HSIP can't function, a result of the unlimited expansion of the factories in HSIP."

[27]Four 8-inch wafer manufacturing plants started their operation at the end of 1996, including TSMC's third factory, UMC's third factory, TI-Acer's first factory, and Vanguard International Semiconductor Co.

[28]Domestic water usage for 1.3 million people in the Hsinchu and Maioli areas is 413,300 tons per day (source from replying message dated 17th April 1998, Water Resource Bureau of Ministry of Economic Affairs, in response to an inquiry about water supply and demand in the Hsinchu and Maioli areas).

[29]A manager pointed out that 'there is no water shortage problem in China (in terms of water supply to the industry). When government persuades business to keep rooted in Taiwan. It provides nothing to improve the investment environment.' The above statement is viewed on China Times, March 2nd 2002. Another example is that UMC criticised Taiwan for its shortage of water and electricity when UMC decided to invest in Singapore.

[30]Whenever government has indicated that it would cut water supplies in the north of the country, home of many electronics factories, stocks often fell to their lowest in several months.

[31]Under the Water Resource Act, the order for water users' rights is: 1, residential and public water supply; 2, agricultural water supply; 3, hydrological purpose; 4, industrial water supply; 5, transportation purpose and other functions.

[32]IC production alone contributed 2.85% of GDP. IC production and HSIP output and profit for water, electricity, and land use per unit is the highest of all manufacturing industries. For example, output/water usage in the year 2000 was $ 23,163 NTD.

[33]The second Baoshan dam will store 32 million tons of water, six times the capacity of the first Baoshan dam.

[34]As Vice Premier Lin said, "the government would come up with a plan to put rice fields out of commission in favour of keeping computer chips and other products rolling off production lines at the science park …" The comments can be viewed in major newspapers on 28th February 2002.

[35]The official raised his concerns:

> "the problem is, because there's no treatment plants to deal with waste solvent, the companies handle waste solvent by discharging it into the wastewater treatment plant that results in a high concentration of VOC in the wastewater of HSIP. It's almost impossible to examine one by one if we really want to." (interview with SIPA official)

[36]The consensus of the Economic Development Advisory Conference (EDAC), held in late August 2001, has contributed to the modification of many regulations to facilitate accelerating economic development.

> "Receiving many responses from the companies in the EDAC, the EPA suggested shifting the permit issuing authority from the Environmental Bureau to SIPA. This not only applied to the HSIP, but also applied to other industrial parks …" (interview with SIPA official)

The permit issuing authority for air emission and wastewater discharge was transferred to HSIP at the end of 2002.

[37]HSIP is located in the two jurisdictions of both Hsinchu city and county. It is not clear which agencies should be in charge of coordination when cross-boundary issues emerge.

[38]Interview with a Hsinchu City Planning Commissioner.

[39]The EIA reports are often criticised for a lack of factual basis and accuracy of data. The EIA's drawbacks in Taiwan also include lack of assessment of alternatives, failure to cover evaluation of clean production and product life cycle, lack of compensation and liability mechanisms for site cleaning, lack of cross-agency coordination, lack of bottom-up citizen participation, and lack of third party monitoring (Lu *et al*., 2002).

[40]The standard accommodates current pollutant emission and leaves some room for future additional emission. For example, the estimated 'suitable' emission level for VOC is based on the ratio of *increasing* VOC emission to the *increasing* rate of O_3 concentration. According to SIPA, when VOC emission doubles (compared to the current emission rate), the concentration of O_3 increases 1 ppb, but when VOC emission increases three-fold, the concentration of O_3 increases 6.4–14.4 ppb. Therefore, it suggested that maximum emission should not exceed twice the current emission (SIPA 2002).

[41]The government has hesitated to implement capacity control on water pollution because water flow (106,000 cmd) in the Kerya River is less than wastewater from HSIP (185,000 cmd) received into the Kerya River. According to the same report, 185,000 tons of water discharge from HSIP per day and the related water quality examining items include BOD (maximum 25 mg/L), COD (maximum 80 mg/L), S.S (maximum 25 mg/L), which are all claimed to be lower than the national effluent standard.

[42]NGO representatives proposed to open up the EMG meetings to the general public and media, but the proposal was argued against by some of the committees. The official representatives are concerned that the dialogues in the meetings may be misinterpreted by the media or that issues may get complicated when the public is involved. There was no conclusion as no consensus was reached. (field note, 25 July 2002).