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Techno-Sustainability in Taiwan

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The Multifunction Polis or MFP discussed in Steven Hamnett's paper is the international metaphor for technological sophistication. Hamnett's paper argues that the creation of technology innovation in Australia is as much the vehicle for economic renewal as the development of an industrial form. In other words, governments are anxious to demonstrate that their nations are technologically competitive. This used to be called "smokestack chasing." Today, the smokestack has become the technology city. Almost every newly industrialized nation in Asia is designing its own version of a *techno-city* based on the Japanese technopolis model and loosely fashioned after the various U.S. technology nodes.

Taiwan is among the last of the Asian Tigers to establish a technology city presence, attempting now to alter its national economic development agenda by creating a Silicon Valley. This small nation has emerged as a leading producer of the world's computer and information systems, producing 10 percent of all microcomputers, 17.5 percent of all terminals, and 67.4 percent of all motherboards, mice, and similar peripherals. Historically, labor-intensive export-oriented manufacturing of computer equipment has accounted for Taiwan's phenomenal growth in earnings and its huge international trade surplus, creating the world's largest foreign reserves with over $82 U.S. billion on hand. The country's incredible productivity has, however, also led to such social and environmental dilemmas as increasing auto dependence and air and water pollution.

The combination of money and technological sophistication is requiring the nation to rethink its economic and political destiny. The most difficult challenge, according to Taiwan officials, is that the country must develop its technological leadership by retaining and attracting its own highly sought-after engineers and professionals now residing in the United States and Europe. This strategy is required for Taiwan to become the technology nerve-center for the emerging China. As a consequence, the Taiwanese government is embarking on a national economic strategy that embraces new high-tech-oriented growth. The backbone of the new high-tech Taiwan is a rebuilding of its urban form to accommodate future industries and to re-capture as well as retain the intellectual resources that leave the country. However, Taiwan is already densely populated, and has severe environmental problems. Thus, the success of transforming Taiwan's economy hinges, in part, on balancing sustained economic development against the sometimes conflicting goal of environmental protection.

In order to meet this challenge, Taiwan is establishing one of the world's most ambitious new cities and regional development building programs. The Taiwan government plans to spend over $300 billion over the next six years to modernize the nation. A major component of this modernization is the design and development of six new cities dedicated to science-based economic development. These new cities range from communities of 30,000 attached to existing metropolitan areas to a new science region built around the city of Hsinchu with a current population of 600,000. The Hsinchu area is being redesigned as a technology region of over 1.3 million. The scope of these developments and their economic consequences are enormous. The Taiwan government anticipates that they will become one of the most productive high-technology research and development nations in the world, using economic superiority as a major international bargaining chip. Taiwan has elected the Silicon Valley regional model over a single tech-park approach, partly because land assembly is so difficult. However, a high-tech lookalike is not enough.

Due to Taiwan's environmental problems, as previously mentioned, it is necessary to develop these new communities to handle Taiwan's modernization drive in an environmentally sound and economically productive way. These new cities are intended to provide a better physical and social environment for the high-tech economic growth of the next century's industries and cosmopolitan population. In addition, concentrating Western-style amenities in only a few locations is strategically sound as well, creating a large enough critical mass to make Taiwan's technology area easily recognized.

In the past year, a project that combines the California Silicon Valley and the North Carolina Research Triangle approaches has been undertaken to design a techno-region for the Taiwan government. These two models were merged because each offered appealing ingredients. The Silicon Valley research park offered the link between university and private-sector activity throughout a wide area, while the North Carolina model provided an excellent example of using a large land mass and central coordination of marketing and infrastructure development.

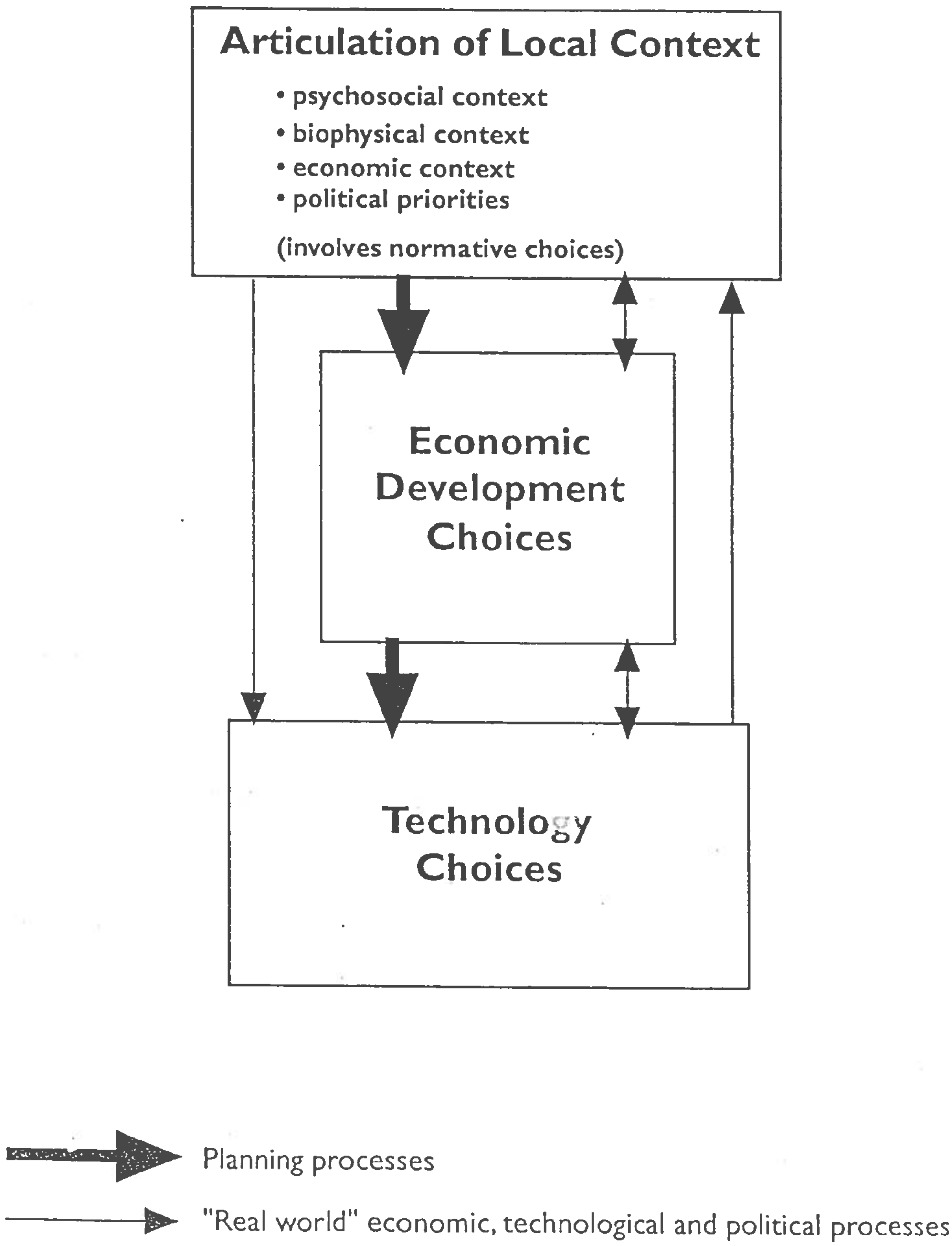
The High-Tech Issues and Images

As with Australia's MFP, the urban form a technology community must possess has been the subject of considerable controversy. Some writers suggest that any metropolitan area is or can become technologically sophisticated (Rees and Stafford, 1986). Others argue that technology communities have particular characteristics, and clear choices can be made to alter a community's technology development potential. Blakely and Willoughby (1990) argue that there are social, cultural, and physical dimensions that can be assembled to develop a node or community conducive to technology development. These normative choices, outlined in Figure 1, are interrelated with other attributes such as the quality of the social and physical amenity environment.

In essence, there are two considerations. First, the community must be located where the surroundings offer high physical amenity. Physical characteristics are as important in the technology era as the presence of iron ore, rivers, or good natural resources used to be when the economy was based on manufacturing and agriculture. Thus, it is unlikely that places too cold, too hot, or in unattractive venues will become "techno-nodes."

Figure 1

Economic Development Planning and Technology Choice



Second, it is important for a community with technology potential to assemble the right set of internal attributes that match the technology industries' knowledge-based requirements and other "human resource attractors." The combination of physical amenity and social/knowledge resources must attract the technology community. In fact, it is fairly clear that the area must be marked off and have a special set of features that give the community a clearly separate identity.

Designing A Tech-Node for Taiwan

Taiwan has adopted the Japanese model of technology inducement to a specific geographic location. That is, the Taiwanese have attempted to attract or create Japanese-style "technopolises" or zones. These tech-nodes, as I prefer to call them, are either a single city, a group of cities, or a region specifically redesigned to attract certain types of technology firms. The national government is a prime actor in identifying, funding, and providing the special infrastructure for these tech-nodes. In most instances, this means either that a new university with dedicated research resources to support a predetermined technology is established, or one or more universities is re-positioned to act as the support base for newly emerging industries in a designated field. Another approach is the "centrally planned model" of technology development (Blakely, 1987: 735). This differs from the U.S. market-led approach inasmuch as it relies on government intervention to create a stimulating climate for certain industrial forms rather than the random chance of market forces. In a more direct "governnment-guided" approach, best illustrated by Singapore's IT (information technology) strategy, the government selects research areas and invests directly in certain technology arenas.

In Taiwan's case, central planning takes the form of the National Science Council, which not only initiates scientific research, but acts as the founder and sponsor of one and possibly more new science cities or regions. The first science city is being built on the framework of the existing city/county structure of Hsinchu, approximately 60 kilometers north of Taipei. In this respect, it is very much like the Japanese *ispolis*, which are based on re-shaping or designating existing communities as high-tech communities or regions.

Hsinchu has been well-supplied by the National Science Council and the national government to play the role of a tech-node. The government has invested heavily in Hsinchu, establishing a major national basic research laboratory that employs more than 6,000 scientists, two universities, and a network of applied research facilities ranging from a new cyclotron to special telecommunication facilities.

In addition to this public infrastructure, the NSC funds and operates the nation's largest technology park, which has the most advanced state-of-the-art physical facilities for technology firms in Taiwan and perhaps in all of Asia. By the end of 1992, HSIP had over 135 firms which employed more than 23,000 people. These firms can be basically sub-divided into computer and peripherals, integrated circuits, telecommunications, opto-electronics, automation, biotechnology, environmental technology, and energy groups. They are primarily first-generation manufacturing establishments, meaning they have moved beyond research and development and have become established in the international market with a set of products or services. These firms use research rather than produce it.

The best example of HSIP's firm profile is the fact that Ace Computer is the park's largest tenant. In many respects, the science-based industrial park is aptly named. It is not presently focused on technology or research— which presents one of the NSC's challenges. While HSIP is successful in housing-developed technologies, the NSC wants the park and the community to become the host environment for the creation of new technologies.

HSIP has attracted firms, but it has not provided the intersection between science development and new product design that Saxenian and others describe as the basis for a strong technology milieux (Saxenian, 1990). In fact, in a paper describing regional linkages, C. T. Wu asserts that HSIP does not have much of a relationship with the surrounding scientific infrastructure or many of the region's firms (Wu, 1992).

NSC's goal is very clear. Taiwan must become a technology exporter and not merely a low-end high-tech merchandise producer. Thus, HSIP is not enough. A total environment must be created, stimulating creative activity that results in both new science and new firms.

Looking for a Better Mouse Trap

From the NSC perspective, HSIP can only be a success if it attracts the kind of people and firms that create new technologies. An oft-stated goal by the NSC leadership is that Taiwan must re-attract its lost scientific brain trust from the United States and Europe. The sub-script of this is that a verisimilar living and working environment will achieve this end in addition to attracting European and American entrepreneurs to Taiwan. In sum, the idea is: "if we build it, they will come."

It is not always clear from the literature or from industrial folklore what the right environment is and what components it must possess. There are several different approaches to "tech-node" building. At this juncture, the NSC has taken on a science-city/region approach by default rather than careful assessment. Figure 2 is an attempt to articulate the features of the various choices NSC examined before making its selection. Each approach can be examined against a common set of variables.

The regional/science city approach emphasizes a total living environment conducive to technology firms and attractive to the technology workforce. Science regions or cities can be created either by government or private sector actions or can merely evolve into their form a la Silicon Valley. The Japanese have attempted, with varying success, to create technology areas. Sophia-Antipolis and the Australian Multifunction Polis are currently the world's best illustrations of this approach.

Figure 2

MAJOR RESEARCH CENTER PARADIGMS

	Basic Components	*Organizational Structure*	*Goal*	*Examples*
Science City/Region	* International Urban Design * Multi-University & Research Centers * Gov't research center * Magnet science facility	* Local/Regional gov't * National gov't involvement in regulation process & designation as tech city * Development Authority manage parks & facilities	* International presence * Agglomeration of technology (node) * Concentration of human resources	Technopolis - Japan Multifunction Polis - Australia
University Research Park	* Single university base * Concentrate on single sector (biotech, electronics) * Specialized university institutes	* University managed sometimes with private developer	* Promote university business interface & technology transfer	Stanford Research Park MIT
Non-Profit Research Center	* Multiple university base * Central resource center * Shared science facility with local business/industry	* Joint university & regional or state gov't managed * Special legislation	* National presence * Technology firm attraction	N. Carolina Triangle Wisconsin Florida
Private Tech Park	* Special infrastructure * Incubator areas * Business offices & related facilities	* Private developers * Joint local gov't & private development	* Real Estate Development * Marketing of facilities to the private sector	Rt. 128 - Boston Harbor Bay - Alameda Silicon Valley - San Jose

Another more modest effort is the University Park, based around a university. The idea here is to create a direct tie between the research generators and the research consumer/producers. This is a U.S. style that has become enormously fashionable throughout the industrialized world. The success rates of U.S. research parks have been recently examined by Goldstein and Luger (1992). They describe the mixed record of these endeavors.

Non-profit research parks have emerged as an attempt to create a base that bridges the university and other research resources in the public and private sector. The North Carolina Triangle is the world model for this type of approach.

Finally, private developers have emerged to fill the market for research-oriented space as well as to design links with universities, national research laboratories, and private research facilities.

These approaches have certain aspects in common, and, in one way or another, form a conceptual base for forging a model. The issue for Taiwan is how to use them to design technologically sophisticated places for new town or community developments in Hsinchu as well as several other communities in the planning stage.

The Techno-Sustainability Challenges

Taiwan is very densely settled along its West coast, where the land is relatively flat, in contrast to the center of the island and most of the East coast, which is covered by mountainous terrain. As a result, agricultural and urban living are in close proximity in most parts of the country. Moreover, as the island has industrialized, it has placed extreme pressures on the small land inventory. Air pollution levels, in Taipei as well as in the other major cities on the West coast, are among the world's worst. Vehicle exhaust contributes most to this pollution, with the island expanding its auto registration by more than 6,000 vehicles a day. Motor scooters lacking anti-smog devices are the dominant means of daily short-haul transport; many are in poor repair and emit clouds of blue smoke. The particulate matter in the air is so severe that an observable number of Taiwanese wear face masks outdoors at all times.

Water pollution is also well beyond World Health Organization standards. Much industrial waste is poured directly into streams and rivers, and there is no tertiary treatment of sewage before it reaches the ocean from any city or village on the island. Finally, other pollutants and toxins are not yet controlled to the degree they are in Europe, Japan, and the United States. As a result, soil, air, and water contaminants emitted from establishments are only slightly above Third World levels.

None of this is to suggest that Taiwan is oblivious to any of these problems. To the contrary, a vigorous new Environmental Protection Agency has been formed that is rapidly moving the country to world standards in all pollution and environmental protection areas. In the interim, Taiwan views this problem as one of the prices of rapid industrialization. Furthermore, new technologies are providing cheaper means to eradicate these problems. As a result, Taiwan is pursuing a strategy of both cleaning up existing conditions and re-building the island nation infrastructure as pollution free through large-scale transportation, water and sewage, and new-town developments. In summary, Taiwan wants to build its way out of its current environmental problems.

The building program to meet these goals is ambitious. A new high-speed rail is proposed to traverse the island. A multi-billion dollar underground and above-ground light rail system is being built in Taipei, and numerous new highway and bridge building projects are underway. But the basis of this new infrastructure is six to ten new settlements modelled on Hsinchu as high-tech communities. These communities will take advantage of modern technology and will also become the nodes for new research-based technology economic development.

Taiwan has both economic and environmental sustainability problems and opportunities in several respects. First, rebuilding the existing city structure is a challenge. Second, a culture clash is occurring as the nation merges into a globally competitive system. The global dimensions of growth are reflected in the building styles and city organization as well as in changing tastes and preferences. For example, the large-lot single-family house is becoming a desired commodity in a small island with very little available space.

There are new tensions on the natural resource base as well. As new settlements are proposed, agricultural lands, foothills, and sensitive watersheds are encroached upon. The direct and indirect dimensions of these changes cannot be effectively measured in an environment already so disturbed.

Finally, there is the technology sustainability issue. Can design or organization create a high-tech milieux? In effect, can Taiwan create the physical, social, and research environment that will attract overseas scientists and retain local ones so they will create new products?

Each of these issues is discussed in the balance of this paper. Obviously, there are no easy answers to these problems. We will use Hsinchu as the reference point for this discussion, evaluating it as a surrogate for a set of newly planned communities.

Settlement Sustainability: Land Use and Jobs, Housing Balance

Hsinchu is planned to grow based on the HSIP Park, which will increase fourfold to become a city within the city. The organization of the new science city is still under discussion. However, the basic structure calls for a blended working and living environment. The rapid growth in Hsinchu even without the Park can be seen in Figure 3. This figure also shows the region's anticipated growth as a science city area. Rapid growth has its own special problems no matter where it occurs. In the case of Hsinchu, growth is being induced into a pattern aimed at serving two goals. First, it will be concentrated on expansion of the Park and its immediate periphery. Second, the style of growth will be Western; that is, more low-rise than the usual Asian pattern. As a result, Science City planners are attempting to design housing in the Park setting as well as develop housing in a

Figure 3

KeyChart 2000

concentrated new town area adjacent to the Park. To accommodate higher-level executive housing, private land is being released for housing developments in the surrounding hills.

Although the planners are proposing higher-density development that connects with a circular municipal light rail, the park is designed primarily for the auto. This design form is a direct replica of Route 128 and Silicon Valley, intended to simulate other high-tech environments. But inherent conflicts in this form and the desired environmental outcomes have not been well articulated.

Another issue is that the surrounding hills are not suited for development of any type; accessibility by public service vehicles will be a severe problem. The hillside vegetation is also very flammable and represents an extreme hazard during some periods. However, to restrain growth there would limit housing-style choices, thereby making Hsinchu less competitive on the basis of housing amenity levels.

The issue of housing style is more than architecture. It represents an entire organization of life. The lower-density style is not only auto-oriented, it is also more amenable to smaller family living arrangements. This has implications for the extended family lifestyle of the Taiwanese as well as the organization and delivery of retail services. Shopping malls and hyper-markets are already being planned at highway intersections to cater to the single-family homeowners, which may affect current community shopping centers.

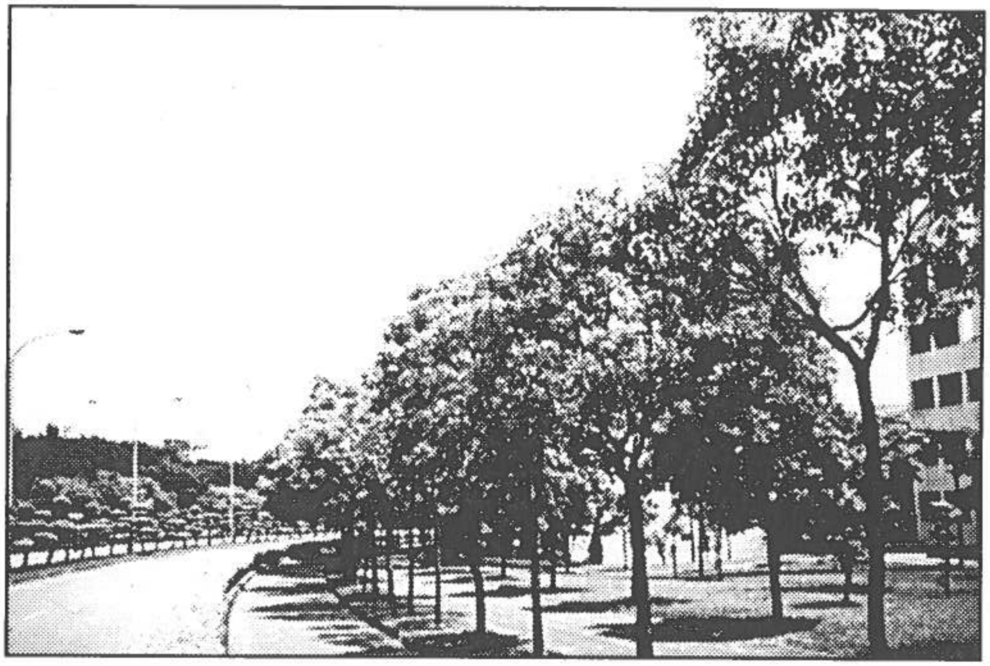
Cultural Sustainability

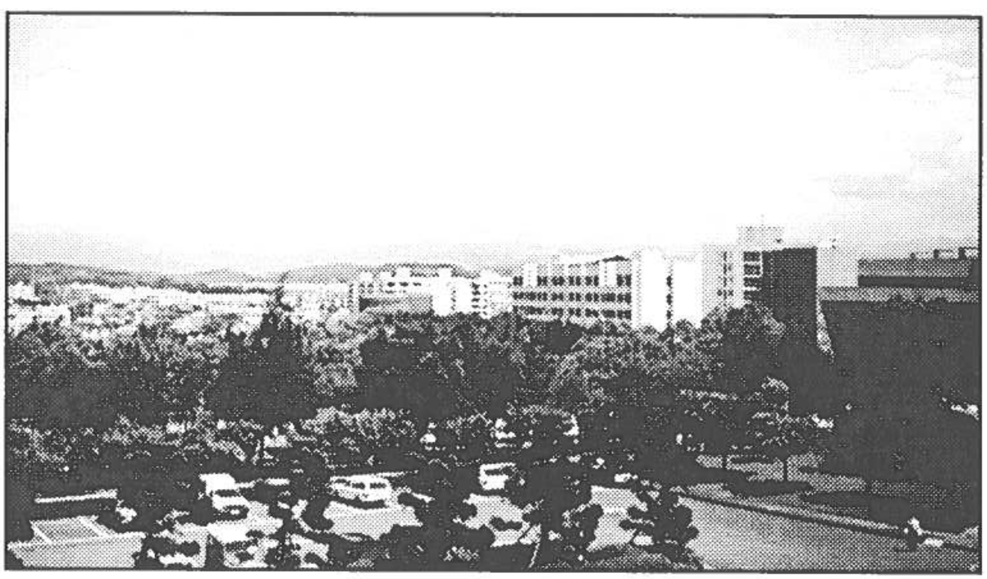
Hsinchu and Taiwan in general are culturally colonized. Western building styles dominate the skyline. Western food and films and other culturally homogenizing influences are widely available. On some levels, this provides comfort and familiarity for Western families or families that have lived in the West. However, on other levels it dilutes local cultural expression by reducing cultural variety and style. The Hsinchu HSIP development epitomizes this transformation. The Park looks and feels like many similar technology parks in the world, although it has some unique features. Housing, for example, is directly incorporated into the Park grounds, which are closed in behind security gates (an increasingly common feature in the U.S.).

Building styles have merged into the "international box" and lack any form of cultural uniquenss or vernacular articulation. As a result, one could be looking at a building of similar style and presentation anywhere in the world. A few buildings have been provided with "pseudo-Asian" expression on the roof gables and trimmings. However, even this passing nod to the local surroundings is so pale that it has to be pointed out by Park employees or it is readily missed.

The Park is becoming the style setter for the science city development. As a result, the organization and design of its buildings are pushing out older forms. In fact, the old city hall is to be abandoned altogether, and a new one is to be built near the core of the new HSIP developments, along with a new shopping mall and cultural center, away from the current central city area. This may

Hsinchu Development





Hsinchu Science Park

mean the demise of the historic core area. Already, encroachments of new buildings and unplanned development have permanently altered the old city system to the point that few historic remnants are intact.

Building form is only a superficial depiction of cultural expression. In the case of Hsinchu, its previous identity is precisely what the 21st century science city is intended to remove or displace. This new identity is intended to assist the community in attracting overseas Chinese and other internationals. The idea is to present them with a primarily Western visual environment augmented with some Chinese character.

In addition to selling Hsinchu to a cosmopolitan constituency, it must also be sold to locals. Currently, professionals in most sectors live in Taipei and drive the 60 kilometers daily to Hsinchu. Figure 4 presents an occupational/sectoral distribution of the Hsinchu population. Informal discussions suggest that there are two reasons for this. One is that Hsinchu schools are not perceived as "good." Since schooling is so important to social and economic progress, the perception that Hsinchu schools will not lead to the best universities is damning.

Another factor limiting Hsinchu is the fact that it is the "backwater." Important people, cultural activities, and other issues of significance occur in the national capital. Hsinchu has to alter its image, to re-make itself into a techno-pole similar to the familiar icons of Silicon Valley or Cambridge, Massachusetts. Of course, the down side of this approach is that it may turn out to leave Hsinchu with no image at all or one alien to its host environment.

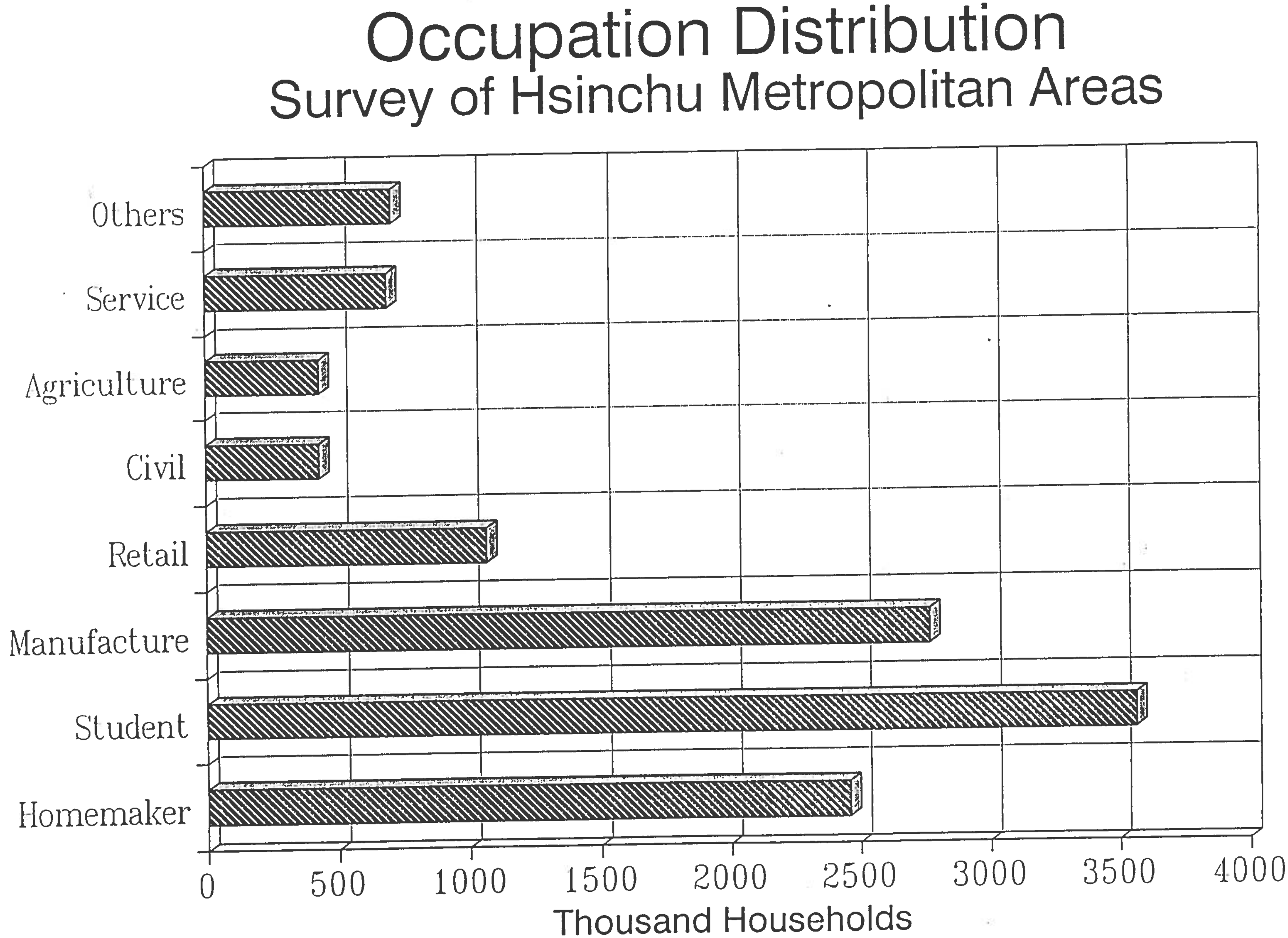
Natural Systems Sustainability

As mentioned previously, Hsinchu is in an environmentally delicate area with several picturesque settings. There are several rivers and streams that serve the province flowing down from the surrounding hills and mountain sides, some of which have been marked off as sensitive. However, one particularly sensitive area is already under threat because of private sector anticipation of the Science City.

Expansion of HSIP will directly threaten the area's wetlands. However, since most of this land has been farmed for many years, this in itself is not a serious issue. The most important thing for Hsinchu is to preserve views and open/recreational space to serve the needs of the potential new immigrants.

One environmental asset not being developed for the Science City is the nearby seashore area. The central city is about 10 kilometers from the ocean. The Hsinchu dock area has nice views but no beach. It is smelly but has a general Old World charm. There are adequate areas for housing and private boat docks. However, local prejudice against the sea makes development along the seashore unlikely in the near term.

Figure 4



Data source: " A Feasibility Study of the MRT System for Hsinchu Metropolitan Areas" Sample size = 2975 households

There is insufficient data for real environmental analysis on the cumulative impact of the development of the scale proposed. Clearly, the added population, autos, and the resource requirements could alter the physical environment substantially. It is possible to model these impacts when better environmental data are available. This process is underway.

Techno-Sustainability

The Science City is an infrastructure but it does not produce science. Thus the real argument for sustainability is whether the national investment will result in new science and new products. The evidence to date is mixed. HSIP is certainly a successful park which has attracted technology manufacturing firms. Some of these firms are new startups, but the majority are existing Taiwan expansions or overseas branch plants. Since land is in short supply and quality industrial layouts almost non-existent, this early success might be anticipated. The real question is whether the growth rate of Hsinchu HSIP can be sustained from internal spinoffs, or new joint ventures, coming from its own firms or from the local university research center complexes. Figure 5 shows the composition of HSIP to date. As the figure indicates, most of the firms are in two types: computer and peripherals, and integrated circuits. The other companies occupying the park are primarily in related markets like biotech.

Hsinchu is a manufacturing center, as Figure 4 shows clearly. According to Wu's research, only 5.25 percent of HSIP firm expenditures was on research in 1992 (Wu, 1992: 10). This indicates that these firms still view research as modifications of known or found technologies and not pathbreaking new science. Creativity is difficult to induce. However, despite Wu's data, it does appear that relationships are being forged between industrialists and scientists. While Taiwan is anxious to promote new science by concentrating human resources in a locus like Hsinchu, it will take decades to know whether this community or any other will reach the creative takeoff point.

The other issue is to what extent the HSIP firms, as internationals, use local resources as suppliers. The existing firms are not yet well integrated into the regional economy. A great deal would have to occur before suppliers would give up current venues for Hsinchu. On the other hand, new suppliers might emerge from the process. As Wu (1992) notes, there is a high degree of polarization in the high-tech development process. The Hsinchu-Taipei region is the growth pole for the high-tech industrial base and pulls all such activity to it. In fact, the accelerated growth of Hsinchu may retard development of other technology nodes elsewhere in Taiwan. Therefore, it is very important for all of the nation's regions to develop complete technology bases rather than remaining concentrated around Taipei. This seems unlikely on the basis of Wu's data (Wu and Leung, 1992: 12).

Figure 5

SUPPORT SYSTEMS REQUIRED FOR ADVANCED TECHNOLOGY CENTERS

Support System	*Science City*	*University Research Park*	*Non-profit Research Park*	*Private Tech Park*
Information Communications Strategic relationships	Teleport & International major communication facilities	Conference facilities	Innovation centres	Publications Media support Commercial Marketing
Human resources orientation	International research scientists	University faculty as consultants	Skilled technicians	Top management skilled and flexible
Education and research facilities	University or Research Institute	Research labs	Research labs	University/Technical College
Environmental quality	High quality houses and recreation areas	High quality recreation and cultural areas	High quality living and working environm.	High quality work facilities and equipment
Business and community institutions	National policy and process	Venture start-up firms	Entrepreneurs and local social network	High-tech specialists as catalyst Close ties with large firms
Local Government Organization	Local and national gov't collaboration	Joint-venture University & Private companies	Information services center	Local gov't provide support infrastructure
Finance	Heavy gov't finance	Research grants	Investor consortia	Institutional finanace
Physical infrastructure	Specialized Infrastructure in support of technology Transportation infrastrucutre	Research facilities accessible to local investors	Fibre optics or related transmission services	International airports Toxic and scientific waste systems
Enterprise facilities	Research Institutes, Universities	Incubator buildings	Innovation centres	Technology and/or business and science parks
Community facilities and support	Good community facilities	Regional recreational, cultural and social facilities (e.g. golf, symphony,		Specialized commercial and professional services
Technology image	International status	Environmental quality reputation	Designation/or reputation for specific technology	Top quality high-tech firms
Planning and development regulations	National directed Regional technology strategy	Provision of research and testing areas	Designated mixed use areas	Controls related to industrial requirements

A Decision Support System for Tech-Nodes

The decision to build HSIP and other technology-based communities has already been made. As these communities come into existence, policymakers are asking what the mix of ingredients needs to be to insure success. Clearly, the physical design is not enough. An understanding of separation of functions within the city, such as manufacturing, housing, and retail, is required to guide the technology community building process. Historically, industry and community were only tied through natural resources and hard infrastructure like railways and highways. The technology is different, inasmuch as a set of "soft infrastructure" requirements are now central to the process. Taiwanese policymakers, like many others in the world, have not been able to integrate the variety of soft and hard infrastructure into a single paradigm that bridges the various tech-node forms. Taiwan decisionmakers need a decision support matrix to clarify the range of options. The matrix (Figure 5) provides a decision guide. It is not the answer, but it is useful in thinking about the mix of physical, social, and community infrastructure that can form the basis for designing a technology community or area of any scale.

In addition to this support matrix, an environmental decision support system has been devised to forecast the environmental consequences of various development alternatives for the Hsinchu area. The model links existing economic, visual, and geographic computer modelling technologies that have not yet been used for city planning, forecasting, and monitoring. Finally, planners have been able to see how merging data into visual form can influence decisionmaking. The initial project is coming to an end just at the time when the pioneering computer simulation and modelling system could yield important information for policymakers concerning the integration of economic and environmental factors. The team is in the process of devising the protocols and operating systems for an integrated visual, economic, and geographic modelling process. This new modelling effort would incorporate three simulation technologies into a common system that could measure the cost, environmental, and visual impacts of any proposed new city based on real data and in real time.

Geographic information systems or even visual and economic models are not new. What is new is the attempt to allow decisionmakers to see the physical dimensions and economic requirements of a project as large as a city in real time. Hsinchu Science City provides a unique opportunity to utilize some of the world's most sophisticated information technologies in the design, assessment, and monitoring of a new international high-tech node. A complete city with several thousand new technology firms based around two national universities and a national research lab will be the template for the plan. While focusing on Hsinchu, the concepts will be applicable to a far wider set of places. Concepts like jobs-housing balance, high density, and travel-intensive design systems, along with Asian versus Western housing styles and design approaches can be examined with geographic, economic, and visual modelling. The project's goal will be to design a computer modelling and visualizing system based on Hsinchu with applications anywhere. The computer modelling and visualizing system can be transferred to other locations and opportunities for analysis once it is developed.

Conclusion and Discussion

Technology chasing has definitely replaced smokestack chasing in the economic development lexicon. Building new physical forms for new technologies does not differ that much from earlier industrial development approaches. The primary difference in these strategies is well illustrated in Taiwan, where the nation is building communities rather than factory buildings "to suit." The goal is to follow the lessons of Silicon Valley, amplified in the literature by Saxenian (1990), and Blakely and Willoughby (1990), which show conclusively that the quality and presentation of the place or venue matters. Thus, Taiwan is basically changing its settlement form, visual appearance, and social instruments to accommodate or induce creative productivity. Balancing the physical, cultural, and social environmental aspects of this process is an enormous challenge.

The "jury is still out" on Taiwan's attempt to transform its economic destiny by re-creating itself as a technology developer versus a high-tech manufacturer with low-end products. However, the evidence available suggests few real alternatives, if the country wants to remain internationally competitive. Will a set of new towns with technology ingredients pave the way to a new future of the island nation? This we do not yet know.

What we do know is that attempting this approach in Taiwan leads to physical and social tensions with the existing environment. Because it is a clear physical form and operating entity, a great deal can be learned from the Hsinchu Science City experiment. New technologies are being pioneered to forecast as well as measure the economic, physical, and visual impacts of various alternatives. This decisionmaking support system represents a powerful resource not only for Taiwan, but for all countries and regions interested in re-positioning themselves for technology-based economic development.

REFERENCES

Blakely, Edward J. 1987. "Innovation in National Industrial Policy." *International Journal of Technology Management* 2(5/6): 731.

Blakely, Edward J., and Kelvin Willoughby. 1990. "Is it Mainly Transfer or Generation." *Journal Technology Transfer* 15(4), Fall.

Lugger, Michael, and Harvey Goldstein. 1992. *Technology in the Garden: Research Parks and Regional Economic Development*. Chapel Hill: The University of North Carolina Press.

Rees, James, and Harold Stafford. 1988. "Theories of Regional Growth and Industrial Location: Their Relevance for Understanding High Technology Complexes." In *Technology Regions and Policy*, J. Rees Towta, ed., N.J.: Rowan and Littlefield.

Saxenian, AnnaLee. 1990. "Regional Networks and the Resurgence of Silicon Valley." *California Management* 32(2).

Wu, C. T., and C. K. Leung. 1992. "High Tech Industries in Taiwan and S. Korea: A Comparison." Paper presented at the International Geographic Congress, Washington, D.C.