Toward a Sustainable Technopolis

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Abstract The chapter offers observations on what makes a technopolis sustainable, and how a technopolis contributes to the sustainability of society outside the technopolis' boundaries. Each technopolis project must attend to sustainability in the scientific/engineering arena, in the social arena, and in the arena of environment and the triple bottom line. The chapter offers criticism of common concepts of sustainability, suggesting that technopolis designers and scientists are well positioned to sharpen our views and practices regarding sustainability.

1 Introduction: Sustainability and Technopolis

It has been my privilege, over the course of a long consulting career, to visit many of the world's technopolis projects, including, here in East Asia, Hsin-Chu, Daeduk, Kansai Science City, Tsukuba, and Oita Prefecture. In 2006, I wrote down much of what I learned in these travels, in a book called *Social Culture and High-Tech Economic Development: The Technopolis Columns* (Phillips 2006), a book which emphasized the vital role of social capital in technopolis development. In this chapter, I would like to share, in keeping with the theme of this volume, observations on what makes a technopolis sustainable.

I take a broad view of sustainability, as indeed each technopolis project will have to attend to sustainability in the scientific/engineering arena, in the social arena, and in the arena of environment and the triple bottom line. I will go further, criticizing the foundations of our concepts of sustainability. I feel confident that

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Table 1 Technopolis success factors

Embracing change
Social capital, especially with cross-sectoral links
Cluster strategies that target specific company groups for collocation
Visionary and persistent leadership
The will to action
Action
Constant selling
Self-investment in infrastructure
Outreach and networking

Source Phillips (2006)

this audience includes the thinkers who can fill the gaps in the sustainability concept, and I present these gaps to you as a challenge.

Table 1 lists the success factors shared by thriving technopoleis. We will touch on many of these in this chapter.

It was also my privilege to attend and to publish (Phillips and Eto 1998) the 1997 Tsukuba Advance Research Alliance (TARA) Symposium on returning university research results to society. Japan's Technopolis Act was to be terminated in 1998 (Suzuki 2004), and Japan prepared to look to universities for a sustainable stream of commercializeable research. This is a first lesson in sustainable technopolis: Government technopolis initiatives may not last; universities endure. Private companies may not survive; but universities endure. Technopoleis hoping for a long run must leverage the presence of universities, and partner with them.

2 Scientific and Engineering Sustainability

2.1 Plan for Massive Tech Shift: Fujitsu and the 2025 Quantum Limit

The TARA symposium's highlights were the remarks of Mr. Takuma Yamamoto, who was soon to retire as Chairman of Fujitsu Ltd. Mr. Yamamoto repeatedly referred to the year 2025 as a kind of watershed. In 2025, he implied, everything would change for Fujitsu.

Curious, I talked my way past Mr. Yamamoto's bodyguards and asked the chairman, "What is going to happen in 2025?" Mr. Yamamoto replied that he expected chip design to hit the quantum limit to Moore's Law in 2025. Every Fujitsu factory involved in circuits, he said, would have to be redesigned, and that would be in the *best* possible scenario!

Progress has been faster than even Fujitsu expected, and current forecasts of the quantum limit range from 2014 to 2020. The limit seems less like a wall and more like a permeable membrane: In certain niches, slight progress has been made in

overcoming the barriers to Moore's Law. These include neural chips and quantum computing.

Nonetheless, new technopolis projects would be foolish to build expensive facilities that may be obsolete in four years. Instead, find science and engineering niches that will allow a long payback period on your infrastructure investment.

2.2 Plan for Cessation of Government Funding

An island in the Mediterranean procured a European Union grant for its technopolis project. An architectural competition was announced, and I was asked to be a judge. The island's ancient and wealthy aristocracy was bitterly opposed to the development. Thus, there were no funds for continuing the project after the EU grant was gone. Moreover, Europe's most prominent architects, who did not get paid, developed a bad attitude about the island and its prospects.

We all know that culture change takes a very long time. The EU did not take this knowledge into account when creating its technopolis grant program. The island's government did not take it into account when launching their project—or if it did, it used the knowledge for short-term political advantage rather than for a sustainable technopolis.

In Japan (Suzuki 2004), the national Technopolis Act terminated in 1998, and the government moved to a policy focused on promoting venture business and links between industry and universities. At the prefectural level in Oita, however, local funds and initiatives continued to build tech and non-tech clusters, Governor Hiramatsu's ties with MITI continuing to serve the region well.

A member of the Oregon Council for Knowledge and Economic Development complained that the financially strapped State slashed funds for nurturing the knowledge economy, but at the same time increased funds for roads and bridges. This complaint is naïve, both from a political perspective and a business perspective. Legislators do not know what "knowledge economy" means. Marketing such an abstract concept to the government, demands cleverness and perseverance.

Roads and bridges get built and maintained in all parts of the state, creating blue-collar jobs everywhere. What could be more appealing to a state legislator? In contrast, technology and knowledge jobs cluster in the districts of the state that are already more privileged. These are few, compared to the number of rural and old-economy districts.

History shows the necessity of keeping the roads and bridges open. After the crashes of 2001 and 2008, however, legislators suspect that the knowledge economy is a flash in the pan or another fraud perpetrated by dotcommers and Wallstreeters.

Smart and sustained effort must be aimed at selling the knowledge economy to political leaders. With luck, you can find high tech companies whose interests are aligned with the technopolis', and recruit their seasoned lobbyists to sell the technopolis project to the government. Even then, do not count on the government being your friend.

3 Social Sustainability

3.1 Godfathers

The government is not your friend, but *individuals within the government may be your best friends.* It is beneficial for the technopolis if these friends are re-elected reliably. Then too, an influential individual who is *not* in government may be a technopolis' most effectively advocate and energy source.

The next table lists the "godfathers" of the world's best-known technopolis regions. The asterisks show those who served from government positions. In this sample, the ratio of government godfathers is just more than half.

The godfathers are super-networkers, connecting entrepreneurs, financiers, researchers, legislators, and other technopoleis, harnessing them to the cause of the local technopolis. The godfathers exert a social force, causing others to want to be close to them, and to show a public spirit, in support of the technopolis, perhaps in excess of that to which they would be naturally inclined (Table 2).

Unless your region has an extraordinary amount of research/technology push (like Boston, for example), an extraordinary amount of entrepreneurial pull (like Israel), or both (like Cambridge), or an extraordinary amount of money (like Washington, DC), you should hope that a godfather emerges and jumps to the front of the parade in your locale.

3.2 Social Capital

History matters. Your region may *leverage* a history of science and entrepreneurship. Or, your region may have to *overcome* a history of insufficient education and hostility toward private business.

There is a patent for cloud seeding (rainmaking), filed in the name of the king of Thailand. The Korean alphabet is attributed to a king of Korea. Though we might view these as instances of politically adept inventors allowing their kings to claim

Table 2 Godfathers of established techno-regions

Austin, Texas	George Kozmetsky
Curitiba, Brazil	Jaime Lerner[a]
Hyderabad, India	Chandrababu Naiu[a]
Oita Prefecture, Japan	Morihiko Hiramatsu[a]
Silicon Valley, California	Frederick Terman
Singapore	Lee Kwan Yew[a]
Sophia Antipolis, France	Pierre Lafitte[a]
Taiwan	Morris Chang

[a] Holders of political office

credit, there is more to the story. The king's name, associated with a technological advance that benefits the entire population, does much to influence a culture of innovation for social betterment. In contrast to Thailand and Korea, all technological advance in dynastic China was solely for the amusement of the emperor. It will be difficult for China to overcome this and to establish a view, within the government and among the people, that technology can benefit everyone.

Social culture, says Harvard Professor Howard Stevenson, determines:

- A region's propensity to reinvest the rewards of business success in still more local businesses—rather than in real estate or offshore bank accounts—and in the social welfare of locals.
- A region's attitudes toward the success of others. Does the society ostracize entrepreneurs, or celebrate their successes?
- A region's willingness to embrace change.

The sociologist James Coleman (1988) defined social capital as "the ability of people to work together for common purposes in groups and organizations." Where there is social capital, Fukuyama (1995) claims, there is wealth. Voluntary civil and civic organizations, each of a scope that is wider than family-level yet not organized by state or national governments, show a technopolis region's confidence that it can shape its own future.

External as well as internal networking is an important aspect of social capital. Visits to other technopoleis can build valuable, lasting networks. When they are just a way to find out what other people are doing, the trips are of limited value. A region with historical disadvantages will have to do something original and different from what has gone before.

The will to action—and actually taking action—are the final aspects of social capital that I will emphasize today. As Peter Drucker said in the context of the 1980s manufacturing crisis, "What we have to learn from the Japanese is not what to do, but *to do it."* All the knowledge, money, and infrastructure in the world, Drucker implied, cannot substitute for will, attitude, and follow-through.

3.3 Grassroots Versus Government-Directed Technopolis Alliances

Japanese research shows that designated technopoleis in that country grow faster than other regions, despite having no financial assistance from the central government. One must beware of circular reasoning here; The technopolis regions were identified by the government *because* of their superior potential. Yet the conclusion that it is the characteristics of the region, rather than government help that makes success, is strong (Kyaw 2001).

In his research into obstacles to new technology parks and clusters in Japan, published in *Technological Forecasting and Social Change,* Hajime Eto (2005)

concluded that "Cultural factors such as value gaps between the two worlds (government bureaucracy and engineering culture) are… responsible for the unsuccessful outcome of S&T policies."

Peter Hall (1998) analyzed historic creative cities, showing their heydays lasted, on average, a few dozens of years. North (1990) gives wealth-creating economies a few centuries. It is reasonable to think that today's pace of technological change will narrow these windows. Each region must choose a technological pony to ride toward economic development. Today those ponies get winded sooner. The region's external network is also the means for finding a fresh pony. Every region that builds wealth on an industry cluster must, in a few years, stake its next wealth-building strategy on a new or redefined industry.

Should an aspiring technopolis region depend on government support, or drive progress locally? In this section, I have emphasized that local characteristics—including the propensity to network and drive progress locally—are key success factors; that the gap between government and technical cultures is a wide one; and that continual self-renewal is the name of the game, which implies a flexibility that government may not be able to deliver. In an earlier section, I stressed the political risk in extending government assistance to projects that might be seen as helping the few rather than helping the many. Furthermore, regions may feel a responsibility to absorb available government funds, rather than to produce projects of real merit.

All these things speak to the desirability of local, grassroots technopolis initiatives rather than dependence on government initiatives. It cannot be denied, though, that government measures have had terrifically beneficial results. Accomplishments like Hsinchu and Oita are absolutely spectacular and much to be praised (notwithstanding that the Hsinchu park is just now experiencing a turbulent time due to reallocation of central government funding[1]). I conclude that *even with central government support, vigorous local and private initiatives are necessary.* The efforts of Stan Shih and Alvin Tong at Hsinchu are good evidence for this conclusion.

Austin's success was very much grass-roots. There was never a massive government allocation for an "Austin Technopolis," though there were smaller grants for individual projects supporting the technopolis. We always asked local governments for small amounts of money, just to make them feel part of the effort. When a major initiative or success was rolled out, we invited government officials to the press conference. If an impression was created that the credit for the success should go to these officials, so much the better.

[1] *TIME* magazine March 23, 2009: "At Taiwan's Hsinchu Science Based Industrial Park, home to many of the island's flagship tech firms, most workers are taking unpaid leave at least one day a week. Ryan Wu, chief operating officer of the job-search website 1111 Job Bank, say conditions at Hsinchu have never been so dire. 'There's extreme panic right now', Wu says".

3.4 Sustainable Technopolis Initiatives

In all but the most blessed regions, sustained initiatives are a necessary condition for ultimate regional success. By the late 1990s, several local initiatives had shown excellent results in Austin, Texas. Start-up and established companies in software, equipment for oil exploration and semiconductor manufacturing, and computers were flourishing. A number of these initiatives' movers and shakers had done well financially; they were tempted to say, "I've got mine, buddy, good luck with yours." There was, in fact, less public sentiment in favor of continued civic initiatives for entrepreneurship. Good had proven to be the enemy of better; people were content. The present author was not inclined to fight an uphill battle to continue the initiatives. Another civic leader, however, argued against resting on our laurels, insisting the public–private cooperative initiatives were needed "now more than ever". Of course, the Internet bubble burst shortly after that, proving him right. Another impressive Austin leader now says, "Every morning I ask myself, what I can do today to make Austin the best place in the world to live."[2] Through the efforts of these gentlemen and others, Austin launched new initiatives for clean energy and for the computer gaming industry. The gaming initiative is flourishing today, and several energy companies have been launched.

There are no overnight successes. The technological renaissance of Austin, Texas, took 25 years—and by some yardsticks, much longer. The transformation of a region by means of technology entrepreneurship is a long-term process, and it is not unusual for a *crisis* to catalyze a region's entrepreneurial economy. Thus a long-lived regional initiative may be necessary, if only to ensure that the initiative organization is there to catch the crisis (whenever it may happen) and bend it to constructive ends.

Mukherjee (Mukherjee 2005) shows how the same pattern of government investment, slow infrastructure, and entrepreneurial development, followed by a crisis-generated opportunity (the Y2K problem) spurred Bangalore's growth in the twenty-first century. Mukherjee adds, "The 'sudden' buzz in Bangalore is actually just a new chapter in a 100-year-old saga. No amount of planning could have telescoped the process into 10 years."

A crisis in food production, accompanied by sharp increase in population, caused the launch of Greece's trade with Sicily, and thence the "rocketing" Greek economy of the sixth through fourth century (Hall 1998, p. 49).

Crises are not part of conventional cluster theory, which instead emphasizes a critical mass of suppliers and competitors. Critical mass was important for Austin and Bangalore, but it was not the whole story.

Three anecdotes, of course, do not prove that crisis is a needed ingredient. However, Portland, Oregon and Palma de Mallorca are instances of 'no crisis, no entrepreneurial transformation.' Even Washington, D.C., with its amazing collection of technology companies already attracted to the US federal money faucet,

[2] These two leaders were, respectively, Pike Powers and Jim Ronay .

Table 3 Top reasons for failure of cluster initiatives

Absence of an explicitly formulated vision for the CI and quantified targets
Initiative framework not adapted to the cluster's own strengths
No office or an insufficient budget for significant projects
Limiting the membership scope
Isolated firms and lack of competition
Lack of advanced suppliers
Basic human capital
Lack of trust and networks
Few supporting institutions
Weak frameworks
Facilitator not having a strong network
No involvement of influential local decision makers
Lack of consensus or difficulties in achieving consensus
No brand-building objective

Source Sölvell et al. (2003)

experienced a new burst of activity in security-related technologies subsequent to the 9/11 tragedy. We can be comfortable agreeing with Linstone and Mitroff(1994), who declare, "Crisis may be the best, if not the only, teacher of how to create an economy that is better matched to the needs of today's world."

These concepts allow us to pinpoint the serious risks in using cluster theory or cluster consultants to kick-start a new technopolis:

1. Cluster theory is mechanical ("put this firm here and that company there…") and ahistoric. The mechanical metaphor of cluster theory imposes a mechanical "solution" that ignores the constraints and opportunities implied by the region's history.
2. The question of how the community responds to crisis is not dealt with.
3. A short-term cluster consultant is not an ongoing network facilitator/partner for the client region, and cannot help with the long-term culture change issues that the region almost certainly must face.

Better to call your technopolis initiative a "regional initiative for technology and entrepreneurship" or RITE, than a cluster initiative (CI). Many of Sölvell et al.'s (2003) reasons why CIs fail, however, also apply to RITEs (Table 3).

4 Environmental Sustainability and the Triple Bottom Line

Sustainability, I've never seen a precise definition of it. I probably wouldn't recognize it if I saw it. It sounds like a good thing, though.

The eminent dean of a leading school of environmental science snorted when he was asked about sustainability. The whole notion, he replied, seems to run counter

to the second law of thermodynamics. At another extreme are advocates of minimizing the impact of people on the planet. Their subtext implies minimizing the *number* of people on the planet. At still another extreme are economists like Solow (1991), who believes everything is sustainable because the price mechanism moderates input substitutions.

We can suspect the dean of taking too literal a view, and suspect the earth advocate of hating people. The economic theorists continue to ignore the externalities that create the environmental problems in the first place. The City Club of Portland (2000) cited one source that advised, "Decouple economic development and population growth from environmental impacts." This is a physical impossibility. Is there a constructive middle ground that is scientifically feasible?

Nothing we do will be sustainable for the very long run. We depend on solar energy (as the dean was no doubt thinking), and the sun will eventually die. Meanwhile, every social process degrades energy, in the aggregate.

- Sustainable cannot simply mean "static;" that would mean the end of innovation and the start of excessive regimentation in all spheres of life. Climate change (that portion that is not anthropogenic) would proceed in any case, and society and the ecology would have to change and adapt.
- Can "sustainable" mean "capable of evolving in a steady, manageable way?" No. There are always Black Swans. Global warming is only one example, and it is one that is more predictable than most.
- People, profit, and the planet? We can all get along sweetly and live lightly on the planet, and still get hammered by a rogue asteroid. Only through technology can we hope to reduce the probability or consequences of an asteroid collision, and better technology will do it better. A static society, creating no new technology, is no answer.
- Notwithstanding that many subsistence economies have lasted for hundreds of years, and have been portrayed by historical writers as noble and fulfilling, we cannot equate sustainability with subsistence regimes. Without surpluses and redundancy, such economies are vulnerable to environmental change.

On what time scale is it realistic to speak of sustainability? How wide are the limits of change, within which we're still willing to say a system has been "sustained?" An impressive number of sources agree the time span is a few generations. The City Club of Portland, the President's Council on Sustainable Development, Sustainable Seattle and others say "for generations to come;" "present and future generations;" "our children and grandchildren." This view sensibly leaves scope for changing the plan when conditions and technologies change.[3]

Thinkers and activists urge companies to attend not only to profits but also to their impacts on the environment and on society. People, profit, and the planet (P^3)—can this view be sustainable? Whether the dialog is cast in terms of P^3 or E^3

[3] Section 4 up to this footnote marker is verbatim from Phillips (2008a, b).

(Environment, Economy, and Equity), technopolis thinkers can help advance it by attending to life-cycle perspectives on products and technologies, and to biomimetic technologies and market mechanisms for recycling/reselling "waste." P^3 also implies taking care of (providing new habitat for) the poor who will be left homeless by rising sea levels. Is renewed mining in warming north polar regions immoral? Of course not. If done carefully, it's part of P^3. Naturally, forensic investigations will reveal who some of the culprits are in anthropogenic climate change. But the excoriated NASA official who said the climate will change with us or without us, and our major challenge is adaptation, was correct. Let's do less arguing about whose fault it is, and learn to do better as we invent preventive and adaptive strategies.

While the British Stern Review (Norris 2007) concludes, "It would be considerably cheaper to stop current climate trends than to try to adapt to a changed world," Norris goes on to note, "It is really hard to get [heat-trapping] gases out of the atmosphere once we put them there." It is a challenge to those in this audience, and to the scientists who work for you, to determine the facts and the best balance of prevention and adaptation.

I don't think adaptive strategies can rely totally on measuring and pricing externalities. (The carbon rights exchanges have been distressingly scandal-prone, according to *The Economist* magazine.) Does the idea of privatization of your city water supply scare you? If so, consider this more extreme example: You exhale CO_2 when you breathe…Will bourses for carbon rights lead to "pay for breath?" We will have to be very clever to design sustainable regimes that are not totally price-based. But we will have to design them.

All in all, sustainability is most workable as a concept when it is defined loosely. In any case, we will not be able to forecast with certainty the impact of a managerial act on people or on the planet any more than we can foresee the impact of a corporate activity on the financial bottom line. (Think about making a sales call on a new prospect, who may or may not purchase your product.) Why not? First, we don't know enough of the applicable science. Second, the complexity of environmental, medical, and psychological phenomena makes prediction error-prone. Third, the impacts on people, on profits, and on the planet will interact with one another!

There are many definitions of sustainability. Perhaps the most familiar is the Brundtland report's: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission 1987).

An admirable sentiment, but a suspicious one. Suppose I borrow money to buy a house that I will bequeath to my children. I may die tomorrow, and the market may go down, leaving the kids unable to sell the house for the amount of the debt. I have compromised their ability to meet their own needs. Suppose I borrow money to build a green business. Green firms face the same business risks as other companies; my children might inherit a profitable business, or they might inherit nothing, my assets wiped out by the bankruptcy of my enterprise. With no funds to

complete their education, they'll have to take out loans, and… well, you get the idea.

Should I then avoid all borrowing?

I cannot guarantee that I won't compromise the future. Should that be an excuse for doing nothing—taking no risk—now?

Obviously, no. A green future depends on innovation. Innovation needs to be financed via debt or equity. And that implies risk. In fact, abjuring risk compromises the future. We dither about the "value" of space exploration, for instance, when resources plentiful unto the *n*th generation are no farther away than the asteroid belt.

The US now has a nine trillion dollar debt. If that doesn't compromise future generations, I can't guess what does. Even fiscal conservatives admit that the large part of the nine trillion spent on bank bailouts was necessary, to keep the economy from death-spiraling.

Yet we continue to talk about sustainability. So I think we don't really believe a definition that emphasizes not compromising future generations. We do care about future generations, but we also have confidence that they'll be smart and compassionate enough to do what we do: Try to fix the broken things we've inherited; innovate boldly; and do what we can to create a better future.

Past generations have done this for us, thus proving that there *is* such a thing as a free lunch. Using a telephone is free, for example. (If you deal with certain mobile providers, you'll argue with that, but bear with me.) Your sixteenth-century ancestors had no phones. You did not personally have to invent the telephone. Yet you get to use a phone—solely by virtue of your luck in being born in the twentieth century.[4] Phone calls substitute for polluting transportation, so they're green. Free, green lunch.

We want to give our descendants more free green lunches. But that part about not compromising their ability to meet their needs—where did it come from?

It echoes injunctions of the Abrahamic religions:

- "Do not charge your brother interest, whether on money or food or anything else that may earn interest" (Deuteronomy 23:19).
- Jesus driving moneylenders from the temple (Matthew 21:12).
- The Koranic prohibition on the charging of interest, which it characterizes as oppressive and exploitative (Qur'an 2:279) (Institute of Islamic Banking and Insurance 2009).

One wonders whether the Brundtland report's slant on sustainability was underpinned, perhaps unconsciously, by the religious feelings of its writers. And, with our current economic mess having been driven by mortgage loans, one cannot call such an underpinning totally wrong-headed (Incidentally, the three Abrahamic traditions do not prohibit equity investment—equity is in fact the central principle

[4] Apologies to any 8-year-olds who may read this chapter.

of modern Islamic banking—notwithstanding that ownership can be exploitative as well).

Compared to the world of the Prophets, though, ours is more crowded, interdependent, and specialized. The few weeks we spent this year with no credit market to speak of were not the kind of weeks we would wish on our descendants. It is necessary and unavoidable that we lend and borrow when it seems wise to risk the consequences. The consequences may compromise future generations' assets.

I offer, with apologies to Dr. Brundtland, a modification of her principle: *Let us always do our best for the next few generations, while not compromising (too much) our enjoyment of the present, nor our capacity for taking bold risk.*

5 Cases

Additional data about Bangalore and Hsinchu round out the information given above.

5.1 Bangalore

The historic development of Bangalore's technoeconomy is shown in Table 4

5.2 Hsinchu

The Hsinchu Science-Based Industrial Park, opened in 1980, is administered under the National Science Council of the Executive Yuan. The park has 300 employees and is one of twelve science parks in Taiwan.

HSBIP now hosts 432 companies, and 17 more are approved for tenancy. Of these companies, 376 are domestic and 54 are foreign. Collectively they employ 130,000 people (average age 30), generate 1.2 trillion New Taiwan Dollars in revenue, and have given rise to 4,400 patents. HSBIP maintains relations with 24 "sister science parks" in 12 countries.

Only 1.3 % of HSBIP tenant company employees have Ph.D.s. This surprising fact brings us back to the park's name (science-based industrial park): Though it is commonly called a science park, it is really about manufacturing.

HSBIP officials attribute the park's success to the interaction of these factors:

- Environment and services
- Incentives and availability of venture capital
- Quality of human resources
- Industry clusters and industry-academic links for R&D.

Table 4 Bangalore timeline

1911	India's British rulers invited Nobel-laureate chemist William Ramsay to help select a site for a science school. Ramsay chose Bangalore
1950s and 1960s	Independent India's first Prime Minister Jawaharlal Nehru set up state-owned engineering companies near Bangalore to fulfill his vision of rapid industrialization. He selected Bangalore because of the talent available at the Indian Institute of Science, the school set up by Ramsay. Non-state companies like Motor Industries Co., a subsidiary of Germany's Robert Bosch Gmbh, moved to Bangalore to supply parts
1977	A socialist Indian government asked International Business Machines Corp. to leave the country after it refused to dilute its stake to 40 %. IBM's departure became an opportunity for entrepreneurs like Azim Premji, who was then running a Bangalore-based vegetable-oil business started by his father. Premji hired engineers and built his first minicomputer
1981	N.R. Narayana Murthy, an engineer who wanted to become a communist politician, changed his mind and set up Infosys Technologies Ltd. with $250 in Pune in western India. He moved the company to his hometown Bangalore in 1983 after Motor Industries gave him his first order
1996	Global companies panicked that the year 2000 date change would crash computers. Premji's Wipro Ltd. and Murthy's Infosys rewrote millions of lines of code for customers worldwide. Bangalore's software industry, which employed only 947 people in 1991, expanded rapidly
2005	Companies like IBM and Accenture Ltd. are hiring in Bangalore to cut costs. Meanwhile, Bangalore's homegrown software makers are competing for consulting contracts outside India that were once the domain of US and European technology companies

Source Mukherjee (2005), used with permission

The environment includes high quality of life at affordable cost, and business services including 24 h automated customs for tenant companies' exports.

Tax incentives/exemptions, government investment, low-interest loans, and "R&D encouragement grants" round out the picture of incentives. However, the success of HSBIP has led the Taiwan government to plan to discontinue tax incentives for high-tech, and transfer them to solar and green industries.

Tsinghua University (science) and Chiao-Tung National University (engineering) are located on the periphery of the park, enhancing industry-university cooperation. ITRI (the Industrial Technology Research Institute) also has two campuses adjoining the HSBIP, and runs incubators for new firms there.

6 Synthesis for the Future

Table 5 brings together the major themes of this chapter.

Table 6 summarizes additional views of a sustainable technopolis based on today's state of the art. It is a completely new way of doing business. New technopoleis cannot hope for sustainability if they follow the practices of the Table's left-hand column.

Table 5 Key factors for a sustainable technopolis

Social capital is an absolutely critical success factor
Leverage the presence of universities
Balance government support with local initiative. Diversify funding sources
History matters. So do crises. Do not be fooled by cluster theory Cultivate godfathers
Develop political savvy. Emphasize benefits to the many, not to the few
Try things that have never been tried before, but that leverage your region's strengths Act
Never give up
Re-examine the logical and scientific foundations of "sustainability"

Table 6 Shared prosperity initiatives compared with conventional aid efforts

Old Political Economy Approaches	Newer Shared Prosperity Approaches
Paternalistic; one-way initiatives and flows	Multilateral initiatives
Strategies imposed from top down	Multiple networked initiatives
Driven by a single issue or problem	Multidimensional, attacking related problems
Rigid	Flexible
Expensive	Inexpensive
Large-firm orientation	Entrepreneurial orientation, with the participation of large firms
Single industry/agency	Multiple sectors, diversified funding
Initiating entity and receiving entity seen as separate and independent	Presumes present or near-future interdependence of participating regions
"Developed and undeveloped economies" view. Strict accord with international product life cycle theory	Acknowledges tech leader and tech follower regions, but understands that useful innovation can come from anywhere
Program-based	Relationship-based; better able to respect and leverage cultural differences
Large-agency programs are prone to bureaucratic inertia and resistance to change	Network initiatives attract innovators and influencers in each region
Fixed or inappropriate metrics for success; often discipline-bound	"Fuzzy goals"; interdisciplinary, multiple-perspective, or transdisciplinary
Money-focused	Financially responsible, but recognizes that knowledge and sense of empowerment are as important as money to emerging regions

Source Phillips (2005, 2006)

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