Appendix: A Primer on Technology-based Economic Development

Part I, Economic Foundations:
An informal look, with special reference to Portland, Oregon

Economic development discussions always turn to the recruitment of foreign companies and the creation of jobs for a local population. These activities refer to the region's external flows: companies and people flowing in and out. We are concerned about growth inside the region, so why focus on what's outside the region?

We will use a thought-experiment to answer this question. A sealed, closed-loop economy may be possible in principle, with no immigration, emigration, or external trade, and with consumption only of locally produced goods and services. However, even the population of such a utopia will age. If they have not had babies in a steady, reliable fashion, labor shortages will ensue. This disruption to a delicately balanced economy may put it in a fatal tailspin.

What's more likely, of course, is that someone will decide to move (migrate) in or out. Or a local will decide he just can't live without a certain consumer product that's made only in Hong Kong.

How to pay the Hong Kong producer for this item? One answer, often used throughout history, is to export unprocessed natural resources. This has always resulted in the same outcome: makers of "high value-added" manufactured goods always enjoy such pricing power over natural resource producers that the latter end up impoverished, or colonized. In the modern world, economic colonization means foreign ownership of landmark buildings and resorts, and the snapping up of homegrown businesses by outside concerns. (This is why there are no corporate headquarters to speak of in Oregon.)

Closed-loop does not necessarily mean "subsistence." Wealth could increase in a closed-loop economy, as local innovations augment the productivity of local enterprises. In this case, cash or local manufactured goods can be exchanged for manufactured goods from Hong Kong once external trade commences. But Hong Kong and other regions can innovate as rapidly as our utopia, or more so, meaning that the race to innovate has been joined. The more innovative the region, the more its value-added exports are valued by foreigners. More export revenue accrues to the region, increasing the region's ability to import attractive goods, support local social services and develop local infrastructure.

This is why economic development officials emphasize growing jobs in the export sector. (Low labor cost can substitute for innovation, for a while, but not in Portland. The U.S. is a low-wage country compared to Sweden or Germany, but sky-high in cost compared to China, and Oregon has a higher minimum wage than many other states. Advantage can also be maintained in the short run by having an over-valued currency. Only nations, though, can revalue their currency - not states or

municipalities.)

In the modern world of taxation, only very rich closed economies would have even a small chance of maintaining their isolation. They cannot circulate the same dollar indefinitely in the local region. In fact, if the national and state tax rates sum to 33%, the dollar can only circulate three times before it's all gone. (That math is not quite right, but it's not far wrong.) Economies close to subsistence (read Nichols' *The Milagro Beanfield War)* can be stable for centuries, but inevitably succumb to colonization when taxed. If, that is, the tax dollars do not come back to the region through national/state programs and rebates. Capturing those programs can be an essential part of an economic development program.

Milagro Beanfield War is set in New Mexico. New Mexico has enjoyed local federal expenditure far in excess of the taxes it has sent to Washington. This is because of the huge federal laboratories at Sandia and Los Alamos. The labs, of course, do not employ many former subsistence farmers, but hire highly educated scientists. Wealth "trickles down," but New Mexico has a very skewed income distribution - that is, much income inequality. The state's population is not of a revolutionary temperament.[1] But where similar economic conditions exist in Africa and the Middle East, there is violence in the streets. (New Mexico is similar to Oregon in that it has a tiny population and a huge land area, with half the population concentrated in or near a single city. Significantly, though, Oregon has no large federal laboratories or military installations.) It is generally believed that social stability is served by a less-skewed income distribution, and this is why, for example, many politicians have striven to create a Mexican middle class near the U.S. border.

Income inequality can be ameliorated by redistribution, i.e., taxing the rich to feed the poor. This does not seem to be popular with Oregonians; we have a Sizemore[2] but no Robin Hood. In any case, redistribution reduces the economic surpluses that are available for investment in innovation. Moreover, additional unemployed individuals are free to move to Oregon, and a new round of redistribution would be needed, and the economy would spiral downward.

Huge income inequality on the one hand, and radical redistribution on the other are both unattractive and unstable. A more palatable path is that of *opportunity:* a socio-economic mobility that gives the less skilled/favored a chance to gather education, training, and wealth. Ideally, the upwardly mobile feel they have a stake in the social order, and in moving up the economic scale, they make room for other ambitious immigrants. Immigrants may come to Portland with or without a job. Unemployed arrivals can either increase Portland's wealth by filling a labor shortage,

[1] In fact, the Pueblo people, in a celebrated 1614 revolution, ejected the Spanish from New Mexico. Nichols refuses to admit that his novel and its two sequels were set in New Mexico, but in interviews has added nods and winks to the unmistakable clues in the text.

[2] Bill Sizemore is an Oregon small-government and anti-tax crusader.

or decrease it by demanding social services, or both.

Educated in-migrants, of which Portland attracts many, may start their own businesses, resulting in job growth. We must, though, recognize the difference between a small businessperson and a true entrepreneur. Conventional small businesses cut the existing economic pie into smaller pieces, sending that ever-diminishing dollar round and round. Entrepreneurs innovate (products, services, manufacturing methods, or business processes), thus making the whole pie bigger, via increased productivity and via increased exports. (It is worth noting that a new small business that does not innovate - say, a convenient dry-cleaning outlet - can still enhance the community's productivity by reducing trips and traffic. After a saturation point, however, one more dry cleaner will do little but reduce the income of the others.)

One problem with defining economic development involves the idea of "quality of life." It would be simpler to exclude this notion from the economic development discussion, and focus only on what can be measured by numbers of jobs and dollars. However, to see the relationship between exports and quality of life, let us consider the maquiladoras on the U.S.-Mexican border. These companies offer mainly low-paying jobs that are attractive only to single people. Young singles migrate from hinterland villages, send most of their wages home, and return home with their savings after they've accumulated enough to get married. None of those wages, except for food and rent, are spent in the border towns, and it shows in the towns' substandard infrastructure. Criminals prey on these youngsters who do not enjoy the close protection of their families.

If the quality of life were better in Laredo and Matamoros, if there were public investment in infrastructure, and private companies offering "family-wage" jobs, families would come to those towns and stay, and in a feedback process, the local economy and society would become ever more attractive. Giving locals a reason to spend locally is good. Reducing outward cash remittances is almost as good as reducing imports, and that is almost as good as increasing exports.

Thus, sustainability is not a new-age notion at all. Exports of value-added goods and services sustain a region. Every region needs its own export strategy. Japan has concentrated on goods, sending us cars and electronics; Switzerland on services, re-insuring our insurance companies and hosting our numbered bank accounts (well, yours, maybe, not mine). The U.S. has "exported" higher education, attracting the tuition payments of the foreign students who come to America for the best education.

These are the reasons that bringing in wealth from outside the region is the key to every region's economic development strategy.

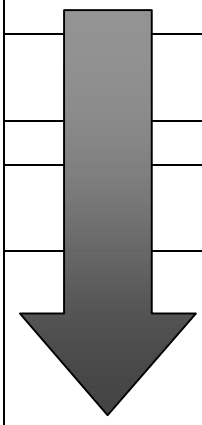
Part II, Economic Development Defined

In Part I of this Appendix, we looked at the economic foundations of economic development (ED), and made some effort to define ED. We did not, though, mention the role of technology in ED. In 1999, the Milken Institute (DeVol 1999) reported that two thirds of economic growth in the 1990s in U.S. metropolitan regions was due to high technology industry. As a result, today, more and more regions are attempting tech-based economic development initiatives.

A region's public and private technology infrastructure attracts the high-tech companies that create jobs. In turn, these companies contribute still more communications, health, education, transportation, and research infrastructure.

Various regions have made tech-based economic development efforts spanning a spectrum that is roughly described in Table A1:

Table A1: Levels of Tech-Based ED Initiatives

Naïve 	Produce more patents, licenses, and journal articles. Try willy-nilly to attract technology companies. Over-emphasize military-to-civilian tech transfer.
	Target and pursue companies that might form a viable cluster and enhance a distinctive regional identity.
	Balance recruitment, retention, and entrepreneurship initiatives regionally.
	Balance self-investment in hard and soft infrastructure, university and federal-lab tech transfer, and marketing efforts to attract and build companies.
Sophisticated	"Integrate and partner the academic, business, government, foundation, and not-for-profit sectors… [to mobilize technology as] a means of attaining economic, social and cultural status for individuals, as well as a way of achieving institutional objectives and ensuring the general welfare of society" (Kozmetsky 2003).

In Part II, we will further define economic development in terms of the activities that comprise ED, and then go on in Part III to explore what makes technology-based ED (which we will abbreviate as TED) different from any other kind of ED.

For effective ED, a locality must have a good product – sites, energy and water supply, schools, airports, optical fiber, and "business environment" – and sell it intelligently and energetically. This balance of hard infrastructure, soft infrastructure, and marketing is suggested by Table A2. Table A2 also details the assets and activities that comprise each of the three ED thrusts.

Good ED balances all three. However, technology changes with spectacular

rapidity. Revolutions in genomics and nanotech closely followed the fantastic developments in computing that transformed industries in the last decade. Marketing follows technology commercialization without significant lag. Because the middle column of Table A2 involves attitudes, social ("soft") infrastructure is the bottleneck limiting the pace of a region's transition to a technology-driven economy.

Table A2's "hard infrastructure" column indicates that ED is possible when companies have access to land, mobility, and reliable utilities, and the citizenry is productive by virtue of being fed, housed, healthy, secure, and connected to sources of information and education.

Parts of the Table's second column also have to do with the education, security and health of the populace, or "human capital." Other parts address social capital, i.e., people's propensity to form civic, trade and professional organizations, agitate for change and follow through on it, and communicate with like organizations in other techno-regions for business exchange and data-gathering purposes.

Table A2: The Three Elements of Economic Development

HARD INFRASTRUCTURE	**SOCIAL INFRASTRUCTURE**	**MARKETING**
Transportation	*Social capital*	*Outward marketing*
Sanitation/H_2O	Associations	To companies
Telecomm	Cultural mindset	To individuals and groups
Voice	Demographics	*Inward marketing*
Data	Entrepreneurial environment	*Targeting*
Wireless	External networking	Leading industries
Building/Construction	*Education / Training*	Leading companies
Housing	Pre-K through 12	• With technology products /processes
Corporate sites	Higher education	• Green/sustainable

Buildable lots	Workforce development	*Packaging/Positioning*
Public spaces	Continuing education	*Incentives*
Architecture	*Health Care*	To companies
Hospitals	*Government*	Self-investment
Schools	Planning	*Competitive intelligence*
Laboratories	Land Use Policy	*Support to existing businesses*
Security/Anti-terrorism	Permitting	
	Zoning	
	Tourism	
	Research	
	Law enforcement	
Taxation		

Government planning, zoning, and permit processes are an important part of the business environment that makes a locale attractive to companies. Tourism aids ED by bringing in dollars to local businesses, and by displaying the region's attractions to outsiders (at their expense!) who may later bring more trade or businesses in. "Research" includes creating new knowledge, new technologies, new uses for recent technologies, and new ways to support the transfer, productization, marketing and use of the technologies.

Target marketing (see column 3 of Table A2) implies a regional strategy: Local organizations cooperate to identify industries that fit with the region's strengths and aspirations and offer opportunities to capture company startups, relocations, and even headquarters. Targeting also means attracting new residents with desirable demographics, for example, families, retirees, affluent couples, or new college graduates. Competitive intelligence is the process of gathering and analyzing information to assess the fit, the opportunities, and the progress of rival regions.

Outward marketing means proactively reaching out to prospective companies, individuals and groups. Inward marketing means tracking and responding to incoming inquiries from prospects. Both are done well if they stick to a core message reflecting the "packaging," competitive positioning, and branding of the region.

Competitive intelligence also reveals what other cities are offering in order to attract relocations and entrepreneurs. The region can then calculate the prospects for payback on an incentive package, the "price ceiling" on any given recruitment

project, and the wisdom of joining any particular bidding battle. Incentives may be direct payments, variances or abatements to a company, or may be self-investment in university faculty positions, new university laboratories, new parks or roads, or airport renovations.

Marketing also includes the measures that governments and local organizations take to make startups and existing businesses feel welcome in the region.

Finally, taxation in the region and its component municipalities (and the states in which they are embedded) must, to the extent possible under many conflicting demands, finance all the above.

Aligning ED Goals: Fable of a Northwest City

Let us assume that a city council (specifically, the Portland city council) wants a liveable city with a growing tax base, and that residents want convenient jobs and shopping; safe neighborhoods; low taxes; and homes they can afford, with reliable, affordable utilities and good schools. Under these reasonable assumptions, the interests of citizens and city do not make a perfect alignment, and I haven't yet mentioned a third major actor in the Portland ED scene, the Portland Development Commission (PDC).

In the 1950s, the new concept of urban renewal, supported by U.S. federal funds, caused Portland to create PDC as the city's urban renewal agency. Urban renewal upgrades the infrastructure of blighted neighborhoods. In theory, the upgrade attracts residents and businesses, and in the long run, raises the tax base. This is economic development. Indeed, the elements of economic development are:

- Physical infrastructure (including transportation)
- Recruitment of relocating businesses
- Retention and growth of existing businesses
- Incubation of new businesses and encouragement of entrepreneurship
- Work force development
- Innovative organizations and partnerships that make the above activities work better in one city than in another city, and thus make one region more attractive than another for workers, executives, and firms.

Tax-increment financing (TIF) supplemented federal dollars as a way of paying for urban renewal. TIF temporarily freezes the tax base of urban renewal districts (URDs). This can create some discord in the community, as schools and other real community needs fail to see the funding increases they would get were the tax base not frozen. Discord in Portland got worse as federal matching money dried up, leaving TIF as the sole means of financing urban renewal, and thus the sole means of

financing PDC - and because of some abuses (ejection of families from long-established neighborhoods) on PDC's part in the agency's early days. The abuses gave rise to questions of transparency, accountability, and public input to PDC decisions.

Picking up on the convenience and cleanliness aspects of "liveability," the city opted for a high-density growth strategy, disdaining environmentally dirty industries. Both were worthy decisions. High density means lots of concrete gets poured per square foot of URD, perhaps bringing a higher payoff for TIF funding than other municipalities experience. However, high density also means there are few large campus development opportunities for companies; urban land is at a premium. Portland's bias against dirty industry shaded into a general anti-business reputation for the city, whose largest employer is a university. This put a damper also on prospects for relocation of corporation headquarters to downtown Portland buildings. Well-known as a planning-oriented city, Portland caused relocating companies to hesitate in ways they would not hesitate, for example, were they considering a move to Houston, a city that is known for free-market based land development and is poles apart from Portland in its approach, philosophy, and (some would say) liveability. Portland's embrace of clean multimedia, software, and creative services companies came curiously late, and though it has been successful in some ways, these companies are not becoming major employers.

Because of this anti-business reputation, and because TIF may only be used for physical infrastructure, the last five elements of economic development have gotten short shrift in Portland.

Several further forces affected the history of PDC and ED in Portland: First, the city never revisited PDC's mission after the agency's initial charter in 1957. The passage of time has rendered some aspects of the original charter irrelevant. Second, the amount of land under URD designation reached the 15% (of total municipal area) statutory limit. Third, there is not a strong chamber of commerce working to recruit, retain, grow, and launch businesses. PDC is "the closest thing" to an economic development agency in the city. Fourth, the trend toward regionalism – an approach to economic development that crosses city and county boundaries – in many parts of the U.S. conflicts with PDC's jurisdiction, which ends at city limits. Fifth, much of the land within recent URDs is owned by tax-exempt non-profit entities like Oregon Health & Science University and Portland State University. Urban renewal will not increase the tax base on this land.

For good reasons as well as bad reasons, then, PDC has essayed a course of "mission creep," taking on responsibilities and activities beyond what was originally envisioned. The definition of "blight" became nearly infinitely malleable. This lets additional neighborhoods look like worthy urban renewal projects once existing URDs sunset and free up their portion of the 15%. PDC sees its future as an

economic development agency, not just as an urban renewal agency. There is, however, no funding mechanism for non-infrastructure ED projects. PDC responds by (i) earning revenues by coordinating some ED activities of outlying cities, (ii) winning some state and federal grants, (iii) raising independent investments via the "Portland Family of Funds," and (iv) concentrating on infrastructure development at the expense of recruitment and business support activities.

PDC has filled a void in regional and city ED. Some say ED should happen outside PDC. This would be the end of PDC as an agency, because urban renewal seems to be going out of fashion. Some facts – e.g., that PDC is a public agency subject to open records acts[3], and some business recruitment projects are more successfully done in secret – simply mean that PDC needs private-sector partners who can take on these facets of economic development. PDC may indeed have the expertise to engage in ED, and as ED becomes more urgent (under globalization and a prolonged recession), PDC is the only major-league ED game in town.

The issue then becomes one of accountability and oversight. I view accountability as having these dimensions:

- *Transparency*. Taxpayers need to be able easily to find out what PDC is doing and how it is being paid for.
- *Sharing cost & risk.* PDC projects should not be seen as give-aways to private developers. PDC, and thus the city and the taxpayers, should share in the potential economic upsides of development projects in URDs (or wherever PDC's future jurisdictions take the agency) as well as the downsides. Realized upsides will help fund economic development.
- *Public input.* PDC must continue to hold regular public hearings, town halls, etc.
- *City-PDC relationship.* PDC must respond to the council's wishes, as the agency is a creation of the council, and *show* that it is responding to those wishes.
- *Business opportunities for small/new/minority developers.* Accountability and transparency demand that opportunities for development profits on URDs not be confined to a small, exclusive club.
- *Simple, clear rules.* Because Byzantine rules, customs and procedures amount to barriers to entry for new developers, another element of accountability is simplicity.

[3] In the U.S., laws that make documents and databases accessible by any citizen, if the compilation or publication of the information was paid for by tax monies.

This brings us to Table A3. It shows that every element of Table A2, without exception, may either be supported by technology or spur technological innovation. A region that mobilizes technology in most of the ways shown in Table A3 is a technology-based economy ("technopolis").

I have mentioned the possibility that a region's strategy may, admirably, target green and sustainable economic activities. This may lead to low-tech objectives, like more commuter miles traveled by bicycle rather than automobile, or it may lead to high-tech objectives like the manufacture of hybrid vehicles. The bicycle strategy is easily copied by other regions, and results in no comparative economic advantage, regardless of the real, absolute benefits of reduced pollution and a healthier population. Specializing in the innovative manufacture of a clean vehicle, on the other hand, yields a distinctive competence that is a sustainable advantage.

Table A3: Technology-Based Economic Development (TED)

HARD INFRASTRUCTURE	SOCIAL INFRASTRUCTURE	MARKETING
Transportation	*Social capital*	*Outward/Inward marketing*
Intelligent Vehicle/Highway Systems	Social networking online	CRM systems
Maglev, TGV, other advanced public transportation	Online meeting spaces, master schedules	Technology-oriented conferences, conventions
Modern international airport	Smart physical meeting spaces	
Sanitation/H_2O	*Education / Training*	*Target companies having…*
Water treatment, wastewater treatment, sewer system, pest control, water supply	Targeted retraining programs	Leading basic technologies
Telecomm	Enrichment programs, science fairs, science & tech museums	Green/sustainable technologies
Proximity to trunks, switches	Distance learning	Health care technologies
Last-mile infrastructure	New academic programs	Technology products and creative/support services for export to emerging world markets
Public access to Internet at libraries, kiosks, public wireless sites	University-connected new business incubators	

Building/Construction	*Health Care*	*Packaging/Positioning*
Advanced/appropriate construction methods, tools, software, materials	Telemedicine, home health maintenance	QOL, amenities for creative knowledge workers
Recently updated building codes	Teaching hospitals	Mathematical models for marketing analysis
Security/Anti-terrorism	*Government*	*Competitive intelligence*
Monitors, screening devices/procedures, reporting, 911 response	Digital government. Intercity technology development alliances	Knowledge Management
Search & rescue	Public-private technology partnerships	
Vaccine supply	*Tourism*	*Incentives*
Computer security expertise	Reservation systems; multi-media tourist information	Data mining tools for pricing and effectiveness analysis
	Research	*Support to existing businesses*
	Advanced researchers	Electronic clearinghouses
	Online collaborative research technologies	

The indented items in Table A3 reinforce the view of economic development

as the collection of efforts a region makes to cultivate a healthy economy. This is a general view of ED, but useful because it helps us avoid the tunnel-vision perspectives that ED is just recruiting or that ED is just infrastructure development. Again, a healthy economy requires a healthy, productive work force with access to information and education – the items in Table A3's first column support this – as well as export-sector companies that are attracted by success in all three columns and in turn finance the three columns' activities via taxes, payrolls, and donations.

The meaning and significance of most of the indented items are self-evident, especially in the first column of Table A3. Some in the other columns, however, want further explanation. Let us start with social capital. In Austin, a law firm maintains a pro bono web site listing all meetings of the city's technology-related organizations each month. This facilitates encounters between people who need to touch base with each other, and allows them to augment their project teams by meeting others with needed skills and interests. In Portland, project teams of OregonRAINS (Regional Alliance for Infrastructure and Network Security) meet in a virtual meeting space called eRoom. This software records all proceedings automatically, reduces highway traffic, and makes meeting attendance easier for members of this alliance for building Portland's computer security cluster. When FTF ("face-to-face") meetings are needed, the cities' smart meeting spaces, with videoconferencing, decision groupware, multiple projection systems, microphones and workstations at every seat, and other electronics make it easy to communicate complex ideas quickly. These spaces also make the city attractive for advanced research conferences and technology conventions that bring world knowledge leaders to the region.

Education is enriched by science fairs, student inventor and student entrepreneur competitions at the primary, secondary and collegiate levels. Guest speakers brought in via teleconferencing also enhance the learning experience, as do facilities for online experimentation at remote laboratories and online research collaboration. The benefits of university-connected technology business incubators are detailed elsewhere in this book.

Teaching hospitals make a city known for the most advanced treatment modalities and surgical techniques. These hospitals tend to be in large cities, so a regional TED strategy will include telemedicine to bring the benefits of advanced medicine to outlying areas. As populations age, the medical monitoring and home health maintenance industries will boom, and pioneers in these products will gain competitive advantage.

"Digital government" is an umbrella term for the ways government agencies facilitate communication, compliance, security and other functions of governance using information technology. (Useful sources on this subject include the newsletter dgOnline, published for the National Science Foundation by the Digital Government

Research Center at the University of Southern California, http://www.dgrc.org. View dgOnline online at http://digitalgovernment. org/news/stories/dgonline_latest.jsp.) Networking among techno-regions is essential for finding suppliers, customers, alliance partners, advice, companies that want to locate in a region like yours, and expansion sites for homegrown technology companies. This kind of networking is done through non-profit organizations like the Association of University Technology Managers, the World Technopolis Association, the National Business Incubator Association, and the Technopolicy Network. Governments also do this directly, viz., the "technology alliance" between the cities of Austin, Texas, and Curitiba, Brazil.

S&T museums draw tourists and conventioneers as well as students. Information services directing tourists to attractions and bargains advance the double-win: Tourists bring their own dollars to be exposed to life in your city. In what other industry do customers pay producers to watch their ads? Tourism applications are also a great way for the region's technology and arts communities to work together.

Distinguished, leading-edge academic researchers are likely to draw the best graduate students, generate patents and attract licensees, and create (perhaps via their students) spin-off companies. When they publish in short-cycle online journals, use the latest electronics for collecting data and sharing lab notebooks, conduct experiments at distant laboratories via remote-control waldos, and allow distant researchers to do the same with their own advanced equipment, this further increases the velocity of innovation.

In some ways, localities are farthest behind on the technologies of Table A3's third column, because public and not-for-profit entities have been slow to adopt the sophisticated marketing techniques of the private sector. CRM systems track the progress of prospects through the sales funnel, do contact management and generate automated messages and reminders. They enable database marketing by preserving data on customer/prospect preferences and responses.

These databases can be linked to competitive intelligence and market research reports, and statistically analyzed to optimize marketing programs.

Regions want to attract companies that produce a steady stream of innovative products that are important to large, fast-growing, industries. Ideally, these products should be not only environmentally friendly and export-oriented, but should enhance the region's TED goals by enhancing the health, wealth, and happiness of the region's population. Electronic markets, electronic auctions, and electronic data interchange can connect to local small businesses, allowing them to be successful suppliers to larger companies.

This explains the individual elements of TED. The possibilities for creatively and super-additively combining these elements seem almost endless. We will close with just four examples of these synergies:

1. Inter-sectoral cooperation lets these technological facilities be used most

effectively and in a way such that everyone need not, e.g., build his own smart auditorium. Sharing does not always amount to charity and need not be seen as a cost item. On the contrary, sharing allows people with different talents and similar goals to meet each other and get things done more efficiently. A regional development plan should anticipate and account for such synergies. (Without implying that it is a good example or a bad one, I refer the reader to http://www.oregonbusinessplan.org.)

2. Citizens and government officials who are knowledgeable about technology, active users of technology, and creative about applying technology in new ways to enhance their lives and their neighbors' lives, are important to this recipe. Examples include the legendary technopolis godfathers Mayor Jaime Lerner of Curitiba and Governor Morihiko Hiramatsu of Oita, and former Austin Mayor Kirk Watson and former Austin City Manager Camille Barnett.

3. In the high-tech region, government agencies and businesses (even small businesses) stay in touch with constituents through a variety of electronic means. See (Phillips, Donoho et al. 1997) for a detailed treatment of multi-media e-commerce.

4. In this era of globalization, technology executives' daily focus is well beyond city limits, and it is difficult to get them to make commitments to local community-building. The few who are committed locally, and who say (as one of my Austin friends does), "When I wake up in the morning I ask 'What can I do today to make Austin the very best place in the world to live?'" are a terrifically valuable resource.

Different regions will use this TED recipe in very different ways. However, the items detailed in these tables are the basic ingredients of technology-based economic development.

Part IV, A Taxonomy of Technology-Based Economic Development Initiatives[4]

Regions grow their technology-based employment by the means shown in Table A4.

[4] Part IV was co-authored by Fred Phillips, Bertha Vallejo, and Patricia Mhondo.

Table A4: Strategies for increasing technology-based employment

- Attracting new companies;
- Nurturing existing indigenous firms;
- Encouraging entrepreneurial start-ups;
- Providing a supportive educational, social, tax, quality-of-life, physical-infrastructure, and cultural context for research, technology entrepreneurship, and business;
- Networking with other regions worldwide; and
- Starting new kinds of institutions that integrate and/or support the five activities above.

As it is now widely known that a critical mass of complementary talent and technology is needed to firmly establish a knowledge-intensive industry in a region (Porter 1998), new local institutions often take the form of "cluster initiatives." Other regional initiatives also focus on just one or more of the bullet items of Table A4, without attempting complete integration of all of them. These varied initiatives, listed in Table A5, are the objects of this study.

Table A5: Types of technology development initiatives

- Entrepreneurship initiatives
- Cluster initiatives
- Technopolis initiatives
- Shared prosperity initiatives
- National systems of innovation
- Regional systems of innovation
- Investment promotion agencies

These several kinds of initiatives can be distinguished by their focus on one or more of the elements of Table A4: Their degree of central direction vs. decentralization, their inward-looking vs. outward-looking orientation, their degree and kind of internal and external networking, and so on. These are the dimensions on which this appendix examines each type of regional technology development initiative. Our aim is to clarify terms, and to help economic development (ED)

practitioners make wise choices when designing new programs under limited budgets.

While few existing initiatives attempt a total integration of all the activities of Table A4, it is also true that few find benefit in pursuing only one item to the exclusion of all others. For example, large companies can provide the technologies, management talent, financing, and ambitious entrepreneurs that are the essential ingredients for a vibrant new venture community. Large and medium companies are often the natural customers of start-ups. For these reasons, a regional strategy focusing solely on high-technology start-ups would have little chance of success; a balanced strategy is needed, reaching out to start-ups, SMEs and large companies alike.

This appendix will discuss each of the initiative types of Table A5, offering examples and evaluative remarks when possible. A discussion section will note overlaps and exceptions to our definitions and those in the literature. A summary will bring together the salient features of the various initiative types.

Entrepreneurship initiatives

Often energized by university centers or trade associations, these initiatives (called RITEs in Phillips (2005a), for Regional Initiatives for Technology Entrepreneurship) seek to foster technology entrepreneurship and intrapreneurship in the region. They do this via educational programs, incubators, competitions, student internships, mentoring programs, and networking/speaker events. Some, like the University of Oregon and the University of Texas, via their student entrepreneurship competitions, network local entrepreneurs with entrepreneurs outside the local regions, in order to expand the entrepreneurs' contacts and their sources of suppliers and alliances.

Most entrepreneurship initiatives now follow the largely successful model pioneered by the IC^2 Institute of University of Texas at Austin, in which the university, government, and corporate sectors work together to:

- Assemble the capital, entrepreneurs, technologies, and managerial experience needed to make a new company thrive, and
- Ensure the social, educational, and cultural climate are supportive for

entrepreneurs and entrepreneurship.

University entrepreneurship initiatives may ally with varied and rich sources of technology. These connect entrepreneurs with sources of ideas for improved products and processes. Washington State University's program is connected with Battelle-Pacific Northwest National Laboratories, University of New Mexico's with Sandia and Los Alamos, and University of Texas at Austin's with NASA. These connections help the national laboratories also, as, with decreasing budgets, it is in the labs' interest to help their talented scientists and engineers find entrepreneurial career alternatives.

Entrepreneurship initiatives suffer from several limitations, especially if the initiatives are not integrated into the context of a larger economic development program:

- As mentioned in this section's introduction, there may be insufficient connection with large companies. This robs the initiative of valuable potential entrepreneurs, technologies, management talent, and capital.
- Though it tolerates the entrepreneurship center, the university knows its major donations come from large corporations and not from startup entrepreneurs. The center finds it difficult to get the attention of the university president when it is needed.
- Small and family businesses – those that slice the existing economic pie into smaller slices – are far more numerous than innovative entrepreneurs who make the pie larger. Eventually the initiative finds it more profitable to serve the small-business market, which is willing to pay for good business advice.
- Contrariwise, it is difficult to find funding for initiatives to support high-growth entrepreneurship. Venture capitalists' rigid business model does not allow much in the way of promotional expenditures, and by the same token, VCs frown on university incubators' desire to take a small percentage of equity in assisted start-ups. Soon after these startups "graduate" from the incubator, they may experience changes in their top management; new managers with no memory of the incubator's contributions to their firm's early success hesitate to offer financial support to the incubator.

- It is widely acknowledged that no viable funding mechanism supports technology startups through the "Valley of Death," the period between proof-of-concept and prototype development. Though it is reasonable to suppose a public-private entrepreneurship initiative might solve this problem, none has yet done so in the U.S. Other nations taking less laissez-faire approaches to the matter have conducted companies across the valley of death, but there is debate about the efficiency of these approaches.
- The initiative may take too narrow a view of high technology, for example, looking only at IT or semiconductor sectors. Austin, Texas has successfully extended its entrepreneurship-facilitating efforts to the music and computer gaming industries.

Technopolis initiatives

These are the most heterogeneous of the initiatives discussed herein. Early Japanese efforts (Tatsuno 1986) were centrally directed, locally focused and concerned exclusively with large government and corporate laboratories. Modern technopolis efforts (Biswas 2004; Araki 2000; Gibson, Kozmetsky et al. 1993) are well-balanced in terms of industry sectors, company segments, decentralized planning processes and worldwide networking.

Technopolis efforts are also, among the initiatives examined here, the most comprehensive and ambitious in scope, with regard to a local/regional economy. Technopolis initiatives may in fact venture into city planning. (This was certainly the case with the first Japanese technopolis, Tsukuba, at which site a city was built from a greenfield, and also with Curitiba, Brazil.) Despite their local character, these initiatives were global "before globalization was cool," perhaps because of researchers' propensity to interact with colleagues worldwide.

While Tsukuba was almost exclusively research-oriented, modern technopoleis (e.g., Daeduk in Korea, where the World Technopolis Association is now headquartered) take pains to balance the value chain, collocating research institutes, manufacturers, suppliers, and distributors.

Because of their comprehensive, regional-growth orientation, technopoleis are

unlikely to focus on a single industry segment or cluster. Rather, they include several industries while remaining selective about the use of limited resources.

Technopolis growth requires cooperation among broad swaths of local interest groups. For this reason, these exciting initiatives are practical only where the hand of government is strong, where extraordinary public-private collaboration is possible, or where a charismatic "godfather" evangelizes a vision for the region (Phillips 2005a).

Cluster initiatives

Cluster initiatives build on the understanding (Porter 1998) that in the high-tech economy, companies and their suppliers jointly benefit from the exchange of informal knowledge that is made possible by proximity, and moreover, that after a critical mass of companies and employees is achieved, a "lock-in" effect ensures the further growth (or at least continued presence) of the industry in the region.

There is nothing unsound about the idea, and indeed cluster theory describes exactly (if not completely) many of the happenings in the last decades in Silicon Valley and elsewhere. However, perhaps because of the powerful Harvard (Porter's employer) marketing machine, economic developers have seized on this well-publicized concept without giving due regard to other options, or have attempted to create clusters where conditions did not justify it (see, e.g., Phillips 2005).

A few other features and limitations of cluster initiatives, in principle or in practice, are:

- Clusters may not involve advanced technology at all; the cluster concept is equally (or perhaps even more) applicable in low-tech industries where the transfer of tacit knowledge is a paramount consideration. Hence the furniture cluster of North Carolina.
- Cluster initiatives may focus exclusively on large firms to the exclusion of entrepreneurial startups.
- Cluster theory's focus on collocation and lock-in is mechanical and does not encompass the social and multi-dimensional characteristics considered by other types of initiatives.
- A focus on a single cluster industry precludes the cross-sectoral cooperation that

other initiatives may value, e.g., the connection of high-tech with local arts and tourism industries.

Shared prosperity initiatives

Shared prosperity (Kozmetsky and Williams, 2003; Kozmetsky et al, 2001; Marshall, 1999; Phillips 2005) is an idea as closely related to political economy as it is to economic development. It has to do with sharing knowledge with neighboring and distant regions for purposes of accelerated development of both advanced and emerging regions. For these reasons, shared prosperity initiatives (compared to the other kinds of initiatives discussed here) place more emphasis on external networking.

Under entrepreneurship or cluster initiatives, resources are concentrated in order to build companies or the critical-mass presence of certain industries; the subsequent sharing of wealth outside the target group is implicitly left to passive "trickle-down" mechanisms. In contrast, shared prosperity initiatives adopt equity as an explicit goal. Shared prosperity is not about giving a larger share of fixed resources to the less well-off. It is about pooling knowledge and innovation in order to make the economic pie bigger for everyone.

Shared prosperity, then, implies promotion of social/political stability and avoidance of armed conflict, via increased interaction among regions and reduced income inequality. Shared prosperity initiatives recognize that modern development depends as much on exchanges of knowledge and "the sense of possibilities" as it does on transfers of funds. High technology enters the shared prosperity equation because technology industries are visibly knowledge-driven, making them industries in which knowledge and empowerment are truly more important than money. This is because innovation, driven by knowledge and empowerment, should attract investment in the free market, making traditional government aid transfers unnecessary.

Excellent examples of shared prosperity initiatives are the projects of the IC^2 Institute (University of Texas at Austin) in Belize (Gibson, Cotrofeld et al. 2004) and on the Texas-Mexico border (Gibson, Rhi-Perez et al. 2002).

Obstacles to shared prosperity initiatives are:

- The new awareness of the power of networking for policy-making is diffusing slowly among political decision makers. (Notwithstanding that networking for individuals' professional benefit is a well-accepted principle!) Because network-based initiatives tend to be decentralized, it is not yet clear to governments how such initiatives may be "directed."
- Similarly, governments and corporations are accustomed to controlling project via their purse strings. The idea that shared prosperity depends on knowledge exchange and transfer of empowerment even more than it depends on funding is one that most institutions have not yet assimilated.

Systems of innovation

In contrast to neoclassical economists' focus on profit-maximization and market variables, the Systems of Innovation (SI) approach comprehends the interplay of economic development agents in a more dynamic way, highlighting the role played by the demand side in the innovation process (Lundvall 2002; Nelson 1993). SI shifts attention to the interaction of the system's actors: knowledge producers (e.g., universities), users of knowledge (e.g., industry), producers of basic research (e.g., R&D departments or centers), and, users of applied research (e.g., firms).

Literature on SI as a framework for analyzing technical or technological change has grown rapidly since the early 1980s. While there is no single, universally accepted definition of the SI concept, there is a consensus that its relevance lies in highlighting the interactive linkages among the components of the system, and the linkages' effects on the innovative activity of economic agents in the geographic or sectoral area of interest.

"Systems" are sets of interconnected elements ("building-blocks") standing in interaction within an environment, exhibiting their own internal dynamics. Innovation systems have three main characteristics. They are *open* to other systems; *evolving* constantly, as they are exposed to transformative pressures from the outside and to institutional learning from inside; and, they are *social* systems, shaped by and shaping human action. Innovation systems are open and evolving but their characteristics and ways of operation have deep historical roots. Examples include the Swedish Iron

Cannons Company's systematic innovations in casting techniques from 1630 through 1670 (Davistown Museum undated), or Danish Agro (Christensen et al. 2005).

There is a certain level of agreement among scholars that innovative performance depends on the nature of the linkages and relationships among the components of the system (OECD 1997). However, there is no consensus on what constitutes the innovation system's building blocks, their relevance, or their roles in innovative activity. The main actors recognized in the SI literature are knowledge-performing sectors (i.e., universities, research institutes, and technological centers), firms and governments. Due to the different roles that these actors play in different environments, and their unequal importance in various historical times and contexts, there is ongoing debate on the nomenclature for defining the components of the system and the roles they play in innovation.

Broadly speaking, a system of innovation is made up of components, relationships and attributes. *Components* are the operating parts of the system, consisting of individual actors, organizations, physical or technological artifacts, and institutions. Inter-organizational networks or linkages constitute the system *relationships*, and interactive learning processes give shape to the *attributes* of the system.

SI has been conceptualized both in narrow and broad terms. In the narrow sense, SI includes the organizations and institutions, such as knowledge centers, directly related to searching out and exploring technological innovations. Authors defining SI in broad terms address all habits, routines, practices, rules, norms and laws which regulate the behavior and interaction of the system's agents, and all interrelated institutional actors that create, diffuse, and exploit innovations. In both contexts, the SI concept rests on the premise that "understanding the web of interaction among the agents involved in innovation is essential to improving technology performance and national competitiveness (OECD 1997; Lundvall 1988, 1992; Johnson 1992)."

As a framework of analysis, the SI concept offers a new approach for understanding innovation in a more dynamic way (Mytelka 2000). It recognizes the importance of knowledge in the economic development of a country, as well as the

nature of institutions involved in its generation, and the relevance of the use of the systems approach (OECD 1997).

The study of SI involves formal economic theories, such as division of labor, evolutionary theory and economic growth. It is an integrative theory, making use of knowledge from innovation and industrial dynamics, economic development and economic geography. Innovation systems are also a tool for historical analysis (e.g., Freeman's 1997 and Nelson's 1993 studies on Japan and the U.S.), and a tool for policy makers in re-aligning sector policies. It is an analytical framework micro-founded in the user-producer interaction as well as inter-organizational learning and work-interactions including diverse modes of organization and intra-organizational learning. Learning is fundamental in SI, as it underlies social capital and economic development, which in turn are crucial for the valorization of intellectual capital[5].

The systems of innovation framework embraces all important determinants of the innovation process and helps trace the relationships among its components (governments, industries, firms, academia, institutions) in the development of science and technology (OECD, 1997). In tracing these networks, SI authors have found different levels and/or channels of interaction between the building blocks of the system of innovation.

The first and most basic level is the interaction between firms (ECLAC, 2002). Firms in the business sector play a fundamental role in economic and technological development (Galli and Teubal 1997). In particular and most strikingly, firms improve their innovative performance through cooperation (OECD 1997).

The ways firms interact, compete and innovate have evolved, and in the new competitive world, require more complex articulation than in the past. Informal linkages and contracts, alliances, competitive pressures, movement of personnel and personal exchanges are some of the informal channels through which knowledge flows among institutions. Closer links between customers and suppliers are also essential for the innovative activity of firms (OECD 1997). The user-producer interaction is another critical parameter for innovative success (Lundvall 1992; OECD 1997). The newer, more expansive view of this interaction allows firms to

learn from their clients and suppliers, and fosters technology transfer at the consumption and production level.[6]

Other important channels for knowledge flows in innovative processes are the interaction between departments and functions within the firm in "search and problem solving" activities (Freeman 1997; Gjerding 1992), as well as in-house and contractual R&D activities (Teece 1988). Technical collaboration between firms (e.g. R&D collaborations and strategic technical alliances), equipment procurement, joint ventures, cross-patenting, and mergers and acquisitions are also important channels for knowledge transmission between enterprises. These kinds of interactions induce technology transfer at the research and development level (Muller, 1999); in diffusing knowledge and technology between firms; and in improving their organizational routines, products and process innovations and diversification, vertical integration and horizontal diversification (Teece 1988; OECD 1997; Oyeyinka 2002).

In order to achieve the benefits of interaction, and to be able to produce new forms of knowledge and achieve higher levels of innovation-related skills, a firm requires certain knowledge bases or learning capability (Ernst et al. 1998; Mytelka 2000; Oyeyinka 2002). According to Dosi (1988), this cumulative knowledge capability of the firm defines the technological paradigms[7] that the firm is able to follow in order to achieve further innovations. The codified and/or tacit knowledge that the firm has "stockpiled" will allow it to continue on a certain trajectory of technological innovation (Dosi 1988; Mytelka 2000; Oyeyinka 2002).

However, these interactions among firms (or industries) are not a sufficient condition for innovation to occur. There are other agents in the system (e.g., universities, research institutes, financial organizations and governments) that contribute to the way interactions take place. When these components of the system are added, a second level of interaction is reached. These other agents constitute

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[5] See Michael Woolcock's (e.g., 1998) work for more on social capital and economic development.

[6] Here Johnson and Segura-Bonilla (2001) cite a 1999 working paper (in Danish) by J. Müller of the University of Aalborg.

[7] Defined as 'the needs that are meant to be fulfilled, the scientific principles utilized for the task, the material technology to be used… [They are] a pattern of solution of selected techno-economic problems based on highly selected principles derived from the natural sciences… a set of exemplars, and a set of heuristics' (Dosi 1988, pp.224-225).

important parts of the environment in which the agents perform. This wider network of interaction among the SI actors plays a fundamental role in the innovative activity of the economy, increasing or decreasing the firms' opportunities to improve their technological capabilities (OECD 1997; ECLAC 2002).

Linkages among the business sector, research institutes and universities promote knowledge generation by diffusing and linking the different kinds of knowledge generated in them. Each actor in the R&D-performing sector performs a specific function in knowledge generation. Universities generate basic and generic knowledge; R&D institutes are mission-oriented knowledge producers and finally, applied research and technology development is the competence of the business sector (Galli and Teubal 1997; OECD 1997).

This interaction among the system's actors occurs through diverse channels. The most common channels for formal interaction among knowledge user-producers are, *inter alia:* joint-technology projects, joint-research activities, specific research contracts, market transactions, unilateral flows of funds, skills and knowledge, and financing of staff and researchers (Galli and Teubal 1997; OECD 1997). Informal channels such as contracts or social relationships are also important in knowledge flows and access to technical networks.

Interaction among agents with different orientations, purposes and natures brings more complexities to the system. In addition, the macroeconomic environment in which the SI is settled has important effects on the performance of the innovation process.

All the macroeconomic features, social interactions, rules and policy restrictions and formal and informal institutions shape the system, have an influence on the way agents interact, and, as a consequence, shape the innovative activity of the economy. This is what ECLAC (2002) considers the third level of interaction.

Together, these three levels of interaction give shape and character to the "system of innovation" concept.

Innovation systems have been defined at different levels according to the units of analysis, levels of interaction and scope considered in the analysis. Thus, in the SI

literature we can find diverse approaches, such as[8]:

- Transnational innovation systems (Cantwell 1989),
- National Innovation Systems (Freeman 1997; Lundvall 1988, 1992)
- Regional Innovation Systems (Cooke 1998)
- Local Innovation Systems, or Industrial Clusters (Porter 1998)
- Sectoral Innovation Systems (Malerba 2004)
- Corporate Innovation Systems (Granstrand et al. 1992)
- Technological Systems (Carlsson et al. 2002)
- Triple Helix (Etzcowich and Leydesdorff 1997)

Although these different conceptualizations of SI differ in scope, they should be seen as complementary rather than as rivals. Among them, perhaps the most widely diffused has been the sectoral and national perspectives. The sectoral system of innovation is another widespread SI-approach. It is based on the idea that different sectors or industries operate under different technological regimes which are characterized by particular combinations of opportunity and appropriability conditions, different degrees of cumulativeness of technological knowledge, and different characteristics of the relevant knowledge base (Carlsson et al. 2002, p.236).

A National System of Innovation (NSI) is seen as a system that creates and uses innovation and competences. An NSI analysis addresses not only industries and firms, but also other actors and organizations, primarily in S&T, including governments' roles in technology policy. The analysis is carried out within national boundaries and it fits both with the focus on technological capability and the focus on institutions. Although science communities appear to become global and the national level seems to be losing relevance in this era of globalization, "…as long as national states exist as political entities with their own agendas related to innovation, it is useful to work with national systems as analytical objects (Lundvall et al. 2002, p.215)."

When considering SI as a framework for analysis in developing countries, it is important to remember that it is a concept originating in developed economies, based on empirical findings in developed countries. However, countries differ substantially

[8] For a more detailed comparison of the various system approaches, see Carlsson et al. (2002).

in their organization and characteristics, levels of public and private financing of research institutes, R&D and S&T expenditures as a percent of GDP, and institutional factors, and their innovative and learning capabilities (Niosi et al. 1993; OECD 1997; Johnson 1992). As a consequence, the performances of innovation systems are not uniform among countries. The availability of data regarding innovative activities differs substantially among countries, as does comparability of data.

Patents, scientific articles, publications, citations, literature and firm-surveys are some of the direct indicators used to measure productivity in SI studies. However, such measures are not available in the same degree (or at all) in different countries. Alternative indirect indicators commonly used in measuring innovative vitality in systems of innovation are R&D and S&T expenditures as a percent of GDP, production and trade of high-tech products, and others (Niosi et al. 1993; OECD 1997; ECLAC 2002).

Other factors to be considered in measuring the performance of the SI are the ownership nature and size of its units (Gregersen 1992; Lundvall 1992), and the regional distribution of the innovative components of the system, usually measured through network analysis and/or cluster analysis (Mytelka 2000; Oyeyinka 2002).

Different levels of performance among countries and among innovation systems are explained by differences in levels of interaction between the actors of the system; mismatches between basic and applied research in the public and private sector; effectiveness of technology transfer institutions; and information and absorptive differences among the enterprises and other actors of the system (OECD 1997).

It is precisely these differences between countries that make SI a strong analytical approach. SI analyses identify the relationships among the interacting economic participants in the innovation process and highlight interrelationships among policies. SI is a concept that focuses attention on failures or weaknesses in the system, which affect the innovative performance of the region, industry, sector, or country. It offers new rationales and new approaches for policy-making for enhancing the innovative capability of firms (OECD 1997; Mytelka 2000).

SI brings the proven and powerful tools of system analysis to the study of

TED, and valuably establishes this study outside the ivied walls of the economics department. Though the ultimate goal of the SI approach is to enable strategic interventions in the system, it is not clear that this has yet been accomplished. SI has, however, led to some enlightening new comparative views of innovation in different countries, e.g. Lundvall and Tomlinson (2000).

As with the other initiative types analyzed here, there are some risks attached to the systems of innovation approach. SI is a *reconceptualization*, re-framing ideas from innovation theory and economic geography in systems-theoretic terminology. One risk is that researchers, reveling in the new reconceptualization and busy translating old ideas into new terms, may not actually add new knowledge to our understanding of technology-based regional economic development. A second risk involves the respect of the scientific community. Researchers with a background in systems science, watching organizational behavior scholars' discovery of "systems thinking" in the 1990s (due to the work of Peter Senge), reacted much as the Arawaks might have in 1492, had these Caribbean indegenes seen a newspaper headline announcing "Columbus discovers America." Finally, SI seems more popular in Europe than in the U.S., and one hopes methods and terminology will not diverge so far that transatlantic networking of initiatives becomes difficult.

Investment promotion agencies

In order to discuss investment promotion agencies in context, we must make a brief digression into the meaning of foreign direct investment (FDI), its importance, and trends and determinants of its flows.

Foreign direct investment: Definitions and trends

According to the IMF and OECD definitions (Duce 2003), direct investment comprises a lasting interest by a resident entity of one economy (direct investor) in an enterprise that is resident in another economy (the direct investment enterprise). The "lasting interest" implies the existence of a long-term relationship between the direct investor and the direct investment enterprise and a significant degree of influence on the management of the latter. Foreign direct investment gives the investor a controlling interest in a foreign company (Daniels and Radebaugh 2004, p.11). This control distinguishes direct investment from portfolio investment. When two or more

companies share ownership of an FDI, the operation is a joint venture.

FDI includes corporate activities such as plants or subsidiaries in foreign countries, and buying controlling stakes or shares in foreign companies. It does not include short-term capital flows (Progressive Policy Institute, undated). There are two ways companies can invest in a foreign country. They can acquire a controlling or influential interest in an existing operation (acquisition or merger) or construct new facilities (Daniels and Radebaugh 2004, p. 251). The latter is called a greenfield investment.

Foreign direct investment is thought to be more desirable for the invested region than non-controlling investments in the equity of its companies. This is because portfolio investments are so mobile they may be withdrawn as soon as a better opportunity arises elsewhere. FDI is generally patient whether things go well or badly in the short term[9]. By generating employment, raising productivity, transferring advanced managerial skills and technology, and enhancing exports, FDI plays an important role in regional development strategies, particularly contributing to the host region's industrial and technological development.

In recent decades, different factors have helped to bring about an increased growth rate in FDI worldwide. These include rapid increase in technology, liberalization of government policies on cross-border movement of trade and resources, development of institutions that support and facilitate international trade and increased global competition (Daniels and Radebaugh 2004, p. 7).

Developed countries remain the prime destination of FDI, accounting for more than three-quarters of global inflows and more than 90 percent of outflows. Flows to developing countries rose from $158 billion in 2002 to $172 billion in 2003, but varied by region. Inward FDI to the Asia-Pacific region reached $107 billion, up from $95 billion. Latin America and the Caribbean, however, experienced a fourth consecutive year of decline, although it was marginal, from $51 billion in 2002 to $50 billion.

FDI inflows to Africa totaled $20 billion in 2004, only 3% of global FDI inflows (UNCTAD, 2004). Africa recorded 28% higher inflows in 2003 ($15 billion,

up from $12 billion in 2002), driven mainly by natural-resource projects. The structure of FDI in Africa remains skewed towards primary products, although inflows to services are rising.

Quality Foreign Direct Investment

The quality of FDI inflows is connected to the depth of involvement of the investment project in a host country, the participation in technology-intensive projects or the generation of knowledge spillovers to the host country (Kumar 2002). Quality FDI brings jobs, strategic technology, knowledge and skills to the host region. It is export-oriented and encourages sustainability of the region's or the country's balance of payments. Quality FDI is also expected to comprise long-term, environmental friendly investments, with sustainable production linkages with local companies.

Determinants of inward FDI growth

This section lists the factors that determine FDI inflows into a given geographical location. Each factor reassures investors that they may expand their sales, acquire needed resources and minimize business risks. Not all factors are equally important to every investor in every location at all times.

- *Regional trading blocs* (RTBs) are essential determinants of FDI. These represent various forms of economic integration among countries. They are designed to promote cross- or inter-country trade and mobility of factor services from within member countries by fostering a more market-oriented pattern of intra-regional resource allocation.
- *Language and business culture* are also determinants of FDI inflows. In a destination where, for example, English is commonly spoken by the majority of the population, one would expect more FDI inflows from English speaking countries than if the case were otherwise.
- *Tax exemptions, tax holidays or tax reduction* for foreign investors, and similar incentives can play a positive role in attracting FDIs into a given destination. Some other types of incentives that may play similar roles include

[9] http://economics.about.com/library/glossary/bldef-foreign-direct-investment.htm

guarantees against arbitrary treatment in case of nationalization.

- *Labor availability* and relatively low labor costs, high skills and efficiency are important factors determining FDI inflow into a given destination.
- *Economic and structural reforms* in a country are very important in winning foreign investors' confidence to take their investment funds there. Such reforms can be very wide and far-reaching. The reforms involve the relaxation of entry restrictions in various sectors, deregulation in various industries, abolition of price controls, easing of controls over mergers and acquisitions and trade practices, removal of government monopoly, privatization, independence of the Central Bank, elimination of import licensing, removal of foreign-exchange, exchange rate and interest rate controls.
- *Non-discriminatory treatment* of investors, consistency and predictability in government policies are also among the FDI determinants. Investors need to be in a position where they can plan their activities efficiently within the policy environment of the government. Those government policies that directly or indirectly affect investments should be reliable, accessible, up to date and widely publicized.
- *Economic growth* in turn determines market prospects. It is more likely that FDI will flow more to destinations with promising economic growth both in the short and long run.
- *A country's membership in a binding multinational investment agreements and institutions* concerning FDI can reduce the perceived risk of investing there. When the risk of investing in a location is reduced, we expect to see an increase in investments there. Such agreements include several bilateral investment treaties and double taxation treaties. Among the organizations that have an impact on the flow of FDI are the World Intellectual Property Organization (WIPO); the convention establishing the Multinational Investment Guarantee Agency (MIGA); the Convention on the recognition and enforcement of foreign arbitral awards; the Convention on the settlement of investment disputes between states and nationals of other states.
- *The presence of investment opportunities and natural resources in* a country,

needless to say, is another important FDI determinant.

- *Attractiveness of the host country's market*: A large domestic market implies a greater demand for goods and services and therefore makes the host country more attractive for FDI.
- *Infrastructure development*: Good infrastructure increases the productivity of investments and therefore stimulates FDI flows.

Strategy and organization for investment promotion

Wells and Wint (2001) define investment promotion as "activities that disseminate information about, or attempt to create an image of the investment site and provide investment services for the prospective investors". Promotion includes the granting of incentives to foreign investors, the screening of foreign investment, and negotiation with foreign investors, which is normally conducted by organizations dealing with investment promotion activities.

The national policy context is an integral part of effective investment promotion. An investment promotion agency (IPA) will find it difficult to market and promote its location unless the basic policies to facilitate FDI are in place. As UNCTAD (2004) argues, an FDI-enabling framework is a pre-condition. The enabling framework includes macroeconomic policies, investment policies and a degree of economic stability. For an effective IPA strategy, it is important that there is clarity of objectives with a strong logic behind them. The size, structure and priorities of the IPA will be influenced by why a country wants to attract inward investment.

Effective investment promotion is focused on targeting key sectors or industry clusters. Where to focus depends on the country's objective is and what the country wants to promote. That is, does it need new greenfield investment, expansions by existing investors, joint ventures, M&As, or other types of strategic partnerships? If the country's objective is to focus on sector size or on sector positioning, then that is where it will target its investment promotion**.** Singapore Economic Development Board (SEDB) is an extreme example among IPAs in that it will not support investors unless they are in target sectors or clusters.

Incentives can and do affect investment location decisions (Loewendahl,

2001). Some of the incentives that attract FDI include tax reductions, national, regional, or local grants, and other special purpose incentives, employment incentives, recruitment and training assistance and site or infrastructure improvements. However, emphasis on incentives varies considerably across regions. For example, the Industrial Development Agency (IDA) in Ireland, SEDB and Investment, Trade and Tourism of Portugal (ICEP) are among the few agencies in the world that have control over incentives and can put an "offer on the table " to an investor even before they have committed to invest. At the other extreme, Denmark does not offer any incentives at all for foreign investors. In the middle of this spectrum, the Portland (Oregon) Development Commission is organized to obtain a quick consensus on incentive offers from many constituent agencies and neighboring governments (Doctor, Albers et al. 2005).

Main functions of IPAs

Governments compete to attract foreign direct investment into their regions, and establishing an Investment Promotion Agency has become a central part of most countries' development strategies (UNCTAD 2002). Since the early 1990s, governments have been establishing Investment Promotion Agencies (IPAs) with the specific objective of attracting inward direct investment, which brings needed capital and access to international markets. As investors have many good locations to choose from, IPAs must promote the attractiveness of their region by making investors aware of its investment opportunities, by improving the region's image, and by providing an enabling investment environment. According to UNCTAD (2004), today there are over 500 IPAs worldwide, and the number is increasing steadily.

These are institutions established to coordinate investment activities and encourage investment flows into a country. They have a role in communicating and disseminating investment information to investors. IPAs also have a role of coordinating most activities aimed at improving the business environment in the host country. This role can range from providing assistance to potential and existing investors in their daily problems to lobbying for key policy and legal reforms (World Bank 2003). Investment promotion can be divided into four main activities: Strategy and organization, lead generation (targeting and marketing), facilitation (project

handling), and investment services (after-care services).

Morisset and Andrews-Johnson (2001) list the major functions of IPAs:

- *Image building* is the function of creating the perception of a country as an attractive site for international investment. Activities commonly associated with image building include focused advertising, public relations events, and the generation of favourable news stories by cultivating journalists, etc.
- *Investor facilitation and investor servicing* refers to the range of services provided in a host country that can assist an investor in analyzing investment decisions, establishing a business, and maintaining it in good standing. Activities in this area include information provision, "one-stop shop" service aimed at expediting approval process, and various assistance in obtaining sites, utilities, etc.
- *Investment Generation* entails targeting specific sectors and companies with a view to creating investment leads. Activities include identification of potential sectors and investors, direct mailing, telephone campaigns, investor forums and seminars and individual presentations to targeted investors. Investment generation activities can be done at home and overseas.
- *Policy advocacy* consists of the activities through which the agency supports initiatives to improve the quality of the investment climate and identifies the views of the private sector on that matter. Activities include surveys of the private sector, participation in task forces, policy and legal proposals, and lobbying.

Hurdles for the further development of IPAs are:

- In the race for maximizing FDI flows into developing countries, policy makers often tend to overlook the quality of incoming FDI. Investment inflow still tends to be short-term, low-technology and labor-intensive. In order to be more competitive, developing countries need to attract more long-term manufacturing sector projects, involving high technology and capital-intensive methods of production.
- Developed countries have used IPAs effectively in their process of development;

it is now the turn of developing countries to use them.

- FDI statistics are published for nations rather than for regions. It is difficult for regions to use public statistics as a policy tool, or generate their own regional statistics.
- IPAs may experience controversy regarding their level of autonomy (Doctor, Albers et al. 2005).

Exceptions and hybrid initiatives

Many techno-regions led by "godfathers" – Austin, Curitiba, Oita and Hyderabad come to mind – have been driven more by the force of their personalities than by the specificity of their goals. It is, therefore, difficult to categorize the initiatives that have taken root in those cities. Especially when they are not elected officials, godfathers find it expedient and constructive to utilize "fuzzy objectives" (Phillips 2005) that blur the taxonomy.

That these initiatives are not readily pigeon-holed does not reduce their effectiveness. The Portland Education Cluster[10] adopted its cluster initiative mission only after its third meeting. To draw people who might have been reluctant to commit to participation in a cluster initiative, the organizers billed the first events as simple social networking for executives in the city's education-oriented companies. A proposition was put forth that if the group were to find common interests that could be advanced by common effort, more meetings would be held. Otherwise, they could enjoy each other's company, go home after a pleasant evening, and no more would be said. The bottom-up energy that spurred working groups and a web site led to the group's coalescing as a cluster project that has kept the initiative thriving since 2003.

Further comparisons and summary

Regional entrepreneurship initiatives and cluster initiatives share an emphasis on internal and external networking, on learning, and on exchange of information and skills.

Though technopoleis may involve many industrial clusters, technopolis

initiatives predated our formal understanding of knowledge industries' positive returns to scale, which is the underpinning of high-tech cluster theory. If early technopolis initiatives were effective in building clusters – and it is clear that they were – it was because of historical happenstance and because of the initiative organization's informal, seat-of-the-pants grasp of what is needed to build a modern industry. (And in the case of government-led technopoleis, because of the governments' ability to muster resources outside the market price system.) In addition, technopoleis usually involve public-private partnerships that work to build a local presence in several industries rather than just one cluster.

Sölvell, Lindqvist et al. (2003) find that a dedicated facilitator is essential to cluster initiatives. Technopolis and shared prosperity initiatives, in contrast, need a godfather or godmother with much more social status, connectivity and clout than even experienced professional facilitators can bring to bear.

Nonetheless, cluster initiatives and entrepreneurship initiatives have many common concerns and features. Sölvell, Lindqvist et al. (2003) show that cluster initiatives are growing common even in technology-follower regions, involve cross-sectoral cooperation, and depend on a regional vision for the future. The latter, in turn, depends on intensive discussion, networking, and consensus-building.

We find systems-of-innovation (SI) approaches to be more scholarly and passive. Like the others, SI zeroes in on networks as the key phenomenon. Rather than *doing* networking, however, SI approaches *study* existing networks. While other initiative types for the most part recognize the primary importance of metropolitan regions, SI researchers study national, transnational, regional, and sectoral innovation systems with equal interest.

Table A6 summarizes the key features and differentiators of the types of initiatives discussed above.

Table A6: Technology-based ED initiatives: Key features compared

	Goals	Geographical focus	Degree of central direction	Orientation and kind of	Theoretical basis

[10] http://www.portlandedcluster.com

				networking	
Entrepre-neurship initiatives	Encourage innovation. Build supplier base. Balance the ED strategy. Enrich educational offerings.	Metro area. With state universities, may have state-wide mission. There are some national entrepreneurship organizations.	Little.	Mostly within the local entrepreneurial and investor community. Some (like Texas' Moot Corp™) network worldwide.	Finance. psychological and sociological theories of entrepreneurship. Otherwise, experimental and experiential.
Cluster initiatives	Build self-sustaining mass of supplier/ manufacturer/ customer companies in one or a few industries.	Metro regions.	Little.	Intra-industry.	Information economics (positive returns). Economic geography.
Technopolis initiatives	Sustainable, diversified technology economy for the metro region and hinterlands.	Metro regions.	Technopoleis in e.g. Japan, Korea, still very much government initiatives. Elsewhere, reliance on public-private partnerships.	Internal (but cross-sector) and external networking. External networking is to link to other cities at similar levels of development.	Strategic technologies. City planning. Social network theory. Mapping of industry flows; input/output analysis. Marketing.
Shared prosperity initiatives	Equity. Stability. Diversify sources of innovation.	Networks of regions.	Little government involvement in early stages. Decentralized initiatives.	Focused on selected neighboring or distant regions. External networking dominates.	Political economy. Development economics.
National systems of innovation	Understand the linkages among all actors in the innovation process, and ultimately enable purposeful intervention.	Nations.	Implied that decisions to inter-vene in system will be centrally directed. Higher degree of govern-ment initiative/ direction than other initiatives.	Interactions among local actors and between these actors and a generalized "environment."	Systems theory. Economic geography. Selected parts of economic theory. Theories from diverse other disciplines.
Regional systems of innovation	Understand the linkages among all actors in the innovation process, and ultimately enable purposeful intervention.	Regions.	Implied that decisions to inter-vene in system will be centrally directed. Higher degree of govern-ment initiative/ direction than other initiatives.	Interactions among local actors and between these actors and a generalized "environment."	Systems theory. Economic geography. Selected parts of economic theory. Theories from diverse other disciplines.
Investment promotion agencies	Encourage inward direct investment.	Nations or particular districts within nations.	Government-led in most of the world; occasionally led by private chambers of commerce.	Internal networking for current available facilities; external networking for potential investors.	Marketing. Finance. Labor economics. Logistics. Others.

There are many kinds of economic development programs other than those seen in Table A6. These have been excluded from discussion here because, generally

speaking, they are of less interest for technology-intensive regions or regions wishing to become technology-driven. We have, for example, excluded tax-free Enterprise Zones and Export Zones (EZs). EZs, because of their location or because access to them is restricted, are unlikely to generate the knowledge spillovers that are the lifeblood of a techno-region. EZs are short-term measures for increasing port activity or for increasing small-business opportunities for low-income people, and are valuable for those purposes. They are unlikely, however, to offer tax revenues, long-term jobs, significant attraction for venture investors, or diverse improvements to urban infrastructure.

The near-universal embrace of technology-related objectives by economic development organizations has given rise to the variety of initiatives discussed in this appendix. The authors hope the "annotated taxonomy" offered above will help those involved in economic development to conceptualize and operationalize ED projects more effectively.