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Incubating and Networking Technology Commercialization Centers among Emerging, Developing, and Mature Technopoleis Worldwide[1]

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Abstract: The ability and desire to access knowledge and to be able to learn and put knowledge to work is central to regional economic development and for globalization to be a force for drawing the world together. This chapter presents the logic, conceptual framework, and key elements for leveraging codified knowledge and tacit know-how through Internet and web-based networks and face-to-face communication and training programs. The objective is to accelerate regional economic development and shared prosperity through globally linked and leveraged Technology Commercialization Centers (TCCs) and to enhance the competitiveness and accelerate the growth of select regionally-based SMEs.

Keywords: Incubation; Innovation; Commercialization; Entrepreneurship; Knowledge creation, diffusion, and adoption; Networking.

Introduction

Technology continues to shrink the world. There is no choice other than to participate in the global community. Science and technology is too precious a resource to be restricted from drawing the world together. That is what the 21st century is all about. (Dr. George Kozmetsky, Chairman of the Board, IC² Institute, The University of Texas at Austin)

This chapter is focused in the belief that technology can be a force for drawing the world together and that the ability to learn, and put knowledge to work is central to regional economic development. Building on these two beliefs the authors present the logic, conceptual framework, and elements of a strategy for leveraging codified knowledge and tacit know-how through Internet and web-based networks and face-to-face training programs to accelerate technology-based economic development through globally linked and leveraged Technology Commercialization Centers (TCCs) to accelerate the growth of select regionally-based small and medium sized enterprises (SMEs).

The suggested plan brings together business entrepreneurs, academia, and regional government in targeted emerging, developing, and mature technology regions or Technopoleis worldwide. Each TCC will be viewed as an 'experiential learning laboratory' where lessons learned will be used in world-class research, education, and training programs. The activities described in this chapter are designed to function as an integrated program which, over time, will contribute to and leverage local and global initiatives for knowledge transfer, accumulation, use, and diffusion to accelerate sustained economic growth and shared prosperity worldwide.

The ongoing 'communications revolution' is making the tasks of globally linking public/private collaboration and knowledge acquisition, transfer, and adoption at least feasible. Indeed, there are two important advantages for today's SMEs that were not available to entrepreneurs in the mid- and late-1900s:

[1] Technopoleis (Greek for technology and city state) are regions of accelerated wealth and job creation through knowledge/technology creation and use. Innovation is the adoption of 'new' knowledge—knowledge that is perceived as new by the user.

(1) The distance canceling power of Internet and web-based communication; and consequently.
(2) The possibility of global access to talent, technology, capital, and know-how by leveraging and partnering through modern information and communication technologies (ICT).

This 'death of distance' as Frances Cairncross (1997) puts it, reduces the inherent economies of knowledge clusters and opens up the field to new entrants. These developments appear especially promising for the developing world, potentially enabling them to economically tap into informational and technical sources hitherto available only in mature technopoleis. The proposal to accelerate the development of globally linked TCCs is based on the realities that:

(1) few regions in the developing world can hope to match, at least in the short-term, the physical and smart infrastructure of established technopoleis such as Silicon Valley, California and Austin, Texas, where there is an overwhelming agglomeration of technology, talent, capital, and know-how; and
(2) regional, national, and global computer-based networks in the knowledge age allow for, if not encourage, the development of non-geographic bound or virtual technopoleis.

A key question for the 21st century, therefore, is how necessary and sufficient is the regional development of 'smart' infrastructure in all its aspects (i.e. talent, technology, capital, and know-how) or physical infrastructure (i.e. science parks, incubators, and high-tech corridors) in the emerging internet-based economy where the movement of knowledge is increasingly through ICT? And it may be asked, which sectors or components of this infrastructure must be physically co-located or digitally networked at different stages of firms becoming globally competitive?

As a starting point we focus on the importance of fostering entrepreneurship at the grassroots level. To do this we target small and mid-sized technology-based enterprises (SMEs) that might be considered relatively successful at the local level but are in need of assistance (e.g. talent, technology, capital, and know-how) to achieve accelerated growth and global market penetration. At the moment that these virtual networks are created around the SME, it becomes a Learning & Innovation Pole (LIP).

A LIP is operationalzed at the most basic level as an SME that is linked to other SMEs in an Internet and web-supported global network and also has access to a range of support activities such as training programs, workshops, and mentoring activities. Rather than relying on a well-defined geographic area to provide all of the networks and services required for success in knowledge-based economic efforts, LIPs rely on regional and global cooperative and collaborative networks and training programs to provide service and assistance on a real-time, as-needed basis. LIPs will be able to shift and grow to take advantage of emerging opportunities and market needs.

While physical proximity is becoming less and less important to regionally-based economic development because of the pervasiveness of advanced ICT, successfully fostering the growth and global competitiveness of select SMEs in targeted regions will take more than computer-based networks and web connections. There needs to be a sense of community and relationship building. There needs to be local visionaries, champions, and implementers. And to sustain the regional and global partnerships and alliances there needs to be a meaningful flow of know-how and resources and win-win partnerships among all members of the network.

Conceptual Background

Traditionally, wealth creation in developed and developing nations, has emphasized physical assets. The capital stock of a nation was thought to be a measure of national prosperity, and the attraction of foreign direct investment became a prime strategy of less developed regions. As the world moves into the 21st century, however, the emphasis is on knowledge transfer, accumulation, adoption, and diffusion as being critical to economic development. As the World Bank noted in its 1998 *World Development Report*:

> It appears that well-developed capabilities to learn—the abilities to put knowledge to work—are responsible for rapid catch-up ... The basic elements (to develop these learning abilities) appear to be skilled people, knowledge institutions, knowledge networks, and information and communications infrastructure.

This section provides a summary of the theory of knowledge transfer, accumulation, and use to create a better understanding of the process through which knowledge and learning can be leveraged for regional economic development. Knowledge transfer, adoption, accumulation, and diffusion are key to sustainable economic prosperity in the emerging global economy of the 21st century. As stated by Abramovitz & David in a 1996 OECD report, "The expansion of the knowledge base ... (has) progressed to the stage of fundamentally altering the form and structure of economic growth". Rapid advances in information and communication technologies and declining costs of producing, processing and diffusing knowledge are transforming social and economic activities worldwide (The World Bank, 1998).

While the current knowledge revolution is resulting in many positive outcomes, there is concern that it is accelerating the polarization of the 'haves' and 'have nots'. Scientific and technical advances have increased the economic welfare, health, education, and general living standards of only a relatively small fraction of

humankind to unmatched levels. The unevenness of such development among, and within, both developing and developed regions has increased significantly. Two hundred and fifty years ago, for example, the difference in income per capita between the richest and poorest countries in the world was 5 to 1. Today, the difference is approaching 400 to 1 (Landes, 1998). The underlying reasons for these inequalities are complex and, according to most analyses, are to be found in the outcomes of the social and economic revolutions that pre-date the current knowledge revolution. While the industrial revolution lowered the costs of manufacturing and distribution, over time this economic and social revolution also tended to divide the world into industrialized and non-industrialized nations and fostered bi-modal societies of wealthy and poor.

The current knowledge revolution is critically different from the past industrial revolution. It is based upon a shift of wealth creating assets from physical things to intangible resources based on knowledge (Stevens, 1996). Knowledge-based economic regions tend to be located near leading universities and research centers in the most advanced regions of the world (Quandt, 1998; Smilor, Gibson & Kozmetsky, 1986). Lucas (1988) argues that people with high levels of human capital tend to migrate to locations where there is an abundance of other people with high levels of human capital. Indeed, the importance of the physical proximity of talent, technology, capital, and know-how or 'smart infrastructure' has been argued to be crucial to fostering regional wealth and job creation (Audretsch & Feldman, 1996; Audretsch & Stephan, 1996; Gibson, Smilor & Kozmetsky, 1991; Rogers & Larsen, 1982).

Despite the strong arguments for the importance of physical proximity or agglomeration of 'smart infrastructure', advances in telecommunications and information technologies are transforming our perceptions of geography (Cairncross, 1998). Advances in ICT are key to explaining the shift from the industrial age—coal, steel, and material items—to a global knowledge-based age—information, human capital, and ideas. While it is still difficult to realize what William Mitchell (1995) calls 'cities of bits'—where the majority of the world's people are connected through telephones, televisions, faxes, and computers to a world-wide web—key influencers in business, academia, and government are increasingly realizing opportunities to use the special characteristics of knowledge and ICT to foster regional development through cooperation, collaboration and competition.

A better understanding of the process through which knowledge and learning can contribute to economic development in developing as well as developed regions is urgently required. In this regard, it is important to define knowledge and to realize how it differs from physical things (Dosi, 1996). Here we follow the analysis of Conceição et al. (1998), who build on Nelson & Romer's (1996) differentiation between ideas and skills, or software and wetware.

- Software ('ideas'): Knowledge that can be codified and stored outside the human brain, for example in books, CDs, records, and computer files. Software (as defined here) is referred to as the 'structural capital' of private and public organizations and includes intellectual property that is codified (Edvinson & Malone, 1997). When employees leave their place of work the software remains.
- Wetware ('skills'): Knowledge that cannot be dissociated from individuals, is stored in each individual's brain, and includes convictions, abilities, talent, and know-how. Wetware is referred to as the 'human capital' of private and public organizations and is the know-how or intangible resources that provide key added-value for enterprise development and accelerated growth (Edvinson & Malone, 1997). When employees leave their place of work the wetware leaves with them.

These two kinds of knowledge differ: (1) in the way they are produced, diffused, and used; and (2) in the level of codification. While ideas correspond to knowledge that can be articulated (in words, symbols, or other means of expression), skills correspond to knowledge that cannot be formalized or codified. This apparently simple difference has very important consequences in terms of the way knowledge is produced, diffused and used.

The classification of knowledge in this manner is very significant in the context of this paper which aims to use Internet and web-based links to accelerate growth and job creation. The transmission of software, or codified knowledge, is not much affected by geographic distance, especially in this age of high-bandwidth and near-zero transmission cost (Swann & Prevezer, 1998). However, the transmission of wetware, or tacit knowledge, cannot be easily accomplished without face-to-face contact (ibid.).

Not only does this indicate the importance of including face-to-face contact in the proposed LIP Program, it also indicates the types of industries that will most benefit from an Internet and web-based network. That is, from a technology transfer point of view, leading edge technologies that are highly dependent on wetware skills are unlikely to benefit from only the access that LIP networks provide. But, more standard technologies that are further along their life-cycle and therefore require more codified knowledge would benefit greatly from the financing and marketing links provided through the LIP network. This is because new technologies spur the development of skills required to use them. However, as these technologies become more sophisticated, the required skill levels tend to decrease and the ability to codify the required knowledge increases. As a result, selection of SMEs in the targeted regions will not necessarily focus

on advanced technology (e.g. new materials, semiconductors, biotechnology), but will emphasize the use of appropriate ICT and business processes in the regionally based enterprises. It is clear that modest technology and innovative management processes can produce substantial wealth and job creation for a region (Conceição, Heitor & Oliveira, 1998).[2] The business and networking focus of the Learning & Innovation Poles (LIPs) therefore, will be based on the assessment of the technology and infrastructure strengths, weaknesses, opportunities, and threats (SWOT) of each selected region.

Today, the really substantial gains in wealth are to be found in the use and diffusion of knowledge. However, without skills, ideas may be irrelevant. Similarly without ideas, there may be no need for new and better skills. In short, it is important to stress that the accumulation of knowledge leads to the creation of wealth only if the knowledge is effectively transferred, adopted, and diffused.[3]

In the proposed LIP/TCC Program, personal networks and partnering programs (e.g. education and training, conferences, etc.) linked via ICT will be used to facilitate the collaboration of regionally-based Learning & Innovation Poles as members of a global learning and innovation network. This global learning and innovation network will facilitate the transfer and use of existing knowledge and the creation of new knowledge for regional economic development. To foster equitable knowledge transfer, accumulation, diffusion and use of both *software* and *wetware*, this project holds to three principles of operation.

Principle No. 1: When establishing Learning & Innovation Poles, we must deal with social as well as physical constructs that link participating people and institutions in networks of knowledge production, sharing, adoption, and diffusion that lead to self-reinforcing learning cycles (Fig. 1).

In competitive marketplace economies, business or financial global networks often do not operate to the benefit of less developed regions, indeed such networks often contribute to unequal development. A key question is whether such networks, linking the 'haves' with the 'have nots', go beyond awareness to the actual development of capabilities for knowledge accumulation and application in the less developed sites.

Principle No. 2: Centers on fostering networks in which the interaction leads to increased learning capability in all network nodes, but in which the rate of learning is higher in the less developed nodes (Fig. 2).

This project also strives to encourage and facilitate local ownership of activities and results. To be truly sustainable, the processes of innovation must occur within, and be 'owned' by the champions in each node. Therefore, it is critical that regional champions or businessmen/women feel that they 'own' LIPs. This idea leads to **Principle No. 3**, *which centers on fostering the regional 'ownership' of the activities and the results or return-on-investment of the network*. A sense of ownership can be fostered by shared decision-making structures in which the ultimate choice and responsibilities lie with local participants rather than external facilitators.

Technology Commercialization Centers

The objective is to foster the global linking of regional champions and enterprises in view of the realities and challenges of the international marketplace. The networks that we propose building via the LIP/TCC project are centered on identifying select SMEs and regional champions for long-term partnerships. These networks will be sustained by being task focused for short-term success as well as for longer-term vision. Figure 3 depicts how LIPs know-how networks will assist targeted companies in targeted regions cross the knowledge transfer and application gap to market applications, leading to firm diversification and expansion and new firm formation.

Technology Commercialization Centers through Learning & Innovation Pole Networks will strive to shorten product development cycles by broadening

[2] For example, in Austin, Texas a Fortune 500 company, DELL Computers was started out of a university dorm room in 1982 by one entrepreneurial student at the University of Texas at Austin. The entrepreneurial idea was to build customer designed computers using off-the-shelf technology and direct marketing, initially over the phone and increasingly over the Internet. Based on this modest start-up, over 7,000 people are employed in the Austin area with additional manufacturing and sales operations in Asia, Europe, and Latin America.

[3] History is full of examples where the producers of an innovative technology by not using and diffusing it were surpassed by others who did. Two examples serve as illustrations: One at the grand scale of the history of civilization; The other at the much smaller scale of contemporary corporate warfare. China developed what was, after the invention of writing, one of the most important ideas for the progress of humankind-the movable type printing press. This technology dramatically increased the possibilities of codifying knowledge. However, Imperial China restricted the use and diffusion of this technology to the affairs of the Emperor and his court. As a result it was Europe that benefited most from this invention by promoting its widespread use and diffusion (Landes, 1998). A more contemporary example is provided by Xerox PARC, a state-of-the-art R&D facility located in Sunnyvale, California. In the 1970s, housing some of the world's most brilliant researchers, PARC discovered many of the fundamental computer and software concepts and technologies that have become the basis of today's computer industry. Apple Computer, at the time a Silicon Valley start-up, used PARC developed knowledge and technologies in its innovative and successful Macintosh computer generating considerable wealth and jobs. In the 1980s it was Seattle-based Microsoft that benefited from the software technologies developed years earlier at PARC.

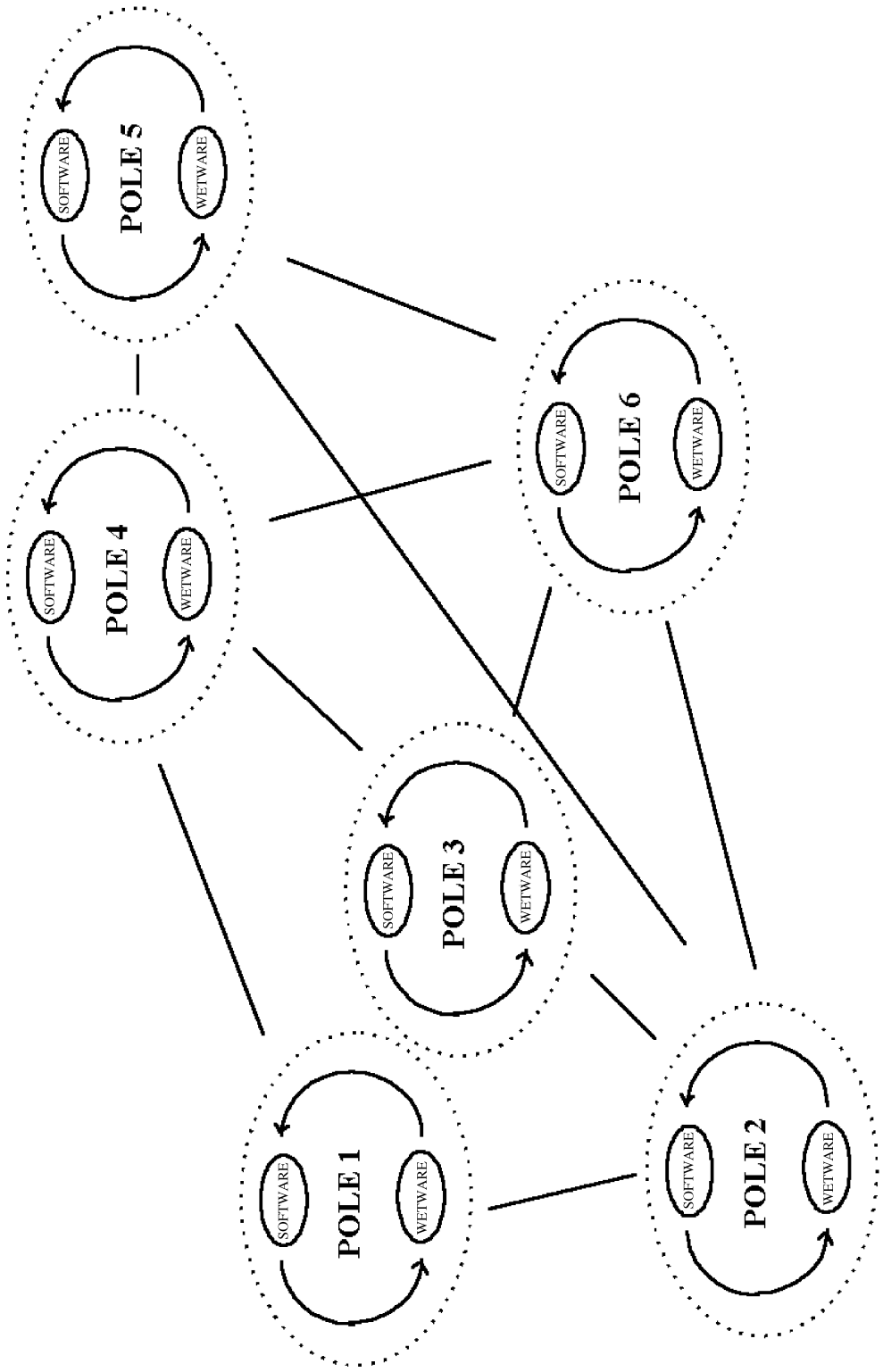
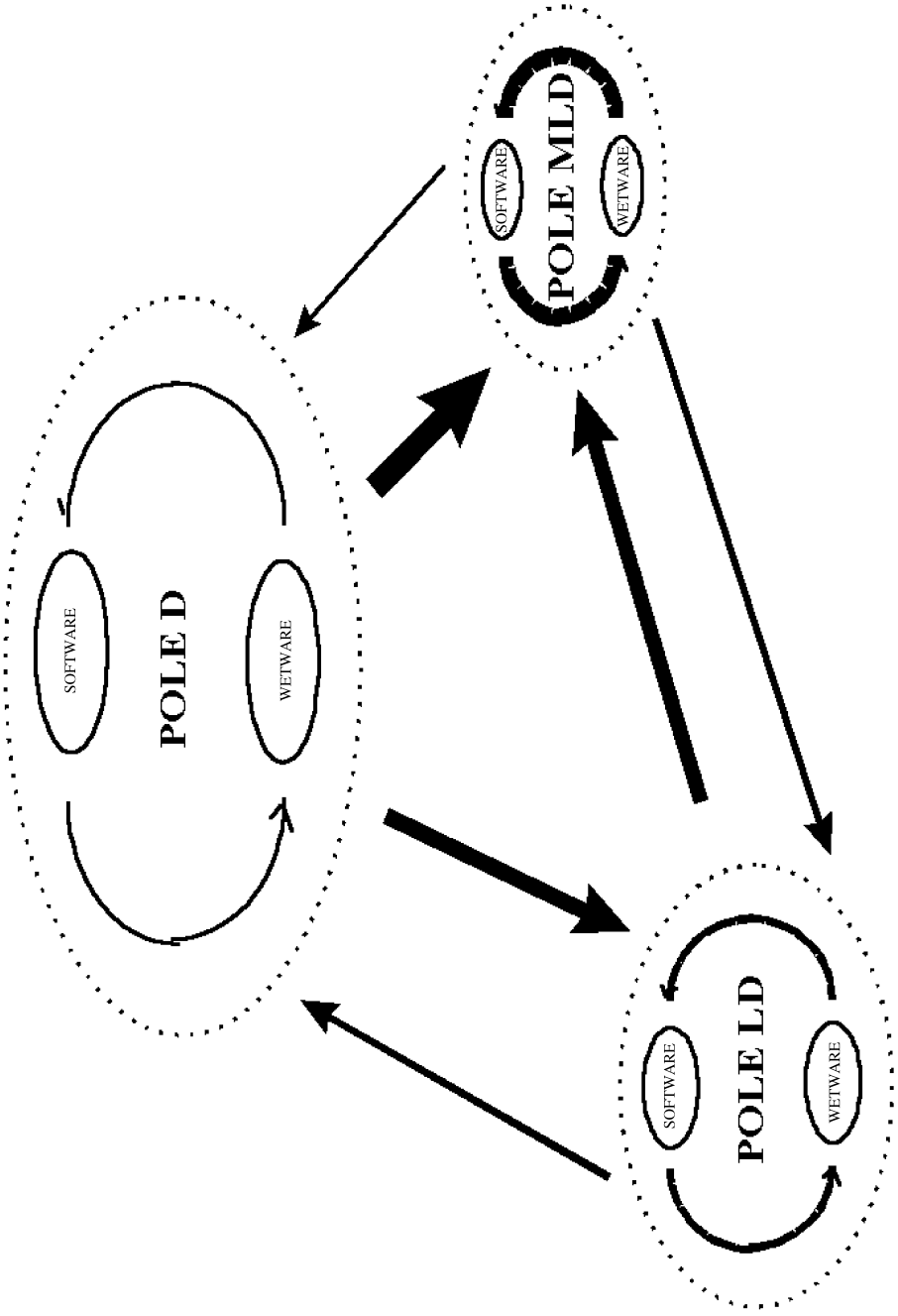


Figure 1. Learning and innovation poles as networks among regions.



D = Developed Pole
LD = Less Developed Pole
MLD = Much Less Developed Pole
Arrow density implies the richness of knowledge transfer and application

Figure 2. A learning network based on proportional reciprocity.

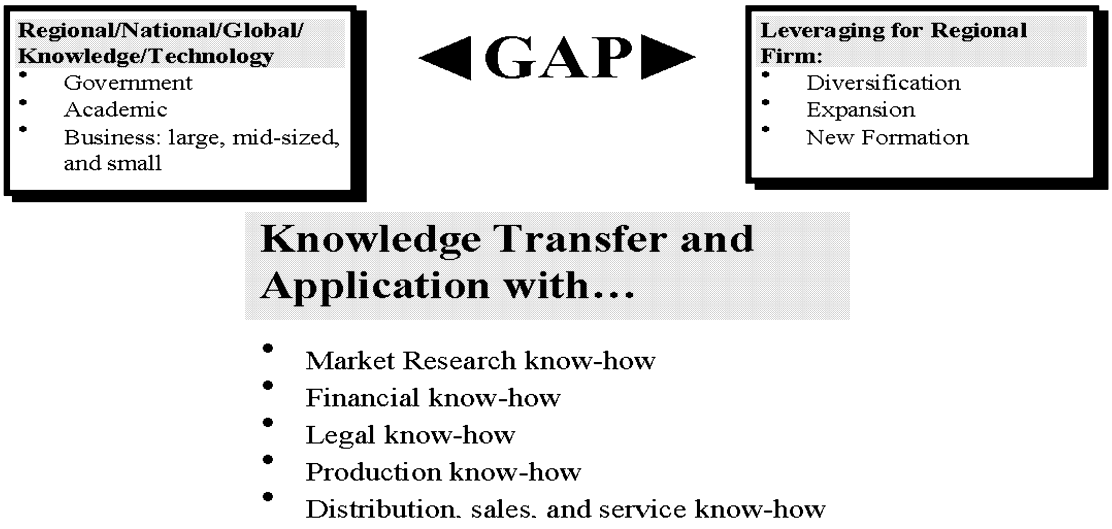


Figure 3. Crossing the knowledge transfer and application gap with know-how.

entrepreneurs' global know-how in such areas as market research, finance, advertising, quality issues, management, sales, and service (see Figs 4 and 5).

Common challenges to having targeted SMEs think and act globally are:

(1) success in home markets and a home-country bias;
(2) limited personnel;
(3) limited resources;
(4) limited time;
(5) limited tolerance for extra problems and challenges of going global (e.g. the fear of losing control of one's intellectual property);
(6) ignorance of critical success factors in foreign markets;
(7) legal, trade, and governmental constraints.

These challenges need to be balanced against the benefits of a SME being part of the LIP/TCC Program. Such benefits include:

(1) access to needed and often critical knowledge;
(2) global market access and niche market opportunities;
(3) access to needed talent, technology, capital, and know-how;
(4) minimizing mistakes and misspent resources;
(5) maximizing speed to the market and the commercial potential of a venture;
(6) Being aware of 'your' firms global strengths, weaknesses, opportunities, and threats.

The objective of the LIP/TCC program is to foster the global linking of regional champions and enterprises with venture financing, managerial and marketing know-how, and supporting services.

Partnerships with local champions (e.g. business leaders, professors, and students from local universities/colleges, and influencers from the local chambers of commerce) will be formed. Existing institutional data will be used, as much as possible, to conduct a benchmark/scorecard of each targeted

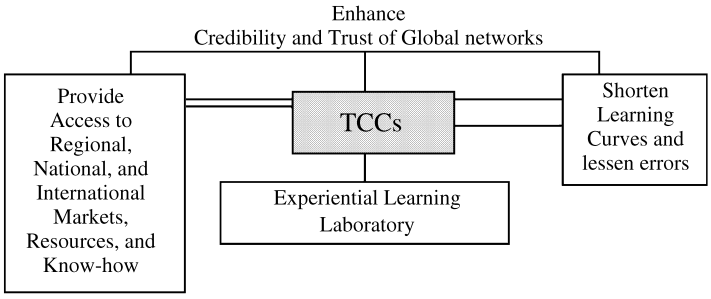


Figure 4. Technology commercialization centers as learning and innovation poles to foster venture success and accelerated growth.

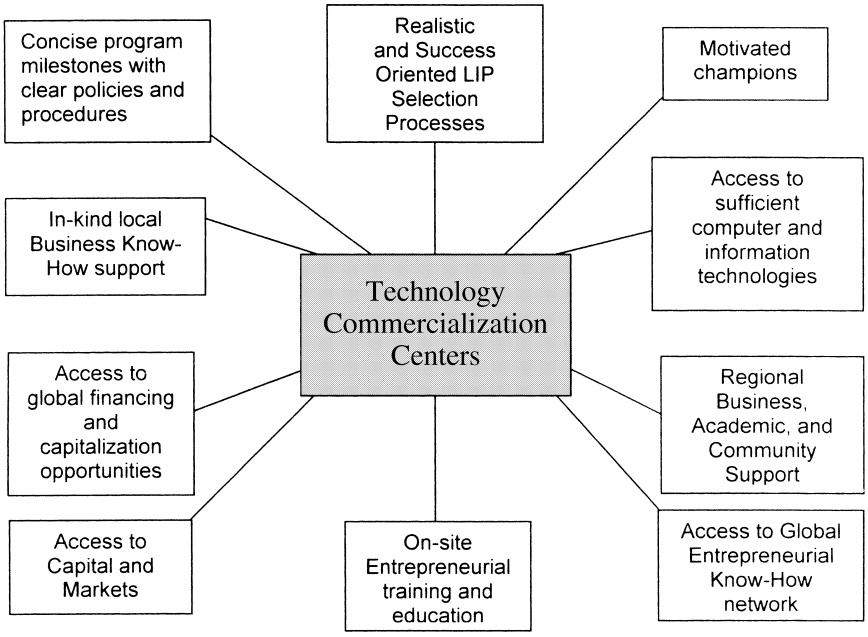


Figure 5. Ten success factors for Learning and Innovation Pole (LIP) development.

region. This benchmark will focus on identifying and leveraging existing capabilities:

(1) for nurturing Technology Commercialization Centers in each target region; and
(2) for networking these poles nationally and globally through the use of ICT and personal networks.

Regional assessments will focus on:

- R&D and technical expertise related to current and future businesses activities in the region—the talent and technology base for growing existing and new firms and industries;
- core strengths and assets, competitive advantages in terms of regional, national, and global markets;
- assessment of existing regional innovation systems;
- scorecard (employment, founding date, spin-offs, growth, etc.) of existing small, mid-sized, and large firms in the region;
- assessment of emerging clusters of activity, location of multi-nationals, branch plants, and headquarters;
- interviews and survey of key regional leaders (academic, business, and government) to facilitate regional understanding by the researchers and regional support and ownership by key local champions.

A number of data collection activities are recommended to provide local advisory boards and stakeholders the information necessary for them to make informed decisions regarding the facilitators and challenges to facilitation technology-based economic development in selected LIPs. These aspects may include, but are not restricted to:

- specific and measurable objectives for the regional SME;
- formation of business partnerships;
- location and size of specific components of the regional SME;
- technological profile; market and competitive orientation of the SME;
- options for expansion;
- financing needs and sources;
- time schedule;
- networks strengths and needs;
- supply of services and consulting;
- structure of LIP oversight.

Building Networks

Using ICT, personal networks and partnering programs will link TCCs as important resources for sustaining each LIP. Internet and other ICT links (e.g. video) will be established between each of the TCC sites with an emphasis on fostering collaboration among the LIPs. The proposed networks will attempt to identify regional champions for long-term partnerships. These networks will be sustained by being task focused for short-term success as well as longer-term vision.

While there is an appreciation for the national, institutional, and organizational contexts of each TCC, the focus is on the individual level of analysis and action (Fig. 6). The initial objective is to have the

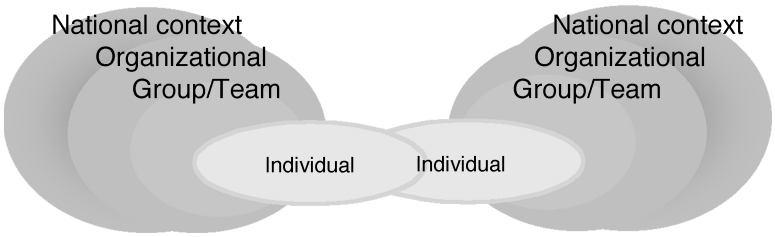


Figure 6. Focus on individual level of analysis and action.

selected TCCs benefit from the codified knowledge and tacit know-how of the LIP network and training activities that focus on access to talent, technology, capital, know-how, and market access. The LIP network will strive to shorten product development cycles and time-to-market by broadening local firms' global knowledge in such areas as finance, market research, advertising, quality control, sales, and after-sales support and service.

The LIP networks will focus on six functional objectives:

(1) *Networking for Markets*: The identification of markets and successful execution of marketing strategies is a determining factor in the success and sustainability of small and medium technology-based firms.
(2) *Networking for Capital*: Access to adequate financing is one of the most critical factors for the success of technology-based firms. Broad public/private/NGO partnerships could be established to offer integrated access to services such as financial planning, support for obtaining grants, and opportunities for access to venture, development, and seed capital.
(3) *Networking for Inter-Firm Linkages*: A networked approach is ideal for maximizing the impact of programs and projects, such as partnerships, alliances, and linkages to outside suppliers. Most clusters in developing countries tend to rely heavily on the local supplier base, which may become insufficient for their rapidly growing needs. Careful coordination is required to ensure that the local suppliers are able to match increases in demand so that jobs may be retained and created and that other substitute supply streams can be brought online as required.
(4) *Networking For Technological Support*: Electronic networks are extremely useful tools to diffuse the benefits of technological support, providing services such as technology assessment and forecasting, technology gateway (assistance on technological choices and on marketing assessment of innovative projects), and access to outside technical information. These services could also be concentrated in one or a few centers and could be provided by public agencies, private consultants and business associations.
(5) *Networking to Expand Access to Technology Transfer Opportunities*: The use of electronic networks for technology transfer is already being established in several places to stimulate investment in S&T, R&D, technology transfer, development of commercial potential of R&D, spin-offs. Networks are necessary tools to facilitate access to technology transfer opportunities worldwide.
(6) *Networking for Talent and Know-How*: SMEs often do not have and cannot afford the entire range of technical and business talents and know-how required for success in local and global markets. The process of identifying and hiring such talent and know-how on a short-term as-needed basis is also difficult for smaller enterprises. Networks of talent and know-how would be a great asset that would allow SMEs access to the experts at affordable rates and opportune moments.

While established SME firms will be the initial focus of the LIP Program, there is a critical need to develop the infrastructure and resources of the region to promote accelerated development of knowledge based firms from the bottom-up as a longer term strategy. The basic need is to improve the process of knowledge transfer, acquisition, absorption, and diffusion. The issues involved include education, physical infrastructure construction, and improved policy environments. For example, if knowledge acquisition—whether imported from abroad or created at home—is to lead to economic development, it must be absorbed and applied. This requires universal basic education as well as opportunities for lifelong learning (World Bank, 1998). Also, the extent and economy of modern ICT greatly expand the potential for both the acquisition and the absorption of knowledge, but this can only happen after a basic level of telecommunications infrastructure is acquired.

The following are potential areas for action (Quandt, 1998):

- *Creating and Strengthening Local Technopolis Management Structures*: The first step is the creation of an organizational and functional structure for the

local cluster, preferably leveraging existing groups and associations. This would involve both private and public sector participants. The establishment of linkages with other technopolis managers will enable a better understanding of stakeholder needs and markets and will improve organization methods. The creation of a permanent, dedicated business and technology information network would make communications more continuous and interactive, rather than sporadic exchanges that normally occur only at periodic meetings.

- *Determining Educational Needs and Offering Training*: Based on regional descriptive profiles and targeted interviews with local stakeholders, education requirements for the LIPs and targeted companies can be ascertained. Courses could then be offered through local workshops as well as via the Internet to help improve the skills of local trainers. For example, the IC^2 Institute is currently working with several global partners to offer long-distance educational programs—degree and certificate—focusing on technology commercialization and forming virtual teams of 'students' to evaluate the commercial potential of innovative technologies (www.IC2.org).
- *Fostering Personnel Exchanges*: Visits of key personnel among regions in the network would greatly facilitate knowledge, technology and know-how transfer. For example, one of IC^2 Institute's global partners, the Instituto Superior Técnico has established an IMPACT Program for leading Portuguese entrepreneurs to build markets in the United States. Exchanges of students, faculty, and entrepreneurs facilitate these processes.
- *Building Local Skills and Training IT Specialists*: A skilled workforce is one of the most important localization factors for technology-based companies, and a major constraint to the development of technopoleis in many less developed regions. This characteristic is essentially place-based, yet virtual technologies may boost the development of human resources in more remote locations through training centers, distance education, career planning, virtual job markets, and also support business development through the establishment of virtual entrepreneur schools providing all kinds of training—technical, managerial, marketing, etc.
- *Optimizing and Sharing Facilities*: For each region, the required facilities for a viable technopolis could be kept to a minimum, provided they are integrated into a shared system. The operational support infrastructure could be optimized and many facilities could be shared over the network, including prototype centers, pilot plants, online library, test laboratories, and online conferencing facilities.

Technology Commercialization Centers will focus on select entrepreneurs and business enterprises in targeted regions. These sites will be studied over time to provide data and case examples for research as well as for job and skills training. It is important to involve a range of regions with a variety of characteristics, challenges, and opportunities for wealth and job creation. Metrics for success will be regionally-focused and will be identified and followed over time. In general these metrics will include:

Targeted to Specific SMEs
- Global technology and business assessment.
- Market assessment: regional and global, existing and emerging.
- Intellectual property rights and protection.
- Capital access.
- Increased profit.
- Accelerated growth.
- Access to new technology and business processes.
- Shorter time to market.
- Management and employee development.

Government Oriented
- Job creation.
- Space utilization.
- Capital creation.
- Incremental revenues (i.e. taxes, services, etc.).
- Development of regional 'smart infrastructure'.
- Increased global awareness and competitiveness.

Academic Oriented
- Training of faculty and students.
- New curriculum development.
- Successful placement of students.
- Experiential, on-the-job learning.
- Enhanced favorable relations with community.
- Research and publications.
- Revenue generation (i.e. royalty, license fees, etc.).

Conclusions

The feasibility of establishing meaningful and sustainable Technology Commercialization Centers that are networked as LIPs rests on the effective use of ICT as well as regional and global partnerships and partnering programs that facilitate the diffusion and adoption of tacit knowledge. While the role of business, academic, and government sectors in building regionally-based technology centers (i.e. technopoleis) has been observed and experimented with for over 20 years, it is much less clear what are the key resources and conditions for accelerating the growth of virtual technopoleis and how these criteria might change depending on geographic location. The questions the LIP Program seeks to examine are:

(a) How does one best accelerate entrepreneurial wealth and job creation in SMEs through Internet and web-based access to talent, technology, capital, know-how, and markets?
(b) What 'smart' infrastructure must be physically present at SME locations and what can be virtually

linked regionally, nationally, and globally and how does this change over firm growth and maturation?

(c) What are the critical components of regionally-based technopolis development in the emerging Internet and web-based knowledge economy of the 21st century?

(d) Can a developing region 'leap-frog' the 20–40 years it has traditionally taken to build technopoleis without first building world-class research facilities and state-of-the-art science parks, and the agglomeration of 'smart' infrastructure (i.e. finance, legal, marketing, manufacturing, sales and distribution, global expertise, etc.)?

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