Available online at www.sciencedirect.com
SCIENCE DIRECT
Technovation 26 (2006) 419–443
technovation
www.elsevier.com/locate/technovation

Technological learning for entrepreneurial development (TL4ED) in the knowledge economy (KE): Case studies and lessons learned

Elias G. Carayannis[a,*], Denisa Popescu[b], Caroline Sipp[c], McDonald Stewart[d]

[a]*Department of Management Science, School of Business and Public Management, George Washington University (GWU), 401G Monroe Hall, 2115 G Street NW, Washington, DC 20052, USA*
[b]*The World Bank and School of Business, GWU, Washington, DC, USA*
[c]*Inter-American Development Bank and School of Business, GWU, Washington, DC, USA*
[d]*School of Business, GWU, Washington, DC, USA*

Abstract

Innovative technologies are reshaping the global economic landscape, by improving speed and ease of communications and interaction among the various economic actors involved in the productive cycle.

In this paper, we discuss the role that technological learning and information and communication technologies (ICT) play in fostering entrepreneurial development in the Knowledge Economy and support our conceptual constructs with a series of case studies from developed, developing and transitioning economies.

We compare and contrast entrepreneurial initiatives, policies and practices and the experience of ways and means to promote learning and entrepreneurship such as global/local (glocal), real–virtual incubator networks (G-RVIN) and other real and virtual infra-structures and infra-technologies (such as Innovation Networks and Knowledge Clusters or INKC) and derive lessons learned for policy makers, practitioners and entrepreneurs.

Keywords: Technological learning; Knowledge transfer; Absorptive capacity; Technological innovation; Real and virtual business incubator networks; Innovation networks; Knowledge clusters; Information and communication technologies (ICT); Small and medium enterprises (SME); New ventures; Intellectual property rights (IPRs); Knowledge economy; e-Development

1. Objectives of the paper and related areas of research

This paper addresses the roles that technological learning and information and communication technologies (ICT) play as catalysts and accelerators of knowledge creation, diffusion and use in the process of economic development.

The areas of research that this paper draws upon and contributes to are:

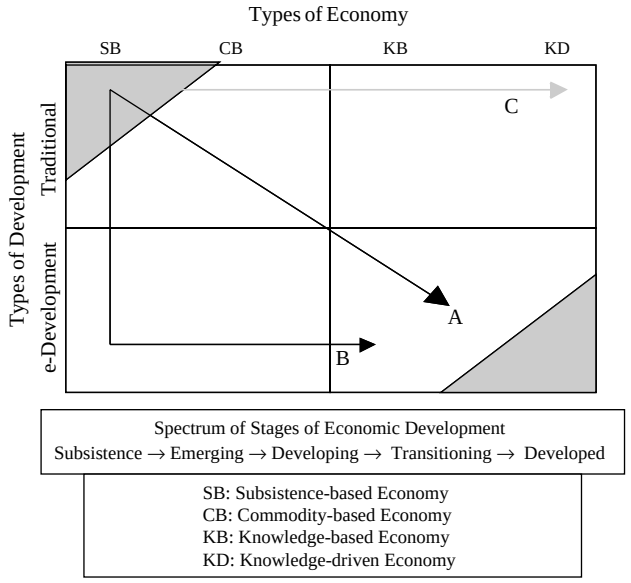
(a) economic development
(b) technological learning and knowledge transfer, absorption and use
(c) technological innovation and entrepreneurship

Specifically, we provide a conceptual framework that may serve as an integrative bridge between macro- and micro-ideas and themes such as identifying optimal practices and pathways in economic development as a result of *a more functional congruence* of stages of economic development with technology and learning strategies for small and medium enterprise (SME) formation and growth (see Fig. 1).

The cases we use to corroborate our arguments are drawn from a number of countries and sectors in developing countries with a variety of profiles in terms of the degree, scope and scale of the role that knowledge modalities and processes play in the development enterprise. These cases serve to illustrate vectors, actors and crucibles of entrepreneurial development such as business incubators and networks thereof, technology and knowledge clusters and innovation networks including agglomerations of large/small, public/private entities and partnerships focused on knowledge creation, diffusion and use.

* Corresponding author. Tel.: +1 202 994 4062; fax: +1 202 994 4930.
E-mail address: caraye@gwu.edu (E.G. Carayannis).

0166-4972/$ - see front matter © 2005 Elsevier Ltd. All rights reserved.
doi:10.1016/j.technovation.2005.04.003



(A) *Faster, easier and better way to move towards knowledge-based economy*

(B) *Costly, slow but more common way in transitioning economies for moving towards the knowledge economy.*

(C) *Slowest, costly and more limited way.*

Fig. 1. eDevelopment pathways towards the knowledge economy destination. (Adapted from Carayannis and von Zedwitz, 2005c).

The central motivation for this paper is our belief that the 'goodness of fit' between the stage an economy is in and the development strategy adopted (including the use of technology and role of knowledge) determine the quality, speed, and sustainability of development (see Fig. 1). In this context, our efforts focus on learning from development experiences, in particular related to SME formation and growth, to develop a methodology for establishing an optimal match typology between development stage and development strategy.

This approach is partly inspired by the research findings of Robert Solow among others:

> "Nobel laureate Robert Solow published his theory of growth in a couple of articles in 1956 and 1957. His conclusion surprised many, and still surprises many today: investment in machinery cannot be a source of growth in the long run. Solow argued that the only possible source of growth in the long run is technological change." (Easterly, 2002: 47).

Another conceptual pillar and source of motivation for our efforts, is the work of Joseph Schumpeter on 'creative destruction' and technological change which was again listed as the pre-eminent driver of the process of sustainable economic growth "which incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. The process of Creative Destruction is the essential fact about capitalism." (Schumpeter, 1942: 82).

We consider entrepreneurial initiative as one of the main—if not the main—ways to drive technological change and catalyze and accelerate sustainable growth, hence our motivation to better learn from past entrepreneurial initiatives aimed towards fostering economic development.

2. Introduction and definition of terms

2.1. Introduction

There is ample and growing evidence that intangible resources such as knowledge, know-how and social capital will prove to be the coal, oil, and diamonds of the 21st century for developed, developing, and emerging economies alike.[1] Moreover, there are strong indications and emerging trends that there are qualitative and quantitative differences between the 20th and the 21st century drivers of economic growth:[2]

> The world economy is in the midst of a profound transformation, spurred by globalization and supported by the rapid development of ICT (Information and Communication Technologies) that accelerates the transmission and use of information and knowledge. This powerful combination of forces is changing the way we live, and redefining the way companies do business in every economic sector.

We are currently going through a dynamic era for the economies of the world where a country can transition fast both upwards (see the case of Ireland) or downwards (see the case of Japan) and this trend has become increasingly more pronounced and in an accelerating fashion during the last decade. This new era is punctuated by:[3]

- Development of a service-based economy, with activities demanding intellectual content becoming more pervasive and decisive
- Increased emphasis on higher education and life-long learning to make effective use of the rapidly expanding knowledge base
- Massive investments in research and development, training, education, software, branding, marketing, logistics and similar services

[1] The Global Competitiveness Report 2001–2002 (WEF and Harvard CID, 2002).

[2] Toward e-Development in Asia and the Pacific: A Strategic Approach for Information and Communication Technology (ADB, 2001).

[3] China and the Knowledge Economy: Seizing the 21st century (Dahlman and Aubert, 2001).

- Intensification of competition between enterprises and nations based on new product design, marketing methods and organizational forms
- Continual restructuring of economies to cope with constant change

The challenge and the opportunity in particular for advanced developing and transitioning economies is to evolve and possibly leap-frog *from lower to middle income*, *knowledge-*, *technology- and know-how-importing and using countries to high and sustainable income*, *knowledge-*, *technology- and know-how-generating and exporting ones*. For such a transition to be effective and sustainable, key success factors are *innovation and knowledge clusters and networks* linking public and private, domestic, regional, and global sector research and technological development entities:[4]

> Innovation through the creation, diffusion and use of knowledge has become a key driver of economic growth and provides part of the response to many new social challenges. However, the determinants of innovation performance have changed in a globalizing knowledge-based economy, partly as a result of information and communication technologies. Innovation results from increasingly complex interactions at the local, national and world levels among individuals, firms, and other knowledge institutions. Governments exert a strong influence on the innovation process through the financing and steering of public organizations that are directly involved in knowledge generation and diffusion (universities, public labs), and through the provision of financial and regulatory incentives.

The Knowledge Economy, while relying on and leveraging heavily technology and especially ICT, also needs a harmonious policy and institutional environment, a consistent regulatory framework and a plausible business environment to promote innovation. Yet, this does not necessarily imply that the government is the sole actor responsible for developing towards the Knowledge Economy. Examples of viable strategies and interventions, have shown how Knowledge Economy and e-Development allow for better integration and cooperation between the private and the public sector.

The significance and relevance of technology is two-fold. In one case, it widens the gap, leaving developing countries lagging. In the other, technology can optimize and maximize development efforts. Deeper cooperation among international donors and recipient countries is needed to allow the optimization role of technology to overcome the widening effect it imposes to the gap between North and South.

The convergence of transformations and discontinuities both in the means of production as well as the nature of the outcomes of economic activity (products and services) and the pronounced shift *from product-focused*, *tangibles-based economies to service-focused*, *intangibles-relying ones*, necessitate re-thinking and possibly re-inventing ways and means to support the mission (as well as the business) of global, regional, and national policies and practices of economic development.

In this context, the validity of Joseph Schumpeter's and the Austrian School of Economics' principle of *creative destruction* is further corroborated. This principle underscores the importance as both a challenge and an opportunity of the continual replacement, renewal and reinvention of socio-economic, technological and political institutions, practices, and infra-structures. Hence, the role of private and financial sector development as an *enabler*, *catalyst and accelerator* of bottom-up, entrepreneurial initiatives coupled with top-down creative and realistic innovation policies in developed, developing and transitioning economies becomes increasingly central. At the core of our proposed domain of intellectual discourse and especially using a systems approach, lie the processes of *higher order economic and technological learning* as cited in Dyker and Radosevich,[5] Matthew,[6] and Carayannis:[7]

> The concept of economic learning captures the notion that some economies seem to be able to accommodate changes (e.g. products, technologies, markets) better than others. They do so partly through the flexibility of their firms themselves, but also through their capacities to promote inter-organizational linkages and collaboration and, above all, through the capacity of public institutions to imbibe and develop innovations, and then disseminate those innovations in various forms to firms, thus accelerating the process of adaptation…Matthew makes a useful distinction between first-, second-, and third-order economic learning. First-order learning takes place within firms (organizations). Second-order learning takes place between firms through arrangements like sub-contracting, licensing, consortia, equity partnerships or joint ventures. Third-order economic learning takes place both outside and within firms but in such a way that their operating conditions are changed. It is

[4] Innovative Clusters: Drivers of National Innovation Systems (OECD, 2001).

[5] Building the Knowledge-based Economy in Countries in Transition-From Concepts to Policies (Dyker and Radosevic, 2000).

[6] Organizational Foundations of the Knowledge-based Economy, Matthew J. (OECD, 1996).

[7] The Strategic Management of Technological Learning: Case Studies from Power Generation, Transportation, Pharmaceuticals, and Software US and European Firms, CRC Press, 2000.

'meta-learning', or learning how to learn; it takes place at the level of the economic system as a whole.

In the developed countries, *Knowledge* has become one of the key input and output factors of economic activity. In addition, new technologies are facilitating the process of globalization of economies and societies. In such a context, *technological learning* (Carayannis, 2000, 1993, 1994, 2001, 2003) and *knowledge* have become crucial factors of economic, social and *especially entrepreneurial development*, which empowers people and entrepreneurs across the world in taking advantage of opportunities and chances unknown and unexplored until recently.

This relevant role of knowledge in economic and social development brings about the concept of the *Knowledge Economy (KE)*, which is simply another evolution of development phases following the Agriculture Economy and the Industrial Economy.

2.2. Definition of terms

In this segment we attempt to define and operationalize the following concepts that we consider key to our research considerations:

(a) e-Development
(b) Knowledge Economy
(c) Innovation Networks
(d) Knowledge Clusters
(e) Technological Learning
(f) Knowledge Transfer
(g) Communities of Practice
(h) Absorptive Capacity

There are no well-articulated or established definitions for *e-Development* or the *Knowledge Economy* and that has been often a source of confusion as the following quotes indicate:

- "We define *knowledge-based economies* as those which are directly based on the production, distribution and use of knowledge and information" (OECD, 1996).
- "*A knowledge-driven economy* is one in which the generation and exploitation of knowledge play the predominant part in the creation of wealth" (UK Department of Trade and Industry, 1998).
- "For countries in the vanguard of the world economy, the balance between knowledge and resources has shifted so far towards the former that *knowledge has become perhaps the most important factor determining the standard of living*—more than land, than tools, than labor. Today's most technologically advanced economies are truly knowledge-based" (World Development Report, 1999).

Our working definition for the *Knowledge Economy* is as follows:

- The Knowledge Economy is a state of economic being and a process of economic becoming that leverages intensively and extensively knowledge assets and competences as well as economic learning to catalyze and accelerate sustainable and robust economic growth.

Our working definition of *e-Development* is as follows:

- e-Development is a set of tools, methodologies, and practices that leverage ICT to catalyze and accelerate social, political and economic development or in other words, e-Development is ICT-enabled and KE-inspired development that may enable the economies of developing and especially transitioning countries to become Knowledge Economies (see Fig. 1).

In addition to the concepts of e-Development and the Knowledge Economy, we also introduce working definitions for two other important knowledge creation, diffusion and use modalities, that play a central role in our research on the role of technological learning for entrepreneurial development, namely, Innovation Networks and Knowledge Clusters.

Our working definition of *Innovation Networks* is as follows (from Carayannis et al., 2005[8]):

- Innovation Networks[9] are real and virtual infra-structures and infra-technologies that serve to nurture creativity, trigger invention and catalyze innovation in a public and/or private domain context (for instance, Government–University–Industry Public–Private Research and Technology Development Co-opetitive Partnerships[10,11]).

[8] Carayannis Elias, Editor and David Cambell, Co-Editor, 'Mode 3' Knowledge Creation, Diffusion and Use in Innovation Networks and Knowledge Clusters: A Comparative Systems Approach Across the United States, Europe and Asia, Praeger Books/GreenWood Press, Forthchoming, Summer 2005.

[9] Networking is important for understanding the dynamics of advanced and knowledge-based societies. Networking links together different modes of knowledge production and knowledge use, and also connects (sub-nationally, nationally, trans-nationally) different sectors or systems of society. Systems theory, as presented here, is flexible enough for integrating and reconciling systems and networks, thus creating conceptual synergies.

[10] Carayannis, Elias G. and Jeffrey Alexander, Strategy, Structure and Performance Issues of Pre-competitive R&D Consortia: Insights and Lessons Learned, IEEE Transactions of Engineering Management, May 2004, vol. 52, no. 2.

[11] Carayannis, Elias and Jeffrey Alexander, Winning by Co-opeting in Strategic Government–University–Industry (GUI) Partnerships: The Power of Complex, Dynamic Knowledge Networks, Journal of Technology Transfer, vol. 24, no. 2/3, pp. 197–210, August 1999. Note: Awarded 1999 Lang-Rosen Award for Best Paper by the Technology Transfer Society.

Our working definition of *Knowledge Clusters* is as follows (from Carayannis and Campbell, 2005a):

- Knowledge Clusters[12] are agglomerations of co-specialized, mutually complementary and reinforcing knowledge assets in the form of 'knowledge stocks' and 'knowledge flows' that exhibit self-organizing, learning-driven, dynamically adaptive competences and trends in the context of an open systems perspective.

Largely due to new technologies for efficient production, transmission, and processing of knowledge and information, other intangible resources such as know-how and social capital become the coal, oil, and diamonds of the 21st century.[13] This trend is punctuated by several factors:

- Widespread adoption of innovative technologies to create new business models, reduce transaction costs, and enhance effectiveness and responsiveness of the public sector.
- Development of a services-based economy, with activities demanding intellectual content becoming more imperative.
- Increased emphasis on higher education and life-long learning to make effective use of the rapidly expanding knowledge base and build a competitive edge.
- Massive investments in research and development, training, education, software, branding, marketing, etc.
- Intensification of competition between enterprises and nations based on innovative product designs, marketing methods and organizational forms.

The critical new role of Knowledge in economic and social development therefore brings about the concept of the *Knowledge Economy (KE)*. This economy is based directly on the production, distribution and use of knowledge and information. In more general terms, the Knowledge Economy is the theoretical framework and broad economic concept that outlines major forces in the economy driven and led by innovation and knowledge.

So far, it is primarily the developed market economies that have been able to take advantage of KE, gaining even more competitive advantage in the global economy and widening the gap between developed and developing countries. Yet, developing and transitioning countries still have the potential to catch up and leverage the concept of 'Knowledge Economy' by utilizing one of its main driving forces—Information and Communication Technologies (ICT)—through the process known as *e-Development*.

[12] Carayannis Elias, Editor and David Cambell, Co-Editor, 'Mode 3' Knowledge Creation, Diffusion and Use in Innovation Networks and Knowledge Clusters: A Comparative Systems Approach Across the United States, Europe and Asia, Praeger Books/GreenWood Press, Forthchoming, Summer 2005.

[13] The Global Competitiveness Report 2001–2002 (WEF and Harvard CID, 2002).

We next define and discuss the concepts of technological learning, knowledge transfer and communities of practice:

Our working definition for *technological learning* is as follows:

- Technological learning is defined as the process by which a technology-driven firm creates, renews, and upgrades its latent and enacted capabilities based on its stock of explicit and tacit resources. It combines purely technical with purely administrative learning processes (Jelinek, 1979).

Teece et al. (1990) define learning as "a process by which repetition and experimentation enable tasks to be performed better and quicker and new production opportunities to be identified". Furthermore, they focus on the nature of learning as both, an individual and an organizational process:

> Learning processes are intrinsically social and collective phenomena. Learning occurs not only through the imitation and emulation of individuals, as with teacher-student, or master-apprentice, but also *because of joint contributions to the understanding of complex problems*. Learning requires *common codes of communication* and coordinated search procedures.

Our working definition for *knowledge transfer* is as follows:

- Knowledge transfer is viewed from an *information theoretic* (Shannon and Weaver, 1949) and a *meta-cognitive* (Simon, 1969; Sternberg and Frensch, 1991; Halpern, 1989)/*linguistic* (Chomsky, 1971, 1993) perspective as a *knowledge transfer process*, where the human problem solver and technology manager is seen as both a technician and a craftsman (Schon, 1983), a 'lumper' and a 'splitter' (Mintzberg, 1989).
  - The problem solver typically relies on *multi-layered technological learning and unlearning* (Carayannis, 1992, 1993, 1994a, 1994b, 1994c, 1994d; Dodgson, 1991, 1993) to create, maintain, and enhance the capacity of individuals, groups, and organizations to transfer and absorb knowledge in the form of *embodied* and *disembodied* (Von Hippel, 1988) technology in the form of *artifacts*, *beliefs*, and *evaluation routines* (Garud and Rappa, 1994) and *tacit* and *explicit* knowledge (Polanyi, 1966, 1958; Nonaka, 1994, 1988).
  - Moreover, knowledge transfer occurs across scientific disciplines, professions, industries, economic sectors, geographic regions, and societies/countries (Reisman, 1989, 1991). This motivates the linguistic view of technology sharing and absorption in the form of a firm's technological *absorptive capacity* (Cohen and Levinthal, 1990) as well as *transformative capacity*

(Garud and Nayyar, 1994), since it requires effective communication among practitioners with often divergent *technical rationalities* (Schon, 1983).

The literature on knowledge transfer is organized into two mainstreams that deal with intra-organizational transfer and communities of practice, and inter-organizational transfer. However, Iansiti and Clark (1994) argue for a combination of external acquisition (capacity to access knowledge through relationships) and internal integration (ability to transfer knowledge within the organization) as one of the contributing sources to the performance of firms like NEC and Nissan.

The literature on intra-organizational knowledge transfer focuses on the factors influencing the efficiency of knowledge transfer. Hansen (1999) identifies the characteristics or capabilities of the sender and receiver, and the context. The literature on knowledge transfer within communities of practice focuses on the transfer and sharing of knowledge between people within a certain community of practice, where new knowledge is usually formed during the communication/interaction processes occurring within the group (Wenger, 1998). Extensive studies of distributed collaboration and knowledge sharing among business organizations show how communities of practice can enhance communications, improve organizational performance, and support collective goals. Wenger (1998) argues that production of knowledge is being shaped by organization context and relationships between professionals bond together by a joint enterprise (CoP).

Our working definition for *communities of practice* is as follows:

- Communities of practice (CoP) are defined as a persistent, sustained social network of individuals who share and develop an overlapping knowledge base, set of beliefs, values, history and experiences focused on a common practice and/or mutual enterprise (Barab and Duffy, 2000).
  - Wenger (2004) has identified three dimensions of communities of practice:
    - Domain: the area of knowledge that brings the community together
    - Community: the group of people for whom the domain is relevant
    - Practice: the body of knowledge, methods, tools, stories, cases, documents which members share and develop together.

Nonaka and Takenchi (1995) state the importance of tacit company knowledge as the basis for communities of practice (CoP) and transforming it into explicit company assets. Wender and Snyder (2000) gives examples of successful CoP as both internal company networking groups as well as with members from different companies.

The other stream within the knowledge transfer research, inter-organizational transfer literature argues that the outcome of knowledge transfer is highly dependent of the absorptive capacity of the recipient (Cohen and Levinthal, 1990).

Our working definition for *absorptive capacity* is as follows:

- The notion of *absorptive capacity* refers to the capacity of the recipient to assimilate value and use the knowledge transferred. Similar notions of 'learning' have been defined by Marshall (1965, 4) as the acquisition and use of exiting knowledge and/or creation of new knowledge with the purpose of improving economic performance.

Braun (2002) introduces a conceptual model for knowledge flows that shows how a large company with high connectivity and an integrated infra-structure for information and knowledge exchange vis-à-vis communities of practice can lead to a higher level of trust and subsequent innovation and competitive advantage. He identifies the critical factors to consider in terms of knowledge exchange between organizations as follows:

- Adequate technology (infra-structure and data exchange)
- Trust and cooperative relationships
- Common interest
- Exchange of tacit and explicit company knowledge for the public good aspect of the company.

3. Research motivation and operationalization: e-development towards the knowledge economy and the role of entrepreneurship in knowledge-based economies

Technology changes the way society functions. The dramatic advances in technology over recent decades have collaterally precipitated wide-sweeping and profound change to the functioning of almost every form of human exchange, the world over. What emerged in developed economies during the latter years of the 20th century is knowledge-based economics—an evolutionary framework of social transaction that now dominates the behavior of mankind in the 21st century.

Earning monopoly rents on discoveries is important to provide incentive to invest in R&D for technological innovation. This is why protection of intellectual property rights (IPRs) is fundamental to growth, and traditional economics sees 'perfect competition' as the ideal. Enhancing human capital is critical for GDP growth, as well. To make investments in technology, a country must have sufficient human capital.

In contrast, during the industrial era, machines replacing human labor created wealth. Many people associate the knowledge economy with high-technology industries such as telecommunications and financial services. Actually,

knowledge workers are workers who manipulate symbols rather than machines. Architects, bank workers, fashion designers, pharmaceutical researchers, teachers, and policy analysts are all examples of knowledge workers.

More than 60% of US workers are knowledge workers. Knowledge gained by experience is as important as formal education and training—life-long learning is vital for organizations and individuals and its intellectual capital is a firm's source of competitive advantage.

According to Routti (2003), the knowledge-based economy can be characterized as fractal—*non-linear*, *unstable*, and *stochastic*. The knowledge-based economy creates profit avalanches. Entrance is easy for small, intelligent companies, but there is no space for organic growth; the market is instantly global and a newcomer can attain dominance in 10 years. It also differentiates itself by the convergence of technologies, which removes market sector boundaries: wireless, satellite, cable, and telecom no longer belong to discrete sectors. In a mobile information society, services as well are different, impacted by the presence of Internet, virtual organization, or network transactions.

Information and Communication Technologies (ICTs) are enablers of change; they release creative potential and knowledge and open up global markets and foster competition. Network transaction economies resemble the most complex network: the human brain. The digital revolution can be a great equalizer, but national policies must be right to enable it. Proper training and education can make a network transaction economy, or knowledge economy, more effective and efficient: *smarter*. This elevation requires methodical enhancement of the business development environment, e.g. via business incubators. Advancement also requires enhancement of the network technology infra-structure, i.e. ICT. The state of the art is the virtual incubator, in which ICT extends and multiplies the effectiveness of business incubation at lower cost.

Adam Smith defined *Land*, *Labor* and *Capital* as the key input factors of the economy in the 18th century. Joseph Schumpeter added *Technology* and *Entrepreneurship* as two more key input factors in the early 20th century. He thus recognized the role and dynamic nature of technological change and innovation as well as path dependencies in shaping the health and future of the economy and moving away from the static approach of Neoclassical Economics.

In the late 20th and the beginning of the 21st century, numerous scholars and practitioners such as Peter Drucker, have identified *knowledge* as perhaps the sixth and most important key input and output factor of economic activity. We would like to also emphasize the role and significance of *technological* and *economic learning* as a driver of productivity gains and an accelerator of economic growth and prosperity (Carayannis, 2000, 1993, 1994, 1998, 1999, 2001, 2002).

We feel that there is a clear role, opportunity and challenge for entrepreneurs around the world to catalyze and accelerate economic development and convergence and leverage the digital divide through bottom-up, entrepreneurial initiatives in the private sector.

Economic growth is driven by the accumulation of knowledge and new technological developments create technical platforms for further innovations. These technical platforms, in turn, are drivers of economic growth. Technology raises the return on investment, which is why developed countries can sustain growth and why developing economies cannot attain growth without it. Even with unlimited labor, natural resources, and ample capital, traditional economics predicts that there are diminishing returns on investment.

As J.B. Say has stated, innovation is about changing the yield of resources and in this context, knowledge-based and knowledge-supported entrepreneurship via real and virtual, global and local (glocal) infra-structures such as the incubator networks we discuss later on, will be the pre-eminent driver of innovation in the 21st century. This perspective becomes particularly promising and enticing in the context of e-Development initiatives towards the Knowledge Economy that we profile in the case studies that follow.

e-Development allows us to perceive the challenges and opportunities of development in a new light in terms of the *scope and speed as well as the quality of technological and economic change*. The role of ICT in the creation, diffusion, absorption and use of knowledge for development (K4D), has been shown to be instrumental and with increasingly substantial and emerging potential (WDR, 1998; WBI: China and the Knowledge Economy, 2001; WBI: Republic of Korea: Transition to a Knowledge-Based Economy, 2001) (Carayannis and von Zedwitz, 2005c; Carayannis and Popescu, 2005b).

We reviewed the economies of several nations within a spectrum of possible states of development as follows, and we related those to development pathways (see Fig. 1):

(a) *Subsistence-focused*. Where survival is the issue, i.e. Afghanistan today.
(b) *Commodity-based*. Where commodities are the dominant means and goal of economic production and exchange and within that category there are barter-based economies up to some transitioning economies.
(c) *Knowledge-based*[14]. Where knowledge is one of the key means and goals of economic production and exchange and one of the key economic resources with high degree of utilization and sharing.
(d) *Knowledge-driven*[15]. Where knowledge is the major means and goal of economic production and exchange and the most valuable economic resource under continual renewal, sharing, and utilization.

[14] OECD (1996).
[15] UK Department of Trade and Industry (1998).

Technological innovation and economic learning are key modalities of economic development and growth.

e-Development brings about new ways of old interventions…	
Privatization	e-Privatization
Deregulation	e-Legislation
Education and human capital	e-Learning
Government reform	e-Government and e-Procurement
Finance	e-Finance
Business climate	e-Government, e-Procurement, e-Taxation, e-Registration
R&D and innovation	Technology parks and incubators

…and creates room for innovative applications
e-Society for increased participation of the civil society
Electronic flows of documents in the public administration to increase efficiency and transparency
Access to rural finance
Increase speed and flexibility
Improve general quality of services across industries and sectors of the economy
Opportunities for cross-country and cross-sectorial development

The set of tools, competencies and applications of e-Development in the Knowledge Economy may be distributed among four main pillars of general development:

- Institution Building
- Capacity Building
- Policy making
- Investment Making

The dimension of a more effective and efficient development resulting from e-Development interventions may be highlighted by the role of:

KE The Knowledge Economy framework provides the foundation for the recognition of the potential of transitional and even developing economies to catalyze and accelerate their development by leveraging ICT and e-Development practices.

e-Dev e-Development may provide the ways and means to accelerate and catalyze the transition to the knowledge-driven economy including the potential for transitioning economies to leapfrog developed economies with less focus on e-Development in special and specific sectors or in niche markets.

ICT ICT may allow commodity-based economies to evolve into knowledge-based and possibly knowledge-driven economy

The need for e-Development interventions is stressed also by the development of the e-Economy and the increased competitiveness and openness that it brings about. The Knowledge Economy is fostering market transparency, integrating separate geographical markets and facilitating integration into innovative global markets.

Moreover, the need for standardization, of both processes and policies, calls for action of an overarching organization that can provide appropriate guidance and advisory services to transitional economies willing and able to take advantage of knowledge economy.

3.1. e-Development and the private sector

e-Development focuses on the recent advancements in ICT such as fixed-line and mobile communications and computer-assisted networks, with Internet and Intranet as their most common form. Traditional communication technologies, such as TV, Radio and telephone, as well as postal networks are included in the category of ICT.

The relevance of e-Development to private sector development (PSD) and especially entrepreneurial development, is based on the ability of ICT to perform several vital functions. Technology can be used to physically interconnect various actors of the economy and society to create new opportunities for efficient interaction and cooperation through networking and clustering. ICT-based media can be deployed to disseminate vital information for business development, improve information flow between various government agencies that interact with the private sector, and to increase the technical and managerial capacity of private and public sector professionals through e-learning.

In this sense, e-Development creates opportunities for information dissemination and knowledge sharing in a manner that levels the competitive local and global 'playing fields' thus opening windows of opportunity to aspiring entrepreneurs (Carayannis and von Zedwitz, 2005c; Carayannis and Popescu, 2005b). Finally, e-Development allows process acceleration and automation to improve business and government processes as well as increase efficiency of interaction and transactions between the public and private sector. The combination of these tools allows for advanced applications that revolutionize ways of conducting business and improve delivery of public services to private sector.

Yet, it is important to remember that e-Development is not about technology per se and is not limited to promotion of ICT applications across business and government. e-Development is a comprehensive approach that influences all aspects of developmental activities—such as policy making and education and training—to create *an enabling environment* for the purposeful of innovative technologies for broad-based development.

Human capital development and opportunities to share knowledge become central to sustain viable development strategies. Computers and telecommunications, the key infra-structure of the Knowledge Economy in the same way as railways and roads for the industrial economy, make it possible to create, accumulate, manage and share knowledge. However, the Knowledge Economy is not simply and only about hard factors—computers and

telecommunications—but also about soft factors, such as cultural capital, human resources, and most crucially, an *entrepreneurial mindset*:

> "China is the most dramatic example of having technological knowledge but failing to sustain growth of income per head…but the Chinese chose not to compete in world economy with their advanced technology, and they closed their borders. So China remained stagnant through the 19th century, when Westerners using some of the same (Chinese) technologies were able to impose their will on China (Just think how history would be different if the Chinese had discovered America).' (Easterly, 2002: 175–176).

3.2. New venture formation in the knowledge economy and society

We next review several new venture formation and support modalities such as small and medium enterprises (SMEs), business incubators, technology clusters, and Information and Communication Technologies (ICT) in the context of the Knowledge Economy and Society.

3.2.1. Business incubators

An incubator is an economic development tool designed to accelerate the growth and success of entrepreneurial companies. It offers an array of business support resources and services such as on-site management, marketing resources, access to appropriate rental space and flexible leases, shared basic office services and equipment, and technology support services or assistance in obtaining the financing necessary for company growth. The incubator's main goal is to produce successful firms that graduate the program financially viable and freestanding. Incubator graduates create jobs, revitalize neighborhoods, commercialize critical new technologies and strengthen local and national economies (National Business Incubation Association (NBIA), 2003a).

Technology incubators are a specific type of business incubator, a property-based venture that provides tangible and intangible services to new technology-based firms, with the aim of helping them increase their chances of survival, generate wealth and jobs, and diffuse technology. Their objectives are economic development, technology commercialization, property venture/real estate development, and entrepreneurship. They play a visionary role in the sense that they allow governments and NGOs to demonstrate their efforts to address problems of regional development and unemployment. Fig. 2 diagrams how different strategic objectives and competitive scopes define five archetypes of incubators (Carayannis and von Zedwitz, 2005c).

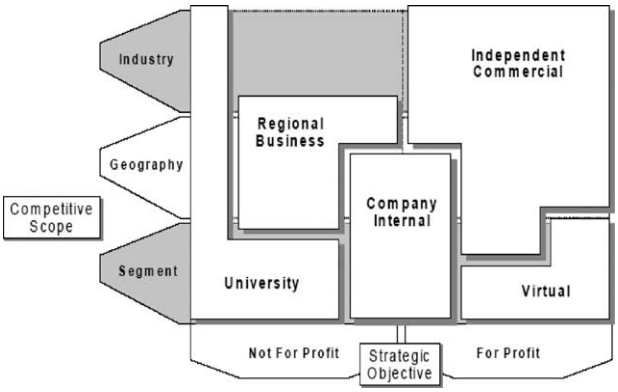


Fig. 2. Typology of incubators by competitive scope and strategic objective. (Adapted from Carayannis and von Zedwitz, 2005c).

3.2.2. Overview of SMEs

There is no unique definition of Small- and Medium-sized Enterprise (SME) that exists and is applicable to all sectors of the economy. The European Commission and the World Bank use statistical concepts to define SMEs. For the European Commission, an SME is defined as having fewer than 250 employees, either with annual revenue not exceeding €40 million or with an annual balance sheet total not exceeding €27 million, and no more than 25% of its capital controlled by an organization, which is not itself an SME. In EU, SMEs represent 99.8% of all enterprises and two-thirds of all employment (European Space Agency (ESA), 2000).

In contrast, the World Bank Group (2000) subdivides SMEs into three groups: micro-enterprises, small enterprises and medium enterprises:

- Micro-enterprise: Ten or fewer employees, total assets not exceeding $100,000 USD, total annual sales not exceeding $100,000 USD
- Small Enterprise: Between 10 and 50 employees, total assets $100,000 to $3 million USD, total annual sales $100,000 to $3 million USD
- Medium Enterprise: Between 50 and 300 employees, total assets $3 million to $15 million USD, total annual sales $3 million to $15 million USD

SMEs are characterized by their ability to react quickly to changing market conditions, which constitutes a competitive advantage. SMEs are also recognizable by their increasing shares in employment and output. SMEs lag in terms of technology adoption (at least currently), but have a higher propensity for product innovation after adoption of IT. Smits (2000) underscores the high priority of SMEs on political agendas since they are critical economic drivers—drivers of innovation, economic growth, and employment. However, these entities are facing critical economic challenges such as increasing competition from globalization, restrictions on access to finance, difficulties establishing networks with foreign

partners, imperfect access to research results and technology transfer, speed of change in the ICT environment, uncertainty of sustainability, and lack of sources to address the information needs of small enterprises and the knowledge-based economy (Smits, 2000).

3.2.3. ICT and incubators

ICT and incubators afford a solution to SME challenges. ICT extends the reach and rapidity of network transactions: telephone, fax, voice mail, e-mail, and teleconferencing are technology enablers that facilitate organizational exchange so that ideas, information, knowledge, and efforts can be shared and merged with greater productivity, efficiency, and synergy and all at a lower cost. ICT also transcends geographic and political boundaries.

It extends ready access to market intelligence and business resources such as industry technologies, infrastructures, and trends; competition, competitors, and emerging threats; sources of financial, technical, and managerial support; complementary producers, potential partners, and emerging opportunities; customers, potential customers, and externalities affecting those buyers; as well as suppliers and distributors, and their potential alternatives.

ICT is available or can be made available to almost any environment. In developed countries, e-mail and Internet access have become ubiquitous, teleconferencing capability now has a quality level high enough to encourage real-time collaboration (RTC), replacing the need for travel in many contexts, and satellite connectivity will continue to expand global access (Kaku, 1997).

3.2.4. Technology clusters (vs. knowledge clusters)

A technology cluster is a critical mass of local knowledge, expertise, personnel, and resources used by firms to gain competitive advantages. Conceptually it is similar to a business incubator, but scaled larger and composed of more-established businesses. A *technology cluster* is a likely place for the incubator client to move to upon graduation and it differs from a *knowledge cluster* (Carayannis and Campbell, 2005a) as defined above, has a more intangible nature and can transcend and overlap with several technology clusters.

The geographical display of clusters usually follows one of thee cluster topographic models: the hub-and-spoke model, the satellite platform industrial district model or the state-anchored district model. The hub-and-spoke model is based on one or more companies and/or central facilities as a core around which suppliers and related activities are spread. The satellite platform industrial district is a congregation of branch facilities of externally based multi-plant firms. Finally, the state-anchored districts are based on public or non-profit organizations around which other firms and organizations clusters. The cluster formation is defined by the following attributes (Enright and Kai, 2000):

- Geographic scope: natural vs. virtual clusters
- Density: dense vs. sparse
- Breadth: horizontally related industries
- Depth: vertically related industries
- Activity base: core-strategy-setting
- Growth potential: innovative vs. mature
- Innovative capacity: high vs. low
- Industrial organization: firm relationships
- Coordination: hierarchies, markets or intermediate forms

The dynamics of the cluster's performance are determined by its co-location synergy (government, university, and firms), personal relationships, intangible culture, institutional elements, interaction logic and learning logic. A strong physical and ITC infra-structure is a baseline requirement to establish and sustain a prosperous cluster. A strong educational system is important for developing local talent and attracting outside talent. Specialized talent and training are more important than abundant labor. Universities and specialized research centers are the driving force behind innovation. Mechanisms for commercialization are essential if innovation is to translate to economic success. Government can have a significant influence on the business environment both positively and negatively.

Some determinants of cluster creation are specific to the type of cluster considered, whether it is a natural, geographic cluster or a virtual cluster/network. Natural clusters are facilitated by the fact that tacit knowledge is seen as increasing in importance relative to successful innovation, and because tacitness has become more important in competitive advantage under new management and organization strategies. Some wider organizational change, such as closer supply chain and JIT, encourages spatial proximity as well. The increasing importance of customers—'market pull'—necessitates innovation co-location and stress is growing for certain external contacts, such as 'first time' and face-to-face. Yet, geographic clusters can encounter a number of common pitfalls, such as (Porter, 2001):

- Failure to communicate needs to other important actors
- Cluster-killing competitive strategies of firms
- Discouraging the entrance of local rivals
- Neglecting investment in the engines of innovation—universities and research centers
- Neglecting physical infra-structure
- Government policy discouraging investment and constraining regulations
- Focusing on narrow geographic areas
- Biases towards 'high-tech' clusters (e.g. IT or biotech alone)
- Ignoring traditional strengths
- Recruiting big companies, not building competitive clusters

- Inattention to commercialization issues
- Insufficient cross-disciplinary collaboration

Conversely, some factors are more conducive of virtual clusters/networks. The increasing codification of knowledge and science, new forms of ICT, the increased dispersion of R&D, design, engineering, and technical support (both nationally and internationally), the move towards 'flatter' organizations, and increased managerial experiences and learning of global business management all facilitate the creation of virtual incubators.

For SMEs to engage in clusters has clear benefits. They increase productivity and efficiency, provide efficient access to specialized inputs, employees, information, institutions, and 'public goods' such as training programs and training institutions, and ease the coordination across firms. They allow for ongoing, visible performance comparisons and strong incentives to improve against local rivals, stimulate and enable innovations, and increase the ability to perceive innovation opportunities.

The presence of multiple suppliers and institutions assist SMEs in knowledge creation; experimentation is made easier given locally available resources. Clusters facilitate commercialization and make opportunities for new companies. New lines of business are more apparent, and barriers to entry into cluster-related business are lowered.

4. Concept validation via e-development case studies from practice

This section introduces the analytic framework to be applied to a diverse selection of case studies, grounded in the fundamental concepts and instrumental methodologies of e-development and knowledge economy as delineated above, and respective of the two thematic areas of this paper: using business incubators for new venture formation, and using ICT to support and promote SMEs.

In the e-Development case studies we reviewed, we found of particular interest the use of ICT to foster entrepreneurship and transfer knowledge by Diasporas all over the world. The support of the Diaspora can be found in various forms. The first one can be illustrated by the case of the Hsinchu Industrial Park in Taiwan where most of the companies have been started by returnees. This does not only tackle the talent drain that affects most developing countries, but returnees make a highly value-added contribution in the creation of new ventures. However, the case of Taiwan seems to be an exception.

The majority of Diaspora contributions we identified involved a digital Diaspora (e.g. Digital Diaspora Network, Digital Partners). Cases have been identified in Africa, South Asia and Latin America. The rational for these types of networks is that the entrepreneurial spirit inhabits all countries, but a lot of opportunities are missed due to the lack of information. Using ICT, the members of the Diaspora can communicate with their home countries about possible opportunities, advise them in the entrepreneurial process, as well as tech them about the use and possibilities of ICT.

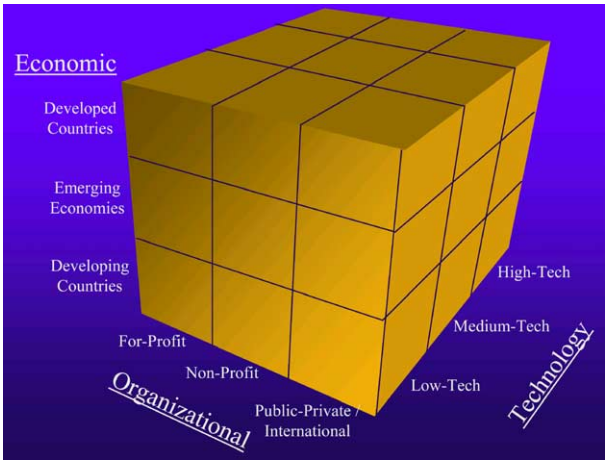


Fig. 3. Three dimensions of analysis of e-development in the knowledge economy.

The Diaspora can also make its contribution to the learning and development of the countries in a more passive way. This situation arose in Bolivia as e-commerce was being pushed towards the indigenous communities and a web site was created (http://www.boliviamall.com) so that Bolivians abroad would stay connected to their cultural heritage while supporting the economic development and technological advances of their country (see Appendix A).

Each case study is coded in three dimensions for evaluation: economic level, organizational level, and technology level, and each level is subdivided into three sub-levels. The case studies are summarized and analyzed in this state-of-the-art survey, to afford substantive information in each analytic dimension (see Fig. 3).

4.1. Economic level: developing countries, emerging economies, developed countries

The economic level is further broken down into developed countries, developing countries and emerging economies, as special case of developing countries. In developed countries, quality of life in rural areas is comparable to that in the urban areas. Developed countries have reached a stage of economic development characterized by the growth of industrialization, the amount of money made by the population (national income) is enough to pay for schools, hospitals and other services; and their population growth is usually slower than in developing countries. In simple terms, the World Bank defines them as follows (Soubbotina and Sheran, 2000):

Developed countries (industrial countries, industrially advanced countries). High-income countries, in which most

people have a high standard of living. Sometimes also defined as countries with a large stock of physical capital, in which most people undertake highly specialized activities. According to the World Bank classification, these include all high-income economies except Hong Kong (China), Israel, Kuwait, Singapore, and the United Arab Emirates. Depending on who defines them, developed countries may also include middle-income countries with transition economies, because these countries are highly industrialized. Developed countries contain about 15% of the world's population. They are also sometimes referred to as 'the North.'

Developing countries comprise low- and middle-income countries where most people have lower standard of living with access to fewer goods and services than most people in high-income countries. Currently about 125 developing countries with populations over 1 million; in 1998, their total population was more than 5.0 billion. Developing countries are broadly split into two categories, the middle-income and the low-income groups. According to 2002 statistics, the GNP per capita of middle-income countries ranged from $755 to $9266; low-income countries, also referred to as Least Developed Countries (LCDs), had a GNP per capita below $755 (The World Bank Group, 2003).

Emerging economies are the most economically progressed of developing countries. In terms of GNP per capita, they correspond to the medium–low and medium–high country groups but are characterized by a regulated and functioning securities exchange, or in the process of developing one, and the fact that shares traded on the stock exchanges must be available for purchase by foreign investors, even if subject to certain restrictions (Kovalskaya et al., 2002).

4.2. Organizational level: for-profit, non-profit, public–private/international

At the organizational level, we focused on for-profit, non-profit and public–private/international entities.

A for-profit entity is any organization whose primary objective is to have revenues exceed expenses and return the remainder (profit) to its shareholders. These could be private or public enterprise, business, firm, proprietorship, partnership, corporation, or other form of organization having emphasis on the financial performance metrics of operations. In the event of dissolution, the assets owned by a for-profit entity are distributed to creditors and individual owners. This type of organization is typically taxed by governmental authorities.

Non-profit entities, also including not-for-profit and non-for-profit, are an association or organization of persons banded together for a specific purpose. Under US Code, the association must have a written document showing its creation, with at least two persons attesting. The definition of an association can vary under state law (Internal Revenue Service, 2003). The primary purposes of operation are exclusively for religious, charitable, scientific, literary, cultural, educational, recreational or other non-profit pursuits. This definition also comprises some non-governmental organizations (NGOs) that are local in scope or serving small-scale transnational interests, e.g. professional associations, regional development authorities. Non-profit organizations can be privately held, but they should not distribute profit to individual members in any form. In addition, no part of the assets, income or earnings of the entity is to benefit any individual or member. In the event of dissolution, the assets owned by such association, corporation or other entity are distributed to another association, corporation or other non-profit entity. Non-profit organizations may qualify for tax-exempt status (Blaisdell Center and Shell, 2003).

The third subset of the organizational level of analysis we broadly refer to *as public–private/international*. This encompasses government, governmental agencies, and governmental alliances at all levels, publicly subsidized institutions for education or research, large NGOs, and alliances and consortia for research and development, that are collaborating.

4.3. Technology level: low-tech, medium-tech, high-tech

Ultimately, we refined the analysis at the technology level, differentiating low, medium and high-tech (Smith, 2000).

The entities qualifying for one of the following four criteria were considered high-tech:

1. Makers and creators of new technology, whether in the form of products, communications, or services
2. Engaged in the development, market deployment, or adoption of innovation and emerging technologies, such as biotech (e.g. pharmacology, genomics, bioinformatics, pharmacogenetics), IT/ICT (e.g. Wi-Fi, i-mode, robotics, neural networks, photonics) or materials engineering (e.g. ceramics, polymers, semiconductors, composites)
3. Devoting the bulk of assets to R&D, value lies almost entirely in the future
4. R&D intensity: Industry spending more than 4% of turnover (e.g. ICT or pharmaceutical)

To qualify as *medium-tech* the organizations under consideration met one of three criteria:

1. Manufacturers and producers of existing technology, whether products, communications, or services
2. Engaged in the fabrication, process improvement, or incremental innovation of established technologies
3. R&D intensity: Industry spending between 1 and 4% of turnover (e.g. vehicles and chemicals)

Finally, entities qualifying as *low-tech* were matched on of three criteria:

1. Producers and harvesters of mature technology
2. Engaged in the replication and maintenance of mature technologies

4.4. Dimensional synthesis of case studies in e-development and knowledge economy

In this section, we synthesize the fundamental concepts and instrumental methodologies of e-development and knowledge economy respective of the analytic dimensions of economic level, organizational level, and technology level, as exemplified in the case studies. Additional dimensions of scale and time are also explored, and inferences extracted from the case findings are interpreted in terms of their similarities and differences:

- Table 1 summarizes cases drawn from developing countries, arrayed by organizational level and technology level.
- Table 2 summarizes cases drawn from emerging economies, arrayed by organizational level and technology level.
- Table 3 summarizes cases drawn from developed Countries, arrayed by organizational level and technology level.

The case descriptions are color-coded to visually differentiate those cases pertaining primarily to using business incubators for new venture formation (coded in the tables in black text), and cases pertaining primarily to using ICT to support and promote SMEs (coded in the tables in blue text).

4.4.1. A fourth dimension: scale

Synthesis and discussion of the fundamental concepts and instrumental methodologies of e-development and knowledge economy would not be complete without an evaluation of the analytic dimension of scale. In the context of the topic, scale refers to global, regional, and local levels of influence and operation, as modeled in Fig. 4. In the specific context of issues central to e-development, Carayannis and von Zedtwitz offer this perception:

> The global–local real–virtual incubator networks model may be particularly helpful in less developed economies, where incubators can help bridge knowledge, digital, socio-political and even cultural divides and help increase the availability, awareness, accessibility and affordability of financial, human, intellectual, and even social capital, the key ingredients of entrepreneurial success.

4.4.2. A fifth dimension: time

Synthesis and discussion of the fundamental concepts and instrumental methodologies of e-development and

Table 1
Developing countries, by organizational level and technology level

Developing Countries	Low-Tech	Medium-Tech	High-Tech
For-Profit	Phone and fax extend the reach of a village sunglass maker.	Internet brings a global market to sandal makers at Ecosandals.com in Kenya.	VCs answer survey of new venture success factors.
Non-Profit	Indirect Internet access broadcasts on Radio Sagarmatha in Nepal.	Web mail services are delivered by Kabissa.org throughout Africa.	Quipunet connects Peruvians living around the world to home.
Public-Private / International	Development Gateway Foundation delivers information and knowledge sharing capability worldwide to reduce poverty and support sustainable development	UNECE promotes development in Eastern Europe, Baltic States & CIS. UK IDPM supports ICT in SED in developing countries.	Romania promotes competition in the ISP market.
Legend: ■ Incubators ■ ICT			

Table 2
Emerging economies, by organizational level and technology level

Emerging Economies	Low-Tech	Medium-Tech	High-Tech
For-Profit	Enterprise offers business incubator for women in Jordan	JTG provides venture capital incubator for early-stage IT firms in Jordan	Hsinchu Science-Based Industrial Park attracts expatriated engineers to return to Taiwan.
Non-Profit	Jhai Foundation helps farmers install pedal-powered Internet in Laos.	USAID Project Fabrykat 2000 designs a stronger manufacturing technology transfer system in Poland.	IBI helps build Silicon Valley business incubators in the U.S. for Korea, Scotland and India.
Public-Private / International	Development Gateway Foundation delivers information and knowledge sharing capability worldwide to reduce poverty and support sustainable development.	IADB promotes policy for sustainable development in Latin America and the Caribbean. Researchers write an academic prescription for virtual incubators in China.	TradenetSL provides virtual incubator services to export firms in Sri Lanka. Technical cooperation activities in Korea exhibit a steep upward trend.
Legend: ■ Incubators ■ ICT			

Table 3
Developed countries, by organizational level and technology level

Developed Countries	Low-Tech	Medium-Tech	High-Tech
For-Profit	PRSource.com reopens its online source for public relations services.	Microsoft sponsors incubator program for independent video game developers.	VCs answer survey of new venture success factors. MediMined wins NBIA award for technology incubator client (USA). NTT DoCoMo transforms multimedia market in Japan.
Non-Profit	FAME Renaissance incubates multimedia businesses in impoverished urban communities (USA).	ETHM launches entrepreneur training center for economic revitalization of distressed urban community (USA).	NBIA advances business incubation and entrepreneurship.
Public-Private / International	Telecottage brings ICT access for development in rural Australia	WDA promotes ICT for SMEs in Wales.	TEDCO fosters technology transfer. (USA). Arno valley promotes clusters of SME ICT producers in Italy. Finland experiences phenomenal success in ICT and the new economy.
Legend: ■ Incubators ■ ICT			

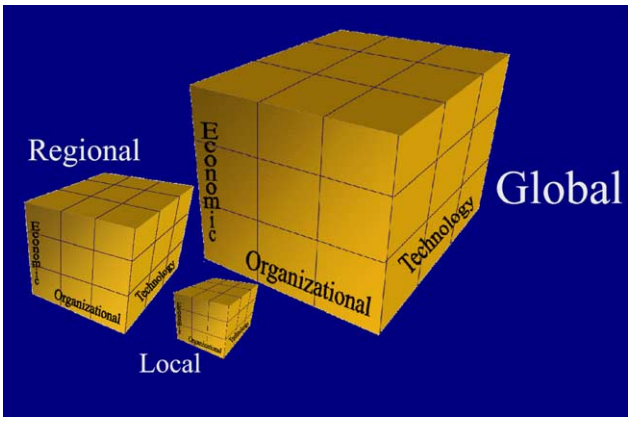


Fig. 4. The dimension of scale.

knowledge economy would not be complete without an evaluation of the analytic dimension of time. In the context of the topic, scale refers to immediate, short-term, and long-term periods of performance, as pictured in Fig. 5. In the specific context of issues central to technology innovation, Hamel and Prahalad offer this insight:

> The future is now. The short term and the long term do not abut one another with a clear line of demarcation 5 years from now. The short term and long term are tightly intertwined. Although many of tomorrow's mega-opportunities are still in their infancy, companies around the world are, at this moment, competing for the privilege of parenting them.

4.4.3. Dimensional synthesis of cases—economic level: similarities

The world is going through a dynamic era where a country's economy can transition quickly either upwards or downwards, and this trend has become increasingly more pronounced. At all levels of social and economic development, people seem eager to have access to ICT and all that it promises to offer. Everywhere in the World, even across the most remote areas of the least developed countries, pioneers

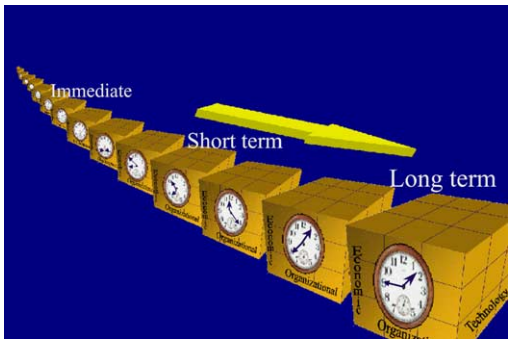


Fig. 5. The dimension of time.

are delivering knowledge-based skills and resources. Where there is no infra-structure to support the newest and best, people are pooling their efforts, creativities, and meager means to extend the reach of the information age and share the enlightenment of connectivity. Where knowledge economy resources are more available, people are revising their ways of social transaction to leverage the improvements into even greater advantage.

At all levels of economic development, policy makers are deliberating or crafting improved regulatory environments to facilitate and promote the fruition of knowledge economy. Regulators are demonstrating a commendable understanding of the factors and conditions, and many are taking action to open up opportunities for their constituents. Organizations at all levels are engaging in directed strategic assistance to entrepreneurs and other stakeholders.

4.4.4. Dimensional synthesis of cases—economic level: differences

Clearly, the availability of existing resources and the leverage to build more are disparate between economic levels. In the developing countries, progress enacts on a small scale, in modest ventures by individuals or teams of relatively few actors. While involving more actors and commanding more attention, larger development projects in these nations tend to be exploratory, prescriptive, or still being studied. The greater resources available in emerging economies and developed countries permit positive actions earlier, which further stimulate economic growth. The healthier economic condition of many developed countries, particularly those of scant natural resources (lacking comparative advantage) is directly attributable to this upward spiral of technology investment, deployment, and adoption (competitive advantage).

When it comes to e-Development, developing countries are thinking about it at a policy level, but acting on it in fragmented cells of small enterprise. Emerging economies have made commitments and started to take concerted action at the policy level, including policy actions to foster the success and cross-pollination of small enterprise. Developed countries got that way—or sustain their prior development level—by having exercised their commitments and supporting actions from the outset of knowledge-based economy.

4.4.5. Dimensional synthesis of cases—organizational level: organizational level: similarities

The fundamental economic challenge facing all forms of social organization is at the very heart of economic discipline: *The management and allocation of scarce resources.*

Regardless of organizational form or level, no single entity has everything that is wanted or needed to pursue that organization's mission to its fullest. For-profit enterprises must deliver financial returns to investors

Non-profit organizations must deliver targeted services to recipients. Public–private/International bodies must

deliver an environment in which constituents grow and prosper. In all cases, the organizational mission must be accomplished before scarce resources are withdrawn or used up, but these same scare resources must be invested to build a for-profit enterprise up to a self-sustaining level; must be budgeted at a level adequate for a non-profit organization to fulfill its mission competently; and must be committed by public–private and international institutions with prioritizations based on where the resources will do the greatest good for the most people, particularly in growing the resources to make more resources available. In all cases, collaboration and productivity can yield the sustaining level of results more economically—higher output per unit input: efficiency.

4.4.6. Dimensional synthesis of cases—organizational level: organizational level: differences

The motivation for operational emphasis is inherent to the organizational form and level. The primary purpose of for-profit enterprises is to increase shareholder wealth. Other social benefits are incidental not central, but most for-profits are in the business of selling social benefits (economic goods) rather than profiteering from causing harm. The primary purpose of non-profit organization is to deliver specialized services. If this action creates or saves money, it is incidental not central, but generally, non-profits are not geared to be purposefully wasteful. The primary purpose of public–private/international institutions is to create and preserve environments in which the other organizations (and individuals) can function best to pursue their primary purposes without unreasonable restriction, but be constrained from engaging in harmful, wasteful, or unfair practices with respect to other organizations (and individuals).

4.4.7. Dimensional synthesis of cases—technology level: similarities

Regardless of technology level, business incubators facilitate and enhance new venture formation, and improve the survivability and growth of the enterprise. From relatively low-tech office services or technical advisory assistance in low-tech business sectors, to high-tech mobile teleconferencing or research investigations into untested technology markets, the business incubator extends the reach and resources of the start-up firm.

Regardless of technology level, ICT supports and promotes SME development. From relatively low-tech phone and fax lines, to high-tech portable information terminals or the collaboration of scientists, engineers, attorneys and financial investors to patent and deploy a next-generation breakthrough, ICT enables the efficient transaction of knowledge exchange and gains in knowledge capital.

Competency of all organizational levels—in all economic environments—is elevated by technology. The introduction of technology at any level, however modest, becomes a platform upon which the next technology can be adopted, and subsequent adoptions become increasingly easier for the user community.

4.4.8. Dimensional synthesis of cases—technology level: differences

The accessibility to technology is predominantly dictated by economic environment, by the very definition of economic levels for countries, although even the poorest countries have wealthy residents who have access to the highest technology, and the wealthiest countries have residents whose access to high-tech benefit is limited. Wherever this disparity occurs, it is often called the digital divide. While developed nations are investing hundreds of billions of dollars in a move to 3G networking with completely mobile data connectivity, the poorest developing countries are hand carrying e-mail copies to recipients on paper or diskette. Fifteen percent of the earth's population is providing nearly all of the world's technological innovations. Fifty-two percent is able to adopt these into production and consumption. Approximately one third neither innovate nor adopt.

But as a technology matures, adoption leads to recovery of capital costs, prices go down and availability goes up, permitting diffusion into more economic sectors to accelerate.

4.4.9. Dimensional synthesis of cases—scale: similarities

The accessibility of ICT makes it increasingly easier for remote locales to participate in global commerce, diminishing geographic, political, and cultural boundaries. In the context of real and virtual networks of business incubators, the wide-range access connectivity is called *gloCal* (Carayannis and von Zedwitz, 2005c). This compares with the term 'global village' in common parlance. ICT and network architecture is eminently scalable, provided that each node has connectivity to at least one other. As more nodes are added and interconnected, the exchange efficiency and transaction potential increase exponentially, amplifying the gloCal diminution of boundaries. At the highest level of proliferation, each new node is a network unto itself, all constituents of which have feasible access to all the constituents of all the other nodal networks. The number of connections on a network of membership networks or interactive groups is calculated by Reed's Law: 2N-N-1.

It genuinely is a World-Wide Web. ICT and virtual incubator networks enable economic integration, which is a force for good. Globalization does not cause poverty. Globalization is the only feasible cure (Crook, 2001).

4.4.10. Dimensional synthesis of cases—scale: differences

At all levels of scale—local, regional, and global—the economic benefits of ICT and business incubators have the same impact and availability. Access and implementation differences are a function of prevailing economic level and infra-structure. A wealthy person in a poor locale

experiences connectivity challenges, which can be surmounted by supplemental technology, which perhaps that wealthy person can afford. Geographic remoteness is an obstacle whether the inhabitants are poor or wealthy, until infra-structure development brings connectivity to those who can afford it. These investments by those who can afford them create conditions that improve the affordability to everyone there.

4.4.11. Dimensional synthesis of cases—time: similarities

Economic development is an ongoing process. The drive for survival and ascent is both immediate and perpetual. Failure to act now, or at any time in the future will lead to social setbacks. Those who advance will pass those who do not compete. Economic vitality depends on active transactions. Knowledge economy moves faster than did the industrial economy, and ICT accelerates this trend.

4.4.12. Dimensional synthesis of cases—time: differences

Realistically, not everything can happen at once, particularly in the prudent management of scarce resources. Developing countries and policy makers need to target investments wisely, staged according to technical and financial feasibility. But the same planning and investment prudence pertains to every venture and organization.

A multi-billion-dollar program is of no less import to the stakeholders of a 3G ICT network than to the stakeholders of a transnational education program. Stakeholders are not just owners and investors, but also the policy makers, managers, technicians, workers, advisors, producers, consumers, users, and beneficiaries who are impacted by the outcomes of the program. Success is in everyone's interest. Failure is not without consequences. An immediate investment in e-development for knowledge economy can lead to short-term gains in knowledge capital, which in turn will leverage the capacity for an even greater long-term economic yield.

5. Lessons learned and critical success and failure factors for e-development in the knowledge economy and society

Regardless of externalities, each organization seeks to sustain itself in competition and cooperation with other entities that depend on the same finite pool of resources. The fundamental challenge is the very heart of economic discipline: *the management and allocation of scarce resources*. The advantage of knowledge economy is that knowledge grows by sharing—donors do not forfeit what they know when passing knowledge to recipients, who in turn can share with others. The greatest phenomenon of knowledge-based economics is this multiplier effect: *sharing knowledge capital actually creates more of it*.

Research and innovation must be managed today to secure sustainability for tomorrow. Open innovation is a policy of collaboration. Companies must manage intellectual property (IP) to manage research: they need to access external IP; they need to profit from internal IP. Researchers must be knowledge brokers as well as knowledge generators. Companies can profit from one another's IP. No one company has claim to all the smart people in a field. Competition and collaboration can and must co-exist.

Open innovation is knowledge diffusion and recombination, producing the 'seed corn' of tomorrow's breakthroughs. Researchers must recognize their own potential, and be able to articulate possibilities to a receptive management for further development (Chesbrough, 2001). Routti (2003) reinforces this claim that science-driven academic research is vital to returns.

Scientists decide the basic research; industrialists decide the applied R&D. Management culture must encourage risk-taking. Fear of failure suppresses creativity and innovation, which undermines competitiveness. Failure is a great educator. Institutionally, a deviation from plan is an irregularity, but competitively it is creative, innovative, exploratory work. Creativity is essential. There is tremendous 'white space' in market opportunities—new products, processes, markets, and unknowns. Strategic community creation is a calculated alliance of many stakeholders to manage the risk and facilitate adoption.

The priorities of new venture formation in the knowledge economy are: ICT and Internet access; linkages to investors and lenders; formation of lean management and advisory boards comprised of experienced individuals, competent in their fields of discipline and having as few members as needed to get the job done; and planning and securing facilities. The priorities of e-development and sustained growth are: the ability to evaluate and react to risk well; protection of product; stimulation of existing market; and the available population of skilled knowledge workers—whether centralized in a physical facility or linked via virtual organization.

The Knowledge Economy and Society rely upon knowledge stocks and flows to function, prosper and grow. Entrepreneurs need the knowledge to build a reliable infrastructure using incubators for new venture formation. New technology businesses need to move through the growth process rapidly and get their products to market before they run out of resources. Businesses need to use technology clusters to stimulate sustained innovation and growth. Everyone gains by providing electronic access to goods and information. Entrepreneurs need to understand the criticality of using ICT to support and promote SMEs, and using virtual incubators to enlarge and extend the accession and dissemination of knowledge.

5.1. Using business incubators for new venture formation—success factors and best practices

The following factors have been identified as the most critical to the successful and superior use of business incubators for new venture formation.

- The ability to evaluate and react to risk well
- The access to the right expert at the right time
- Protection of product
- To understand and exercise technology transfer privileges and intellectual property rights
- To foster actions oriented towards the production of academic spin-offs and entrepreneurial spin-offs
- To strengthen the education system
- To define programs for assistance and training in entrepreneurial functions
- Stimulation of existing market
- To promote venture-capital actions
- Having developed a good success formula, replicate it and franchise it

5.2. Using business incubators for new venture formation—failure factors

The following factors have been identified as having been most contributing to failure in the use of business incubators for new venture formation.

- Incompetence risk
  - Entrepreneurial team lacking sufficient capability, principally in
  - Marketing
  - Input sourcing
  - Managerial competence
- Inexperience risk
  - Lack of familiarity with target market and relevant track record
- Product risk
  - Insufficient uniqueness of product/service relative to competitors (differentiation)
  - Inadequate product protection
  - Untapped market potential

5.3. Using ICT to support and promote smes—success factors and best practices

The following factors have been identified as the most critical to the successful and superior use of ICT to support and promote SMEs.

- To acquire technological knowledge from outside sources to supplement a narrow base
- The know-how and skills capacity (technical, managerial and developmental)
  - Both within the local ICT-sector and among secondary ICT-users
- To start training in ICT applications and business skills at the earliest opportunity, and engage all stakeholders in continuing update training
- Open infra-structure development to competition
  - And use the access to market information to more precisely evaluate competitive offers
- To provide financial support for SMEs
- To increase the birth rate of SMEs
- To develop competitive SMEs
- To promote entrepreneurship and adaptability
- To engage in strategic community creation to advance and control the creative destruction of market infrastructure from multiple vantage points
- To use expanded access to market intelligence to predict market trends and make strategic plans to shift market emphasis accordingly
- To provide an attractive environment for SMEs
- For knowledge-based businesses to have their own intellectual property
  - Otherwise they are just selling commodities

5.4. Using ICT to support and promote SMEs—failure factors

The following factors have been identified as the most having been most contributing to failure in the use of ICT to support and promote SMEs.

- Studying the opportunity too long, thereby losing optimality or missing out entirely (paralysis by analysis)
- Not realizing that technology can be both overestimated and underestimated at the same time
- A general lack of financial, technical, and managerial resources
- Poor or unenforceable policy on ownership and transfer of knowledge and know-how (inadequate IPR protections)
- A corporate culture that is too rigid or risk averse
- Failure to recognize and actualize creative or innovative potentials

5.5. Lessons learned—public policy

Governments have not surrendered their power to capitalism, even if the world's biggest companies are more powerful than many of the world's governments. Democracy is not a sham. People rule, not profits. Admittedly though, companies would run the world for profit if they could. What stops them is not governments, but markets. Economic parity arrives when technology allows people to pursue their own goals and they are given the liberty to do so. If technology can support trade across borders, and people choose to trade across borders, integration occurs. Because people have freely chosen it, the outcome is accepted, and because a free market is self-equilibrating, the trade precipitates economic benefits as well. Government must have a long-term commitment to building a market economy, and defending the mechanisms and protections in which a free market thrives (Crook, 2001).

5.6. Lessons learned—public practice

Technology-enabled free trade is an economic equalizer. Governments have power, but they do not always exercise it wisely. They are unreliable servants of the public interest. But limited government is not worth buying Markets keep the spoils of corruption small. Government that intervenes vigorously is worth a great deal. Especially in developing countries with weak legal systems, taming capitalism by regulation or trade protection often proves such a hazardous endeavor.

Central strategic planning works best from a demand-side intervention, enacting and enforcing regulations that enable people to get what they want, while protecting society from harmful, wasteful, or unfair practices.

Historically what fails is central planning of supply side regulations that specify what people may have, through prohibitions and licensing, by creating surpluses and shortages, or by setting quotas and prices to influence commerce and trade.

Distributed tactical planning works best under the control of the entrepreneurs, organizations, and actors operating in a free-market system. Government and NGOs function best when serving as facilitators and resources, not as managers and operators. If national governments or NGOs disable markets, the economic consequences can be dire, with direct spillover into political and social consequences. Governments must build transnational bridges of collaboration and cooperation, with immediate and long-term long commitment to building a market-oriented economy unimpeded by traditional boundaries.

5.7. Lessons learned—private policy

Research and innovation must be managed today to secure sustainability for tomorrow. Open innovation is a policy of collaboration. Companies must manage intellectual property to manage research: they need to access external IP; they need to profit from internal IP. Researchers must be knowledge brokers as well as knowledge generators. Companies can profit from one another's IP. No one company has claim to all the smart people in a field. Competition and collaboration can and must co-exist. Open innovation is knowledge diffusion and recombination, producing the 'seed corn' of tomorrow's breakthroughs. Researchers must recognize their own potential, and be able to articulate possibilities to a receptive management for further development (Chesbrough, 2001).

Science-driven academic research is vital to returns. Scientists decide the basic research; industrialists decide the applied R&D. Management culture must encourage risk-taking. Fear of failure suppresses creativity and innovation, which undermines competitiveness. Failure is a great educator. Institutionally, a deviation from plan is an irregularity, but competitively it is creative, innovative, exploratory work. Creativity is essential (Routti, 2003).

5.8. Lessons learned—private practice

The priorities of new venture formation in the knowledge economy are: ICT and Internet access; linkages to investors and lenders; formation of lean management and advisory boards comprised of experienced individuals, competent in their fields of discipline and having as few members as needed to get the job done; and planning and securing facilities.

The priorities of e-development and sustained growth are: the ability to evaluate and react to risk well; protection of product; stimulation of existing market; the available population of skilled knowledge workers-whether centralized in a physical facility or linked via virtual organization.

All knowledge workers must have access to the Internet and competency in its use, ample training in computer literacy in addition to their specific technical expertise, and basic computer, math, and language skills. Firms must practice ongoing training to keep skills current; competitive advantage is volatile and requires constant reinforcement.

The advancement of Science and Technology requires improvements in policy and regulatory environment for the application of S&T to economic development, and the identification of potential risks and benefits of new and emerging technologies. The future of technology innovation depends on the building of strategic partnerships in S&T for economic development, and capacity building for competitiveness. This will be facilitated by the promotion of universal Internet access at affordable costs.

To globally sustain the Knowledge Economy will require strengthening in the area of basic and applied research in developing countries and international scientific networking, technology support institutions and science advisory mechanisms, and building human capacity worldwide. Humanity cannot rely on natural resources or manufacturing for sustainability. Future viability demands identifying new technologies and applications, and encouraging international collaboration to support research in neglected fields.

Long-term growth depends on creating loci of innovation activities. Weaknesses in national, sectorial, and regional determinants make weaknesses at the level of the enterprise. The experience of post-socialist economies shows that a sole emphasis on networks may be misplaced and support to network organizers is equally or more important.

The emphasis should be on functions and programs, not more organizations. Notwithstanding the spirit of enterprising individuals, the organizational, hence policy position may be more status quo than pro change. ICT networks are a vehicle to attain social capital, not social capital itself.

Countries excluded from access to regional networks will fall behind and it seems that one way out may be to foster, catalyze, nurture and accelerate bottom-up, entrepreneurial initiatives undertaken by as best as possible empowered, educated and risk-wise individuals trying to escape poverty:

"We have learned once and for all that there are no magical elixirs to bring a happy ending to our quest for growth. Prosperity happens when all the players in the development game have the right incentives. It happens when government incentives induce technological adaptation, high quality investment in machines and high quality schooling. It happens when donors face incentives that induce them to give aid to countries with good policies where aid will have high pay-offs, not to countries with poor policies where aid is wasted. It happens when the poor get good opportunities and incentives, which requires government welfare programs that reward rather than penalize income…The solutions are a lot more difficult to describe than the problems. The way forward must be to create incentives for growth for the trinity of governments, donors, and individuals." (Easterly, 2002: 289–290).

Appendix A. e-development and knowledge economy—case studies from practice

A.1. Case studies in the use of business incubators for new venture formation

Real Practices—Case 1			
UNECE Promotes Development in Eastern Europe (United Nations Economic Commission for Europe (UNECE), 2001)	Economic level Organizational level Technology level	Developing countries Public–private/ international Medium-tech	Business incubators for new venture formation

The United Nations Economic Commission (UNECE) established the Working Party on Industry and Enterprise Development for Europe in 2000. It serves specifically Eastern Europe, the Baltic States and CIS. The priority purposes agreed upon at their summit are:

- To build bridges between East and West;
- To promote enterprise development and capacity building;
- To advocate public–private partnership and private sector involvement in economic development;
- To introduce best practices from UNECE networks;
- To promote electronic techniques for business communications and practices in countries in transition; and
- To bring together decision-makers from business and government.

Real Practices—Case 2			
Hsinchu Industrial Park, Taiwan (Devan and Tewari, 2003)	Economic level Organizational level Technology level	Emerging economy Non-profit Medium-tech	Business incubators for new venture formation

Although tackling the causes of the talent drain will take time for most countries, Taiwan is an exception. 'The Hsinchu Science-Based Industrial Park is a key attraction: Silicon Valley returnees started more than half of the companies there, and it now accounts for roughly 10% of Taiwan's gross national product.'

In the 1990s, roughly 650,000 people from emerging markets migrated to the US on professional–employment visas. Over 40% of foreign-born adults in the US have at least some college education, making the US the epicenter of global talent drain. Foreign-born workers now make up 20% of all employees in the US information technology sector and globally, approximately a third of R&D professionals of developing countries have left them to work in the US, EU, or Japan. Many S&T expatriates have returned to Taiwan, attracted by their nation's long commitment to building a market-oriented economy, coupled with initiatives such as the creation of a venture capital industry and investments in research and education—has prompted many expatriates to return.

Real Practices—Case 3			
US AID Project Fabrykat 2000 in Poland (US Agency for International Development (USAID), 2002)	Economic level Organizational level Technology level	Emerging economy Non-profit Medium-tech	Business incubators for new venture formation

USAID/Poland funded its first technology transfer program from September 1998 to September 2000: Fabrykat 2000. US AID funded the 2-year project to build the Polish manufacturing technology transfer system as a facilitating mechanism to integrate Poland into the EU. The project facilitated the establishment of new Technology Transfer Centers (TTC) in Warsaw and Krakow, trained the Polish TTC management and staff in all aspects of technology transfer operations and program management, provided specialized assistance from US and Polish solution experts to each center's SME clients, while mentoring TTC staff members, and assisted the TTCs in promoting themselves as engines of local and regional economic growth and undertaken activities designed to enhance TTC resources. The program provided technical consulting to 113 SMEs in Poland. It also made available specialized assistance in venture capital, lean and agile manufacturing methodologies, collaboration software and training, technology transfer models, and business planning. The project strengthened the financial, marketing and technical capabilities in four technology transfer centers and also

demonstrated the potential of building partnerships and strategic alliances between US firms and Polish enterprises. The experience demonstrated shortened technology transfer cycle and reduced costs through the use of Internet tools.

One of the key lessons of this program is that technology can be both overestimated and underestimated at the same time. There were several cases where the benefits of awareness, availability, and accessibility to the global grid of knowledge experts were apparent, but also non-apparent, elegant and powerful solutions to challenging technical and business problems were provided quickly via virtual consultation, often, saving travel time and costs. Yet, in some cases, attempting to solve problems only by virtual interaction proved inefficient and ineffective.

Real Practices—Case 4			
IBI Builds Incubators in US for Foreign Firms (The Information for Development Program (infoDev), 2002)	Economic level Organizational level Technology level	Emerging economy Non-profit High-tech	Business incubators for new venture formation

The International Business Incubator (IBI)—the Business Embassy of Silicon Valley—is a non-profit business incubator sponsored by a collaboration of business, government and academic organizations. Headquartered in Silicon Valley, CA, it is a technology incubator for international companies; it assists early stage for-profit companies worldwide and is committed to making its international client businesses a success through growth and strategic partnering. IBI's staff has direct experience with development and implementation of incubator projects, particularly the ones focused on specific technologies and industries or focused on economically disadvantaged populations or responding to the impact of defense downsizing and base closings.

IBI provides the following services:

- Applying the Silicon Valley business model to high-tech start-ups
- Providing basic incubator services in local clusters, in US and internationally
- Providing virtual incubator services to all clients
- Providing specialized advisory services to foreign ventures establishing operations to do business in the US
- Providing advisory services to foreign governments to setup incubators of their own, replicating and franchising their winning formula.

In addition to incubator services and training, they also have a Delegation Program, which consists of visits and seminars by consulates, trade missions, US Department of Commerce, academic leaders, and other business incubators from a number of different countries. The media coverage associated with it is a welcome by-product for the start-ups and the incubator. IBI also provide world-class market research at a much more competitive price. By bridging the information gap, it allows for a substantial reduction in the time-to-market.

Real Practices—Case 5			
ZongGuanCun: Virtual Incubators in China (Xu et al., 2001)	Economic level Organizational level Technology level	Emerging economy Public–private/ international Medium-tech	Business incubators for new venture formation

Researchers are advocating government support for a virtual incubator in the Information Technology industry in ZongGuanCun, China. ZongGuanCun is the 'Chinese Silicon Valley', located adjacent to Beijing. Nearby are 73 universities and colleges, and a population of over 300,000 students.

Most IT businesses in China are small, due to newness of the technology to China, and predominant platforms are in English. Other challenges the researchers report are global fragmentation of an industry reliant on strategic alliances with outsiders, and a shortage of venture capital in the recently and incompletely liberated market economy. Only 26% of Chinese companies have a strategic management plan with an outlook of 5 years or more. In the past, socialist economy planning seldom considered markets. intellectual property rights (IPRs) are not enforced or are non-existent in most areas.

The recommendations advanced by the researchers to the Chinese government include: (1) globalized participation in IT is critical to creating wealth; (2) Government support is needed for alliances with universities, institutes and other companies; (3) the creation and promotion of a venture capital market is urgent; and (4) the creation and enforcement of IPR laws is equally vital.

Their recommendations to Chinese entrepreneurs include: (1) strategic management is the center of enterprise management and risk management in a rapidly changing IT market; (2) human capital and good enterprise culture are critical to support knowledge-based economy; (3) alliances and outsourcing are very important for learning and business development; and (4) the Internet provides a method in IT to build alliances and track market changes unimpeded by geographic barriers.

A.2. Real practices case studies in the use of ICT to support and promote SMEs

Real Practices—Case 6

Ecosandals.com: The Internet Brings Global Market to Sandal-Makers in Kenya (The Information for Development Program (infoDev), 2002)	Economic level Organizational level Technology level	Developing country For-profit Medium-tech	ICT to support and promote SMEs

A micro-enterprise in Korogocho, Kenya manufactures high-quality rubber sandals by recycling tires, which they sold locally in this impoverished city of 400,000 from the period 1995 to 2000, employing four workers.

In 2001, the project went on-line. Within a month, orders were coming in from around the World, and within a year, the demand had increased six-fold. As of mid-2002, the production team in Korogocho had expanded to 27: nine young mothers and 18 young men. These young adults had all dropped out of school for lack of fees, and without this employment might otherwise be scavenging for less than a dollar a day—a typical economic condition in this distressed area of Kenya, one of the World's poorest.

Sandal-makers earn a minimum of 30% of profit on each sale, which can be as much as 480 shillings ($6), having a substantial impact on the producers' lives and livelihoods. All sandal-makers have access to the Internet, and in addition to their productive, gainful employment, all are learning basic computer, math, and language skills, as well as on-line marketing. The project continues to grow and provide resident participants with steady income, training, computer literacy, and a reliable working environment. They now produce a bi-monthly newsletter, distributed to 55 countries.

This village micro-enterprise has 'gone global'. ICT turns the formula of development upside down. Korogocho residents operate in an on-line world where they produce and sell quality footwear, author a newsletter that is sent across the world, and correspond with and educate customers sitting in more developed nations. The sandal-makers are 'the helpers' and their customers abroad are 'the helped'. Globalization need not be just about the big multi-national corporation that dominates, educates and dictates to the little developing country. It also can be about the little multi-national corporation dictating terms of sale to customers in far more developed settings.

Real Practices—Case 7

Kabissa.org: Web Mail Services are Delivered Throughout Africa (The Information for Development Program (infoDev), 2002)	Economic level Organizational level Technology level	Developing country Non-profit Medium-tech	ICT to support and promote SMEs

Kabissa.org delivers web mail services throughout Africa. The concept originated in Nigeria in 1998, to provide human rights groups with access to e-mail, for improved reporting of human rights abuses. Organizations were desperate for capacity building, training, and access to the net. Kabissa was setup on a non-profit basis, headquartered outside of Africa, to ensure that non-profit organizations throughout Africa working in improving the lives of people in Africa may have a presence on the Internet.

Without advertising and other hidden costs, organizations are able to access space on the Kabissa server, with costs recovered through donations and provision of additional features such as domain hosting, mailing lists, and on-line databases. African organizations have serious difficulty accessing the Internet reliably; many do not have access to computers, and they often have no telephone service or power. Kabissa began offering access to net resources via e-mail: users can send the internet address of an on-line resource to an e-mail box, and get a copy of the resource returned to them via e-mail, so they can plan their Internet research and spend less time on-line.

Kabissa joined forces with other NGOs to publish a social justice newsletter delivered weekly via e-mail. Development professionals in very remote areas get information and answers to their questions on a timely basis via a range of topical e-mail newsletters and a mail server. From remote villages with no phone lines, users can travel to collect their e-mail on diskette to take with them, and likewise send e-mail messages from diskette they have brought from the village. As of mid-2002, Kabissa serves over 300 member organizations in 32 African countries.

Real Practices—Case 8

Quipunet: Web Service Connects Peruvians Around the World (Davies, 1999)	Economic level Organizational level Technology level	Developing country Non-profit High-tech	ICT to support and promote SMEs

Quipunet is a virtual organization for global Peruvians—a forum designed to connect citizens abroad to home, and bring information access to rural Peru. The service was inspired by spiraling growth of the Internet. Founders thought they could just connect and send information galore, but they have been daunted by challenges. Despite the lack of reliable infra-structure, and unanticipated learning curve, through sheer perseverance and determination Quipunet's members have achieved a great deal of progress. They have learned to host virtual seminars and to work with virtual, global teams. They have trained users in Internet tools. They have creatively incorporated alternative methods of communication to encompass people without direct on-line access.

Of the many obstacles encountered, language barrier was among the highest, as this impacted even those who served as pivotal nodes. "Countries that do not know English is like entering a candy store with your hands tied behind your back, being able to see, and not touch, tantalized by all the information available," said one founder. Content would need to be sent out for sector specific translation, as the

vocabulary of particular sources would contain so many unfamiliar technical terms. The infra-structure of the rural places was poor, or in most cases non-existent, and connectivity, where available, was very expensive.

Real Practices—Case 9			
UK Institute for Development Policy Management (IDPM) Supports ICT in SED in Developing Countries (Duncombe and Heeks (2001))	Economic level Organizational level Technology level	Developing countries Public–private/ international Medium-tech	ICT to support and promote SMEs

Among numerous functions The UK Institute for Development Policy Management (IDPM) supports ICT within small enterprise development (SED) to further international development targets. The Institute advocates four functional 'Action Areas' for ICT and SME development: (1) ICT as an enterprise output—SMEs producing hardware, software and telecommunications products; (2) ICT as a primary, processing technology—SMEs providing data entry services, ICT-based business services, software customization distance learning, etc.; (3) ICT-related support activities—computer training, consultancy, content provision and other services; and (4) ICT as a secondary processing technology—covering communication (e-mail/Internet/mobile), data processing (small business information systems) and ICT-based manufacturing systems.

The first three of these categories encompass the ICT-sector and are primarily concerned with the production of ICT goods and services. The fourth category includes all other SME sectors that are ICT consumers. ICT provides the most direct benefit (employment, growth, and local capacity) within the ICT-sector itself (Action Areas 1–3). Action to support the local ICT-sector should, therefore, be a priority to government, private enterprise and NGOs—particularly those concerned with implementing ICT within wider poverty alleviation programs, specifically in health, education, environment, and governance. In most low-income developing countries, ICT-sector support should focus on Action Area 2 and 3—primarily digital products, software customization, ICT-based services, training and consultancy, and other ICT-based business services. In large and/or industrializing developing countries, there will be more scope to focus on Action Area 1—manufacturing computer hardware, telecom products and computer software. ICT also provides considerable indirect benefit to other sectors (Action Area 4) by improving the efficiency of business processes and through enabling SMEs to develop new products and services.

Mechanisms for support will be country specific. There is little experience amongst donors in project support, either in the ICT-sector itself or amongst secondary users, but general requirements for policy/project support apply. The mission success formula demands support at all levels.

For enterprise-level support, enterprises may have little need for direct business assistance, but can benefit through policy measures that facilitate access to finance, reduce the cost of access to infra-structure, support skills and technology, and create market access (through linkages and vendor development programs). For intermediary level support, commercially based organizations will be the most effective intermediaries, specifically sector-based trade associations and chambers of commerce at the local level, and umbrella and employers associations at the national level. In the ICT-sector it is important that intermediaries are supported that represent the local industry, and not other academic or governmental/NGO interests. Other critical intermediaries will offer technical support—such as suppliers and other institutions facilitating technology and management development. For policy level support, most low-income developing countries have no strategic ICT policy. There needs to be support for strategic policy development that includes the ICT-sector and secondary users. Overall, national policy should be directed at improving technical and data infra-structure, facilitating access to technology and networks and the enhancement of ICT skills.

The IDPM reports a particular caution pertaining to 'digital-divide' issues. Digital divide is the term given to the dichotomy of technological access: those who have access have access to much, and those whose access is limited have very little at all. To ameliorate this divide, policy must also address ownership and transfer of knowledge and know-how. ICT is a technology-based means of transmitting information, enhancing knowledge, increasing productivity or creating new products and services. The success of ICT in developing countries will be critically dependent on know-how and skills capacity—technical, managerial and developmental—both within the local ICT-sector and among secondary ICT-users.

References

Barab, S.A., Duffy T.M. 2000. From practice fields to communities of practice. In: Jonassen, D.H., Land, S.M. (Eds.), Theoretical Foundations of Learning. Lawrence Erlbaum: Mahwah, NJ, USA.

Carayannis, E.G., 1992. An integrative framework of strategic decision making paradigms and their empirical validity: the case for strategic or active incrementalism and the import of tacit technological learning. RPI School of Management Working Paper Series No 131.

Carayannis, E.G., 1993. Incrémentalisme Stratégique. Le Progrés Technique. Paris, France.

Carayannis, E., 1994a. A multi-national, resource-based view of training and development and the strategic management of technological learning: keys for social and corporate survival and success. 39 International Council of Small Business Annual World Conference, Strasbourg, France, June 27-29.

Carayannis, E., 1994b. The strategic management of technological learning: transnational decision making frameworks and their empirical effectiveness. Published PhD dissertation, School of Management, Rensselaer Polytechnic Institute, Troy, NY.

Carayannis, E., 1994c. Gestion Stratégique de l'Acquisition de Savoir-Faire, Le Progrés Technique, Paris, France.
Carayannis, E.G., 2001. The Strategic Management of Technological Learning. Boca Raton, FL: CRC Press.
Carayannis, E.G., 2001. The Strategic Management of Technological Learning. Boca Raton, FL: CRC Press.
Carayannis, E., Juneau, T. (co-authors), 2003. Idea Makers and Idea Brokers in High-Technology Entrepreneurship: Fee vs. Equity Compensation for Intellectual Venture Capitalists, Praeger Books/Greenwood Press, July 2003.
Carayannis, E., Kassicieh, S., 1996. The relationship between market performance and higher order technological learning in high technology industries. Fifth International Conference on Management of Technology, Miami, FL, USA, Feb. 27-March 1.
Chesbrough, H., 2001. Open innovation: a new paradigm for managing technology. In: New Business Strategies for R&D, presented to OECD Conference, October 22, 2001.
Chomsky, N., 1971. Deep structure, surface structure and semantic interpretation. In: Steinberg, D., Jakobovits, L. (Eds.), Semantics in Generative Grammar. Cambridge University Press, New York.
Cohen, W.M., Levinthal, D.A., 1990. Absorptive capacity: a new perspective on learning and innovation. Administrative Science Quarterly 35 (1), 128–152.
Dodgson, M., 1991. Technology, learning, technology strategy and competitive pressures. British Journal of Management 2/3, 132–149.
Easterly, W., 2002. The Elusive Quest for Growth: Economists' Adventures and Misadventures in the Tropics. The MIT Press, Cambridge, MA.
Garud, Raghu, Rappa, Michael A., 1994. A socio-cognitive model of technology evolution: the case of cochlear implants. Organization Science 5, 344–362.
Garud, R., Nayyar, P., 1994. Transformative capacity: continual structuring by inter-temporal technology transfer. Strategic Management Journal 15, 365-385.
Halpern, Diane F., 1989. The disappearance of cognitive gender differences: what you see depends on where you look. American Psychologist 44, 1156–1158.
Iansiti ,M., Clark, K.B., 1994. Integration and dynamic capability: evidence from product development in automobiles and mainframe computers. Industrial and Corporate Change 3 (3), 557-605.
Jelinek, Lawrence J., 1979. Harvest Empire—A History of California Agriculture. Boyd and Fraser Publishing, San Francisco, CA.
Kaku, M., 1997. Visions: How Science Will Revolutionize the 21st Century. Anchor Books, New York.
Mintzberg, H., 1989. Crafting strategy. Harvard Business Review 65 (4), 66–75.
Nonaka, I., 1994. A dynamic theory of organizational knowledge creation. Organization Science 5 (1), 14–37.
Nonaka, I., 1988. Creating organizational order out of chaos: self-renewal in Japanese Firms'. California Management Review.
Nonaka, I., Takeuchi, H., 1995. The Knowledge-Creating Company: How Japanese Companies Create the Dynamic of Innovation. Oxford University Press: New York.
OECD, 1996. The Knowledge-Based Economy. OECD, Paris.
Polanyi, M., 1958. Personal Knowledge.The University of Chicago Press: Chicago.
Polanyi, K., 1966. Dahomey and the Slave Trade: An Analysis of an Archaic Economy. University of Washington, Seattle, WA.
Porter, M.E., 2001. Clusters of Innovation: Regional Foundations of US Competitiveness. Council on Competitiveness, Washington, DC.
Routti, J., 2003. Research and innovation in Finland—transformation into a knowledge economy. In: Competitiveness and the Knowledge Economy Research and Innovation Strategies: Cases of Chile and Finland. Inter-American Development Bank, Washington, DC (2003, June 2).
Schon, D.,1983. The Reflective Practitioner: How Professionals Think in Action.Basic Books: New York.
Schumpeter, Joseph A., 1942. Capitalist, Socialism and Democracy. Harper Press, New York.
Shannon, C.E., Weaver, W., 1949. The Mathematical Theory of Communication. University of Illinois Press, Urbana, OH.
Simon, H., 1969. Sciences of the Artificial. MIT Press, Cambridge, MA.
Smits, R.J., European Commission Directorate General Research—SME Unit, 2000. Towards a European, European Research Area—Innovation, SMEs, and the Research Programmes of EU.
Sternberg, R.J., Frensch, P.A. (Eds.), 1991. Complex Problem Solving: Principles and Mechanisms. Lawrence Erlbaum Associates, Hillsdale, NJ.
Teece, D., Pisano, G., Schuen, A., 1990. Firm capabilities, resources, and the concept of strategy. CCC Working Paper No. 90–8. University of Berkeley, Berkeley, CA.
US Agency for International Development (USAID), 2002. US AID Mission to Poland: Europe and Eurasia—Manufacturing Technology Transfer Project (Fabrykat 2000). Available on line: http://www.usaid.gov/pl/fabrykat.htm (2003, June 22).
Von Hippel, E., 1988. The Sources of Innovation. MIT Press, Cambridge, MA.
Wenger, E., 1998. Communities of Practice: Learning, Meaning, and Identity. Cambridge University Press: New York.
Wender, E.C., Snyder, W.M., 2000. Communities of practice: the organizational frontier. Harvard Business Review 78 (1), 139-145.
World Bank, 1998. World Development Report 1998/1999: Knowledge for Development. Washington, DC: Author.
World Bank, 2000. World Development Report 1999/2000: Entering the 21st Century. Author: Washington DC.
World Bank Group, 2000. Small and medium enterprise initiatives. SME Facts July, 1.
World Bank Institute, 2001. China and the Knowledge Economy. Author: Washington, DC.
World Bank Institute, 2001. Republic of Korea:transition to a knowledge-based economy. Author: Washington, DC.

Dr Elias G. Carayannis, (caraye@gwu.edu), is Full Professor of Management Science at the School of Business (SB) of the George Washington University (GWU), in Washington, DC as well as Director of Research on Science, Technology, Innovation and Entrepreneurship for the GWU SB European Union Center and Co-Founder and Co-Director of the GWU SB Global and Entrepreneurial Finance Research Institute (GEFRI). Dr Carayannis received his PhD in Technology Management and his MBA in Finance from the Rensselaer Polytechnic Institute in Troy, NY and his BS in Electrical Engineering from the National Technical University of Athens, Greece. He has published more than 50 refereed journal articles and several other papers in innovation and technology management journals (IEEE TEM, Research Policy, R&D Management, Journal of Technology Transfer, Technovation, IJTM, JETM) as well as 10 book chapters on technology, innovation and knowledge management, creativity and entrepreneurship. He has three published and two forthcoming books on strategic technology and innovation management, project management and entrepreneurhsip and is the Editor of a four book series on Technology, Innovation and Knowledge Management by Greenwood Press/Praeger Books and has five book contracts under preparation with MacMillan Press. He is fluent in English, French, German, Greek, and has a working knowledge of Spanish. He is citizen of the United States of America and the European Union.

Ms Caroline M. Sipp is adjunct faculty, doctoral candidate, and research assistant in the Management and Technology-Logistics, Technology and Project Management Program under the supervision of Dr Elias G. Carayannis at the George Washington University School of Business and Public Management in Washington, DC. In 2001, Ms Sipp received both a Master in Management degree (DESMA) in 2001 from Grenoble Graduate School of Business, Grenoble, France, and an MBA in Finance and Investments from George Washington University in Washington, D.C. She obtained her BS in Business Administration also from Grenoble Graduate School of Business in 1999. Ms Sipp works with the Inter-American Development Bank and is involved in technology utilization, knowledge sharing, and knowledge management as it pertains to international development.

Denisa Popescu is a fourth year PhD student at George Washington University, School of Business where she is covering the areas of management of science and technology, and information systems under the supervision of Dr Elias G. Carayannis. She ia also an information analyst with the Information Solutions Group initiative of the World Bank.

McDonald Stewart has more than 20 years experience in the analysis, design and implementation of information management systems, at all levels of government and in many sectors of business and not-for-profit organizations. Presently, a full-time doctoral fellow and teaching assistant in the Management of Science, Technology and Innovation Program under the supervision of Dr Elias G. Carayannis at the George Washington University School of Business in Washington, DC, Mr Stewart is investigating technology entrepreneurship, knowledge economy, and the strategic deployment of information and communication technologies for economic development. Mr Stewart received his MS in Technology Management from the University of Maryland University College in 2000, and his BS in Business Management and Communications also from UMUC in 1997.