Information Technology Application in Emerging Economies: A Monograph of Symposium at HICSS 40

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Information Technology Drivers for Development

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Can we afford to abandon societies without the information infrastructures they require to sustain themselves? The increasing globalization of the world economies is being fueled by a number of Information Technology (IT) infrastructures and applications. The challenge facing policy makers, practitioners and academics is how to achieve significant and measurable improvements in addressing development goals through Information and Communication Technology. This requires: 1) Strategies for sourcing goods in the less developed countries and marketing services to the more developed countries, 2) Best practices for working in the different countries; 3) Theories and frameworks that explain the effects of IT on development; and 4) Tools and techniques for ascertaining the effects of IT infrastructures in government, civil society and the private sector.

Entrepreneurship appears to be a key driver for development. Empowering small businesses to develop, manufacture and access new markets has become a key factor affecting the uptake of information and communication technologies in emerging economies. A number of case studies have been used to illustrate how ICTs enable access to information, knowledge and expertise. For example, in their study of information systems for rural micro-enterprise in Botswana, Duncombe and Heeks (2002) suggest that the role of ICT in enabling information and knowledge is important for both social and economic development. They found that there was a reliance on localized, informal social networks for their information for rural micro-enterprise. Information from these networks was of poor quality and not readily available; it appeared to fail the poorest and most disadvantaged entrepreneurs. In this, the effects of ICTs on development need to be considered more carefully. Qureshi (2005)'s model of Information Technology for Development suggests that the effects of Information and Communication Technology are cyclical.

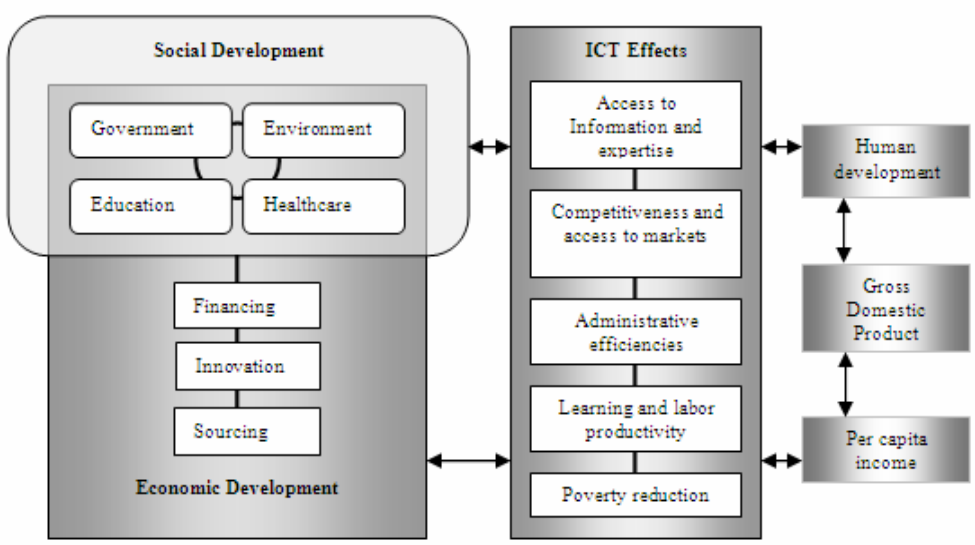

Figure 1. Model of Information Technology for Development (Source: Qureshi, 2005)

The model suggests that development activities are able to benefit from ICT implementations through: 1) better access to information and expertise, 2) increased competitiveness and access to new markets including global markets, 3) administrative efficiencies from low transaction costs, 4) increase in labour productivity through learning and 5) direct reduction in poverty (World Bank 2003, UNDP 2003). These are the ICT effects on development. Should the effects of ICT implementations be positive, the cycle of development will involve an increase in human development and gross domestic product through the use of better tools and techniques. This may lead to an increase in per capita income and perpetuate a positive spiral for social and economic development. Sustained economic growth helps break the shackles of poverty by first increasing average household incomes and second increasing income from taxation which may lead to the provision of better services for the poor. When households below the poverty line share in the average rise in national income, the extent of extreme income poverty (that is, the share of people surviving on $1 a day) is directly reduced (UNDP 2003). Such an upward spiral can also stimulate additional growth through factors such as foreign direct investments in factors of production. These are the positive effects on the cyclical process through which development can take place.

However, should ICT implementations not be appropriate to local needs, digital divides increase, and the reverse can occur and perpetuate a downward spiral. For example, lack of access to information or expertise brought about by the lack of access to information kiosks or inappropriate support for community networking, reduces the ability of a farmer or merchant to sell goods at the most favorable price, thus reducing income generated by their efforts. Similarly the implementation of information systems that intend to provide better access to government services and information can bring about administrative inefficiencies by locking out citizens that have no means or ability to use the information system. In the new global electronic economy, fund managers, banks, corporations as well as millions of individual investors can transfer vast amounts of capital from one side of the world to another at the click of a mouse. As they do so, they can destabilize what might seem like rock solid economies – as has happened in

Asia (Giddens 2003).Those who are negatively affected by the information system are considered Victims in this research and may comprise of people, organizations and even entire regions or countries.

It appears from this model that ICT's provide an infrastructure through which sustained economic development can take place. In particular the use of ICTs to support the development of small businesses through eCommerce appears to be a key driver for development. The above model was used by Qureshi and Davis (2007) to investigate how the digital divide can be overcome through access to electronic commerce. They found that tools available for ecommerce activities do bring about development by empowering local communities to access the services they need. For example local fishermen are able to access assistance through cooperative societies available on the web. Other examples of development through ICTs include the "telephone ladies" who purchase pre-paid cheap telephones and rent out time on these to the rest of the village. This makes them the center of information in the village community and financially independent.

This symposium discussed the changes in the global environment that have lead to the need for a recognition of issues in different parts of the world that are often overlooked. It provides the ability to create a forum in which multiple perspectives can be shared and inform each other. Appreciating research and approaches developed in different parts of the world is needed when implementing information systems applications that are global. Traditional research methods in information systems adoption and diffusion may not necessarily apply to parts of the world that are changing rapidly. Learning from changes in emerging economies and developing research to enable issues in these economies to be addressed through IT can enable more traditional information systems practices to be strengthened. This synergistic research can be more relevant to addressing the interdependencies among world economies. This interdependency among countries fueled by advances information technologies has meant the small businesses can access global markets while operating locally. The access to talent pools in underserved communities can be an advantage that enables small businesses to remain competitive while competing globally. The papers in this monograph address these needs and reflect these trends in the global economy.

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Bypassing The Digital Divide: A Knowledge Networking Strategy For Using ICT To Help Leverage Talent Pools in Developing Regions of the World

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The drivers of self-development: talent, then talent plus appropriate technology

How to bridge the "Digital Divide" is a major topic in the fields of international economic development and social and education policy (Norris, (2001, United Nations 2005). The Digital Divide is simple to define: ICT (information and communication technology) has created a world of haves and have nots in terms of access to the Internet, to jobs in the Information/Knowledge economy, and to the social and economic well being that ICT enables. This threatens the ability of developing nations to escape their "poverty trap" and develop civic institutions. Those axiomatic claims have strongly influenced both ICT research and practice. (Queau 2002)

The aim of this paper is to contribute to the goals of those who share these axioms and wish to help developing nations generate growth via ICT. It presents, however, the very opposite strategy that those proponents have largely adopted. Rather than bridge the divide, our recommendations are to bypass it.

The divide has become a primary target of ICT initiatives that view it as a national issue and recommend policies for bridging it that are focused on infrastructures: wired telecommunications, ICT industry support, education and e-government. In many ways, this viewpoint is a continuation of the mainstream development tradition of national infrastructure focus: dams, electrical systems, transportation and agriculture. The Asian Development Bank's position is typical in this regard:

> "Information and communication technology (ICT) has become a powerful tool in the fight against world poverty, providing developing countries with an unprecedented opportunity to meet vital development goals, such as poverty reduction, basic health care, and education, far more effectively than before. The countries that succeed in bridging the digital divide by harnessing the potential of ICT can look forward to enhancing economic growth, and improving human welfare and good governance practices" (ADB, 2001).

A bleak review of Ghana's "Journey towards e-commerce" states categorically that bridging the DD is "the only hope for the marginalized part of the world to benefit from the global knowledge economy." (Obeng, 2004) That viewpoint implies that ICT infrastructure investment is therefore a powerful magic bullet cure for developing nations' ills. It is a theme that is commonplace in

announcements from the United Nations, European Union, World Bank, ICT industry and associated institutions.

This paper proposes an alternative to this top-down, national infrastructure perspective. Knowledge networking is centered on supporting on a bottom-up basis the self-development of talent pools in cities and regions within countries and on connecting them to the "hubs" of developed nations', including the networks of companies seeking services and institutions offering information and expertise. Knowledge networking is process- rather than planning- or policy-centered. It is an approach to international development built around (1) the global hunt for talent, (2) an "eBig" perspective on the link between ICT and self-development, (3) a spoke rather than hub strategy for job creation and scaling of talent pools, and (4) a shift in perspective on ICT from Big Tech to mobile "tools at hand", and from "information" technology viewed as a causal force for successful development to coordination technology employed to leverage (1), (2) and (3) on this list. Generically, this strategy is one of accelerated development through pragmatic opportunism: its priority is to network two distinct groups: those looking for talent and aiming to source capabilities or products and services that their organizations need and those with talent looking for opportunities to find new spaces to apply their skills, build up their businesses and enrich their communities.

The paper is addressed to three primary communities. all of which have influence on policy, research and application in the sphere of ICT for development. We hope to convince policy makers to shift their perspective on the digital divide and on how to best address the concerns it addresses and thus to influence the prioritization of ICT initiatives, their funding and their goals. Obviously, this implies that we see misprioritization, wasted funding and nisdirected goals in many of today's policies. Our analysis and recommendations argue for a shift from policies based top-down in ICT infrastructure investment to a bottom-up focus on localized talent pools and their behaviors and capabilities.

We hope to provide the ICT and development research community with frameworks that lead them to explore new lines of study that will help sharpen our understanding of how talent pools respond to opportunities and how ICT is best deployed to enable opportunities. In addition, we hope to persuade them that the emphasis on the digital divide as a national issue is intellectually and empirically misguided and that what is more useful is a selective focus on localization. For our third audience, those professionals and practitioners involved with the deployment of ICT technology, we hope to point them towards a stronger emphasis on the use of simple coordination technology tools than on large-scale infrastructures and systems. The practical contribution of this paper will rest on influencing the people of influence in the international field of ICT and its links to development.

Our analysis and recommendations draw on a wide range of research and a wider range of practice. They are built around two core sets of frameworks: the Global Capability Sourcing model developed by Keen (2004, 2004a) and extended by Qureshi and Keen (2005), and the Knowledge Mobilization and Fusion model (Keen and MacIntosh (2002), Qureshi and Keen (2004, 2005), and Keen and Tan (2006). Earlier studies by the authors of implementations in many countries provide background and grounding for the knowledge networking framework

and its application (Tan (1998), Qureshi (1998 and 2005)) and Keen (1992). A more recent paper by Qureshi and Keen (2006) offers a theory-building perspective on knowledge networking built on an interpretivist analysis that links it to business models and vice versa. Together, these investigations and reports offer a new and practical perspective on both policy planning, research and implementation initiatives aimed at answering the question that underlies the term "digital divide: where and how ICT should be deployed as a major enabler of social, economic and human development across the globe. Our answer is through a focus on self-development and localization.

Easterly's recent book, *The White Man's Burden* (2006), added to our ongoing analysis and provides a broad reinforcement of our lines of argument, particularly in his persuasive and well-documented demonstration that self-development succeeds where traditional development almost uniformly fails. The title of his book refers to the historical patronization of Western colonialists and international agencies such as the World Bank and comparable institutions that they, as the best and the brightest, know what the helpless and hapless poor of the developing world need. As we show in our paper, there is nothing helpless about the many widely dispersed talent pools that are connecting to the global economy via simple ICT tools.

Easterly is a professor of economics and was a senior economist at the World Bank, with experience in development programs across the world. Like more and more such experts Easterly is highly critical of the institutional biases and practices in planning, funding and implementing international development. He distinguishes between Planners and Searchers:

> "Planners determine what to supply; Searchers find out what is in demand….. A Searcher hopes to find answers to individual problems only by trial and error experimentation… Searchers have better incentives and better results. When a high willingness to pay for a thing coincides with low costs for that thing, Searchers will find a way to get it to the customer."

This distinction captures fairly vividly the spirit of our view of both the demand and the supply side of ICT innovation for innovators. Search for the Searchers. Do not build "bridges" across the Digital Divide. Bypass it.

To some extent, the shift in focus on ICT that we recommend reflects major trends that were not in force until the past few years. Those include the explosive growth of mobile phones, which offer low cost opportunities for far-reaching innovations in the everyday lives of people in even the remotest villages of Africa, the equally rapid growth of Internet cafés in most cities across the globe, the democratization of publishing and information-sharing via blogs, and the provision of easy-to-install wi-fi instead of costly wired local telecommunications links. Historically, ICT "infrastructure" involved complex policy planning, government and telecommunications industry negotiations, with in many instances price manipulation, by monopolies and/or governments, and long lead times. Wi-fi was unimaginable in that era. The new toolsets are coordination rather than information technology, in that they primarily facilitate communication and conversation between individuals; they thus open up opportunities for knowledge networking. This shifts the locus of innovation for ICT deployment.

Similarly, the locus of talent has shifted. The demographics of developed countries are marked by two consistent features that have led to companies seeking new capabilities wherever they can find them and being able to do so because of coordination technology. The first feature is the heavy cost burdens over and above direct wages of an aging workforce and of social policy. General Motor's financial crises of recent years reflect a situation where the average U.S.-made car contains around $1,200 of steel but also $1,600 of healthcare and retirement benefits. The labor cost burden of Germany has been a major impediment to both job creation and economic performance for well over a decade. The second demographic feature of developed countries is that their birth rates have fallen below the rate needed to maintain population growth; that figure is around 2.1%. In Europe and Japan, the figures are 1.3-1.6%. (Foot and Stoffman, 1997) As global competition has created a dual pressure for cost reduction plus innovation, companies have literally scoured the world in their hunt for talent.

Until recently, however many "spokes" of talent there might be scattered across the globe, there were few hubs for them to connect to, neither technology hubs in the form of national phone and data services or business hubs in terms of corporations actively looking for talent via spokes. A recent speech by the Chairman of IBM, Samuel Palisano (Financial Times, June 2006) captures this shift. He argues that the old multinational firms, including IBM were "colonial" in that they sold abroad but located their main operations at home. Those included R&D, ICT, corporate back offices and most planning functions. All of these are now distributed across the globe often through collaborative "co-sourcing" relationships. While global outsourcing largely reflects the cost-driven pressure to shift routine work to low cost labor markets, the more proactive co-sourcing captures the opportunity to benefit in high-end "knowledge" jobs from the talent pools that are well educated, young (and that hence incur low healthcare and pension burdens for European and U.S. based firms). China and India have been major beneficiaries of both outsourcing and co-sourcing. However, their own economic growth is driving a hunt for new talent. The *Financial Times* reports (June 13 2006) that "the world's two most populous countries face growing critical skills shortages…. India's IT industry, the economy's crown jewel, is abuzz with tales of high employee turnover, soaring salaries and scarcity of experienced managers…..[China's shortages] now pose a bigger threat than scarce natural resources to the nation's growth." The article asks how two nations that generate 7 million college graduates a year can be running short of talent? The obvous answer is that economic growth is talent-driven everywhere. China now needs accountants, general managers and back office supervisors just as much as U.S. and European multinationals do. The Chartered Financial Analysts Institute reports that participants in its prestigious CFA program from these two nations have increased from a combined 20 out of 20,000 candidates in 1995 to 13,000 out of 116,000. Investment professionals with the qualification earn 54% more than those without it. Demographics and economic growth will intensify the shift from outsourcing of routine tasks to sourcing of knowledge-based capabilities everywhere. An encouraging aspect of this shift is that in both China and India wages are increasing by a reported 10% a year in just about every industry. Low-paid jobs are becoming at least better paid.

The forces driving the new global business economy and hence the hunt for talent are accelerating and interacting: (1) deregulation and trade liberalization, which open up spaces both

for sourcing capabilities and selling products and services, (2) coordination technology, the set of standards and tools built around the extended Internet technology base (Web Services), mobile handsets and wireless networks that facilitate the easy linkage between organizations and thus access to and by talent pools as sources of new capabilities, and (3) the standardization of interfaces between product components (e.g., consumer electronics, auto parts) and between processes (back offices, medical testing) that again encourage and facilitate the search for new capabilities and skills, coordinated and integrated through ICT. These forces and their impacts are described by Keen and Williams (2006) in terms of their implications for corporate business models and supporting strategies. From the perspective of international development, the forces clearly disrupt the national status quo, especially in their dramatic and ever-expanding impacts on labor markets through off-shoring and outsourcing. That stable equilibrium – and often economic and social inertia – was built over a long period of time in which regulation and trade barriers dominated, labor was not mobile, and government was the main controller and allocator of resources.

These forces have transformed the nature of ICT deployment. Historically, international agencies had to fund ICT infrastructures and build hubs because there was little if any motivation for businesses to do so; in the context of ICT, their sphere of operation and interest did not include what is now the main source of talent: far-away cities in undeveloped or underdeveloped regions. There were many barriers to even thinking about reaching out from their developed home base; telecommunications regulation and protectionism were the most obvious impediments. For individual countries, the heavy capital costs of switches and transmission links were a major problem, which had to be paid for in foreign currency. All this meant that only large international agencies such as the World Bank and United Nations Development Program would sponsor and direct ICT infrastructure investments. Large companies built their ICT infrastructures to connect to their own geographically distributed units and to key suppliers and customers. Now they connect literally to the world, with Web services (not just the public Internet) the base for their technology architectures. (Keen (2004)).

This means that the world can connect to them. The GCS – Global Capability Sourcing – needs of organizations in developed economies combined with global and local coordination technology toolsets and the demographics of labor markets ensure that any talent pool can become eBig (Keen 2004), regardless of the physical size and state of development of its nation. International agencies are no longer the vital provider of supply and funds. Nor is the nation the unit of development. As we illustrate later in this paper, what is most striking about ICT in even the poorest nations is just how much innovation there is at the local level. Rather than ICT being a matter of nations bridging the digital divide, it has become a matter of how cities even in those nations can compete in the global economy. Bangalore is rich in the overall impoverished India; Monterrey is a leading business center in poor and largely rural Mexico, and anywhere in Central and Eastern Europe world-class ICT developers thrive in otherwise bleak economies.

Cities such as Bangalore, Poona, Shenzen, Monterrey and Budapest have bridged the Digital Divide. Other divides that ICT can do little to bridge dominate their nations; soil erosion, loss of arable land, lack of property rights, and political corruption in rural India and China are not going to be fixed through ICT. Hopefully, though, the innovations and economic growth of these

advanced cities will generate attitudes and investments to bridge those divides. And, also hopefully, knowledge networking plus coordination technologies will accelerate and extend innovations everywhere in those nations.

Innovation through talent pools: growing a billion dollar industry bottom-up

The spirit of and logic behind our line of argument is illustrated by an example that captures both the nature of knowledge networking, GCS and the complex consequences and moral calculus of development that have been fueled by the historical forces of deregulation/trade liberalization, coordination technology and standardization of interfaces. (The third of these forces, standardization of interfaces is not directly applicable to the example, but as Keen and Williams show (2006), it is in many instances the main factor in the commoditization of industry after industry and it is key to the Wal-Mart supplier-provider relationship that the illustration addresses.)

The billion dollar example is the emergence of the Chilean salmon farming industry, followed by Wal-Mart's decision to sell salmon at under $5 a pound, purchasing 15% of Chile's total production (Costco buys around the same percentage) and the huge economic and social consequences of that intersection. Farmed salmon is now Chile's second largest export, amounting to $1.5 billion a year. In 1990, there was no salmon production in the country; as one commentator observes: "Farming salmon in Chile is a little like farming penguins in the Rocky Mountains." (Fishman 2006) Now, the previously poor and largely deserted area along the Southern coastline has 800 farms that directly provide 10% of total employment in the region.

Salmon was for decades a luxury fish, because it had to be caught wild and was difficult to process due to its boniness. Supplies were dwindling through overfishing and regulation restricted catching. As farming grew, mainly in Canada, Norway and Chile, prices dropped and quality improved. Wal-Mart's rapid expansion of its grocery business thus made farmed salmon an attractive product to offer as an affordable everyday meal, As always, the company aggressively drove supplier prices even further down; its entire business model rests on the principle of "Lowest prices. *Always*!" Essentially, Wal-Mart demands a 5% price reduction annually from its suppliers. Stories are legion about its "ruthlessness" (opponents' phrasing) or "toughness" (existing suppliers' euphemism) or "supply chain wizardry" (management fans' viewpoint). Wal-Mart can make or break a supplier and has done both (Flashman offers a fair summary). It helped make the Chilean salmon farming business. It could easily break it, too.

Salmon farming was developed in Norway, where it was a natural evolution in a nation of many fjords, small farms, strong fishing industry, and long coastlines with very cold water. It took off in Chile largely through an "incubator" association of mainly Chilean businesses, named Fundacion Chile that had been contacted by a Japanese firm looking for salmon for sushi and sashimi. The results caught the attention of a number of young Chilean businessmen in the early 1990s who "went to a sort of frontier area – and they stayed in these places and built this industry. It took five to ten years… They had no history of aquaculture in Chile. None at all. But there is a real entrepreneurial spirit in Chile." (Fishman, p.176). By 2005, Chile had become the

leading producer and exporter of salmon in the world, overtaking Norway and exceeding Alaska's sales of wild salmon. The talent pool had won a huge market.

The proceedings of the Alaska Salmon Forum in 1999, sponsored by the state government, show the Alaska industry on the defensive. As just about every gourmet will agree, its wild salmon is as superior to farm salmon as beef bourguignon is to a frozen TV dinner, but the farmed product owns the market. U.S. imports overtook exports in 1997. Imports from Chile had grown from 12,000 tons in 1994 (versus Canada's 40,000) to 50,000 tons (overtaking Canada). The figure for 2005 was 360,000 tons, with Wal-Mart buying around 40,000 tons. The industry created over 50,000 jobs. It is just as arguable that Wal-Mart made the Chilean success as that Chile made Wal-Mart's in salmon sales.

Regardless, a talent pool created a new industry. A leading importer stated at the 1999 conference that:

> "Your competitors are among the brightest people ever to hit the fish business. Chilean salmon farmers don't have pitchforks in their hands or grass in their teeth… They're well educated (most have engineering degrees), they're well financed, and they're young and very clever entrepreneurs. Shrewd businessmen who have aggressively built, with virtually no government assistance, a huge export industry from zero in about ten years time……. They sit behind computer screens calculating business strategies… They study your landings history and trends, and they study your forecasts, in order to calculate how many little coho, trout and Atlantics they should put into the water each year……..
>
> "When an obstacle gets in their way, they sit down and figure out how to go around it or through it. For example, they've figured out how to put together a complex logistical transport system which brings fresh boneless salmon fillets about 1800 miles by truck from the dirt roads in the remotest areas in the south of Chile, near the Antarctic Circle, over and through the Andes Mountains to the airport in Santiago. Six to eight thousand miles overnight and by air in 48-72 hours from the time the fish comes out of the water." (page 23)

Later speakers contrasted the Chilean supply chain management and distribution system with that of Alaska: "logistically it's a nightmare." The Chilean system, by contrast, "opens up a lot of avenues for a retailer." (page 29) "A" retailer of course includes Wal-Mart. The Chilean talent pool created the innovation (a major element in their knowledge networking was tracking, applying and improving on the key technology that opened up the mass market: the pin-bone-out machinery that guts the fish, taking off the head and tail, and that removes the small pin bones that restaurateurs hate and consumers largely won't deal with). Wal-Mart added scale to the innovation.

The evolution of salmon farming in Chile is in itself an illustration of the main thesis of our paper. The growth of the industry rested on talent pools; the government provided some seed capital and made agreements with a Japanese company interested in obtaining fresh fish for its

own domestic market, but there was minimal direct foreign investment or a comprehensive government planning/funding/subsidy process. As a detailed World Bank review of the history of the Chilean industry indicates, salmon farming posed many highly localized problems. “No two salmon operating farms are identical… Water quality, temperature, salinity and a vast range of ecological variables related to the microorganisms that populate each particular lake and marine location vary.” (Katz, 2004) The growth engine was the many family-funded SMEs that basically evolved the industry through trial-and-error learning. There was and remains no strong national R&D base; universities and government had almost no role in knowledge generation. The SMEs relied very heavily on knowledge networking via Missions to other countries, particularly Canada, the U.S. and Japan, in search of technology and science. This enabled the Chilean farmers to be early adopters and enhancers of the filleting machines that were the key to making salmon a mass market consumer item; of course, today, such knowledge networking is greatly accelerated and enhanced by the Internet.

Katz comments that “the firms that have succeeded in identifying the unique set of ecological, environmental, technological and organizational forces and adapted accordingly, have forged ahead, with other companies lagging behind.” In other words, self-development by local talent pools created a billion dollar industry from scratch in an area where there was no infrastructure, no experience, no proven demand, no ICT and no business case for any international funding organization to launch a major project. All it had was a talent pool.

Salmon farming in Chile is now a mature industry. It may be viewed as a major development success or an equally major environmental and social problem. There is a growing scientific literature on the pollution, waste products, disease, and decline in other fish stocks generated by the need to provide over two pounds of food to the carnivorous salmon to produce one pound of product, which farming has created. There is also a more politically centered discussion of the harsh labor conditions and poor wages of the workers, as cost pressures increase, with Wal-Mart very much a driver of these pressures. (The successful candidate for President made salmon farm workers’ wages in Regions 10 and 11 of Chile a major element of her platform in 2005; there are 20 national regions). The SMEs are long gone. Large foreign firms dominate production, with the largest company being a subsidiary of a Dutch multinational. Salmon farming is a monoculture and very vulnerable to boom and bust cycles.

And large buyers dominate the supply chain. The key word here is “buyers.” The traditional development model of funding by what may be termed establishment agencies builds suppliers, often with little discussion of potential global buyers; hence the frequent focus of ICT investments on e-government. Talent pool-based development coalesces around something that buyers seek – process capabilities such as call center and back office services, products as in the case of Chile and of course Asian manufacturing, medical services that offer high skills and low cost, as with Mexico, Singapore, Abu Dhabi, India and many other regions, and ICT skills, with Eastern Europe challenging India as the talent base for Western nations’ outsourcing. When buyers find sellers and the reverse, there will be “development.” We place the term in quotes to acknowledge that the social consequences of such growth are contentious and many of them negative: pollution, urban congestion, corruption and labor abuse; whether the development context is India’s surge in IT and call center jobs, China’s manufacturing boom or Brazil’s surge

in ethanol production, the same social, economic, human and political conflicts and trade-offs are created.

We suggest that the Chilean experience is more typical than atypical. It differs strongly from the traditional development model that underlies the traditional approach to bridging the traditional digital divide. Bridging the digital divide does not in and of itself achieve the same economic and social impact as the talent pools' self-development. The needed enabling transportation, shipping and trading infrastructures emerged from the Chilean innovation and did not precede it. It is unlikely that the innovation would have been in and of itself enabled by building the infrastructures first, which is a major recommendation in the ICT field concerning wired telecommunications. Nor would a focus on funding R&D and strengthening the government role in financing seem likely to have increased the pace of innovation. Certainly, an increased degree of government policy intervention may have mitigated some of the ecological problems and many commentators have criticized Chile's lax labor laws. The industry benefited from trade liberalization, especially in the U.S./Chile agreements that opened up the export market; by contrast, Norway, the main competitor to Chile, was wrecked by an anti-dumping tariff imposed by the U.S. that lead to many bankruptcies among farming companies.

The salmon farming scenario corresponds quite closely to one of the most trumpeted successes in the field of ICT and economic development, one that is often axiomatically viewed as support for the establishment perspective on the digital divide: that it creates a "stark disparity" in the fortunes of developing nations that requires infrastructure funding and sustained national policy. That success is the rise of Bangalore as a world hub for ICT talent and outsourcing. The assumption is that this was a triumph of policy and planning. In fact, there is plenty of evidence to show that, as with salmon farming, it was driven far more by the combination of talent pool innovation and GCS. The Indian government had since the 1970s targeted software exports as a major opportunity. What generated the critical mass that has made Bangalore such an ICT innovation center were the initiatives and contacts by Jack Welch, CEO of GE in the mid-1990s. Key to these were, first, Welch's meeting with the head of WIPRO, the growing Bangalore ICT firm. That directly led to contracts with WIPRO to handle back office services, as part of Welch's "Neutron Jack" slashing of the GE organization (over ten percent of staff were laid off). GE Capital's establishment of its own outsourcing firm in 1997 which grew to 15,000 employees by 2003, and GE's use of the Bangalore IT talent pool for both its Y2K remediation work and for the large amount of software development that it did for other firms, such as Kodak. Around 70% of GE's IT work in India is resold overseas by GE.

Knowledge networking links such talent pools (spokes in a value complex) to organizations looking to source capabilities (hubs) (Qureshi and Keen (2006)). We argue here that this is a more productive perspective on ICT for social and economic development than the conception of the Digital Divide. An empirical study by Qureshi, Keen and Mehruz that includes a number of "vignettes" and data samples from blogs on the behaviors of individuals in poor countries across the world in adopting simple ICT tools, mostly just mobile phones, shows very clearly that the term "poor entrepreneurs" is not in any way an oxymoron. In case after case, shopkeepers, housewives, taxi drivers, and other ordinary people looking to better their lives seize the opportunity that at-hand ICT tools open up to them – simple and low-cost devices and services

that are readily available and easily used. More broadly, as the expansion of ICT skills in such areas of the world as Eastern Europe and the explosion of medical tourism in Asia show, whole new sectors of an otherwise stagnant economy are being created through talent tools suddenly getting access to ICT tools. This suggests that the key to bridging the digital divide is to find the talent first and give it the tools to increase jobs and income rapidly. Talent pools are local rather than national. The discussion of the digital divide is dominated by viewing it as national in nature. We propose the development rule should be: Talent first, infrastructure second.

If bridging the digital divide is the answer, then what is the question?

We continue our case for this argument by addressing four main questions whose answers are key to validating or refuting the establishment position. It then moves on to offer specific recommendations for investment in knowledge networking via talent pools:

1) Is the Digital Divide as important as those who have a heavy investment in it assume?

2) Are their major proposals for bridging it realistic, appropriate and effective?

3) Given all the analogies with the Information Highway/Superhighway and the Networked/Knowledge/Global economy as the key infrastructures of the 21st century, is bridging the DD primarily an infrastructure issue?

4) Is the natural unit of analysis and planning for international ICT development the nation, as e-readiness and global competitive indicators suggest?

The answers presented in this paper to these questions are No, No, No and No. The Digital Divide is a red herring; it should in many instances be a secondary concern in allocation of funding compared to the many other divides that poor nations suffer from. The divides include the basics of living: water, hygiene, healthcare and housing – and jobs, the most critical bridge across all the divides. The water divide, too, will generate much of the poverty of the future and possibly future wars. Sewage, floods, polluted water, drought and parasitic illnesses are of far more consequence to well-being in many African nations than any other single factor; villages need mosquito nets before they need PCs.

Mosquito nets provide a contrasting example to the Chilean story of bottom-up development. Easterly illustrates the constant failure of large top-down initiatives to provide such bed nets to villagers and/or launch education programs in using them as protection against malaria. (Sharon Stone raised a million dollars on the spot for this purpose at the 2005 Davos World Economic Forum attended by President Clinton and Britain's soon-to-be-Prime Minister; most of the items funded were diverted to the black market or even used as fishing nets.) 70% of Zambians given free nets did not use them. By contrast, a non-profit organization "stumbled" across a clever way to sell them for fifty cents in Malawi through a two-channel strategy centered on poor patients in antenatal clinics and more affluent urban Malawians. This resulted in an increase in the percentage of children under five who were sleeping under nets from 8 to 55 between 2000 and

2005. The initiative, which is being adopted in many other countries, did not come out of the organization's Washington headquarters or from the World Economic Forum. It was the invention of the local staff, mostly Malawians. It relied on knowledge networking with nurses in the antenatal clinics (plus incentives for them to get the news out and to keep the nets in stock.) (Easterly)

To repeat our main line of argument: ICT infrastructure will not in and of itself compensate for the ravages of the water/mosquito net divide or even contribute to "bridging" it. The "in and of itself" is key to our phrasing here. ICT can compensate and contribute if it helps talent pools that are making effective changes on the ground. In many instances that simply means putting ICT literally in the hands of key people in a knowledge networking complex – i.e., give them a mobile phone. In the Malawi example, the role of ICT is to make a simple contribution to supply chain management: ordering and delivering nets as needed.

It is notable that programs proposed by such communities as Davos and United Nations Task Forces rarely recognize the contribution that mobile phones have made to local innovators in developing countries whereas the press on an almost daily basis publishes examples of genuine transformation in everyday life through standard mobile tools. Stated simply, if you have access to cell phone service, you have all the infrastructure you personally need to get moving on something. If you are talented and have access to mobile communications, that something is innovation. In economies where annual average GDP is in the $100-1,000 range, if these innovators add just $50-500 to their income, the multiplier effect is huge. To quote from Qureshi, Keen and Kamal (2007):

> "Daniel Mashva heaves his sack of cabbages and sweet potatoes into a rickety shared taxi and travels nine hours under the scorching sun to the market in Johannesburg. By the time he arrives, half his tiny harvest is rotten and the 48-year-old father of five returns to his impoverished village just a few pennies richer. That was before new cell phone technology changed his life. Mashva now dials up to a virtual trading platform on his new high-tech phone and sells his produce direct from his small thatched hut on the fringe of the vast Kruger National Park. "I check the prices for the day on my phone and when it's a good price I sell," he told reporters from his village in the remote Northeast of South Africa. "I can even try to ask for a higher price if I see there are lots of buyers." Mashva is one of around 100 farmers in Makuleke testing cell phone technology that gives small rural farmers access to national markets via the Internet, *putting them on a footing with bigger players and boosting profits by at least 30 percent*. {Our emphasis added) (Source: Zee News http://www.zeenews.com/znnew/articles.asp?rep=2&aid=292033&sid=ZNS)

Cell phones are "consumer electronics" and just tools for talking; they are inferior in functionality to smart phones, PDAs, laptops, PCs and Internet-centered services. Yet they provide poor entrepreneurs like Mr. Mashva with more than he has ever had in his life in terms of leveraging his income. Talking generates knowledge networking. Qureshi, Keen and Kamal (2007) address how such access tools need to be extended through knowledge networking

architectures to create a critical mass and to evolve more comprehensive infrastructures (such as the trading platform which is a knowledge networking hub into which the farmers spoke), but the activation of knowledge networking is at the individual level. Talent drives innovation. Infrastructure does not by itself create talent. The focus on heavy fixed ICT infrastructure and education investment that the DD definition and resulting syllogisms about the logic of development have led to among international funding agencies are both inefficient and ineffective; it reflects obsolete views of ICT as a set of monolithic "systems" at a time when the new modularity and mobility of wireless and Internet-based components are encouraging local initiatives everywhere. Hanna (2006) provides an insider's critique of the historical establishment assumptions and strategies for ICT funding and how they are being revised to move in the direction we propose here. His in-depth review of ICT development in Sri Lanka includes lessons from earlier less successful large-scale infrastructure investment projects led by the World Bank, in which Hanna played a leading role. (2006) He states that his book:

> "Fits into the recent "new realist" approach to understanding successes and failures in ICT for development and the outcomes arising from the tugging and pulling by disparate stakeholders, over time. Much of the 1990s literature was marked by rhetoric arguments about why ICT is good for development. By the late 1990s and to date, there was a shift to e-readiness studies and analysis of ICT investments and diffusion. This is the dominant conceptual approach today: static, apolitical and highly aggregated indices of e-readiness and knowledge assessments. The emerging new realism is aware of process and sensitive to the institutional and political dynamics that shape e-development programs and projects."

ICT in and of itself is not the issue for using ICT to generate growth; *self*-development, not "development" is the key. Finally, and most importantly for the practicality of recommendations made in this paper, the DD perspective overlooks the ingenuity, localization of innovation, specialization and initiative of talent pools across the world, in many places that are indeed outside the reach of major ICT infrastructures. This talent needs ICT support to help it create growth and to leverage its innovation and effort. That ICT base is widely available. It needs to be mobilized through knowledge networking. It also needs, however, to link its individual spokes into hubs – buyers, employers, investors, and partners that recognize and reward their initiatives.

"On average": why e-readiness scores are a distraction and distortion

Our arguments shift the focus of ICT for development from the national to the local. This challenges the mainstream policy and investment tradition. Research relevant to the DD is awash with surveys whose statistics largely report aggregate figures and rely on averages. These hide the nature of the wide variance around the mean and give little concrete detail of the on-the-ground dynamics of economic and social development relevant to ICT. The best-known measure, the National Readiness Index, published in the Global IT Report, ranks countries on 64 variables. Brendan Luyt points out that such e-readiness measures (he has identified over 1500 surveys; 68 countries have been surveyed 10 times) offer a single number that makes it easy to understand

and communicate, but that also implies a universal path to ICT development. The precision of the scores is part of their appeal and scientific-sounding allure: in 2005, Canada, for instance, moved up from Number 12 worldwide to Number 9, (out of 65 nations) and from a score of 8.03 to 8.37 out of 10, while Estonia and Bulgaria stayed very much in place, at 27th and 44th. China is in 57th place.

No one reading the list would guess that Estonia includes the talent pool that developed Skype, one of the most innovative developments in the ICT field and that was bought for $2.6 billion by eBay, or that Bulgaria is attracting more and more IT outsourcing contracts. As for China, a few figures from a wide range of sources demonstrate how distorted a picture survey averages provide and how they distract attention from opportunities other than fixing national infrastructures. China's government is notorious for its aggressive efforts to control the Web and limit individuals' initiatives to establish their own sites and blogs. Yet even so, there are around 200 thousand Internet cafes, 45 blog hosting services, 2 million active blogs, and 100 million Internet users. In addition, China has over 300 million mobile phone users. Alibaba.com is the world's largest business-to-business Web portal, with over 7 million registered business users in China and another 2 million spread across 200 countries. Founder, a leading software firm established through the University of Beijing, has sales of around $2 billion. UFSoft has 60 subsidiaries, 60 customer service centers, 100 training centers and 500 distributors (Saxenian, 2003). China's software output is fairly close to that of India and Ireland, in terms of revenues, and is growing by 30% a year.

These examples must be myths if the e-readiness rankings are reliable. Surely it is the rankings that are the myth.

There has been a wide discussion on the politics of international development aid and funding that throws some light on why these national e-readiness scores have been so dominant in planning, research and assessments. Luyt argues, in close agreement with Easterly's analysis, that the gainers from the Digital Divide as a "problem" are four large constituencies: information capitalism, developing country governments, the development "industry," and global civil society, and that the "solution" requires their leadership.

The information capital group is the intersection of large corporations seeking skilled labor via their own ICT infrastructures plus the ICT industry of providers of such infrastructures. Their perspective is well captured in a 2006 PR announcement:

> "Foreign Relations Minister Carlos Morales Troncoso has announced that Bill Gates offered to support the Dominican government in the development of information technology during a meeting they held in Washington……. So that it achieves a level of development similar to India's, where he has also provided great support for the IT industry.
>
> Microsoft Chairman Bill Gates sketched out a vision for the future Wednesday in which a cell phone will become a "digital wallet," able to receive e-mail and even scan business cards, while computers and TVs will merge. Microsoft Corp., the

> world's largest software maker, also wants to "redefine the way that citizens think about how they work with government and how efficient communication takes place," Gates told about 300 political, business and academic leaders from Canada, Latin America and the United States at the company's Government Leaders Forum. The two-day event is intended to explore ways to improve government use of computers, as well as the transition to what Gates called the "knowledge economy."……..
>
> Gates, the keynote speaker, pledged to continue Microsoft's commitment to Latin America. "I'm very optimistic about the countries in Latin America. It's a market that we've invested in, and the growth opportunities that come out of that have been great for us," he said. Gates and other Microsoft officials cited a "Partnerships for Technology Access" initiative, in which the company aims to help governments and local industries in underserved countries and regions. In Mexico, for instance, Microsoft is working with hardware vendors, local Internet service providers and government agencies help families buy so-called "smart homes" equipped with computers, said Gerri Elliott, corporate vice president of Microsoft's Worldwide Public Sector. She and Gates called such programs critical to bridging the "digital divide" between developed and less-developed countries."

Developing country governments, of course, welcome such announcements and look to improve their "competitive" position and profile in the global economy. Funding agencies have historically encouraged them; there is a constant tenor in discussions of "more" and "bigger" investments to end poverty – and bigger infrastructures. Civil society, the thousands of organizations that take a social, political, ethical or educational position on development, similarly argue in favor of aggressive international and national "progress." All of these forces turn the entire discussion of the role of ICT into what should be the national policy, with movement up the e-readiness league table a primary measure of impact.

But the e-readiness data are highly flawed indicators. Survey statistics assume a normal distribution, reliable measures of variance and very, very Meaningful Averages – the mean of the distribution. In practice, averages mean little in the global context of the Digital Divide; on average, for instance, Finland, Singapore and the U.S. are global leaders in e-readiness and global competitiveness. Go eighty miles west of Helsinki or south of Washington, DC, and you have crossed the Digital Chasm. Look inside Singapore's high-density building blocks and you will in many instances find less usage of the Internet for education than in urban areas of Chile. Chile has for several decades been one of the most advanced and competitive telecommunications markets in the world – on average. But around 20 percent of the country has no reliable basic phone service. And so on. Knowing the national readiness score of a country tells one little about its talent pools and what they are achieving.

Averages and aggregate figures are no more reliable in developed nations. Just counting the percent of households in a country with Internet access gives no indication of whether that access is used for game playing, chat, education, or information search. Barbara Combes summarizes a

wealth of research on the nature of Net generation use of the Internet and shows that among U.S. schoolchildren "Web-savvy" often equates to shallow and narrow search, simplistic reliance on a few sources of information with minimal critical enquiry and an indifference to basic concerns about accuracy and reliability. (Combes 2006) Rather than this being information "behavior" it is information convenience. It says little about the impact of ICT on leveraging economic performance in the knowledge economy. Claims that the provision of PCs in U.S. schools would close the nation's DD are poorly supported. All they do is provide poor kids with PCs that make very little difference to their lives as long as there are more consequential divides that they must cross, such as food and transportation.

None of this in any way means that ICT is not important in economic development or that telecommunications infrastructures are not enablers of growth or their lack is not a blocker to it. Our argument is simply that ICT is not ***causal*** in its impacts on ***national*** development and that the e-readiness perspective and all its rankings and averages look in the wrong direction. ICT is ***correlative*** and ***local*** in its impacts. Its effectiveness is driven by social more than technical innovation. It is about the exceptional not the average.

All this means that much of the most useful discussion of how to bypass the Digital Divide must be anecdotal and exemplary, drawing on exceptional cases and hoping to make plausible generalizations from them. The exceptions need to be sampled and turned into trends and only then into averages. The figures from China are examples. One of the most striking aspects of the widely cited explosive ICT growth in India and China is that it has been driven by the exceptional rather than the average and by the opportunistic rather than the planned. Talent pools are, by definition, exceptional; they often reflect special situations or even serendipity. Much of the sudden emergence of Eastern Europe as a new center for ICT development and operations appears to be related to its highly disciplined university engineering programs. Similarly, Mexico's and Barbados's specialization in document processing reflects their logistical position; physical paper needs to be transported so that while electronic services have moved offshore to Asia, paper travels across the U.S. border or on short-haul flights (Barbados and many other Caribbean centers were early examples of outsourcing by American Airlines). The rise of Ireland, India, and the Caribbean in telephone call center services has a lot to do with the conservative tradition of their English language education systems with their roots in British conservative curricula. Makati, a section of the Philippine's capital city, in the 1990s became a global help desk, partly because its talented high school students lacked access to university places but formed a technical elite that could be sourced by the global consumer electronics manufacturers.

The switch in focus from ICT as development infrastructure to localized talent pools as opportunity transforms the notion of "e-readiness." Here are just a few anecdotal and totally unscientific illustrations of why this paper dogmatically says "No" to the four questions posed above:

1. The Nigerian scam: this is one of the world's most successful small business and entrepreneurial successes. Yes, it is illegal and immoral and despicable. But year after year, it uses the Internet to thrive. Yet, on all indicators of the combination

of e-readiness/infrastructure/competitiveness and other Good Things, Nigeria is close to the bottom of the list. But it has a talent pool of entrepreneurs who know how to use the Web and e-mail. So, too, does rich Abu Dhabi, where that kind gentleman whose ex-Minister father was so cruelly mistreated has left the millions of dollars behind that you – and only you – can benefit from if you e-mail your bank account number and access information. Nigeria's talent pool did not need an ICT national infrastructure to get stealing. Nor did the Emirate crooks have to wait for fiber and broadband to join the scam. A core argument in this paper is that the main issue for bypassing the DD is how to leverage and cohere the resourceful, inventive and energetic talent pools of poor countries so that they can be innovators on their own behalf and help their families and communities live a better life. A valid counterargument to our position is that if, as in the instance of the Nigerian scam and the explosive growth in Russia and surrounding republics opens up anarchy rather than development. Thus the ICT planning and policy role should be to recognize that globalization is highly localized and highly specialized but also to ensure effective knowledge networking architectures that include requisite security, protection against false information, community directories, and metadata that helps add intelligence to knowledge networking. This topic is outside the scope of this paper but is addressed in Qureshi, Keen and Mehruz. Keen and Tan (2006) suggest that the Semantic Web is the base for such metadata development.)

2. Kerala fishermen, Bolivian potato growers, Canadian Intuits, South African cab drivers, Bangladeshi housewives and Mexican day laborers uniformly and consistently have used the Internet and mobile technology to access information about markets, bypass many of the intermediaries who have profited from their lack of knowledge, build cooperatives with new bargaining power and invent small but significant improvements in their everyday life. All without a systematic, national, policy-driven infrastructure and economic development plan. There is a frequent condescension in the literature on ICT infrastructure and education policy that assumes a general level of helplessness and lack of initiative in target countries. This viewpoint does have some grounding in researchers' and investment agencies' experience with widespread corrupt and inefficient government units that are key players in the ICT arena, often as blockers. However, it greatly underestimates the degree of self-development that individuals and groups are demonstrating everywhere. Even in Ghana, for instance, a country that is not even included in most of the e-readiness league tables, innovation thrives, as Luyt points out:

   "A local software firm, Soft, successfully competes in the operating–system market due to the realization of its founder, Hermann Chinnery–Hesse, that Africa needs something cheaper and more resilient than Windows. He has attracted international investors to his business (Hale, 2003b). Other Ghanaians are also busy trying to extract wealth from information technology. Francis Quartey runs a large and successful Internet service provider, Intercom Data

Network in Accra while another of his countrymen has established the country's first call center."

Luyt observes that these innovations come from elites and, as with the emergence of a massive new middle class and consumer society in Bangalore and Shanghai, often do not bridge any divide for the mass of the poor in their nations. We concede his point and accept that such talent pool business initiatives may create information and business capital rather than a broader social capital, but argue that the money, jobs and surrounding services they create help bootstrap development or at least open up options for social capital development. The rule of thumb in India is that one new job in the ICT field generates around 7 additional ones: services, retailing, etc.

3. In countries that lack telecommunications infrastructures, coherent ICT policies and a critical mass of industry and government support for national ICT developments, there are plenty of Internet cafes, small ISPs and, in most urban areas, low cost access to the Web. In addition, many "poor" countries are richer in basic wireless service than many parts of the U.S. Here are a few figures on the cost per hour of Internet café service from *Wired Magazine* (May, 2006): Nairobi $0.84, La Paz $0.38, Antigua, Guatemala $1.30, Lagos $0.77, Lima $0.38 and Kinshasa, Congo $1.50. If the infrastructure problem in ICT is so large and so critical then why are these services available and available at far lower costs than in "advanced" countries (e.g., Oslo $4.50, Montreal $4.38, Tokyo $3.41, and New York City $12.80)? These figures have to be adjusted to reflect the relative national income and vary from 5-8% for most cities but 20-30% for several African locations. That said, the evidence is clear: entrepreneurs are able to offer low cost Web capabilities even where the national telecommunications infrastructure, policy and industry are weak. When e-mail can be sent from cybercafes in Katmandu and when in China they are "ubiquitous and cheap even in remote towns" (*The Economist*, April 29, 2006) then there is something missing in the standard refrain that a major blockage to closing the Digital Divide is the lack of telecommunications infrastructures. From the perspective of knowledge networking, the explanation for the contradiction is that while the "big hub" infrastructures of national wired phone and data services are indeed often woefully underdeveloped, the "small spoke" distributed capabilities of mobile handsets and cybercafes are far less so and that it is these that provide the base for leveraging talent pools.

   The author of this paper is a member of the board of directors for a small orphanage in Katmandu that rescues children off the streets and provides shelter and education. It is totally "wired" and the children are personally tutored and, of course, use the Internet as part of their learning. The talent pool here is a U.S. couple personally funding the venture (in knowledge networking terms, the "hub"), local teachers and social workers (the "spokes") and an ingenious and street-smart technical expert. Nepal has no national ICT infrastructure or industry

critical mass. Yet, the house and office are as advanced in their use of technology as any SOHO (small office, home office) in a leading e-readiness nation.

4. Eastern European ICT talent pools: Without fanfare and without Grand Projects in ICT infrastructure investments, Bulgaria, Romania, Georgia and many other areas of previously stagnant Eastern European bloc areas are now major players in ICT. Skype, the force that has just about guaranteed the demise of most of the telecommunications establishment, was developed in Estonia, where the company's ICT and production staff are still located. Bulgaria is the global center for all of Adidas' ICT operations, including point of sale and data warehousing. The head of India's Infosys, the largest business process outsourcing company in the world, stated in early 2006 that "if the engineers are in Romania, that's where we'll go." This is business self-development in action. Of course, many of the goals of both governments and investment agencies center on building social capital rather than, as some critics charge, just providing low cost labor capital for multinational firms, but given the general conclusions that large-scale ICT deployments have rarely met even their most limited goals, surely there is a strong case to be made that a shift in focus from the macro policy to the micro self-initiative may be a more productive complement and in some instances even alternative.

5. Mexico is a "developing" nation, with most of its population living in poverty, its government notoriously corrupt and drug gangs among the most powerful forces in the economy. It ranks half way down the e-readiness lists. Yet Monterrey, Mexico, ranks in the top ten in any survey of the best business cities, and several of its companies are leaders in business and technology: The cement manufacturer Cemex, for example, is among the most cited innovators in ICT in leading business books (Hamel) and its subsidiary Neoris is the second largest outsourcing services provider in Latin America. The local university, Monterrey "Tech", is the largest on the continent and highly ranked globally, with several thousand electronic campuses. The state of Nuevo Leon, of which Monterrey is the capital, has a gross economic product of $50 billion. Its governor has established a program to help Monterrey become a City of Knowledge. It will be hosting the 2007 Knowledge Management Forum, a massive event.

In all these instances, there really is a digital divide ***within*** the countries. But there is no ***national*** divide. At the aggregate level, Ghana, Nepal, Bulgaria and Mexico fit all the DD stereotypes. But in each instance there is no lack of localized innovation and sustainable economic growth. The knowledge networking strategy for assisting development relies on leveraging what is already happening in localized business self-development. Rather than view ICT as "information" technology and of value for knowledge-building and education, it shifts the focus to ICT as coordination technology of value for extending knowledge ***use*** and contacts, including contacts among professional and business groups. A low-cost blog that shares information about East European e-commerce and multimedia small businesses may have more impact in this regard than major multi-year,

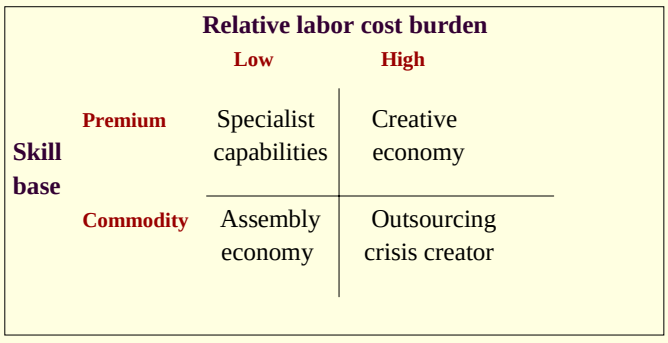
multi-stakeholder national programs. A mobile phone in the hands of a nurse….. Wi-fi in any one of the 45% of the 20,000 Indian second-tier engineering schools that are private rather than public institutions. A portal such as Eli Lilly's InnovCentive initiative that links around 60,000 individuals, colleges and small firms to solve research problems that it poses (doubling the success rate), where many of the institutions registered as problem-solvers are in semi-developed regions of the world. All these use knowledge-sharing as the currency of development.

The recipe for innovation through ICT begins with "Find the innovators first. Add a sprinkling of ICT." The recipe for bridging the digital divide begins "Forget the very idea. Find the innovators first. Add a sprinkling of ICT."

Global Capabilities Sourcing

Much, perhaps even most, of the turbulence today in global business can be explained through the simple two-by-two matrix shown below. It has been derived from observation over a number of years and tested in a number of contexts. (Keen 2004) It seems to hold up well conceptually and empirically. It reflects the impact of the three historical forces mentioned earlier: deregulation/trade liberalization, coordination technology, and standardization of interfaces and modularity of products and processes. Associated with and in many instances created by these forces are the commoditization of more and more industries' products and services, outsourcing as core to a business strategy instead of a minor add-on, the explosive growth of China and India, the relative sudden soon-to-be- explosion of Eastern Europe and other new "e-Big" global players, and many of the social problems of developed nations. In the background of the trends that the GCS framework summarizes are the diverging demographic profiles of developed and developing economies.

Figure 1. Global Capability Sourcing: the search for talent



The GCS matrix shows two broad categories of skills – commodity and premium – and two levels of labor cost burden – low and high. The dichotomies obviously do not capture the full dynamics of labor markets. In China, wages per hour in the textile industry increased by 10-20% in 2005 many companies have been unable to pass the costs on to large customers. The labor cost burden still remains low in comparison with Central American competitors but high enough that China to whom apparel companies have outsourced manufacturing is itself outsourcing to countries such as Vietnam. That said, the matrix robustly and parsimoniously captures the four areas of differentiation in the global economy. Each of these requires a differentiated talent pool and knowledge networking. Each represents a differentiated perspective on and response to the digital divide concerns.

The lower left-hand quadrant is that of commodity skills and low labor cost burdens. It is best illustrated by the global apparel industry. A commodity skill may be compactly defined as a task that (1) can be learnt in six weeks and where full productivity is reached in six months or (2) is a cost-effective candidate for automation. Apparel manufacturing fits both of these criteria, which is why it has been a major labor market in so many poor countries. It is quite literally part of an assembly economy. That economy is the one most open to labor abuses, such as those widely reported concerning factories producing goods for Nike. There is no product or process differentiation, the forces driving globalization lead to more and more commoditization and there is always someone offering a lower price (This reality is often referred to as the China price – whatever your own price is minus 30%).

The assembly economy is one where the digital divide is about as important as, say, the gourmet food divide. Offering fine French cuisine to textile factory workers in, say, Bangladesh together with education on healthy nutrition would be an absurd and quixotic initiative. Only in instances where there are hidden and underused talent pools can ICT contribute to job improvement by creating opportunities in the Specialist quadrant of the matrix. Our analysis suggests that there will be many such small and fragmented groups, but for the rural and urban poor in the sweatshops and on the farms of poor nations the money spent on ICT is a misuse of scarce development funding. Going back to Bill Gates' enthusiasm about offering smart homes to people in the Dominican Republic, the "new realist" view of development via ICT might well classify that as just absurd.

What is not at all absurd is infusing coordination technology as fast and as broadly as is cost-effective in the top-left hand quadrant of the GCS matrix, which is where many and perhaps even most of the effective impacts of ICT on economic development are being shaped: specialization through premium skills in low labor cost burden economies. Qureshi, Keen and Merhruz briefly discuss the more than two hundred thousands jobs and half a billion dollars of GNP added to this impoverished nation's economy that has been driven by the diffusion of mobile phones together with their commoditization that has led to a 30% reduction in prices, fueling more usage and more growth. Here, there is a dynamic interaction between supply and demand. Mobile phone penetration has grown from 0.2% of the population to 7%, a massive increase but also one that is still a small fraction of the population and hence a continued growth opportunity.

Across the world, such specialization marks the growth of spokes that link into GCS hubs: document processing in the Caribbean and Mexico, X-ray and MRI interpretation in Manila, medical records management in Slovenia and, of course, IT and back office operations everywhere and anywhere. There are many variants of specialization. The common trend, which is very much a matter of concern in developed nations, is the exploitation by companies in sourcing capabilities based on the increasing levels of educated talent pools in such areas as architectural document design processing, patent application research (why pay a college graduate $60,000 to sit at a PC and search the Internet when there is an even better qualified one in Romania, India, China or Vietnam?), engineering, medical testing and data analysis and many other fields. Again, the national e-readiness types of survey can give a misleading picture here. They suggest that it is the 7 million graduates a year coming onto the job market in India and China that is giving them the capability sourcing edge. Most of those graduates are very weak, and the *Financial Times* article cited earlier states that there is such a need for trained managers, accountants and financial planners in those countries that firms there are recruiting in the United States. But the sheer weight of numbers favors such countries. Even if only 10% of engineering graduates in China or India are well skilled, that figure is still many times greater than the annual talent supply of Western nations.

The specialist sector of ICT-enabled capability sourcing varies very widely. It includes the large Asian contract manufacturers like Solectron and Flextronics who exploit scale and low overhead (in the 2-5% range versus the typical 15% for the firms that slap their own brands on the products) and who now make most of the worlds' mobile phones, laptops and printers, the call centers and back office business, and many areas of medicine and pharmaceutical products. The degree to which a company relies on distributed capability sourcing and specialization is illustrated by a diagram in *Newsweek* in 2006 that shows the many countries manufacturing components of the Boeing 787 fuselage. The rear wing tips and tailbone are built in South Korea, the cargo doors in France, the passenger doors in Sweden and the landing gear doors in Canada. Australia, Japan, the UK and Italy build other components. (Caryl 2006) China provides the leading edge of the tailfin but lacks expertise in manufacturing with composite materials that are a superlight replacement for aluminum, so the trailing edge of the tailfin is made in Japan. "What's the point of doing it all yourself when you can do it better and more cheaply when you spread it around the world?…… In 20 years it will be impossible to distinguish what is an American, Asian or European aircraft."

The specialist quadrant of the GCS matrix is the one most clearly suited to knowledge networking. That means it should surely be ***the*** priority for targeting ICT for development.

The other two quadrants of the GCS matrix are more a matter of policy and re-development in countries that are on the rich side of the digital divide. These are ones high up on the e-readiness national indices. That does not help the many cities, business functions, professions and middle-aged workers who are part of the bottom-right hand side of the GCS matrix: the Outsourcing Crisis Creator. They have only commodity skills but work in high labor cost burden economies, where their take-home pay drops as companies follow the logic of the quotation from *Newsweek* of "What's the point of doing it all yourself when you can do it better ***and*** more cheaply when you spread it around the world?" It's all being spread around the world now and it is creating the

outsourcing crisis that ironically is largely the result of the very opposite of the traditional digital divide: it is the very availability of coordination technology that makes it so easy to take jobs away from people who in many instances have multimedia PCs in their homes, broadband telecommunications, mobile phones, Yahoo, Google, credit cards they use on eBay and in many instances college degrees in engineering and IT. Going back to the quote from the Asian Development Bank, it is the countries that have digital divide that are facing labor market crises, social disruption, anti-immigrant movements and the use of Chapter 11 bankruptcy filings by companies in order to cancel union contracts and pension fund obligations:

> "The countries that succeed in bridging the digital divide by harnessing the potential of ICT can look forward to enhancing economic growth, and improving human welfare and good governance practices" (ADB, 2001).

So all that is needed to solve the outsourcing crisis for families affected by globalization, standardization and coordination technology is that they should upgrade their PCs?

The issue here is, again, talent pools. For reasons of cost, education, age and economic policy, many people are caught in the outsourcing trap through no fault of their own and with no knowledge-capability solution of their own – the only solution is talent building. The future of cities, regions and nations in the developed economies rests on how they are able to build capabilities and roles in the Creative Economy. That is the domain of design firms like Apple that no longer is a computer "manufacturer." It sources high-end technology capabilities from Taiwan, which outsources to specialist manufacturing firms in Mainland China and elsewhere. It is the illustrated by the teams that employed more ICT in filming and editing the billion dollar *Lord of the Rings* than most large companies use. It created a new talent center in New Zealand. It is how countries like India and China are creating localized and specialized high-end capabilities in medical research and pharmaceuticals. Half the world's AIDS drugs now come from India, which has been the strongest player in developing generic versions of patented drugs.

This last example, generic drugs, is a reminder of the dynamic nature of skills and talents in terms of both innovation and maturation. The quadrants of the GCS matrix are not static. Today's premium skill is tomorrow's commodity. Historically, the two leading Indian companies in generic drug development have been able to command a 40-60% price for their products compared to the patented equivalents. That figure has dropped to as little as 5%. The explanation is obvious, given the GCS matrix; there are competing specialist firms across the world springing up in technology parks – often funded by players in the Creative Economy – and start up labs. The Big Pharma companies that have seen their profits erode as their R&D pipelines are no longer producing blockbusters are co-sourcing such capabilities to position themselves for when patents expire – and to use coordination technology to link talent pools to their R&D base.

ICT is one of the key enablers of such supply-demand interactions. Wherever there is a branded portal, such as Eli Lilly's InnovCenter for R&D, Dell's online e-commerce Web site or Li & Fung's global coordination platform that in effect "runs" 7,500 independent textile factories in servicing the largest European and North American clothing retailers, then this is a hub open for business and the business comes from spokes. The hubs grow through the spokes and vice versa.

As our example of the Chilean salmon farming spokes and the Wal-Mart hub indicate, the result is economic development that may or may not be desirable social and environmental development. But it certainly is job development.

The core of our perspective on the digital divide is that this dynamic that is driven by knowledge networking opportunities for poor entrepreneurs and hub-spoke specialist opportunities for supplying the demand for global capability sourcing is the key for planning and action. Hanna speaks of the "new" realism in the shift in establishment thinking about the role of ICT in national development. We add "business realism" as the next shift, with a key lens being the focus on the local rather the national, on distributed talent pools rather centralized experts, on simple coordination technology tools rather than national ICT infrastructures, and, to use Easterly's distinction, on Searchers rather than Planners.

Recommendations for an "influence" agenda

The aim of this paper is to influence the thinking of three communities of influence on the ICT/development relationship for which the digital divide is a surrogate: those who influence policy, those whose research influences policy, planning and practice and those whose expertise influence ICT choices and deployments. We conclude the paper with succinct recommendations for their agendas:

Recommendations for Policy:

1. Discontinue the many activities and discussions of the digital divide as a national issue and e-readiness scores as the metric of progress; encourage and emphasize localization and knowledge networking.

2. Focus on talent pools as the driver of development and hence of ICT deployment. Locate such pools and identify the simplest, cheapest and most easy to use ICT tools that leverage their knowledge networking.

3. Incorporate more clearly in policy-making and funding the spoke-hub interaction that is implicit in the Global Capability Sourcing matrix. Facilitate specialization capabilities of value in the global talent hunt via local talent pool linkages into business hubs.

4. Fund the governance and architecture planning mechanisms that ensure adequate security, reliability, integrity and recourse to protect the talent pools and build confidence and trust in the spoke-hub relationships.

Recommendations for Research:

1. Study distributed talent pools: their characteristics, behaviors, modes of innovation and needs for knowledge networking. Include the entrepreneurial poor.

2. Study the many localized centers of innovation in cities within individual countries: the "hidden jewels" of development such as Jena (East Germany), Monterrey (Mexico) and the Ghana software industry).

3. Explain through research studies the anomaly of low-price and ubiquitous Internet cafes in countries that are low on e-readiness indices and their implications for stimulating ICT innovation.

4. Explore the implications of demographic shifts for developed and developing economies hub-spoke and Global capability Sourcing relationships over the next 25 years (a nation's core labor force of 2026 has already been determined by the births of 2000-2006).

Recommendations for Application:

1. Build tools-at-hand that minimize the need for education, support and continued expenditures and that facilitate accelerated and local development by talent pools. These most obviously include cell phones, wi-fi, Internet cafes, and blogs.

2. Develop knowledge networking hubs, such as simple trading information portals for farmers, blogs for sharing knowledge and expertise among distributed professional communities and, for the future, Semantic Web tools that add intelligence to search engines in order to help lesser educated talent pool entrepreneurs enrich their information-seeking behaviors.

One area of ICT policy, research and application that we have deliberately not addressed in this paper is e-government. That is because this is generally the area of ICT usage least driven by talent pools and in many instances it has been a failure as a result of that fact. There are many instances of large investments leading to limited staff interest and support, wasted resources and limited use. A typical example is a fairly ambitious and hence expensive e-government knowledge management portal developed in Estonia where a case study found that there were only 5 out of 15 Web pages that did not contain out of date information, contributing regional agencies varied widely in their understanding of the purpose and processes, and the researcher's conclusion is that "citizens do not see much point in spending their energy and time" on accessing the Web pages. (Reinsalu 2006). An in-depth study of ICT investments targeted to a Tanzanian center for government training similarly concludes that "there has been very little implementation progress over the 10-year period studied." (Furuholt and Orvik 2006) That said, there are other instances where there have been striking benefits to citizens mainly through their being able to use cell phones to get information instead of having to travel, often for several days, to a large city and wait in long lines. We suggest that e-government for development is a specialist domain that merits its own policy, research and application. We suspect, however, that our analysis will explain the main reasons for the successes and failures in e-government and that the results will correspond closely to Easterly's distinction between Planners and Searchers.

Our paper challenges many of the assumptions about the nature of the digital divide and how to bridge it. We hope that our challenges are positive in their nature and that they help the policy,

planning and application communities in their work. That is after all what "development" should be about: providing help.

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From Wired to Wireless: Singapore's Ubiquitous Digital Hub

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Abstract

"An Intelligent Nation, a Global City, powered by Infocomm", this is Singapore's vision unveiled in June 2006. The 10-year multi-billion dollar IT plan known as the Intelligent Nation 2015 (iN2015) — is Singapore's latest information and communication technology (ICT) roadmap that focuses on three concepts - "innovation, integration and internationalization" - to create a digital ecosystem that contributes to enhancing the social well being as well as to develop a sustainable competitive economy in Singapore.

Singapore's concerted efforts in deploying the use information technologies (IT) goes back to the early 1980s. Today, IT investments have pay off as IT has been deployed pervasively in government, businesses, and homes. The IT industry has also contributed a successful digital economy for Singapore. Singapore's IT successes are attributed to its policy makers who had the foresight and vision to provide comprehensive IT plans, map proactive strategies, and execute the IT plans effectively. Since the country's first IT plan on computerizing government agencies, the government has consistently implemented a 5-year strategic IT plan to harness the potentials of IT so as to transform all facets of living, at work, at play and at home. Most plans are articulated to tap on the opportunities provided by technological advancements and also considering the competitive environments at the time. For example, in the early days, it was simply to computerize for efficiencies and productivity, however, as the world moved into Internet technologies, Singapore responded with its IT2000 plan to build a National Information Infrastructure (NII) to wire up the island into an Intelligent Island connected by Singapore ONE (one network for everyone), a nation-wide network. 'Connected Singapore' emphasize the potentials of the convergence of computing, communication and content, and more recently, iN2015 aims to create Singapore as a choice for the world's digital hub using ubiquitous and intelligent digital technologies.

Singapore's innovative, dynamic and forward-looking IT blueprints have impressed and attracted attention form many countries, with some emulating the Republic's approaches and policies whilst others such as Jordan, Kuwait, Middle East, and Sri Lanka are seeking Singapore's advice in developing similar Singapore's e-Government solutions which have been ranked highly in international benchmarking studies.

Using the supply-push and demand-pull model, this paper provides an analysis of how Singapore conceptualizes and develops the fundamental information infrastructure to create its digital

economy. The paper also analyses the interplay of how the government influences the diffusion as well as mandates or regulates its adoption. Although Singapore's unique experiences may not be directly transferable to other countries, nevertheless, it may provide some insights in implementing ICT innovations and strategies.

Building Successes on Information Technologies

Since the early 1980s, Singapore has recognized that information technologies are important enablers to build its economy as well as to enhance the quality of life of its citizens. Indeed, IT laid the foundation stone for the many success stories for Singapore. It is still pursuing relentlessly new possibilities of more advanced technologies to sustain Singapore's competitive future. Indeed, credit is given to its policy makers who had the foresight and vision to provide comprehensive plans, to map proactive strategies, and most important to execute the IT plans systematically. Consistent with its early vision to create an IT industry, today, Singapore has successfully built a robust infocomm industry with total revenue of about S$37.89 billion in 2005, and creating an export infocomm market (58 per cent) compare to its domestic market (42 per cent). It can be said that the infocomm industry has grown to be an important contributor to Singapore's gross domestic product, accounting for 6.5 per cent of its GDP in 2005 (iDA, 2006a).

Singapore's innovative and forward-looking information technology blueprints have impressed many countries, with some emulating the Republic's approaches and policies. It is interesting to note that Waseda University in Japan established a research outfit in 2001 called the 'Institute for Singapore IT Strategy', and started a 30-lecture module on Singapore's IT Strategy. Singapore's success in implementing the IT roadmaps has received many accolades from the international communities. For instance, Singapore was selected as one of the top seven intelligent communities in the world for 2005 by the Intelligent Community Forum (ICF), a well respected non-profit US-based broadband research group think tank. According to the ICF, the top seven communities (the other six include France, Japan, Brazil, UK, China, and Canada) represent trends and best practices that typify the direction that communities took in order to grow in the Digital Age. These countries were selected based on the following criteria: significant deployment of broadband communications to business, government and residences, with government providing the catalyst; effective education, training and workforce development to build a skilled labour force for the 'knowledge economy'; government and private-sector programs that promote digital democracy by bridging the digital divide; and innovations in the public and private sectors, with effective economic development and marketing that leverages broadband. (iDA, 2005b).

Other accolades which the city state has received include being ranked top first and second for overall Networked Readiness in 2005 and 2006 respectively by the World Economic Forum's Networked Readiness index. Singapore is also consistently ranked amongst the top 3 e-Governments in Accenture annual global e-Government Report (2000-2005). In the United Nations' 2005 e-Government Readiness Report, Singapore's ranking in both the e-Government Readiness Index and e-Participation Index improved from the 8th and 4th positions in 2004 to 7th and 2nd respectively in 2005. Although Singapore ranked fifth in the World Economic Forum's

Global Competitiveness Index in 2005 but it was bolstered by being number one in position in its Index's Technology Readiness component (iDA, 2006a). Infact, in the World Economic Forum Global Information Technology, Singapore has always maintained its position in the top three economies in the Global Information Technology Index for four years running. However, in 2006, Singapore's drop from the number one position to second, which shows that other countries are also continually making strides as well. Therefore, to maintain its relevance in the global digital economy, Singapore needs to continually innovate and developing its infocomm infrastructure to be relevant and robust.

Applying the 'supply-push' and 'demand-pull' framework

Using the supply-push and demand-pull framework that was adapted from Gurbaxani et al. (1990), Tan (1998) provided a broad descriptive analysis of how Singapore developed and implemented its IT plans, how it promoted the adoption and diffusion of information technologies as well as how it also created and grow its digital economy from 1980 to 1999. Briefly, the framework identified the government's role in two dimensions: the nature of involvement and the level of involvement (see Table 1). The first dimension, the nature of involvement identifies two activities – the first activity being supplying IT capabilities (supply-push) by creating, producing and transferring IT and the second activity essentially to stimulate the demand of IT (demand-pull) by motivating the communities into adopting information technologies. The second dimension, the level of involvement identifies the government's role in two categories – the first category, 'influence' which refers to how the government provides incentives to coax the deployment of IT, and the second category, 'regulation' which refers to how the government 'mandates', provides standards and requirements in the use of the technologies.

Insert Table 1

To illustrate the supply-push and demand-pull concept of Singapore's IT adoption and diffusion, this section will summarize the important aspects of past plans to provide some perspectives and background leading to the recently launched iN2015 Plan. The background is necessary to understand what IT infrastructure had been implemented, what IT capabilities had been developed and achieved. Indeed, iN2015 can be considered as being closely linked to previous IT developments; it can also be considered as a continuing development of previous initiatives but twigged to take into account the emerging information technologies of the next ten years. In summarizing past IT plans and initiatives, this section will only highlight the major events or activities of each previous plan as some activities and programmes overlapped and intertwined within and between each of the previous strategic IT plans. In this context, it is to be noted that the forces of each plan may not fall neatly into the two-by-two matrix as depicted in Table 1.

<u>The National Computerisation Plan: 1980 – 1985</u>

The first IT plan known as "The National Computerisation Plan" began in the early 1980s with the main focus to computerize all civil service departments and agencies to increase work

efficiencies and productivity through the automation of tradition work functions. The civil service computerization programme (CSCP) was an important exercise, as it streamlined and re-engineered many redundant traditional processes. The outcomes were impressive when operational efficiencies increased in the public sector. For example, there was shorter turnaround time for applications or for enquiries of services and information, and it was noted that each visitor's passport was cleared within thirty seconds at the airport, and registration of companies which used to days was done within a few minutes. An audit in 1988 found that there was a return of S$2.71 for every $1 spent on the CSCP (NCB, 1986). Consistent with its goals, IT manpower grew from 850 to 5,500 and the computer software and services industry grew 10-fold in revenue. The first IT plan could be analyzed as a period in which the government created the supply of IT capabilities and know-how (supply-push) by developing the fundamental infrastructure and applications of public services. Its role was basically to 'lead by example' and influence the adoption of IT.

The National IT Plan: 1986 – 1991

The second plan in 1986, known as the "National IT Plan (NITP)" was conceptualized at a time when Singapore was experiencing a decline in the economy, and so the Economic Committee highlighted that IT could make potential contributions to sharpen Singapore's long term competitive position. IT should be exploited further to improve productivity and competitiveness in every sector of the economy as well as developing a strong export-oriented IT industry (Wong 1992). Considering that Singapore's trading economy consisted of many small and medium sized enterprises (SMEs), it was therefore important to improve the private sectors' productivity along with the public sectors. However, it was difficult to get SMEs to computerize their systems, less create a critical mass of adopters. The Small Enterprise Computerisation Program (SECP, later known as the Local Enterprise Computerisation Program (LECP)) was then set up to provide incentives for SMEs to deploy IT. The incentives included financial subsidies for IT feasibility studies, awareness education and training programmes, and the appointment of advisers from the National Computer Board (NCB) or academia to educate executives on the benefits of using IT. The SECP/LECP scheme provided an attractive package from the following institutions: NCB provided the expertise, and Economic Development Board (EDB) provided financial assistance for consulting fees, the purchase of computers, as well as providing subsidies on training IT skills. There were also tax incentives for the purchase of IT products. The diffusion of IT was strong as computer penetration at the end of the period increased to 70 per cent for enterprises with more than ten employees (NCB 1994).

During this phase, the government computerization programmes took a more advanced approach in that integrated inter-organization networking systems were developed. TradeNet was an exemplary integrated network system that was developed to facilitate the exchange of trade documents for clearing of customs. The system allowed the computerized exchange of inter-organization business and trade documents conforming to EDIFACT, an established international standard. With TradeNet, what used to take Customs two to three days to clear trade documents, they were cleared within fifteen minutes (King and Konsynski, 1995a). This phase could also be described as a period where there was a supply-push of IT capabilities, mobilizing knowledge with the private sectors. The government played an influencing role by providing the many assisting schemes to the private sectors to adopt IT. However, it could also

be analyzed as a time when the government was trying to 'regulate' as standards were set for clearing trade and custom documents with 'penalties' in terms of imposing higher fees if documents were cleared manually. The success of TradeNet prompted the development of many other integrated networking systems such as MediNet for the healthcare community, LawNet for the legal fraternity, and PortNet for the shipping community (more details in Tan, 1998).

IT 2000: 1992 - 1999

The third plan known as "IT2000" aimed to transform Singapore into an Intelligent Island where IT could be used pervasively at work, home and play and its purpose was to increase its economic competitiveness as well as to enhance the quality of life. It was a period where the potentials of Internet technologies were often reported, thus, the ambition of the 'Intelligent Island' roadmap was to create a critical node in global networks of commerce, communications and information. As the ambition was to develop a global switching centre for goods, services, capital, information and people, it was necessary to develop the National Information Infrastructure (NII). Called 'Singapore ONE' (One Network for Everyone), the nation's high-capacity fast-speed broadband information network was built based on Asymmetric Digital Subscriber Line (ADSL) and hybrid fibre coaxial connections to cable modems to deliver interactive, multimedia applications and services. During this phase, it was necessary for the government to capitalize on deploying the broadband network to create its demand, and so the Inland Revenue Authority of Singapore (IRAS) introduced 'e-filing' of income tax returns. Having built the integrated networking systems to tie the backend of public and private systems, there was a conscious effort to ensure there was a demand-pull for the services. Today, many e-government services can only be accessed electronically, for example, registering a company, filing companies' annual return or even getting information. It would have been meaningless to promote eCommerce if Singapore was not linked or plugged into the world, so to further create the demand for online business transactions, a Policy Committee was set up to review the legal, regulatory and enforcement issues to facilitate e-Commerce Consequently, a policy framework for eCommerce, the Electronic Transaction Act was passed in 1998 (Tan, 1999).

Infocomm 21: 2000 - 2003

The fourth plan called the "Infocomm 21", took an approach to re-emphasize infocomm as a key sector of growth to boost the competitiveness of businesses in Singapore, and that the Intelligent Island needed a paradigm shift to go global especially with the Internet revolution. Its vision was to develop Singapore into a vibrant and dynamic global Infocomm capital with a thriving e-Economy and a pervasive and infocomm-savvy e-Society. Therefore to globalise, the Singapore government took the first step to liberalize the telecommunications markets so as to further develop the information infrastructure in collaborations with leading international telecoms players to increase domestic and international connectivity. The liberalization provided much keener competitions amongst the telecom players which in turn provided more affordable web connections to consumers. There were also various programmes to promote the development of web services and wireless access, for example, mobile payment, online purchasing of cinema tickets, making donation online using mobile payment, mobile ordering in restaurants etc.

This was also the time that the e-Government Action Plan (eGAP) programme was launched and the purpose was to deploy more efficient government processes and procedures to interact with

its citizens, businesses and employees. The e-Government Action Plan I was conceptualized to focus on the dynamics of the following relationships – government to employees (G2E), government to businesses (G2B) and government to citizens (G2C). Its objective was to integrate various government services on a portal so as to provide a one-stop interface with the public. With the e-Government portal, it hopes to empower active and collaborative learning and knowledge sharing with its citizens and businesses so as to further improve operational efficiencies and effectiveness.

Although most Singaporeans were able to access the Internet, nonetheless, there were still pockets of digital divide, and to bridge the gap, the 'e-inclusive society' programme was initiated where the government partnered with the private sectors to help those citizens (senior citizens, homemakers, disabled etc) who were on the disadvantaged side of the digital divide. For example, for the poor families who could not afford to buy computers, there was a PC reuse scheme to deploy old PCs for their use, or PCs were made available in community clubs and welfare homes. There was also a nation-wide infocomm literacy programmes aimed at teaching basic computer and Internet skills to those who are computer illiterate. For those who are computer savvy and to encourage them to embrace an 'e-lifestyle', there were campaigns aimed at bringing awareness of the possibilities of ICT in – 'e-Learning', 'e-Entertainment', 'e-Communication' and 'e-Transactions' etc. Thus, in a way with all the different campaigns, the public had no compelling reasons why they should not to be connected. To analyze the ICT adoption in this plan, it could be analyzed as a period where there was a stimulation of demand-pull sprinkled with the government's role in coaxing the citizens as well as the employees to adopt the many e-Government services. There was also support, financial as well as resources to encourage young adults and school kids to contribute to the building of the IT ecosystem.

Connected Singapore: 2003 – 2006

The fifth plan called "Connected Singapore", was perhaps a continuation of "Infocomm 21" and it aimed to further realize new possibilities through more pervasive connectivity of the power of computing, communications and content. Briefly, this plan facilitated the e-GAP II, identifying four strategies to enable individuals, organizations, and businesses to deploy ICT more pervasively. The first strategy was to develop a secure infocomm infrastructure for connectivity, creativity and collaboration. The second strategy was to develop Singapore's global hub for digital distribution and trading of digital assets. The third strategy was to grow new economic activities and create new jobs for the infocomm industry especially in value-added mobile services, multimedia processing and management, web services and portals. The fourth strategy was to align key business clusters and processes and government services by architecting and deploying common infrastructure and standards.

The 'Connected Singapore' concept also provided the connected digital lifestyle where the purpose was to tap on the advancing 'infotainment' technologies that brought together information, communications, and entertainment. Some cinemas in Singapore have gone digital, and in the pipeline, HDTV and IPTV are in the process of being developed. The 'Smart Homes' initiative was launched to enable smart technologies such as mobile devices operating over an integrated broadband and using Internet Protocol-based connections to access smart appliances around the homes. Further, with 3G networks in place, communications would evolve to rich

multi-party multimedia devices with mobile instant messaging and location-based services. Again, this is an interesting plan where there was more supply-push to create the demand when the environment gets digitized progressively. Indeed, most school kids are pretty IT-savvy in using broadband to collaborate with fellow students on school projects, playing computer games and communicate in chat rooms, forums, blogs etc.

The Intelligent Nation 2015 - iN2015

The 'Intelligent Nation 2015 – iN2015', Singapore's sixth IT Plan launched in June 2006, can be considered an enhancement of previous plans but targeting at more advance ICT technologies. The multi-billion dollar IT plan drafted with feedback from industry leaders and the public appears futuristic as it provides the ideal state which ICT can and will be deployed in all facets of living. The plan also aims to ensure that the city island remains an attractive place for businesses, investments, and research and development. In moving forward, it forecasts that the new waves of technologies like nano- and bio-technologies as well as sentient technologies enabled by smart sensors, sensor networks, and small computing devices will be widely used. It also forecast that advance ubiquitous broadband and short range wireless technologies will be the order of the day. In essence, to ensure that Singapore plays a key role in ICT advancements, the iN2015 vision focuses on three themes - 'Innovation, Integration and Internationalisation' – and if all goes well, the goals are as follows - to create 80,000 new jobs in the infocomm sector, to double the sector's contribution to GDP to the tune of S$26 billion, and to create the sector's export revenue to S$60 billion by selling its 'Made in/from Singapore" products and services (iDA, 2006a).

To drive Singapore's ability to innovate, integrate and internationalize its ICT plans, four strategic thrusts were emphasized. The first strategic thrust is to establish an ultra high speed, pervasive, intelligent and trusted infocomm infrastructure. The sophisticated ultra-high-speed wired and wireless networks will provide access at gigabits speed to anyone, anywhere, and anytime and it must be affordable – being "the cheapest in the world' (Straits Times, 2006a). The wired network will be IPv6-ready, a standard which is expected to be widely deployed whilst the wireless network will adopt 3G and high speeds packet data access (HSPDA) to provide more pervasive nation-wide coverage. With the high speed broadband network, Singaporeans can access, for example, to monitor one's health remotely or to visit a virtual classroom for online learning or instruct a digital concierge to book tickets in the ubiquitous digital environment. The second strategic thrust is to develop Singapore IT enterprises for global markets especially in niche areas like e-Government, Digital Media and Entertainment and Education and Learning. The third strategic thrust is to develop a globally competitive infocomm-savvy workforce focusing on higher value-added activities such as in intellectual property creation and exploitation. The fourth strategic thrust is to spearhead the transformation of key economic sectors, government and society through more sophisticated and innovative use of infocomm. The key economic sectors identified are digital media and entertainment, education and learning, financial services, healthcare and biomedical sciences, manufacturing and logistics, and tourism, and hospitality and retail. Of course, the government sector is also an important sector seeing that Singapore has already built its capability in e-Government solutions. The following sections

provide an overview of the initiatives to be taken to develop each of the key economic sectors identified in the iN2015 vision.

Digital Media and Entertainment

Singapore has long been an important exchange for physical goods and services. By 2015, it aims to be an important exchange for digital goods and services, a global 'Digital Exchange', for managing, processing, and distributing digital content like online games, digital cinema and video, music etc. It therefore will develop applications and solutions to create the digital vault for content owners to store, trade and account for their digital assets and resources. It will provide digital keys to secure and safeguard content, and to manage licensing and intellectual rights. It will also provide digital courier for end-to-end delivery, payment management and sales fulfillment of digital assets. The Digital Exchange platform will create a Digital Asset Marketplace where global media and entertainment businesses can congregate, create, and trade digital assets. How realistic will this vision be? According to the steering committee in the cluster, Singapore is well positioned to be such a marketplace as it already has the trust, strategic location, established financial trading status and a strong IP rights protection regime. Further, it also has access to more than 13 Gbps of extensive and direct Internet connectivity to over 20 countries, making the Singapore the most connected city in Asia (iDA 2006b).

Education and Learning

Learning in 2015 will be different from what we experience today. It will be a more personalized learner-centric environment that caters for the diverse types of learners. The learning environment and space will extend beyond the classrooms, and students will be able to access learning components anytime, anywhere. School compounds and campuses will be provided with wireless hotspots for learners to enjoy seamless Internet connectivity. Learning through collaboration using online and mobile interactive activities will be a key feature to engage students in active learning. It is envisaged that each student will be provided with a personalized infocomm device, to serve as a doorway to textbooks, lessons and projects. Content will be delivered via ultra-high speed broadband networks. Indeed, the initiative will catalyze the development of innovative learning applications and content which Singapore hopes to position itself as a centre for innovation in the use of infocomm technologies for education and learning.

Financial Services

With over 500 financial institutions in Singapore, and with the total funds managed out of Singapore in 2004 amounting to more than S$570 billion, and being recognized as the fourth most active foreign exchange trading centre in the world (http://www.bis.org), it is not surprising for Singapore to want to develop a trusted gateway and innovative hub for financial services. With this in mind, it hopes to develop the next-generation electronic payment solutions across different channels for businesses and consumers, that is, to provide a nationwide payments infrastructure to facilitate payment transactions of goods and services, through payment methods such as micro-payment and mobile payment systems. Although the financial payment value chain is a highly complex process that involves the alignment of procedures of different parties like the banks, regulators, third party providers, however, if Singapore can develop the payment value chain to align and be secured with international payment standards and procedures, it is poised to attain its status as the hub for financial services. The availability of new payment

solutions will catalyze transactions across all sectors of the economy and create new commercial activities. To be a global trusted hub, international accreditation standards will have to be adopted to develop a national trust framework to help secure, protect and manage users' financial assets, activities and identities online as well as supporting an e-payment infrastructure that harmonizes with international standards and procedures.

Healthcare and Biomedical Sciences

The objective is to provide "an infocomm-enabled personalized healthcare delivery system to achieve high quality clinical care with excellent services, cost-effectiveness and based on strong clinical research" (iDA, 2006e). It will develop a 'Health Information Exchange' system that will provide the integration and exchange of healthcare data across healthcare providers so that doctors will get a holistic view of patients' medical needs. Further, the 'Integrated Healthcare Continuum' will integrate the processes and procedures across the healthcare value chain so that patients with chronic diseases can manage their healthcare at home assisted by technology. It is also hoped that these programmes will facilitate the data flows between the healthcare sector and biomedical sciences research so as to improve clinical care which will be based on the applications of evidence-based medicine. Implementing the healthcare information management system appears sensible; however, there will be various clinical challenges which have to be addressed, for example, data protection and privacy of patients, the ethics of using patients' record for research, the access of the data, the storage of the data etc.

Manufacturing and Logistics

Manufacturing has long been one of the key engines of economic growth in Singapore. In 2005, it contributed to about 30 per cent of Singapore's GDP (Singapore Department of Statistics, 2006). Being well known for its efficient sea, air and land logistics capabilities, Singapore is positioning itself as a high-value manufacturing hub and a supply chain nerve centre powered by infocomm. As supply chain activities are becoming more globalize and strategic for manufacturers and logistics companies, Singapore hopes to be the supply chain nerve centre as it is already a global leaders in the sea container transshipment hub. It will set up a 'TradeXchange' that is designed to be an integrated trade documentation platform for the trading and logistics community to be linked to other trade facilitation systems such as TradeNet, Portnet and Cargo Community Network which are already in place. It will build adaptive supply chains and enable complex manufacturing capabilities (iDA 2006f). Singapore is also take a lead and developing RFID solutions at seaports and airports to improve business processes as well as addressing the global concern of terrorism.

Tourism, Hospitality and Retail

The main objective is to provide a pleasant experience for visitors to Singapore before, during and after their trip which, in turn, will enhance the growth of tourism. For instance, the 'Digital Concierge' Programme will allow visitors a one-stop access to tourism-related content and services through the mobile devices or channels such as the Internet, kiosk or interactive television. It will also facilitate online purchases of products and services such as booking concert tickets or registering for an event. It is believed that providing such conveniences to access personalized, location-based information and carry out transactions on-demand, anytime, and anywhere, Singapore will be a more competitive tourist destination. Also, to cater for

business travelers, the EASE (EnAbling Speedy rEgistration) programme will provide visitors all the necessary arrangements from transport, accommodation, registrations at conferences, meetings etc in a seamless processing mode identified by his biometric access (iDA 2006g). There is also the possibility of integrating such a system with immigration processes to expedite processing.

eGovernment – iGov2010

Although Singapore leads in e-Government solutions and systems globally, infocomm continues to bring changes or innovations to the way the government serves and interacts with its constituents. Today, about 1600 e-government services are available to the public on the e-Government online portal, and services ranged from filing income tax returns to registering a company, paying bills and fines to accessing public information and news. It has been noted that more Singaporeans are using online transactions to interact with government agencies. A survey conducted in 2005 found that there was a 15 per cent increase over 2003 in online transactions with the government in areas such as income tax filing, CPF (Central Provident Fund) online services and job matching services. The survey also noted that some 57 per cent of people in Singapore carried out some type of transactions with the government in 2004, compared to 49 per cent in 2003, and 43 per cent in 2002. (The Business Times, 2005b).

In moving forward, the 'iGov2010' was also recently launched with a vision 'to be an Integrated Government that delights customers and connects citizens through infocomm'. And to implement its vision, four strategic thrusts were identified to seek the next transformational breakthrough to integrate all public-sector and agencies systems and capabilities seamlessly. The four strategic thrusts are as follows: to increase the reach and richness of e-Services to its citizens and communities; to increase citizens' mindshare in e-Engagement; to enhance capacity and synergy in government; and to enhance national competitive advantage. Though the initiatives can be challenging, nevertheless, if successfully implemented, Singapore Government will be noted as having adopted a world-class user of information technology. Also, as its citizens and customers are more Internet savvy and are exposed to more sophisticated online services; the government will have to embrace newer technologies, for example, using mobile technology to deliver personalized e-services so that it can facilitate citizens' mindshare in nation building, such as gathering citizens' feedback, and supporting public consultations. Of course, issues such as security, privacy, and identity will be addressed in order to fully realize the potential of a ubiquitous networked environment. In order to collaborate with industry, it is also important that the government plays a key role in developing the "National Enabling Platforms, Policies and Standards (EPPS)" to provide a trusted, seamless environment and cost effective environment for the development of new services (iDA, 2006h). And in early 2006, iDA called for a S$1.5 billion tender for a Standard ICT Operating Environment for the government sector (The Business Times, 2006a).

Foundations to build the connected ubiquitous hub

Over the years, Singapore has consistently been laying important foundation stones to build its digital economy and global hub. It had put substantial investments in developing the conduits or pipelines for the wired and wireless nation; in nurturing the expertise, the skills and the

manpower to innovate and develop the systems, and in establishing collaborations with global IT leaders and players. Most IT infrastructure and expertise in Singapore were the results of solid and good partnerships between the public and private sectors. The sections below briefly highlight some aspects of the initiatives that are important to realizing iN2015 vision.

Investments in developing the conduit

Since 2000, Singapore ONE has provided a nation-wide broadband access over ADSL and cable to homes, offices and schools. It also has high speed connections such as SINGAREN (Singapore Internet Next Generation Advance Research and Education Network) and vBNS, the very high performance Backbone Network Service in the United States. Taking the cue that many Asian cities have already started making plans to deploy next-generation super high-speed networks, the government has decided to build, in collaboration with the private sector, an ultra high-speed nationwide broadband network complemented by a broadband wireless network called the 'Next Generation National Infocomm Infrastructure'. It is worth noting that in just six years, Singapore has built close to 28 Tbps of submarine cable capacity compared to 0.4 Tbps in 2000, and that there are currently 350 telecoms service operators and 37 facilities-based operators to provide for various telecom products and services (iDA, 2006j).

To realize the iN2015 vision, it is proposed that an IPv6-ready (to replace the IPv4 protocol in order to cater for increased IP addresses), a next-generation 'National Fibre Network' be deployed to provide access to every home, school and business and deliver real-time sensor-based information, integrated from multiple sources anytime, anywhere, any device at gigabits speeds in a trusted environment. The fixed wireline network will be complemented by a pervasive nation-wide wireless broadband network to meet the diverse access needs of individuals anywhere anytime. Nation-wide enabling platforms, policies and standards specifically in areas of security, privacy, identity, payments, location and inter-operability have also been identified to foster the development of new services. Infact, the 'National Trust Framework' will address the infocomm security and privacy challenges to enable more pervasive adoption of key online services such as banking, healthcare and education.

Complementing the wired broadband market is a fast growing wireless market with a mobile penetration of 101 per cent as at March 2006. Although 3G services were only launched in 2005, and there are currently about 317,600 3G subscribers representing about 7 per cent of the population (iDA 2006j). It is also believed that the growth of 3G applications is rising and to illustrate its adoption, there were some 866 million Short Message Service (SMS) messages or an average of seven messages per subscriber per day in March 2006. There are also some 830 public wireless local area networks (WLAN) or about 1 hotspot per square kilometer which makes Singapore having the highest concentration of public hotspots on a per square kilometer basis (iDA, 2006j). Indeed, Singapore's wireless broadband coverage has extended beyond the island. For example, Singapore Airlines offers high speed in-flight connectivity service to its passengers using wireless broadband.

Investments in developing the infocomm savvy expertise and manpower

Of course, iN2015 vision will be difficult to achieve without the skilled IT manpower. Against the global competitions for IT talents which are still in short supply, the Infocomm Competency

Council's vision is to have an "infocomm-savvy workforce and globally competitive infocomm manpower to drive nation economic competitiveness" (iDA, 2006i). Therefore, two strategic thrusts are identified to develop, attract, and retain infocomm talents in Singapore. The first thrust is to develop infocomm competencies in key economic sectors and the second thrust is to develop globally competitive inforcomm professionals. To remain competitive, Singapore-based infocomm enterprises will move towards higher value-added infocomm activities rather than to compete with China or India as they are more cost competitive. The focus then is to develop manpower on providing solutions, research and development as well as building up a pool of techno-strategists and technologists. Techno- strategies are infocomm professionals who possess both technical and business expertise and are able to integrate infocomm use within an organization. As Singapore is already strong in implementing domain areas in banking and finance, education, healthcare and public administration, the aim is to develop such talents in these areas. Technologists are those who are equipped with in-depth infocomm technical knowledge to engage in R&D. For this purpose, Singapore will focus its R&D in areas such as Interactive and Digital Media, Environmental and Water Technologies as well as Biomedical Sciences which all are heavily reliant on infocomm technology.

Therefore, in a bid to build a strong pool of IT manpower to support the infocomm developments, iDA unveiled a budget of S$120 million manpower development roadmap. The manpower roadmap is one of the foundational pillars of iN2015 masterplan and will drive Singapore's efforts to develop an innovative, entrepreneurial, globally-competitive and infocomm-savvy workforce. Various initiatives were planned such as the Student Infocomm Outreach programme which will pique interests in infocomm technologies amongst the young students in schools, National Infocomm scholarships for overseas attachments, Skills@Work, an initiative to improve the competencies amongst workers in key economic sectors so that they can better leverage ICT for business and productivity improvements (iDA 2006i).

Collaborations with industry IT leaders and player

Investments and research in ICT to realize the iN2015 dream would also not have been possible without the generous support and collaborations with industry leaders such as Intel, Microsoft, HP, Oracle, Sun Microsystems etc. Over the years, iDA had made strategic collaborations to ensure that Singapore contributes to innovations of new generations of IT, for example, research and development in grid computing. As computing grids and utility IT infrastructure are expected to become a reality in the future, iDA collaborated with HP on a S$22 million "National Grid Pilot Platform" project to develop capabilities in grid and utility computing so that IT costs can be reduced at the same time enabling IT infrastructure to be more responsive. Grid computing is a relatively new technology which aggregates resources over many separate computers connected by a network, and therefore makes it easier to solve large-scale computation problems. It is hoped that Singapore would then become the Asia Pacific node in the worldwide research and commercial grid – Global Operational Grid built by a world wide consortium of partners including e-Science in the UK, Tera-Grid in the US, CERN and HP. (CERN is best known for its researcher, Tim Berners-Lee who created the World Wide Web). Oracle too has also joined force with iDA to invest S$25 million to boost enterprise grid adoption in Singapore to develop 10 enterprise grid solutions and train some 300 infocomm professionals in grid computing (iDA, Aug 2004). Other collaborations include CISCO in a S$18

million project to develop the next-generation integrated voice, video and data network that will provide Singapore with seamless, ubiquitous wired and wireless connectivity and to advance Internet Protocol networking technologies to leapfrog current technologies as well as to upgrade the skills and competencies of IT professionals (iDA, Nov 2005). And collaborations with Sun Microsystems focused on developing Next Generation Internet Applications.

Besides collaborations with industry leaders, local enterprises are also encouraged to develop innovative applications and solutions. And indeed, examples of local enterprises which have gone global include Systems Access, National Computer Systems, Stratech Systems, Singapore Computer Systems, Crimson Logic, to name a few. To encourage innovative application, in March 2005, iDA awarded organizations that used infocomm technologies in novel ways to help Singaporeans live a digital lifestyle. For example, Fujitsu Asia developed a wireless solution called 'Food from the Heart', let volunteers from welfare organization collect unsold bread from bakeries and deliver them to welfare homes, and track deliveries in real time; the Singapore Prison Service developed its Internet Home Televisit progarmme that used web-based video conferencing to allow inmates virtual visits by family members from their homes. (The Business Times, 2005a).

Conclusion

The iN2015 vision goes beyond enhancing the economic competitiveness of the nation. It is also about enriching the lives of its citizens by delivering personalized services to make infocomm more relevant. And because it is important that everyone benefits form these new services, iN2015 strives to develop a digitally inclusive society – one which ensures infocomm access and competencies for all. In brief, iN2015 promises Singaporean a 'digital future' where infocomm technology will touch all aspects of our lives and truly affect how we live, learn, work and play. The Straits Times, the local newspaper illustrated the following scenarios (The Straits Times, 2006b) depicting how the digital future will affect us:

Scenario 1 - "Mother flashes her phone over a wireless terminal embedded on an advertising panel to buy and pay for movie tickets, after which an electronic ticket is sent to her mobile phone."

Scenario 2 - "Father views all his investments and bills by logging onto an online portal from his computer or mobile phone. With just a click, he checks on expenses and transfers payments."

Scenario 3 - "Brother clamours to do his holiday homework, which involves playing educational games online. He learns from game play and also interacts with other students."

Scenario 4 - "Using a tablet PC or a hand-held computer, Sister and her classmates access information from the Internet or from the libraries when they are out on field trips.

Scenario 5 - "Baby will no longer need to retake blood or urine tests whenever he visits a doctor. From the family doctor to the hospitals, all health institutions here can share medical records."

Scenario 6 - "Grandpa monitors his health at home with remote health-monitoring systems that are linked to test kits. He takes his own blood sugar measurements and has the information sent electronically to his doctor."

Scenario 7 - "A tourist books his tickets to various attractions as well as makes hotel and taxi reservations on a Digital Concierge website. Everywhere he goes, he is 'recognized' and his mobile device will automatically alert him to special bargains or attractions."

Will the above scenarios be just dreams? Time will tell. However, looking at previous records at how Singapore implements and build upon the many IT plans, it is possible that the vision to pursue iN2105 can be achieved. As in previous plans, the government tends to play an influencing role by cajoling or dangle incentives in the early stage of IT diffusion with perhaps playing a more regulatory role at a later stage, such as passing laws if necessary to ensure its adoption. For the innovations to be adopted – demand-pull – and consistent with what had been seen in the past, the government will influence or coax the diffusion providing incentives for early adopters. Infact to embrace iN2015 vision, there is already a pack of goodies that include "free island wide Wi-Fi for a year, subsidized or even free computers, with Internet access for needy students, thrilling video games as part of the school curriculum and robust security measures and laws to protect privacy" will be provided (The Straits Times, 2006c). However, if a critical mass of adopters is needed to ensure that the innovations are commercially viable, then either more incentives will be given or in some cases, the traditional services will be withdrawn, in which consumers will have little choice but to adopt the new services. There is of course, the interplay between supply-push and demand-pull in the adoption and diffusion of the various IT innovations. Even though market forces will eventual determine the successful adoption or diffusion, there will be times when it is necessary for the government to intervene with some guidelines, standards or requirements for adoption, in this context, the government plays a more 'regulatory' role. For example, policies and standards in the area of identify, security, privacy, payment and interoperability will have to be addressed and established. Indeed, the government has put together a committee to study for a 'National Authentication Framework' in August 2006. In essence, there will be a period of leadership where the government will provide various incentives for the private sectors to collaborate with the public sectors in developing the infrastructure, and the many exciting applications. There will also be a generous budget in the tune of multi-billion dollars for such investments, developments and deployment to push the innovations and supply of ICT.

Analyzing Singapore's IT plans in the last twenty five years, it is interesting to observe that in each phase of the nation's computerization programmes, there appeared to be a fundamental theme as discussed in Tan (1998). Extending the theme of – from compute, to conduit, to communicate, to content – the following observations still stand if we incorporate the last three IT strategic plans. Categorising the IT plans into four phases, it is noted that in Phase 1 during the public and private sector computerization programmes, 'The National Computerisation Plan' and 'The National IT Plan' respectively, the theme was based on 'computing', that is, to automate backend processes for efficiencies. In Phase II generally taking the IT plans on 'IT2000 - Intelligent Island' and 'Singapore One' initiatives, the theme was very much based on

'connecting', that is, in building the national information infrastructure for connectivity. In Phase III during the 'Infocomm 21' and 'Connected Singapore' Plans, the theme appeared to be much on 'communicating' that is, in networking, integrating and delivering the systems using Internet technologies. Perhaps in Phase IV which focuses on iN2015 vision, the current IT plan appears to emphasize on building 'content', interesting applications and solutions to provide services that impact on all aspects of one's life ranging from work, learn, and play. Put in another way, the totally connected island, wired and wireless, will take advantage of the array of services and products that one can access anytime, anywhere using any device and one would only need to pay for the services as per use based on a utility model.

With the launch of iN2015, it can be said that Singapore will no longer be restrained by its lack of natural resources to boost its economic growth. Indeed, it has developed a robust digital global economy based on its IT innovations and concerted efforts in re-defining its strategies to sustain its competitiveness in the global market place. Notably Singapore has put in considerable resources in developing and building its digital economy that it now aims to be a global player, seeking to be a leader in planning and executing IT strategies.

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Table 1: Dimensions of Institutional Intervention

Nature of Involvement			
Level of Involvement	Influence	Supply-push (production) *Knowledge building* *Knowledge development* *Innovation directive* I	Demand-pull (use) *Knowledge mobilisation* *Knowledge deployment* *Subsidy* II
	Regulation	III *Knowledge deployment* *Innovation directive* *Subsidy*	IV *Subsidy* *Standards* *Mandates*

Source: Adapted from Gurbaxani et al. 1990

Stimulating Information Technology Research in Latin America: The Case Example of a Journal Special Issue

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Abstract

Latin America is a rapidly developing part of the world that lags advanced nations in its research on information technology. Academic information technology IT education and research in Latin America can be enhanced through grant support, scholarships and fellowships, academic associations, research centers, accrediting bodies, conferences, and journals. This paper focuses on the challenges and opportunities for IT research in Latin America. It uses as a case example the forthcoming special issue on "IT Advances in Latin America" of the journal, *Information Technology for Development* (ITD), of which the presenter is co-editor. It explains how IT investigators in Latin America can be motivated and encouraged, reviewer networks developed, topics encouraged, and language differences overcome. It also discusses what the special issue has revealed about the special qualities and unique features of IT in Latin America. It recommends further steps for journals, conferences, and granting agencies to encourage the IT research productivity of this world region.

1. Introduction

This paper first considers the development of IT education in Latin America and then examines a special issue of the journal Information Technology for Development as an example of both the promise and challenges of furthering academic IT in this region. Since the special issue has not yet appeared, several papers published in the AMCIS 2006 Conference Proceedings are examined. Finally, this paper points to further steps to improve IT research in Latin America.

As part of the HICSS 2006 Symposium on Information Technology Application in Emerging Economies, this paper constitutes a academic status review on Latin American academic IT and associated policy suggestions. It is based on the author's experience, on information from international organizations such as the Association for Information Systems and the AACSB, on the Latin American tracks of AMCIS for the past six years, and on preliminary experience with the ITD special issue. It is not a research paper and does not utilize research methodology. However, it has the goal of helping to universities, academic units within them, funding organizations, accrediting bodies, and interested faculty in Latin America and other countries.

2. IS Research In Latin America and Its Connection to the Economic Development Stage of the Region

This section is intended to point to a lag or deficit in Latin American IS research and to indicate that some progress is being made to put in place a framework for research. Latin America as a world region presently has a population of 566 million persons (World Population Data Sheet, 2006). It is projected to have 700 million population by the year 2025. By comparison, this is about equal to the projected size of Europe in that year and about twice the projected size of the United States (World Population Data Sheet, 2006).

However, the region has trailed advanced regions in its IT academic research. An important indicator of academic research in a world region is the number and quality of relevant doctoral programs. There are few IT doctoral program documented within Latin America. In particular, in the ISWorldNet listing of IS doctoral programs, there are none listed in information systems for this world region (ISWorldNet, 2006). Another measure is to consider the AACSB-accredited business schools in Latin America, of which there were nine in late 2006 (three in Mexico, two in Childe and one each in Argentina, Brazil, Costa Rica, and Venezuela (AACSB, 2006). Of these only one, Instituto Tecnológico y de Estudios Superiores Superiores de Monterrey, in Monterrey, Mexico, has a Ph.D. in Information and Communications Technologies (ICT). It is indicative of the thrust of Mexican IT that this doctoral program emphasizes mostly intelligent systems, computer sciences, electronics, and telecommunications (ITESM, 2006). In Mexico, most IT undergraduate and master level programs are located in engineering schools, rather than business schools as is common in the U.S. and Europe. However, none of these programs offers a doctorate in IT or IS.

In sum, the situation presently is that this huge world region has one or at most only a handful of doctoral program in IS or IT. An implication is that the preponderance of Latin American scholars seeking doctoral training to obtain it in the U.S. or Europe, and certainly outside of Latin America. As in other scientific, engineering, and business fields, many of them settle outside their original region and some never return.

Hence, it is not surprising that high-quality IS research that originates within Latin American is limited. Further implications are that there is not presently an academic IS journal with editors and reviewers, and offices within Latin America. Likewise there are not significant, large academic associations of IS or IT researchers within Latin America. This is beginning to change, as a regional offshoot of AIS, the Latin American and Caribbean Association for Information Systems (LACAIS) has been formed (AIS, 2006). It is beginning to organize and provide needed leadership in fostering research and scholarship in the world region. Another sign of change is that LACAIS is considering forming a scholarly journal that concerns IS/IT research within and related to Latin America.

Another example of how research can be stimulated is through tracks of mainstream conferences in developed regions, as well as mainstream journal special issues that are intended to draw out, review, and present/publish research from the region. For the past six years, the AMCIS Conference has had a Latin American or Spanish track that each year has reviewed between ten and 50 papers, accepting about half of them for presentation and publication. Most of the papers

have been authored by researchers within Latin America, although some are from investigators based in developing countries. In 2005 and 2006, papers were accepted in Spanish or English, were presented in Spanish, and were published in Spanish, with English as an optional second version, published side-by-side with the first one.

3. Background: Development Stage of Latin America as a World Region

As background for the more detailed discussion of the journal special issue and recommended policy steps, it is important to give background on the economic and social development stage of Latin America and its nations. The region varies from middle level to lower level developing nations. Within its more prosperous nations, there are sectors and organizations that resemble those in advanced countries. For instance, Mexico's National Statistics Bureau (Instituto Nacional de Estadísticas, Geografía e Informática) is a world class national information organization. Another example is the Mexican firm Cemex, which is one of the world's leading ones and technologically advanced. Mexican media firms such as Televisa and TV Azteca are somewhat comparable to those in advanced nations. The Brazilian software industry is advanced. These and many other examples demonstrate parts of sectors and organizations in these countries that resemble advanced nations.

On the other hand, Latin America at the low end has impoverished and illiterate population, shantytowns, and a plethora of small informal businesses. There are large portions of the population in poverty, i.e. for the biggest nations, Brazil has 22 percent and Mexico has 40 percent (CIA, 2006). The informal economies in these countries account for a substantial part of employment, often over 50 percent. Their businesses employ mostly the poor and are unregulated.

A research implication of this situation is that IS theories that are mostly based on advanced nations, may not apply, or may need to be modified. Tables 1 and 2 give features of the economic and population structure for Mexico and Peru. These can be contrasted with Table 3 that shows the similar structure for the United States.

Table 1. Demographic and Economic Profile of Peru

Population 28 million (2006)	
Age structure.	
31 percent 0-14 yr	
64 percent 15-64	
5 percent 65+	
Literacy (15+) 88 percent	
Pop in poverty 54 percent	
Government. Constitutional republic.	
GDP (purchasing power parity)	$0.167 trillion (2005)
GDP/capita (PPP)	$6,000 (2005)
GDP composition	
Agriculture	8 percent
Industry	27 percent
Services	65 percent
Economy description. Minerals in mountains, fishing along coast. Lack of instructure	
Cellular phones 5.58 million (2005)	99 per thousand pop
Fixed phones 2.25 million (2005)	80 per thousand
Internet hosts 270,000 (2006)	9.6 per thousand
Internet users 4.6 million (2005)	164 per thousand

(Source: CIA, 2006)

Table 2. Demographic and Economic Profile of Mexico

Population 107 million (2006)	
Age structure.	
31 percent 0-14 yr	
63 percent 15-64	
6 percent 65+	
Literacy (15+) 92 percent	
Pop in poverty 40 percent	
Government. Federal republic.	
GDP (purchasing power parity)	$1.064 trillion (2005)
GDP/capita (PPP)	$10,000 (2005)
GDP composition	
Agriculture	4 percent
Industry	26 percent
Services	70 percent
Economy description. Free-market economy – mixed modern and outmoded. Expanded competitiveness.	
Cellular phones 47.5 million (2005)	444 per thousand pop
Fixed phones 19.5 million (2005)	182 per thousand
Internet hosts 3.4 million (2006)	31.8 per thousand
Internet users 18.6 million (2005)	174 per thousand

(Source: CIA, 2006)

The Latin American nations are somewhat younger, have lower literacy, and higher poverty levels than the U.S. Their average income levels, even with purchasing power parity applied, are one fourth to one seventh of the U.S. They have proportionately much more of GDP in agriculture and industry and less in services. In all technology measures they trail the U.S., although Peru is much behind Mexico. For instance Mexico's adoption rate of cellular phones is 4.5 times that of Peru.

The demographic and economic differences with the United States would be present for all Latin American nations, but as seen in Tables 1 and 2, there is variance within Latin America.The

reason to bring out these differences is that they influence the environment for IS in this world region. For instance, there is less buying power for the best technology options, so they may need to be foregone in lieu of public domain or homegrown solutions. Cell phone use is at a different stage in Peru versus the U.S. and Europe, since there is only one phone per ten persons. Computer game markets would be different in a Peru and Mexico, with about one third of the population under 14 years.

This brief discussion is not intended to solve the IS challenges brought about by economic and demographic differences, but to point them out as areas for research and to accentuate the need for fostering more IS research about IS in Latin America.

Table 3. Demographic and Economic Profile of U.S.

Population 298 million (2006)	
Age structure.	
20 percent 0-14 yr	
67 percent 15-64	
13 percent 65+	
Literacy (15+) 99 percent	
Pop in poverty 12 percent	
Gov. Constitution-based Federal republic.	
GDP (purchasing power parity)	$12.31 trillion (2005)
GDP/capita (PPP)	$41,600 (2005)
GDP composition	
Agriculture	1 percent
Industry	20 percent
Services	79 percent
Economy description. World's largest and most technologically advanced economy. Market-oriented. Private sector dominates.	
Cellular phones 219 million	701 per thousand pop
Fixed phones 268 million (2003)	899 per thousand
Internet hosts 195.1 million (2005)	654 per thousand
internet users 205 million	688 per thousand

(Source: CIA, 2006)

4. Special Issue of the Journal, Information Technology for Development as an Example of Prospects and Challenges of Academic IT in Latin America

This section focuses on a special issue of the Journal of *Information Technology for Development* as an example of the challenges and potential of IS research in Latin America. Its goal is to give an example of how Latin American research can be stimulated, discussed, improved, and disseminated both to the mainstream IS community and to researchers in Latin America.

Its important to set a background for the special issue The pioneering BitWorld 2000 conference held in Mexico City in June of 2000 brought together over 125 IT scholars from the United States, Europe, and Mexico. 90 papers were presented on a variety of topics involving IS and IT and some papers concerned specifically Mexico and Latin America. Partly as an outcome of that conference, the Latin American track was started at the AMCIS Conference in 2001, and has been offered either as the Latin American or Spanish Track every year since at AMCIS including the upcoming 2007 conference. For the 2005 AMCIS Conference, submissions were allowed in either English or Spanish, and all the sessions were presented in Spanish. The 2006 AMCIS Spanish Program attracted 50 submissions all in Spanish, of which 24 were presented and

published, was one of the centerpieces of the first AMCIS meeting held outside of the U.S. The 2007 AMCIS Spanish Program receives papers in either Spanish or English.

Coming out of the series of AMCIS tracks that culminated with the AMCIS 2006 conference in Acapulco, the three co-editors of the special issue, Martha Garcia-Murillo of Syracuse University, Carlos Navarrete of Cal Poly Pomona, and James Pick of University of Redlands received approval in February of 2006 for the special issue from ITD's editor-in-chief Sajda Qureshi. The special issue particularly built on the stream authors and papers from the AMCIS Latin American and Spanish tracks, but was open to any submission. Authors of the best papers from the Spanish Program of AMCIS 2006 were encouraged to develop them into full-length journal articles and submit them. It turned out that seven of the eight submitted full journal articles, while one Chilean author preferred to submit to another journal.

The language procedures encourage Spanish authors. The papers could be submitted in Spanish or English and were sent to three new reviewers, who reviewed in the language submitted. All finally-accepted ITD manuscripts will be published in English. The reason the journal preferred English for final publication is to allow broad readership and exposure of findings and ideas to a worldwide audience. This had the advantage to develop more collaboration and cooperation between the normal journal audience and Latin American authors. A weakness is that it limits circulation of the articles to scholars in Latin America who either do not received the journal or have limited English capability.

All the papers submitted were published in earlier version on the AMCIS 2006 website. The papers submitted are shown in Table 4.

Table 4. Papers Submitted to Special Issue of ITD

Ania, Ignacio, and Marcelo Mejia	Respecto al Desarrollo de la Industria de Servicios de Software en Mexico (English translation: With Respect to Growth of the Software Services Industry in Mexico)
Ferran, Carlos	From ERP to ERM: Adapting ERP to Short Term Management in Unpredictable Environments
Garcia-Sanchez, Noe, and Luis E. Perez-Barnal	Determinación de Factores Criíicos de Exito en El Proceso de Implementación de un Sistema ERP. Un Estudio de Campo en Empresas Mexicanas (Determination of Critical Success Factors in the Process of Implementing an ERP System. A Field Study of Mexican Companies)
Gomez de Silva Garza, Andres, Ana Lidia Franzoni Velazquez, and Victor Cruz Morales	Un Sistema de Información para la Administración y Consulta de Bases de Conocimiento en la Industria Automotora en Mexico (An Information System for Administration and Consulting from Knowledge Bases in the Automotive Industry in Mexico)
Huerta, Esperanza, and Rodrigo Sandoval-Almazan	Exploring the Digital Divide in Mexico
Joia, Luiz Antonio	Sources of Resistance to G2G Endeavors
Sandy, Jean Carlo, and Harry Bouwman	Designing Mobile Services: Conditions for the Future Development of Mobile Services in Latin America

The papers cover a variety of topics and use approaches ranging from theoretical to empirical. The Ania/Mejia paper gives a framework for and analyzes the little-known software services industry in Mexico. The Ferran theoretical paper seeks to expand the ERP model to ERM (Enterprise Resource Management), which adds a radically new data structure. By contrast, the Garcia-Sanchez/Perez-Barnal paper is a field study of 48 Mexican enterprises which considers the successful implementation of an ERP system in an important enterprise, with the goals of minimizing costs, time, and personnel. It applies Critical Success Factor theory to study ERPs in firms in the Guadalajara, Mexico, metropolitan region.

The Gomez de Silva/Franzoni/Cruz manuscript analyzes the case study of implementing the prototype for a complex, case-based knowledge management system in a large firm of the Mexican automotive industry. Here, an industry-university collaboration led to a success that can contribute to national development. Finally the Sandy/Bouwman manuscript considers the appropriate policies, standards, and types of markets to stimulate the development of innovative mobile data services in eleven Latin American countries.

With the exception of the Ferran paper, they pertain in some respects to uniquely Latin American IT issues. There is not time in this short paper to analyze the particular Latin American aspects for all of them, so instead the special Latin-American aspects for two papers will be discussed.

In "Exploring the Social Digital Divide in Mexico," Esperanza Huerta and Rodrigo Sandoval-Almazan (2006) seek to determine what are the behavioral, infrastructure, and language problems that Mexican internet users, mostly from marginalized societal strata, face at governmental telecenters. The special Latin American context relates to the concept of telecenter. A telecenter (i.e. internet kiosk) was part of the e-Mexico program of the Fox Administration. The program sought to have a public telecenter (i.e. internet kiosk) in each of Mexico's 3,000+ municipios ("counties"). This was to try to reduce the country's digital divide.

Recall that Mexican internet use in 2005 was 1/6, but this was much less in 2001 and even in 2005, a much lower proportion of the marginalized population (perhaps 3-5 percent). The e-Mexico Program had mixed success, so Mexico remains a mid-level nation, with huge differentials in ICT access. The research framework was "digital literacy" (DL) drawn from psychology literature (Eshet-Alkai, 2004).

The paper's findings show that telecenter users lack three behavioral skills from DL framework: (1) *branching* (i.e. ability to navigate in a nonlinear information-seeking environment), (2) *reproduction* (i.e. ability to analyze and synthesize retrieved information, and (3) *information ability* (i.e. to assess information quality). A technical barrier noted is slow Internet speed. The language barrier is lack of English knowledge.

There are a number of new questions that arise from this AMCIS paper that relate to the present paper. Do theoretical models from advanced nations, such as the ones those authors adopted, apply in Latin America? Are new models for Latin America, or developing countries, needed? How strong is global culture, versus regional/national culture? This paper does not seek to answer those questions, but to emphasize that they need to be addressed, not necessarily entirely by these authors but by new sets of studies, conferences, and dissertations.

In "Considering the Growth of the Software Services Industry in Mexico," Ignacio Ania and Marcel Mejía (2006) conducted a survey study of business leaders in the Mexican software services industry ("software services" refers to both producing software and providing support and consulting services). The goal was to conduct the first academic investigation of the Mexican software services industry, which is less developed than such middle-developed nations as Ireland, Brazil, and India.

The Fox Administration policies sought to develop the nascent software industry. It put in its 6-year National Plan to develop ICT industry to a world competitive level. Starting in 2002, the Secretariat of Economy sought through its Prosoft Program to specifically develop Mexico's software industry. It cited the proximity advances of being near the world's largest software industry (U.S.) and the lack of tariffs and duties from the NAFTA free trade agreement. The 6-year goal of Prosoft was to convert the Mexican software industry into the clear leader in Latin America.

The paper doesn't follow a conceptual framework, but mentions several papers about the software industry in Mexico. The research questions are to (1) describe the configuration of the Mexican software industry and (2) make recommendations so the Mexican government can develop it more in the future. The paper also develops three scenarios for the future trajectory of the Mexican software industry
Among the major findings are:
(1) The Mexican software industry is quite small relative to the U.S.,
(2) By far the largest area for the Mexican software services industry is Programming,
(3) A major problem in developing the industry has been human resources errors. Companies have been understaffed leading to poor quality results or delays in projects, or overstaffed leading to cost over-runs and financial losses.

In summary, the special issue has revealed the following about the special qualities and unique features of IT in Latin America: (1) The nations have very large informal economies, dominated by small businesses that often are not licensed. IT exists partly for these enterprises and here it needs to be much better understood. (2) Users are different in Latin America, and need to be studied intensively with no cultural ascriptions or biases. (3) IT training and education are critical deficits in many Latin American nations, and need to be studied with the goal of intervening to improve them. (4) The digital divide appears more acute in many Latin American nations that have wide polarization of the rich and poor.

5. Recommended Further Steps to Advance Academic IT in Latin America

It is recommended that IT investigators in Latin America can be motivated and encouraged, reviewer networks developed, topics encouraged, conference tracks developed, and language differences overcome by the following means:

- Grant support. International and national agencies can develop programs to stimulate IT research within, and about Latin America.
- Doctoral programs in IT need to be developed and supported in Latin America.

- Scholarships and fellowships. These need not only to be focused on bringing Latin American scholars to advanced nations for graduate study, but to retain them in regional, newly developed doctoral and graduate programs, as well as joint programs with advanced nations.
- Academic associations. IT academic associations need to be developed and expanded within Latin America.
    - LACAIS is a very young regional unit within AIS that can be developed further into a leadership position in stimulating Latin American IT.
- Research centers. A few centers already exist such as the one at Instituto Tecnológico y de Estudios Superiores Superiores de Monterrey. Following that example, leading IT programs in Latin America need to start or expand their research centers. To do this, consultants from leading U.S. and European IT research centers could give helpful advice.
- Accrediting bodies. The Latin American accrediting bodies in business, IT, and IS need to set standards and policies that encourage many of the recommendations in this paper.

The journal *ITD* has played a role by recognizing that there are unique features for Latin America that need attention and dissemination for the mainstream academic audiences. There is a role for associations to further IT in Latin America. The only association in Latin American fully focused on the IS field is LACAIS (Latin American and Caribbean Association for Information Systems), the regional group within AIS. Suggestions to AIS regarding LACAIS are as follows:

(1) AIS needs to develop LACAIS much more, so it can take the lead role as an IS academic association in Latin America.

(2) AIS and LACAIS need to support regional conferences as frequently as bi-annually. The conferences should be based on both Spanish and English.

(3) A journal needs to be started that focuses on IT in Latin America and ideally is based in, and published in Latin America.

At ICIS 2005, the new AACSB President reported that although IT enrollments were stable in the advanced nations (U.S., Europe), they were growing rapidly in developing nations including Latin America.

This corresponds to the economic-social-technological maturity stages presented at the beginning of the talk. The continuing growth of academic IT in Latin America can be one source to re-invigorate US academic IT. For instance, U.S. researchers could visit Latin America. Joint research meetings and conferences could be give. Joint undergraduate programs could be established to match the expertise of U.S. scholars with their counterparts in Latin America to together teach the larger cohorts of students. Joint doctoral programs could be established that encourage Latin American doctoral students to study the region's problems and for more to have the interest and motivation as faculty to remain in the region.

Language issues need to be thought through. English mastery is not highly prevalent in Latin America, especially in South America. Spanish is not widely understood by "mainstream" IT

researchers in the advanced nations. There is intermediate ground, involving mixed programs, with the possibility of publication in both languages.

5. Conclusion

In conclusion, this academic review paper on IT research in Latin America points to challenges and issues that have constrained the development of a strong IT research community within the region. At the same time, the paper points to the potential to expand this research. The examples of the AMCIS Latin American and Spanish tracks and the ITD journal special issue show that scholars in the region can be encouraged to participate in mainstream research. More steps need to be taken through organizations such as LACAIS within AIS, accrediting organizations, and national IT leaders within the region, to further encourage development of a vigorous and productive IT research community in Latin America.

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Information Technology Investment Evaluation for Emerging Economies: Tools and a General Framework

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Abstract

We discuss various methodologies that can serve as tools in the evaluation of information technology investments and then combine these tools into a general framework. The methodologies considered include value chain analysis, activity based costing, economic value added, fuzzy logic, and multi-criteria decision analysis. The proposed framework is expected to be particularly useful for organizations that operate in an uncertain business environment prevalent in many emerging economies. In this kind of business environment the historical accounting data has only limited validity for strategic and operational changes. Frequently, when conducting investments decisions, the decision-makers need to balance the tangible, operational benefits with less tangible, strategic opportunities.

1. Introduction

Emerging economies are typified by their rapid growths, vibrant business environments, and promising investment opportunities. There is no universal and widely accepted definition of emerging economies or markets, but there seems to be agreement on three characteristics that differentiate these regions from so-called developed countries: Modest absolute level of economic development, relatively high speed of economic development, and the existence of a regulatory environment dedicated to economic liberalization [1].

The absolute level of economic development is commonly estimated by gross domestic product (GDP) per capita. The speed of economic development is often estimated by the growth rate in GDP [1]. Simplified, emerging economies have lower economic standards, but grow faster than developed countries.

The three distinguishing factors of emerging economies imply that by their very definition, emerging economies present a vibrant and hard-to-predict business environment. Furthermore, emerging economies are much more prone to various kinds of economic and political shocks than developed countries [2].

Irrespective of the various differences and similarities, it is operational efficiency and strategy that determine business success in emerging economies just as in developed countries [3]. In this

context, operational efficiency is defined as the quest for conducting organizational activities resourcefully, while strategy is understood as the search for conducting activities in new and innovative ways.

However, in order to survive and flourish in emerging economies, companies must be able to adapt quickly to changes in the business environment. Such adaptations can be divided into two major categories: strategic shifts and operational adjustments.

Table 1: Responses to changes in business environment

Shifts in Strategy
Changes in product mix Modifications in customer focus Reorganization of organizational structures
Adjustments in Operations
Cost reduction efforts Quality improvements efforts Implementation of new technology

Many of the responses to changes in the business environment can be assisted by information technology (IT). For example, IT can support changes in strategy if a company decides to discontinue some existing product line or introduce a new one. IT can also facilitate operational improvements, such as cost reduction efforts.

Since IT is fundamental to the business, shifts in strategy and adjustments in operations often require new investments in hardware, software, and networks. In such situations, managers need to balance the short-term tangible operational benefits and costs with long-term, less tangible, strategic opportunities.

The objective of this paper is to propose an integrative framework for evaluating IT investments in emerging economies.

The paper is organized as follows. First, we discuss the motivation and theoretical foundation. Then we describe several methodologies that can be applied at various stages of the evaluation process. Next, we present the proposed, integrative framework. We close by summarizing the main results and by discussing some limitations of our approach.

2. Motivation and Theoretical Foundation

Investments in IT consume a substantial portion of corporate budgets [4], and many of these investments are conducted with the focus on cost reduction by automating business processes. However, many of these automate IT investments, with the sole goal of replacing human labor by technology, generally have only a limited impact on firm performance.

One possible explanation for this modest effect on firm performance is that any advantage derived from these types of investments can easily be copied by the competition [5]. A further reason could be that many automate IT investments result in less impressive cost savings than might be expected. Although the direct costs decrease as a result of reducing human labor content, other additional costs may emerge which cancel out the potential gains. In contrast to operational or automate IT investments, strategic or innovative IT investments are generally expected to have a significant positive impact on business performance, since potential problems in the cost structure can often be offset through higher premiums.

For companies in emerging economies however, demanding higher premiums for products to be sold in the global market is not always a realistic option. In general, higher premiums can only be achieved if the products are perceived to be of exceptional quality and possess distinct features. Less favorable customer perception and lack of strong brand names force many firms in emerging economies to market their products at lower prices [6]. Thus, for many businesses in emerging economies, cost advantage is the most important factor for competitiveness.

In general, for an IT investment to have a positive impact on business performance, additional value needs to be created, or overall cost needs to be reduced. Therefore, when evaluating IT investments, to ensure their potential contribution to the improvement in business performance, the interaction of costs among different business processes and activities needs to be considered. The value chain model, which describes an organization as a group of activities [7], appears to be well suited for this kind of analysis.

In order to effectively use value chain analysis for evaluating IT investments, reliable cost estimates for the different organizational activities are essential. The value chain analysis needs to be supported by a highly accurate cost management system which simultaneously focuses on all three categories of costs: direct costs, operating costs (in the following called also overhead), and capital costs. The traditional, volume-based, cost accounting systems are ineffective for value chain analysis because they are designed for accountants to keep accounting ledgers and not for managers to handle operating and capital costs [8, 9].

To reliably estimate the operating costs and the capital costs, some authors have proposed to combine activity-based costing (ABC) with the economic value added (EVA) financial performance measure [10-13]. In this cost management system, also called the integrated ABC-and-EVA system [13, 14], the ABC component is used to trace operating costs and the EVA component handles the capital costs. This integrated ABC-and-EVA system, which is highly effective in tracing full costs to cost objects such as products and services, also seems to be able to handle all aspects of activity costs for the value chain analysis.

Unfortunately, companies that operate in emerging economies, business environments characterized by uncertainty, often do not have dependable accounting data crucial for the standard ABC-and-EVA system. However, fuzzy logic may help when precise and reliable data are absent. Thus, fuzzy ABC has been suggested as an extension of standard ABC, designed specifically for companies operating in an uncertain business environment [15, 16], such as may be encountered in emerging economies. We propose that fuzzy logic may similarly be applied to the integrated ABC-and-EVA system.

In addition to the operational improvements in cost structure, many companies need to consider additional, less tangible, but strategic factors in making IT investment decisions. For example,

telecommunications systems may have rather marginal impact on costs but add substantially to flexibility, and improve coordination in world trade. An investment in IT which allows for better integration and coordination with business partners may not lead to short term, tangible cost savings, but nevertheless may result in an increased customer base. Thus, in evaluating multiple, alternative IT investment options, leading perhaps to different expected levels of cost savings and other less tangible benefits (or costs), multiple criteria decision analysis (MCDA) methods (see for example [17]) can help in deciding among these options.

In the following section we expound on the concepts put forward above.

3. Tools

3.1 Value Chain Analysis

The value chain model describes an organization as a set of related activities [7] needed for transforming the organization's inputs into outputs. Activities that are directly involved in the processing of inputs (e.g. raw materials or components) into outputs (e.g. products or services) are called primary activities, whereas activities not directly involved in the transformation of inputs into outputs, but crucial to effectively carry out the primary activities, are called support activities.

The successful creation of business value is determined by three key factors: the total revenues a company is able to achieve for its outputs; the total cost of its inputs; and the total cost for performing the activities in its value chain. Accordingly, a company is able to create business value if its revenues exceed the combined cost of all inputs and all activities in the value chain. Theoretically, the value chain model should provide clear guidance to managers in their efforts of increasing business value. Thus, for example, using value chain analysis, managers may focus on expensive and under-performing activities, and by making these activities more efficient, reduce cost. In reality though, in many companies, traditional accounting is not supportive to fully assess the cost of their activities [9].

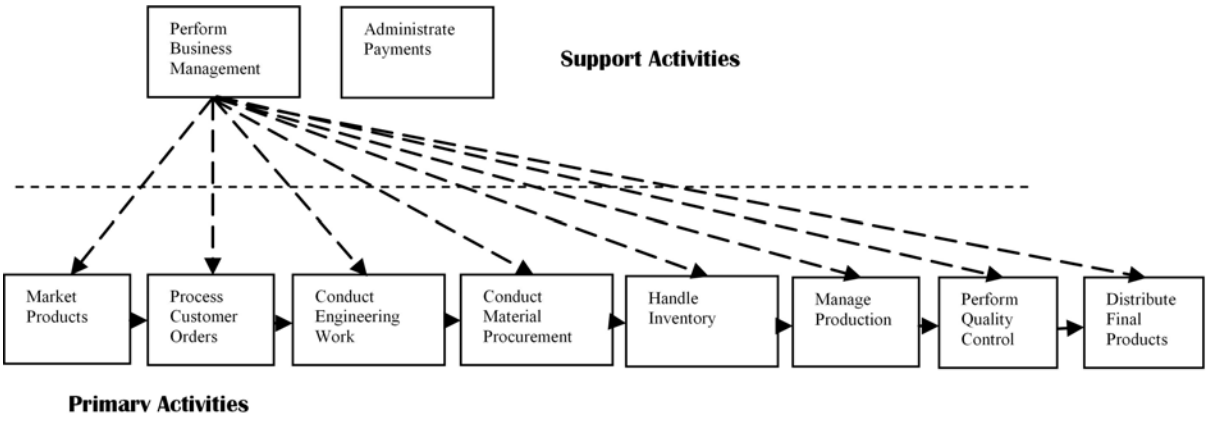

Figure 1. Value chain example

A possible value chain for a hypothetical manufacturing company is depicted in Figure 1. The sequence of its primary activities suggests that the company embrace a pull strategy where customized products are manufactured to customers' orders. The value chain begins with a

marketing activity to stimulate the demand for its product. Then, the incoming orders for customized products trigger a number of steps necessary for generating the final products. Finally, the distribution of the products is the last primary activity in the value chain. The two support activities, *perform business management*, and *administrate payments*, are not directly involved in creating products, but are necessary for carrying out the eight primary activities.

In the real world, the value chain of most companies is far more complicated than in our illustration and may include a greater number of activities. For example, the value chain does not necessarily end with the shipment of the final product, but often includes additional activities such as managing returns, warranty related services, or other after-sale customer support.

3.2 Activity-Based Costing

ABC aims to overcome deficiencies of traditional, volume-based, cost accounting systems, which simply allocate overhead based on direct labor hours [18-20]. This simple overhead allocation often generates incorrect cost estimates for products and services, as the overhead consumption is not necessarily in direct relation to the production volume and labor hour content. It is therefore not surprising that companies using traditional cost allocation methods tend to overprice some of the products while under-pricing other products. In addition, the traditional costing systems, for reasons of simplicity, are not designed for identifying opportunities for improvement and dealing with growing overhead.

ABC is a more advanced costing system based on the recognition that in order to generate products or provide services, an organization needs to carry out a number of activities. Various products or services require diverse sets of activities. Furthermore, the intensity of these activities may vary substantially. For example, more complex, low volume products may require a higher level of managerial attention, than more established, high volume, simple products. In order to carry out these activities, a company must make available the necessary resources. Thus, in essence, it is these activities that are responsible for the consumption of the overhead.

Therefore, in ABC analysis, expenses committed to overhead resources, such as managerial and administrative salaries, are first traced to specific activities. Then, looking at multiple cost drivers, such as product complexity or level of supervision, overhead costs are traced from activities to products or services. Thus, ABC follows a two stage cost assignment procedure, where the first stage fits in very well with value chain analysis.

3.3 Economic Value Added and the Integrated ABC-EVA System

EVA is a financial performance measure focusing on capital cost [21-24]. Simplified, EVA is calculated by subtracting the total costs (direct, operating, and capital costs) from the total revenues. If EVA is positive, all costs are recovered and the company is generating economic profit. In contrast, negative EVA points to a company's inability in recovering its total costs and, therefore, indicates weak performance.

A system that focuses on total costs, using ABC and EVA methods in combination, is the integrated ABC-and-EVA system [13, 14]. In this integrated system, the ABC component is used to trace operating costs, and the EVA component is responsible for the capital costs. Subsequently, since the aim of many IT investments is to substitute direct and operating costs with capital costs [25], using the intergraded ABC-and-EVA system appears to be very

promising and constitutes a sound enhancement of conventional value chain analysis. In the business environment of many emerging economies, characterized by high capital costs, this extension appears to be particularly appropriate.

Table 2: Examples for Cost Categories

Direct Costs	Operating Costs (Overhead)	Capital Costs
Direct Labor Material	Administrative Salaries Managerial Compensation Office Expenses Rent Hardware and Software Maintenance	Interest Payments Dividends

Thus, after establishing the value chain as described in section 3.1 above, cost estimates for performing all activities can be obtained by using an integrated ABC-and-EVA system. As shown in Table 2, the total cost of each activity in the value chain consists of three separate cost categories. Direct cost may include labor cost for necessary personnel and is clearly associated with a specific activity. Operating expenses are all expenses that provide settings and other support for a particular activity. Capital cost may include capital expenses for equipment used by a particular activity.

3.4 Fuzzy Logic

The main motivation for fuzzy logic is to represent vagueness and uncertainty prevalent in human reasoning [26]. Fuzzy logic is less dependent on precise data than traditional logic. Since one of the biggest challenges in ABC implementation is the availability of precise and reliable accounting data, making use of fuzzy logic concepts with ABC in companies operating in the uncertain business environment of an emerging economy, appears to be a natural fit [15]. Fuzzy logic may also assist EVA implementation, as lack of precise and reliable accounting data provide a challenge in estimating the total capital invested.

The application of fuzzy logic reduces dependency on exact numbers by allowing the use of expressions such as “the IT investment has greater impact” or “lesser impact” [26]. This kind of rather vague statements can be captured by a fuzzy set membership function [27], which uses numbers between 0 and 1 to denote the degree of membership. Defuzzification [28] subsequently allows arriving at a “crisp” cost structure.

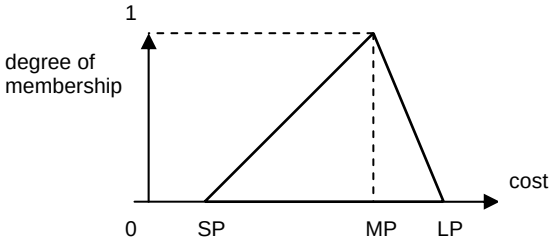

Figure 2. Triangular membership function

For illustration, we use a triangular fuzzy numbers (TFN) membership function [29]. This particular membership function has the advantage of simplicity and is easier to handle than more

complex, trapezoidal or bell-shaped membership functions [16]. The TFN membership function is represented by three values: SP (smallest possible), MP (most promising), and LP (largest possible) [15], as depicted in Figure 2. TFN are commonly used for business related applications, such as capital budgeting [30], since they are intuitive and relatively easy to handle. In essence, the parameter MP represents the most likely activity costs after the IT investment, while the parameters SP and LP represent the optimistic and pessimistic view respectively. The TFN function may be skewed toward SP or LP (as shown in Figure 2).

In the proposed framework, fuzzy logic is used to project changes to the cost of each activity after the planned IT investment is completed. For each activity in the company's value chain, three values (the smallest possible (SP), the most promising (MP), and the largest possible (LP)) costs are estimated as depicted in the example of Table 3, below. Interviews with key personnel and outside consultants are used to derive these three estimation values for each activity [15]. In general, the estimation of the projected activity costs is complex and often very subjective. Fuzzy logic may facilitate merging the different opinions of various experts.

Figure 3, below, depicts the application of fuzzy logic for assessing the potential effect of an IT investment on activities and their costs. SP, MP, and LP activity costs are estimated for the post IT investment time period. In order to better decide if the proposed IT investment will be cost effective, these three projected activity costs can be recombined into a single value by using defuzzification. In the triangular membership function, a center of gravity defuzzification can be achieved by simply averaging SP, MP, and LP [28].

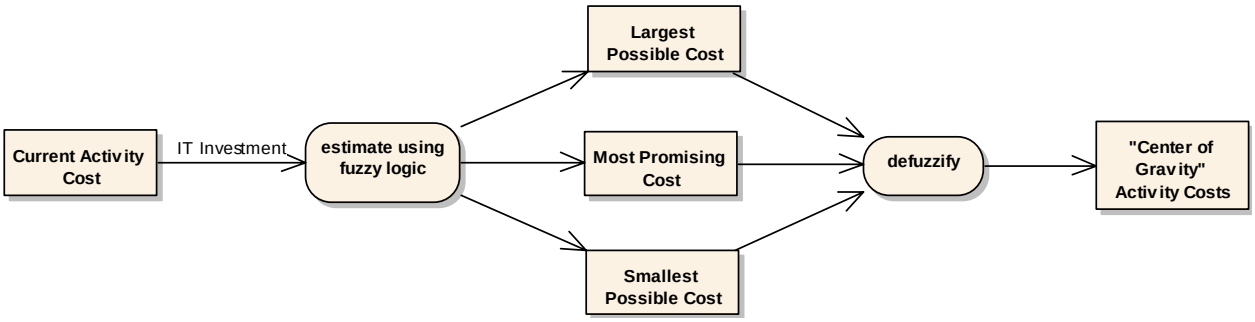

Figure 3. Fuzzy logic estimation

Table 3. Current and projected costs

Activity Costs	Current Activity Cost	Projected SP Activity Cost	Projected MP Activity Cost	Projected LP Activity Cost
Direct	$55,000	$30,000	$35,000	$40,000
Operating	$55,000	$30,000	$35,000	$40,000
Capital	$10,000	$20,000	$30,000	$40,000
Total	$120,000	$80,000	$100,000	$120,000

Table 4. Current and projected activity costs one year after IT investment

Activity	Current Activity Cost	Projected SP Activity Cost	Projected MP Activity Cost	Projected LP Activity Cost
Market Products	$120,000	$80,000	$100,000	$120,000
Process Customer Orders	$60,000	$40,000	$60,000	$80,000
Conduct Engineering Work	$150,000	$130,000	$150,000	$170,000
Conduct Material Procurement	$50,000	$40,000	$50,000	$60,000
Handle Inventory	$80,000	$60,000	$80,000	$100,000
Manage Production	$250,000	$200,000	$230,000	$260,000
Perform Quality Control	$40,000	$20,000	$40,000	$60,000
Distribute Final Products	$80,000	$70,000	$80,000	$90,000
Perform Business Management	$100,000	$100,000	$100,000	$130,000
Administrate Payments	$70,000	$60,000	$70,000	$80,000
Total	$1,000,000	$800,000	$960,000	$1,150,000

Table 5. Current and projected defuzzified operating costs one year after IT investment

Activity	Current Activity Cost	Projected Activity Cost
Market Products	$120,000	$100,000
Process Customer Orders	$60,000	$60,000
Conduct Engineering Work	$150,000	$150,000
Conduct Material Procurement	$50,000	$50,000
Handle Inventory	$80,000	$80,000
Manage Production	$250,000	$230,000
Perform Quality Control	$40,000	$40,000
Distribute Final Products	$80,000	$80,000
Perform Business Management	$100,000	$110,000
Administrate Payments	$70,000	$70,000
Total	$1,000,000	$970,000

The IT investment in our illustration is expected to particularly affect the activities related to marketing the company's products and managing the production. It is expected that the new system will allow for better collection of all kinds of data, permit data mining, and thus allow more focused marketing, which in turn will result in cost savings. In contrast, the IT investment will require capital expenses, which thus will increase the capital costs.

Table 3 shows the current costs and the projected costs one year after the proposed IT investment for the activity market products, for each of the three cost categories. The tangible benefits for the other activities are expected to be rather modest, as reflected in Table 4.

Subsequently, the three projected activity costs can be defuzzified into a single value, to more easily assess the worth of the IT investment. As mentioned previously, in the triangular membership function, a "center of gravity" defuzzification can be accomplished by simply averaging the three numbers SP, MP, and LP [28]. Table 5 compares the current activity costs and projected activity costs after defuzzification.

3.5 Multicriteria Decision Analysis

Most real-life decisions, including most decisions in the typically vibrant business environment of many emerging economies, involve various considerations and multiple factors, which are often conflicting. Thus decision makers are often required to balance short term operational marginal advantages with long-term strategic substantial benefits and look for satisfactory compromise solutions. The decision-making process becomes even more complicated when decision criteria are subjective, vaguely defined, and difficult to measure, such as intangible costs and benefits.

MCDA techniques specifically address these difficult decision situations [17]. In addition, many MCDA approaches accommodate the involvement of multiple decision makers, representing different views and opinions. Therefore, multi-criteria approaches appear to be practicable for assessing the strategic and less tangible value of IT investments, where subjective experiences and opinions of multiple experts are present and welcomed during the decision-making process.

In order to reach a final decision on the desirability of various IT investment options, the more tangible changes in cost structure need to be balanced against the less tangible, costs and benefits. For purpose of inclusion of different perspectives and opinions, such evaluations may, for example, include different management levels: the operational level, the tactical level and the strategic level (see [26]), looking at short term, medium term and long term expectations. Thus, for this decision process, a MCDA method such as the analytic hierarchy process (AHP) [31], may be used for incorporating multiple, possibly conflicting criteria, and multiple decision makers, with perhaps varying experience and status in an organization. Figure 4 shows a possible decision hierarchy.

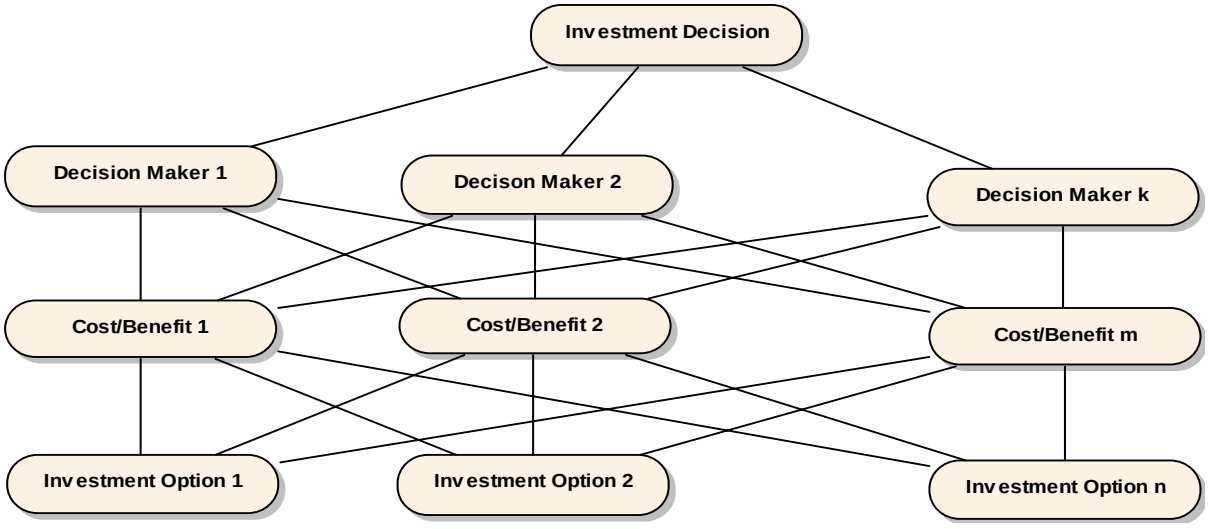

Figure 4. Decision hierarchy

Continuing the illustration from the previous section, and realizing that the expected cost savings are marginal, management may still consider the IT investment, as the new system offers a number of intangible benefits and new strategic opportunities. Thus, to perform a systematic and full evaluation of the desirability of the IT investment, the decision makers need to identify those intangible benefits or costs that will potentially affect the success of the organization. Along with the expected tangible cost savings, these intangible benefits or costs, which depend on a company's specific situation and characteristics, and are mission and strategy driven, represent the decision criteria for evaluating the IT investment options.

Let us assume that for the purpose of our illustration, the following criteria have been identified as potentially most impacting the performance of the organization:

(1) *System Connectivity* is the capability to integrate with other systems. This important trait may result in improved data exchange within the organization as well as better communication with business partners. In addition, system connectivity may increase the availability, accuracy, and timeliness of information for decision-making.

(2) *System Flexibility* refers to the option of adjusting the system to changes in business environment (for example, fluctuation in demand).

(3) *System User-Friendliness* refers to how easy or difficult it is to work with the system. This feature may result in minimizing training costs, improved productivity, and increased user satisfaction with the new system.

(4) *System Security* refers to the level of vulnerability to various threats which may lead to system failure.

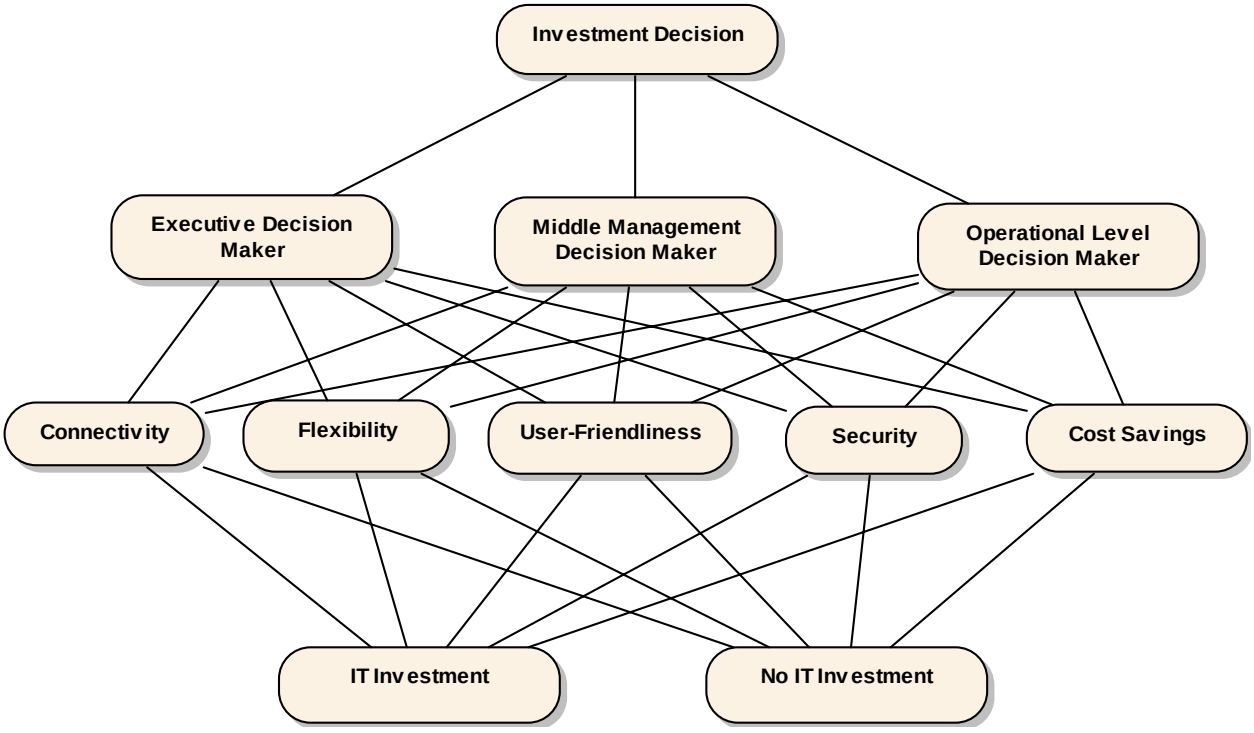

Figure 5. Decision hierarchy for illustrative example

To continue with our illustration, we assume that three experts (with varying influence in the organization) have been invited to participate in the decision-making process and evaluate the significance of the decision criteria with respect to the investment decision. Furthermore, the evaluation of the IT investment option (i.e. investment vs. no investment) with respect to the intangible decision criteria (connectivity, flexibility, user-friendliness, and security) is assumed to be done by experienced IT professionals (see [32] for the involvement of different stakeholders in the decision process). Including the previously conducted assessment of cost saving, the corresponding decision hierarchy can be developed as shown in Figure 5.

Using such a multi-criteria approach and considering the less tangible benefits, many business managers may decide to progress with their IT investment even if the expected direct cost saving from the new system are only modest.

4. The General Framework

The proposed framework for evaluating IT investments in emerging economies involves four major steps. The first step is to identify the major primary and support activities and then to establish the company's value chain. The second step is to estimate the cost for performing each of the activities, based on integrated ABC-and-EVA. If necessary, this analysis can be supported by fuzzy logic. The third step is to assess the potential impact of the IT investment on the costs of each activity in the value chain, employing fuzzy logic. Finally, the fourth step is to evaluate expected changes in the cost structure, and to weigh expected potential cost savings and other expected benefits in order to decide on the desirability of the proposed investment. Figure 6 depicts the major steps.

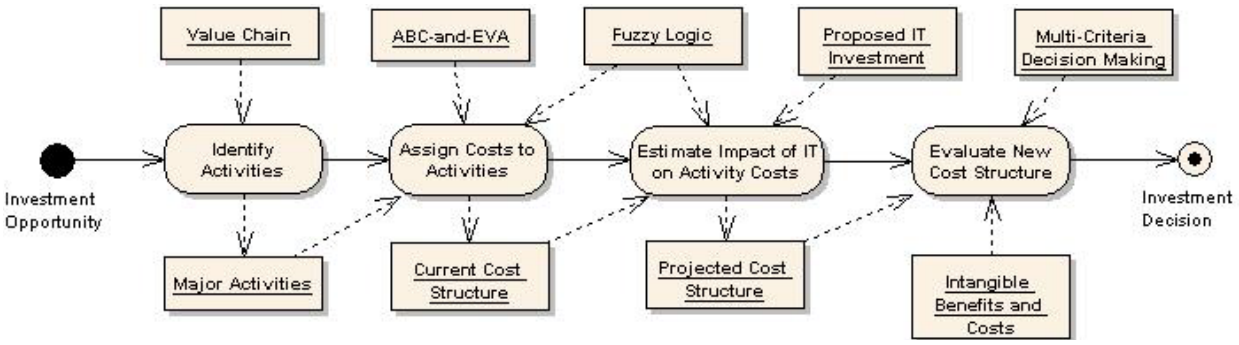

Figure 6. Framework overview

5. Conclusion

In this paper, we propose a framework to evaluate potential IT investments in the specific business environment of emerging economies. Our framework uses ABC and EVA for the purpose of estimating various costs needed for value chain analysis. Fuzzy logic is used to compensate for the lack of dependable accounting data and to asses the potential impact of the planned IT investments on tangible cost and benefits. In order to address intangible costs and benefits, our framework includes MCDA concepts.

By integrating these five concepts, we address substantial limitations of conventional value chain analysis. Value chain analysis, ABC, EVA, fuzzy logic, and MCDA have each proved their significance individually but, to our knowledge, the proposed framework represents the first attempt at integrating these concepts specifically for the purpose of IT investment evaluation.

In addition to making a theoretical contribution to the existing body of knowledge, we believe that our framework is also highly relevant to practitioners. Many companies in emerging economies base their competitive advantage on price, and therefore their investments in IT must ensure tangible cost savings. However, tangible cost savings by themselves may not be sufficient, and other factors, such as intangible benefits of IT investments, must also be considered. Some of these investments may result not only in substantial tangible benefits, but may substantially contribute to the overall development.

One limitation of our illustration is that, for simplicity, we used only one time period in our analysis. In reality, the costs of activities in the value chain are not static and will change over time. For example, an investment in IT may initially increase the cost of certain activities, but these costs may diminish with time. Therefore, for the purpose of real world relevance, it may be reasonable to widen the time perspective to a multiyear investment period.

Finally, our framework is primarily a thought model, based on observations and experience in working with companies in emerging economies. The illustrative example shows the possible application of the framework, but no empirical validation has been performed as yet, which opens multiple options for future research projects.

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