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THE FOUR TIGERS OF GLOBAL E-BUSINESS INFRASTRUCTURE: STRATEGIES AND IMPLICATIONS FOR EMERGING ECONOMIES

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ABSTRACT

Statistics show that the United States is the leader on all fronts of e-business readiness. However, in different geographic regions several other countries are emerging as leaders in e-business infrastructure development. These Tigers of global e-business infrastructure include Singapore, India, Ireland, and Finland. This paper describes the specific e-business infrastructure models that are taking shape in these emerging leaders. The models are differentiated in terms of their underlying IT infrastructures, human capital requirements, alliance aspects, cultural aspects, and institutional environments. The paper analyzes each model as a configuration of activities for creating competitive advantage in e-business infrastructure. Recommendations are drawn for emerging countries striving to increase their participation in global e-business.

Keywords: globalization, e-business, e-commerce, emerging economies, information technology, infrastructure

I. INTRODUCTION

Both developed and developing countries are rushing to prepare for the electronic economy and to build e-business infrastructure. The United States is clearly a leader on most if not all fronts of electronic commerce. For example, the United States tops a July 2002 list of "e-business ready countries" [The Economist, 2003]. While more and more countries recognize the importance of building general e-business readiness, it also becomes clear that it is necessary for different countries to develop specialized e-business strategies that exploit their unique capabilities and resources, and even geographic positions. There is also a need for a variety of models for building e-business infrastructure and participating in global e-commerce. This paper presents case studies of four countries, Finland, India, Ireland, and Singapore that are quickly becoming regional leaders in e-business development. They configured their country capabilities and emerging technologies in ways that enabled them to build national competitive advantages and to attract global e-business firms to locate there. Therefore, we call them The Four Tigers of global

e-business infrastructure. They provide examples that other countries including developing nations can use as models of successful e-business infrastructure development.

To develop our discussion on infrastructures for e-business readiness further, it is first necessary to provide a working definition of both terms.

1. Infrastructure is generally used to describe a stable framework where economic processes take place. Smith [1997] provides a more precise definition of infrastructures that is useful for studying innovation systems subject to public policy decisions. In his conceptualization infrastructures are collective resources for production, which require investment decisions. These resources provide either physical inputs to production or shape the knowledge background to production [Smith, 1997, p. 86]. Our focus is on infrastructures for e-business that require the strategic focus of policy makers and involve substantial and usually sustained capital investments. This quality makes such infrastructures so important for long-term national competitive advantage.

2. Many institutions created tools for measuring e-business readiness. These include The Center for International Development at Harvard University, The Asian Pacific Economic Cooperation (APEC) Electronic Commerce Steering Group, and McConnell International. Table 1 lists definitions for e-readiness given by these institutions and by others. Taken together, the definitions emphasize four different components of e-business readiness:

1. a technological infrastructure,
2. ubiquitous access to information and communication services,
3. favorable government practices, and
4. a willingness on the part of organizations to redesign business processes to take advantage of e-business capabilities.

Thus, the building of e-business readiness is a multifaceted endeavor that involves both private and public societal actors. Capabilities are also built in several layers from organizational information systems to larger technical infrastructures that serve the information and communication needs of the larger population, private organizations, and the government. Developing strategies for e-business infrastructure involves investment decisions about physical and knowledge producing resources that support e-business readiness of firms, public organizations, and the general public.

The emergence of new information and communication technologies provides new opportunities for developing countries to participate in the world economy. The infrastructure and institutional requirements for exploiting information technologies differ from those for traditional manufacturing industries. With relatively small investments in mobile or Internet technology, small businesses in developing countries are able to create new services in their home economy and gain access to international markets. As a result, information and communication technologies are often seen as a chance for leapfrogging stages of development.

On the other hand, the fear of a digital divide is growing. With the accelerating pace of the electronic economy, analysts are concerned that developing countries are left further and further behind [Hudson, 2000]. A new form of information poverty is threatening the prospects for the developing world. These arguments represent two different views on the prospects of developing countries in the global electronic economy. Both sides of the argument have some validity. Although some countries are getting left behind in the information revolution, other developing countries are making significant inroads in IT-enabled industries. Our goal is to use the four country models in this paper to understand how emerging economies may build bridges across the digital divide and develop competitive advantages based on new technologies and their country-specific resources.

Table 1. Comparison of Definitions for E-Readiness

RESEARCH INSTITUTE	DEFINITION FOR E-READINESS
The Computer Systems Policy Project (CSPP)	"An 'e-ready' community has high-speed access in a competitive market; with constant access and application of ICTs in schools, government offices, businesses, healthcare facilities and homes; user privacy and online security; and government policies which are "favorable to promoting connectedness and use of the Network."
The Center for International Development at Harvard University	"An 'e-ready' society is one that has the necessary physical infrastructure (high bandwidth, reliability, and affordable prices); integrated current ICTs throughout businesses (e-commerce, local ICT sector), communities (local content, many organizations online, ICTs used in everyday life, ICTs taught in schools), and the government (e-government); strong telecommunications competition; independent regulation with a commitment to universal access; and no limits on trade or foreign investment."
The Asian Pacific Economic Cooperation (APEC) Electronic Commerce Steering Group	"A country that is 'ready' for e-commerce has free trade, industry self-regulation, ease of exports, and compliance with international standards and trade agreements."
McConnell International report on e-readiness	"An 'e-ready' country has extensive usage of computers in schools, businesses, government, and homes; affordable reliable access in a competitive market; free trade; skilled workforces and training in schools; a culture of creativity; government-business partnerships; transparency and stability in government and an evenly enforced legal system; secure networks and personal privacy; and regulations allowing digital signatures and encryption."
The Mosaic Group	"The framework does not describe an 'e-ready' society <i>per se</i> , but the reasons behind and readiness for growth of Internet infrastructure and usage (which are, by most accounts, requirements of an e-ready society). Unique interactions among the government and businesses, aided by market competition, help cause the growth and distribution of the Internet."
The World Information Technology and Services Alliance (WITSA) survey, 2000	"The report of the survey states that an 'e-ready' country requires consumer trust in e-commerce security and privacy; better security technology; more trained workers and lower training costs; less restrictive public policy; new business practices adapted to the information age; and lower costs for e-commerce technology."
The Leland Initiative Telematics for Africa project at the Center for International Development and Conflict Management (CIDCM) at the University of Maryland	"An 'e-ready' society has an ISP market that has passed through three phases of development: (1) pre-commercial (access limited to a pioneer community), (2) commercial (access is sold to consumers), and (3) competitive (the ISP market has multiple competing actors). The negotiations between actors should be transparent, conclusive, speedy and inclusive of the major players in public, private and NGO sectors."

Source: [Bridges.org, 2000]

Based on our qualitative analysis, we develop an evolutionary model that describes the dynamic process of building a national system of innovation for e-business activities (Section III) and a framework for global positioning in e-business infrastructure (Section IV). We then use our framework to derive implications for emerging economies that want to participate in global e-business (Section V). Our position is that information and communication technologies should not be viewed as simple shortcuts for leapfrogging stages of development. Instead they increase the number of alternative paths for development and thus provide an important opportunity for emerging economies to accelerate their participation in the world economy in new ways. The four case studies indicate that competitiveness in global e-business is based on long-term specialized capabilities rather than general short-term cost advantages. Therefore, focused investments in e-business infrastructure that supports the growth of intellectual capital in specific e-business domains are likely to help emerging economies with significant resource constraints.

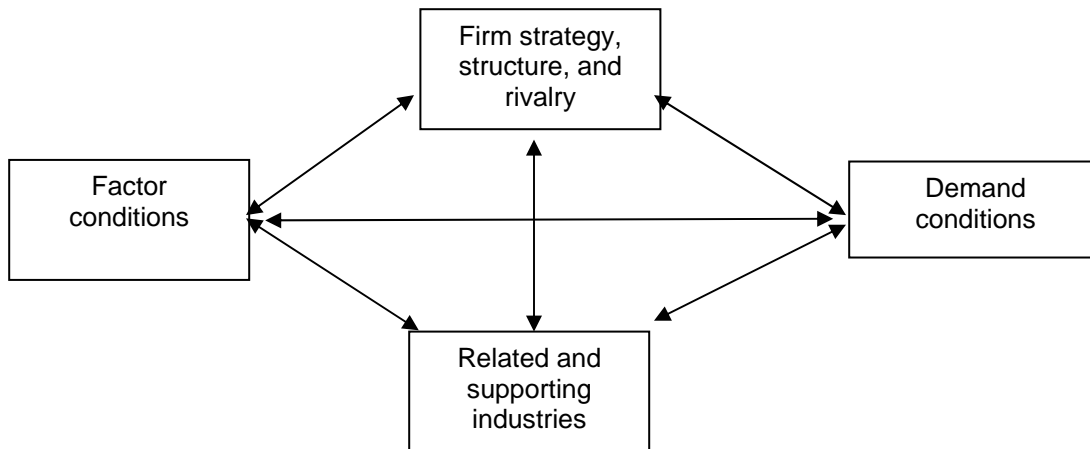
To study the process of building competitive advantage in e-business infrastructure, we draw on three distinct streams of literature.

1. Porter's model of national competitive advantage [Porter, 1990]. We use this model to describe the dynamics of configuring a system of activities for competitive advantage.
2. The knowledge-based view on the location of international business activities. This view is a foundation of an evolutionary model for building national systems of innovation in global e-business.
3. The literature on open economy and development economics provides a perspective on the threat of a digital divide and on the opportunities for accelerated development in the electronic economy.

BUILDING E-BUSINESS INFRASTRUCTURE FOR NATIONAL COMPETITIVE ADVANTAGE

Porter's model of national competitive advantage (Figure 1) is a diamond that consists of four corners:

1. Firm strategy, structure, and rivalry,
2. Factor conditions (including infrastructure),
3. Demand conditions, and
4. Related and supporting industries.



Source: [Porter, 1990, p. 72]

Figure 1. Determinants of National Advantage

In addition, Porter [1990, p. 127] includes the role of government and chance in the model. The national diamond explains why a nation is a more or less desirable home base for competing in an industry. A home base is a platform for setting strategy and developing core products and processes. It is where essential and proprietary skills reside [Porter, 1990, p. 69]. In Porter's framework e-business infrastructure would be an important factor condition for supporting globally competitive IT-intensive industries. Factors may be generic or specialized. Specialized factors often require more focused and risky private and social investments but they also result in the most sustainable competitive advantage [Porter, 1990, p.79].

Our research question, expressed in Porter's terms, deals with infrastructure configurations that provide the factor conditions for building competitive advantages in various e-business activities such as R&D, manufacturing, production of services, and trading. Porter found that often the most important factors are not inherited natural resources but are created within a nation. Thus, developing e-business infrastructure presents a new opportunity for emerging economies to shape the factor conditions that underlie their participation in the global economy.

We recognize that countries can participate in e-business in different ways. Four examples are provided by the Tiger countries:

- Finland producing technological innovations with wireless technologies, manufacturing and exporting information technology based products,
- Ireland producing computer hardware and software for export,
- India specializing in custom software development, business process outsourcing, and IT-enabled services, and
- Singapore building on its expertise in logistics operations in the Asian region and specializing in IT-enabled trading.

The infrastructures that support these strategies vary in their requirements and development paths. For example, developing innovative products for wireless communication requires cooperative efforts with universities and a high level of ICT adoption in the home market for experimenting with new products. It does not necessarily require a high level of foreign direct investment (FDI). The IT export strategy of Ireland does require FDI from multinationals but is not dependent on a high level of IT adoption in households and local companies. The e-hub strategy of Singapore requires a high level of government investment to develop the required logistics infrastructure. A high level of connectivity of local firms and households is also important. Government investment in infrastructure was not so urgent for developing the IT service industry in India where local firms and multinationals also had incentives to invest.

In Porter's [1990] system view of strategy, the activities exploited in a strategy must fit together. They complement and reinforce one another dynamically. For example, India's outsourcing strategy is consistent with a strong culture of professionals in India. Singapore's e-hub strategy is consistent with its central location along major trading routes in Asia. Finland built its expertise in mobile technology on a long tradition in related electronics industries. Ireland complemented its strategy to attract multinationals with specific investments in education. In each case new technologies were used to leverage the country's existing strengths, be they human resources, geographic location, management culture, business domain expertise, or knowledge capital in a specific field.

E-business infrastructure strategies are not only defined in terms of competitiveness of national industries. They also need to address the attractiveness of the country for locating specific e-business activities. Our goal is to provide a framework for identifying a starting point for developing e-business infrastructure that supports the creation of local and regional systems of innovation for e-business activities. Porter's framework does not directly address the question of how a country can create locational advantages for specific industries or activities. To address this question we apply the knowledge-based view and the idea that economic activity is drawn to regions rich in knowledge [Marshall, 1920].

THE KNOWLEDGE-BASED VIEW ON THE LOCATION OF INTERNATIONAL BUSINESS ACTIVITIES

The knowledge-based view of the firm [Kogut, 1991, 1993; Kogut & Zander, 1992, 1993] regards knowledge as the key resource that can serve as a basis for competitive advantage. Such knowledge can include technological know-how as well as organizing principles of work. Organizing principles result from learning and experience that take place over a long time. In general, knowledge about organizing principles is in tacit form and cannot be transferred across firm and country borders as easily as codifiable technological know-how. Therefore, organizing principles are an important basis of firm and country competitiveness.

Countries differ in their underlying organizing principles of work, and these principles develop and diffuse within an inter-industry network of firms. However, country capabilities are developed not only in business firms but also in the wider set of institutions in a country. Therefore, the link between science-based centers and economic organizations is crucial [Kogut, 1991].

The knowledge-based view suggests that country competitiveness is built on long-term capabilities rather than short-term advantages in factor costs. Country capabilities emerge in national systems of innovation (NSI) [Nelson, 1993; Edquist, 1997] consisting of a network of firms and institutions that are able to mobilize resources towards complementary goals. Kaounides argues that such national systems of innovation will play an increasingly important role

in contributing to sources of competitive advantage of firms and industries within countries and will act as magnets for attracting inward flows of foreign direct investment [Kaounides, 1999].

Kogut argues that the preconditions for building national systems of innovation include human capital formation, entrepreneurial activity, and rigorousness of competition [Kogut, 1991]. Our case studies explore the processes by which the Four Tigers of global e-business infrastructure developed their specific capabilities. Based on our four country-cases (Section II), we propose additional preconditions that are more specific to e-business. These preconditions include:

- different types of alliances for knowledge creation,
- national and international connectivity, and
- a management culture for creating long-term capabilities.

We call these preconditions the dimensions of e-business readiness. (Figure 2 in Section III) We suggest that Finland, India, Ireland, and Singapore are on their way to developing national systems of innovation in different e-business activities and we describe their current stages in the evolutionary process. The experience of these countries can be used to develop strategies for emerging economies that are building e-business readiness.

GLOBAL E-BUSINESS AND DEVELOPMENT

In this section we examine the questions:

- Why should participating in global e-business be a priority for emerging economies?
- Why should emerging economies develop e-business infrastructures with specific strategies in mind?

We draw on the literature on open economy, international trade, and development. We briefly review the historical debate on the contribution of international trade towards development and economic growth. We also discuss the key role of technology as a source of economic growth and the institutional preconditions for the successful application of technology to produce global competitiveness.

The theory of trade as 'an engine of growth' grew out of the experience of the Industrial Revolution. The developing countries at the time began their own industrialization processes because they were strongly linked to the center countries of Western Europe through trade. The industrialization of the periphery countries such as the United States, Canada, Argentina, and Australia was largely driven by the expanding demand in Western Europe [Nurkse, 1961]. It was believed that industrialization and economic growth in these countries was due to special external conditions that would not necessarily hold for the developing countries of the 20th century. Later examination demonstrated however that growth in the periphery countries of the First Industrial Revolution was not the result of trade but internal factors such as land, people, and systems of social and economic organization [Kravis, 1970]. In fact, many less developed countries participated in international trade long before modernization of their economies or a significant take-off in economic growth [Reynolds, 1985]. Trade did not bring about modern economic growth in the developing countries of the 19th century or the developing countries of today. Rather, trade's impact on development is favorable in that it reinforces the effects of productivity improvements from internal investments. Trade is more appropriately characterized as a 'handmaiden of growth' rather than 'an engine of growth' [Kravis, 1970].

We could find no reason to believe that the external demand conditions for today's developing countries are any less favorable than for the developing countries of the 19th century. The opportunities for today's developing and emerging economies to benefit from international trade are probably far greater than the opportunities that were available to the periphery countries of the 19th century. The possibilities for communication were greatly enhanced by telecommunications and Internet technologies. In addition, it is now possible to produce and deliver a wide range of services and information goods electronically -- virtually anywhere in the world. Emerging economies enjoy opportunities to enter markets for existing services and to create markets for new services.

As we survey the prospects for emerging economies for participating in the electronic economy we must also keep the lessons of history in mind. International trade alone cannot accelerate economic growth. Development must be based on improvements in productivity, which involves the application of technology. However, technologies can provide productivity improvements only under suitable institutional conditions [Easterlin, 1998]. Therefore, it is important to discuss e-business readiness as a system of capabilities rather than as investments in physical assets. For emerging economies to apply information and communication technologies successfully they need to address institutional and cultural elements that enable them to derive productivity improvements from technology. For example, investing in a highly educated workforce is one of the key requirements for successful application of information technologies. These are elements of e-business readiness, which serves as a springboard for developing a global competitive advantage in e-business activities.

THE DIGITAL DIVIDE¹

The digital divide between high income and low-income groups within developed countries, and between the developed and the developing world creates a new type of poverty: information poverty [Hudson, 2000]. Digital divide arguments are generally supported by statistics showing a growing gap in computer ownership and connectivity between high income and low-income groups. New information and communication technologies are seen as accelerating economic growth in the leading countries while the developing nations are left further and further behind.

An alternative view is to recognize the widening options for development that become available with the advent of new information and communication technologies. Developing countries can now choose among a wider array of technologies to increase their economic productivity [Easterlin, 1998]. The increased choice creates an opportunity for accelerated development. The institutional and infrastructure requirements of information and communication technologies differ from traditional manufacturing technologies that are based on scale economies. Therefore, some developing countries that were not able to apply the technologies of the Second Industrial Revolution fully may still be in a position to use specific information technologies because the requirements for capital and infrastructure for these technologies are less restrictive.

The four countries discussed in this paper attained a high global profile in e-business activities. They are used here as examples of e-business infrastructure development. Although we do not have evidence that each of the Four Tigers created a clear country strategy for e-business, it is apparent that different actors in these countries took initiatives to create competitive advantages. In the case of Singapore and Ireland, the government probably did prepare a fairly explicit plan to develop certain capabilities. In India the initiative came more from firms that also acted as an industry group. Finland, on the other hand, is a small open economy where firms and government bureaucracies often act in conjunction especially when it comes to international trade issues. In each case there is a vision and a plan of action, although the source of the plan may vary. Porter emphasizes that the presence of favorable factors alone is not sufficient to explain national competitiveness. Competitive advantage from factors ultimately depends on how they are deployed – the choice of how to mobilize factors and the technology used [Porter, 1990, p.76].

Section II outlines the foundations and development of e-business infrastructure in the Four Tiger countries. The findings are then used to draw a stage model for developing national innovation systems for e-business activities as well as a strategic framework for country positioning in global e-business infrastructure.

II. THE FOUR TIGERS

The four countries were selected for the case studies as examples of distinct e-business infrastructure strategies in the European and Asian regions. Although other countries in both regions are undergoing significant developments in e-business, Finland, Ireland, India, and

¹ The digital divide concept goes back at least to a 1978 NSF technology assessment study by J. Nilles, P. Gray, and J. Carlson at USC.

Singapore were selected because of their relatively early start in developing e-business capabilities. Therefore, they gained leadership positions and high visibility.

FINLAND

Statistics on Internet use and cellular phone subscriptions indicate that Finland is one of the most wired nations in the world [Finland Statistics, 2003]. However, Finland's capabilities in e-business really became known to the world through the success of its flagship company, Nokia, a producer of mobile phones. Mobile phones and their networks are becoming a key infrastructure. In 1998 more mobile phones were sold worldwide than automobiles and personal computers combined. Of the 165 million mobile phones sold, Nokia manufactured an estimated 41 million. In 1999 Nokia's market share grew to 27 percent while it claimed almost 70 percent of profits in mobile phone manufacturing. By 2000, its brand was the world's fifth most valuable [Steinbock, 2001b, p. xxix].

Nokia's success and Finland's emergence as an advanced information society seemed sudden to the rest of the world. However, the success of the mobile/telecomm cluster and the advanced e-business infrastructure in Finland are a result of key strategic decisions in the public and private sectors and of capabilities built over the long term. Steinbock [2001a] notes that the success of Finland's "wireless valley" is usually attributed to industry competitiveness, population dispersion, and pro-technology attitudes. However, these conditions do not differ markedly from those of other Nordic countries. Steinbock argues that Finland's success rather was based on its unique geopolitical relations to Tsarist Russia and the Soviet Union², public strategies both at regional (Nordic and EU) and national levels (telecommunications liberalization in 1970s and 80s), and first-mover advantages of mobile vendors and operators. Therefore, Finland's competitive advantage is not a result of favorable factors alone, but strategic choices by industrial and government leaders in critical points of time.

Although Nokia's global position is only recent; the company is almost 140 years old. Its founding in 1865 as a small forestry company coincided with a boom in the lumber industry that helped set off Finland's industrialization. Therefore, Nokia began in the traditional factor-driven industries much like other major Finnish companies. However, it was unique in its continuing efforts to grow, upgrade, and innovate. In addition to pursuing technological innovations, Nokia built a differentiation strategy early on both in domestic and international markets. Innovation was not limited to product development but was applied to the whole value chain. The company's use of the umbrella brand (Nokia) for its paper, rubber, and cable products sold between 1890s and 1930s as well as the cellular branding investments in the 1990s are a part of this differentiation strategy [Steinbock, 2001b, p. 8].

Nokia's history demonstrates that competitive advantage in e-business activities was not based on existing factors but decisive investments in key technologies that provided a platform for entering emerging industries. As a result of such choices Finland's history in the electronics and electro-technical industry is more than 100 years [Alhonen, 2001]. It built capabilities in adapting and applying new electricity based technologies over the long term. This history, in turn, contributed to a lack of prejudice on the part of consumers in applying new technologies and to a national innovation culture [Koroma, 2001].

The Finnish education system, due to extensive industry-university collaboration, produces practically oriented engineers. Such alliances create a basis for R&D intensive industries and

² Under the rule of Tsarist Russia, Finland seized the opportunity to gain control over local telecommunications. To avoid Russian intervention, Finnish telephone activities were left to the private sector. While Russians viewed the telegraph as a strategic technology, the telephone was seen as a local rather than international means of communication. As a result, Finnish companies could operate autonomously without threatening the interests of Tsarist Russia. Geopolitical relations also motivated Finland's investment strategy in telecommunication during the Cold War. This era was important for infrastructure construction, and also motivated industrial diversification. Nokia expanded its cable segment and diversified into electronics, which eventually served as a springboard for its entry into mobile telecommunications. For a detailed account see Steinbock [2001a; 2001b].

technological leadership. In recent years special cooperative efforts were launched by the industry and the Ministry of Education to increase the number of IT graduates [Koroma, 2001]. Overall, Finns are highly educated. 65-70% of each generation is offered a chance to study in a university or polytechnic [Koroma, 2001].

Unique aspects of the managerial culture in Finland complement strategies based on R&D. For example, Nokia's management culture could be characterized as informal, non-hierarchical and fast-response [Vihma & Seulamo, 2000]. Finally, the small size of the country enables the formation of tight networks. Technological solutions can be built in the spirit of consensus [Alhonen, 2001]. Finland's tight networks including firms, universities, and government allowed for a focused effort to raise country capabilities, giving rise to the Tiger strategy in communication technology. At the same time the competitive home market served as a test laboratory for new products contributing to Finland's position as a technology leader.

INDIA

The take-off of the Indian software and IT services sector received a lot of attention [Ramamurti & Kapur, 2001; Heeks, 1996]. It acted as a catalyst for a continuing technology-based change and integration of India to the global economy [Wolcott & Goodman, 2003]. The Indian outsourcing business grew out of providing programming services to American hardware and software companies. Pioneering firms like Infosys Technologies, Wipro Technologies, Satyam Computers, HCL Technologies, and TATA Consultancy Services built capabilities in the domestic market and quickly found innovative ways to access American and European markets for programming and more custom software development. Indian firms were able to compete based on their lower costs and good quality provided by their highly educated and motivated workforce. An added advantage was created by the time difference between India and North America that allowed Indian firms to create a 24-hour working day for their customers.

The export revenues of India's software services reached \$6.2 billion in 2002, up from under \$500 million in the mid 1990s. In 2001, as the technology sectors in the United States and Europe took a downturn, India seized the opportunity to market India as a preferred location for global outsourcing vendors [The Economist, 2003]. This strategy is starting to pay off as high technology firms in America see India's locational advantages for both routine work and research and development. For example, companies such as Sun Microsystems, Texas Instruments, and Cisco built design centers in Bangalore to tap into the supply of highly qualified engineers [Kripalani, 2002].

Learning in the software services sector created spillovers into related areas such as IT-enabled services that include back-office operations (e.g., call centers, human resource management, financial services). Such services represent a growth opportunity as North-American firms seek cost-effective ways to address their increasing data-processing needs. [Engardio, Bernstein, and Kripalani, 2003] India's National Association of Software and Service Companies (NASSCOM) reports that IT-enabled services make up an increasing share of India's IT exports, growing from 14% in 1999-2000 to 24% in 2002-2003.

The success of Indian software firms globally is remarkable given the obstacles to internationalization these firms faced in their institutional environment. They countered these barriers by pursuing innovative strategies of internationalization. For example, they pursued innovative financing strategies by raising equity capital in the United States. Collaboration with multinational IT firms also helped to upgrade technological infrastructure. In addition, networks formed with Indian professionals living abroad helped gain access to markets and knowledge in the United States and Europe.

Indian IT services firms face competition from an increasing number of other low-cost producers of software. Therefore, they systematically focus on upgrading their skills and standards for quality. For example, Wipro, a provider of software support and R&D services, was the first company in the world to obtain the Software Engineering Institute's CMM level-5 rating for software development [Ramamurti, 2001]. The quality of Indian software development is fundamentally based on a highly educated work force in IT and engineering [Chappell, 2001]. The Indian educational system always emphasized conceptual fields [Das, 2001], and thus was able

to develop the capabilities required by the software industry. A new kind of professional culture also developed in the IT industry that emphasizes human resources development and knowledge management [Kochikar, 2000]. The trajectory for India's emerging capabilities looks promising:

"India is likely to emerge as the back office of global corporations in the short to medium term and as a leading provider of tradable services in the medium to long term" [Kapur & Ramamurti, 2001].

The unique configuration of knowledge resources -- alliances among multinationals, local entrepreneurs and Indians living abroad -- produced a winning Tiger strategy in software and IT-enabled services.

IRELAND

Ireland is described as the Celtic Tiger for its outstanding economic growth in recent years. Ireland is one of the fastest growing economies in Europe and it was the world's second largest software exporter in the Internet boom years. Ireland's path to success in the software industry began in the early 1980s when the Irish government identified IT and pharmaceuticals as major growth areas. It targeted companies such as Intel, Microsoft, Hewlett-Packard, and Nortel that could locate in Ireland. As a result, Ireland's software industry grew from \$30 million to \$1 billion in sales between 1988 and 1998. [Rapaport, 1999] Large multinationals contributed significantly to Ireland's economic growth. They created a large number of skilled workers and also spawned indigenous hardware and software suppliers. Now Ireland's information and communication technology sector employs approximately 100,000 people in 980 companies. Total exports from the sector were \$31 billion in 2001 and accounted for 33 percent of all Irish exports [IBEC, 2001].

Ireland provides an attractive location for multinationals given its low corporate tax rate, well-managed labor relations, and most importantly its English-speaking, young and vibrant work force. The educational system is also geared to respond to industry needs, and a modern communication infrastructure now connects the once peripheral island to the United States and Europe. In addition, the Irish social culture contributes to an attractive business and work environment [Burns, 2000]. Ireland's membership in the EU since 1973 also helped the country financially and gave young people wider horizons, contributing to a new multicultural orientation [Rapaport, 1999].

Ireland provides an example of strategic government efforts to move from an agrarian to an information-based economy. This change involved cultural, economic, and technological adjustments. Trauth [2000] observed that the Irish socio-economic context contributed to the success of the IT industry in many ways. Irish workers are well-versed in culture and literature. They gained an advantage in information-sector work that emphasizes verbal as well as technical abilities. Information-sector work also favors certain work ethics that are compatible with agrarian work:

- it can be done on a small scale,
- it involves significant personal investments
- it involves personal autonomy and control
- at times it requires cooperation and coming together to work on a task.

On the other hand, certain socio-economic factors create challenges to Ireland's development as an information society. Key challenges include:

- supporting entrepreneurship and risk taking,
- building national confidence and self-image,
- coming to terms with success,
- removing barriers to full participation by all members of the society, and
- balancing outside influences with local culture [Trauth, 2000: 308-344].

The variety of cultural influences explored by Trauth demonstrates that embracing the information society involves managing both cultural driving forces and counterforces.

Ireland's example shows that a national e-business infrastructure strategy requires decisive investments that leverage on national strengths and address country-specific challenges. Ireland's talented labor force and its unique culture allowed it to focus efforts on the software industry. Later on spillovers from the key industry not only triggered growth in other related sectors and stimulated local entrepreneurship but also laid a foundation for a societal transformation.

SINGAPORE

Singapore obtained a status as one of the best places in the world to conduct business. In recent years it ranked among the first in competitiveness and in providing a low-risk environment for business investments [WEF, 2003]. These high rankings reflect the comprehensive infrastructure and logistics environment Singapore created to support international trade. The island is linked to more than 740 ports worldwide connecting trade between Asia, Europe, and America. These locational advantages attracted more than 5000 multinationals to set up their operations in Singapore [Biederman, 2000].

In the past fifteen years, Singapore built further capabilities in e-business. For example, in 1989 the Singapore government implemented TradeNet [Singapore, 2003], the world's first nationwide electronic trade documentation system based on electronic data interchange (EDI). The TradeNet system allows the trading community to submit permit applications electronically to government bodies, and receive approvals almost instantaneously. TradeNet and complementary organizational transformations brought significant productivity gains to public organizations and increases in competitiveness to the Singapore trading community [Teo, Tan, & Wei, 1997].

Singapore's orientation to international trade is based on a regional focus [Osman-Gani & Toh, 1999]. Regional competition also motivated the Singapore government to work hard at building local capabilities. Singapore faced a significant competitive challenge in its traditional manufacturing sector from other newly industrialized economies in Asia. This challenge served as an impetus for focusing on high value-added sectors. Since the 1980s, Singapore sought to attract the control and coordination functions of multinationals [Coe & Young, 2001]. It also emerged as a major foreign exchange center for the region during the 1990s [Langdale, 2001].

By leveraging on its geographic location and investing in telecommunications infrastructure and a strong regulatory framework Singapore gained a leadership position as a trading hub. These same basic factors are central to Singapore's current efforts for building e-business capabilities. Singapore's emerging role as a hub for shipping, financial clearing, computer security, legal work of electronic contracts and deals requires an environment of trust and predictability, with good arbitration and jurisdiction [Endeshaw, 1999]. Singapore is a unique institutional environment in that it is a city governed as a nation [Coe & Young, 2001]. The important role of the Singapore government in development planning helps focus resources towards specific ends. The alliances formed among government and business organizations provide another mechanism for knowledge creation in global e-business.

COMPARISON OF THE FOUR TIGERS

Table 2 outlines the dimensions of e-business models for the Four Tiger countries. The table highlights the differences in the foundations of national competitiveness in global e-business across the countries. Each business model represents a distinct configuration of determinants. In Finland and Singapore, local connectivity is essential whereas in India and Ireland international connectivity is more important. Alliances for creating market and technical knowledge differ among them. Alliances involve government, universities, multinationals, and nationals living abroad. The types of skills employed also differ across countries. The Tigers are similar in that their industries were given incentives for building long-term capabilities. However, the capabilities are based on different foundations and upgraded through different mechanisms.

Table 2. The Four Tigers of Global E-Business Infrastructure

Dimensions of E-Business Model	SINGAPORE The Asian E-Trader	INDIA The Outsourcing Tiger	IRELAND The IT Exporter	FINLAND The Mobile Innovator
SELECTING A SPECIFIC E-BUSINESS RELATED INDUSTRY				
Initial e-business infrastructure strategic focus	Acting as an e-business hub for Asia. B2B trading and B2C e-commerce	Tradable knowledge-based services such as software development and IT-enabled services.	Computer hardware and software exports to the European market.	Creating user-friendly wireless communication devices for global distribution.
HUMAN CAPITAL FORMATION				
Creation of talent pool	<i>Business professionals:</i> English-speaking and cosmopolitan labor force. Facilitative immigration policies geared towards professionals. MIT – NUS collaboration.	<i>Theoretical engineers:</i> English speaking highly educated workers in scientific fields. Education system supports conceptual fields.	<i>Young IT professionals:</i> Favorable immigration policies. Education system geared towards the IT industry and international education.	<i>Practical engineers:</i> Strong education base in engineering and computer science. Industry-government collaboration to increase IT graduates.
ICT INFRASTRUCTURE AND CONNECTIVITY				
Local ICT Infrastructure	Good network infrastructure. High level of broadband infrastructure.	PC-based infrastructure. Most companies need their own generators to ensure power supply. Major outsourcing clients introduce technological upgrades.	Growing IT infrastructure. High cost of consumer and SME tele-communications	Network-based infrastructure. Fully digitized phone services. Highly efficient mobile communication network.
Domestic technology adoption	High household Internet connectivity and PC penetration. Modest adoption of mobile data services. Growing G2C services.	Low levels of Internet use, PC penetration, and mobile phone use in domestic market.	Relatively low level of IT adoption in domestic firms, institutions, and households.	High levels of Internet and mobile phone use by domestic firms and households. Growing adoption of mobile data services.
International connectivity of businesses.	International connectivity to US and Europe. Initiatives for building high connectivity to all major Asian cities.	Connectivity mainly to North America and Europe.	Initiatives for increased bandwidth to North America and to European cities.	A highly sophisticated communications infrastructure connects Finland to the outside world.
ALLIANCES FOR KNOWLEDGE CREATION				
Types of alliances	<i>Government – Business:</i> Government initiatives direct resources towards development goals.	<i>MNE – NRI – Local Firms:</i> Networks with overseas Indians. Alliances between multinationals and local firms. Public-private partnerships to improve local education.	<i>MNE – Local Firms:</i> FDI by MNEs in complementary industries like electronic engineering, pharmaceuticals and healthcare, international service, and financial services.	<i>Industry – University:</i> Close industry – university cooperation, technology parks, and small business centers support R&D intensive industries.

Dimensions of E-Business Model	SINGAPORE The Asian E-Trader	INDIA The Outsourcing Tiger	IRELAND The IT Exporter	FINLAND The Mobile Innovator
MANAGEMENT CULTURE FOR BUILDING LONG-TERM CAPABILITIES				
Management culture	<i>Relationship-based:</i> High level of trust. Traditionally emphasis on professionalism over entrepreneurship.	<i>Techie professionalism:</i> Attention to quality, customer needs, and human resource management.	<i>Irish charm:</i> Aptitude for socializing creates an attractive business environment and contributes to multiculturalism.	<i>Fast response:</i> Individual reliability and responsibility, fast decision-making, and understanding of a shared fate and mission.
GOVERNMENT POLICY				
Examples of government initiatives for e-commerce	First country to introduce e-legislation. 18 years of experience in G2B ICT use. 130 public services available online since launching of eCitizen Center in April, 1999.	Information technology ministry created in 1999. 100% foreign equity allowed in export processing zones. Exemption of customs duty on software used in IT sector. Establishment of software technology parks. Software firms exempt from minimum alternative tax. ³	Favorable tax regime for multi-national technology manufacturers. Social partnership among government, trade unions and corporations to manage labor relations. Telecommunication Infrastructure Bill 1999. E-commerce Act 2000.	Liberalization of telecommunications market started step by step in 1988. Since 1994 every segment of the market was subject to competition. Adoption of "IT driver's license" for every citizen.
BUILDING INTERNATIONAL COMPETITIVENESS				
Basis for competitive advantage	<i>Expertise in international trade:</i> Locational advantage along trading routes in Asia. Sophisticated infrastructure and supporting services for logistics operations. Knowledge of cultural diversity in Asia helps in both B2C and B2B.	<i>Efficiency:</i> Competitive costs, high quality, and on-time delivery. Highly educated English-speaking and professional workforce. Second largest annual output of scientists and engineers in the world.	<i>IT Industry expertise:</i> Creating locational advantages for high technology manufacturers. Cultural and language ties to the United States. Closeness to the European market.	<i>Technological know-how and innovation:</i> High R&D intensity to maintain leadership position in the technology race. Use of open standards accelerates acceptance of technology worldwide. Early experience in highly sophisticated home market.
Geo-economic orientation	Asia	Expanding beyond USA and Europe	Europe	Global
GEOGRAPHICAL AND INDUSTRIAL CLUSTERS				
Industrial clusters	Trading, financial services, logistics.	Software development, IT training, media, entertainment, and back office functions.	Computer hardware and software, financial services, pharmaceuticals and healthcare	Information and communication technology

³ In addition to initiatives focusing on the software sector the Indian government took several initiatives to develop networks to support other domestic companies and the general public. In 1998 competition was introduced to domestic telecommunications and international telecommunications services, international gateways, and ISP services. Regulatory changes to break down divisions among the Internet, mobile phone, fixed phone, and broadcast services are also underway.

Dimensions of E-Business Model	SINGAPORE The Asian E-Trader	INDIA The Outsourcing Tiger	IRELAND The IT Exporter	FINLAND The Mobile Innovator
Geographical clusters	Singapore city	Cities with highly educated workforce such as Bangalore, New Delhi, Pune, Hyderabad, and Chennai	ICT as well as healthcare, financial services and pharmaceuticals in the Galway region	Business-university research collaboration in cities such as Helsinki, Tampere, Oulu, Jyväskylä.

III. NATIONAL SYSTEMS OF INNOVATION IN E-BUSINESS ACTIVITIES

The four country case studies highlight the importance of long-term capabilities for building competitive advantage in global e-business. Equally important to building technological readiness for e-business is engaging in strategies for knowledge creation. The Tiger strategy is characterized by a focused effort of building skills in a specific e-business activity like R&D, IT-enabled services, trading, or manufacturing. The role of government initiatives in accelerating e-business development is obviously important. However, the experience of the Four Tigers demonstrates that the government is not the only driving force behind innovation in e-business. As Gibbs, Kraemer, and Dedrick [2002] found, the best government policies for e-commerce diffusion are often ones that play an enabling rather than a directive role. In their case studies of e-commerce in ten countries, for example, they found that the impact of trade and telecommunications liberalization appeared to be greater on B2B and B2C commerce than specific e-commerce legislation.

Figure 2 describes an evolutionary model for the Tiger strategies. It is divided in three main phases. The first phase involves harnessing the resources of the country for e-business capabilities. E-business readiness describes the institutional and material environments for developing long-term capabilities in global e-business. The four case studies draw attention to five dimensions of e-business readiness:

1. human capital formation,
2. local and international connectivity,
3. alliances for knowledge creation,
4. management culture for building long-term capabilities, and
5. government policy.

E-business readiness creates a springboard for selecting e-business related industries. In Figure 2 focusing on a specific e-business industry is highlighted as the most critical stage, from a strategic perspective, where the process for capability improvement takes off. In the second phase the initial industry creates spillover effects that contribute to industrial and geographical clusters. The country gains a brand identity and critical mass for its e-business activities. In the final phase geographic and industrial clusters lead to intellectual capital formation that is the basis for national attractiveness and national competitive advantage. A national system of innovation in e-business activities is the final stage.

Although Figure 2 depicts three sequential stages with beginning and end points, the framework is meant to illustrate a continuous process where the evolutionary cycle renews and reinforces itself. The factors contributing to e-business readiness become shaped by the choices of economic actors. As the country builds capabilities in one industry, it will open paths to related industries and motivate additional infrastructure investments. In addition, technological change creates discontinuities that become opportunities for emerging economies to enter existing industries or to build a competitive advantage in new ICT-enabled industries. For example, disaggregation of information-intensive services [Apte & Mason, 1995] enabled new types of business models in areas such as human resources process management, telemarketing and call centers, medical transcription, IT services, and security services that may be particularly suitable for emerging economies.

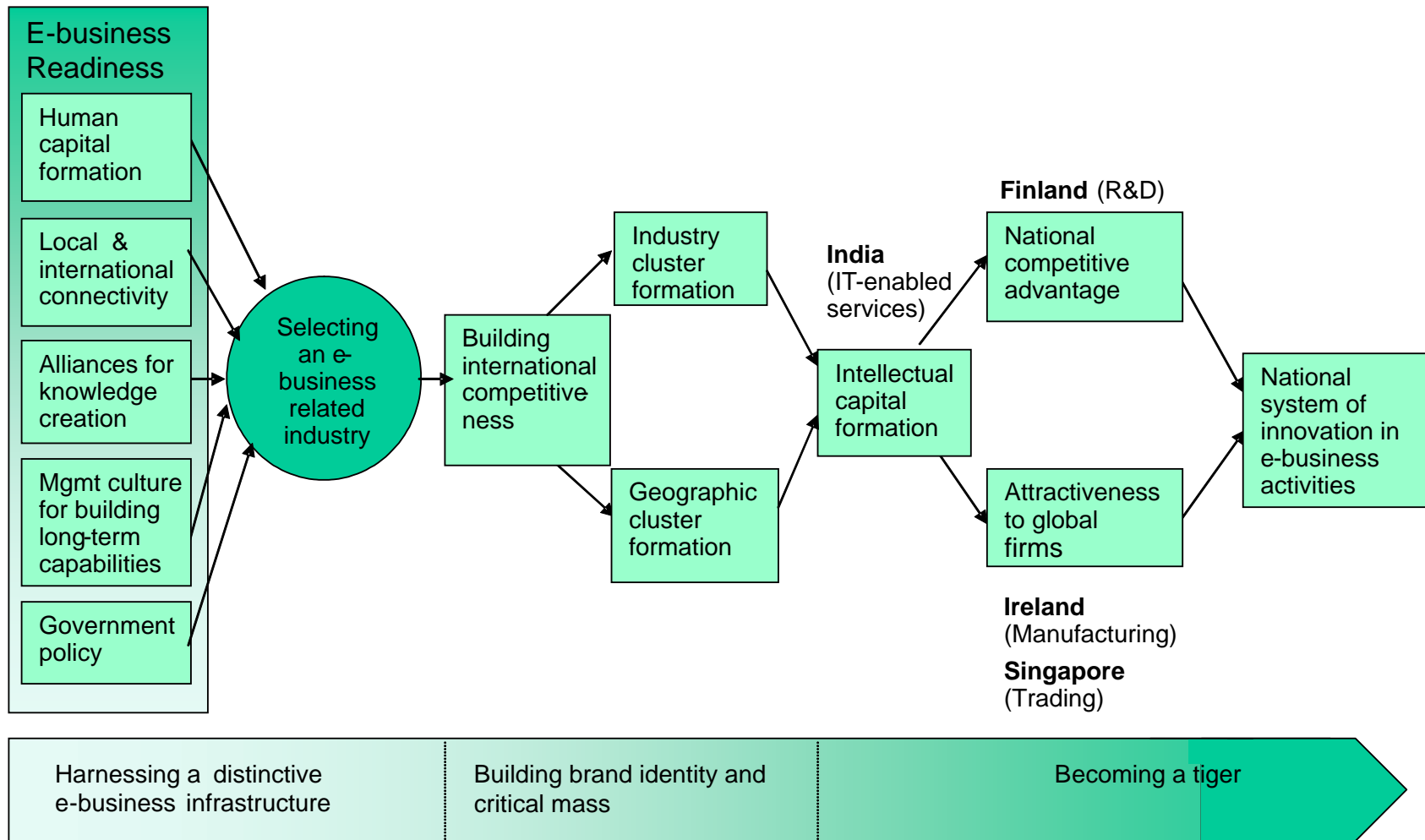


Figure 2. On Becoming an E-business Tiger

In 2003, the Four Tiger countries are in different stages:

- In India significant industry and geographical clusters are already formed, and they are giving rise to a knowledge base in IT-enabled services. The main challenges for India remain to strengthen its competitiveness against other low-cost producers and to create a favorable environment for multinationals to locate their back-office functions in India.
- Finland built a distinct national competitive advantage in mobile communication technology but is only beginning to become a truly attractive location for the R&D activities of multinationals in the industry [Koroma, 2001].
- Ireland and Singapore both succeeded in creating an attractive location for multinationals in their distinct e-business activities: IT manufacturing and trading. They still face challenges in strengthening their national competitive advantages as e-business hubs.

The Four Tigers also highlight the importance of geographical clusters for knowledge creation. In each of the countries e-business related industries sprung up in cities where universities are located or where highly educated labor may be found. Even in the information economy, cities may play an important role as spaces of knowledge flows [Coe & Yeung, 2001]. The importance of geography is also highlighted by the ability of national centers of innovation not only to produce globally competitive e-business industries but also to attract important global firms to locate their activities in that country.

IV. STRATEGIC POSITIONING IN GLOBAL E-BUSINESS INFRASTRUCTURE

National e-business infrastructure strategy may vary along two basic dimensions: geo-economic orientation and infrastructure deployment. Countries may target either a regional or global strategy in e-business activities. In terms of infrastructure deployment, countries may act as infrastructure support centers providing a favorable location for specific e-business activities, or act as infrastructure exporters by producing the hardware and equipment necessary to conduct e-business. Each strategic orientation is built on a distinct set of capabilities that provide a basis for competitiveness. Figure 3 illustrates the four strategies followed for global e-business infrastructure.

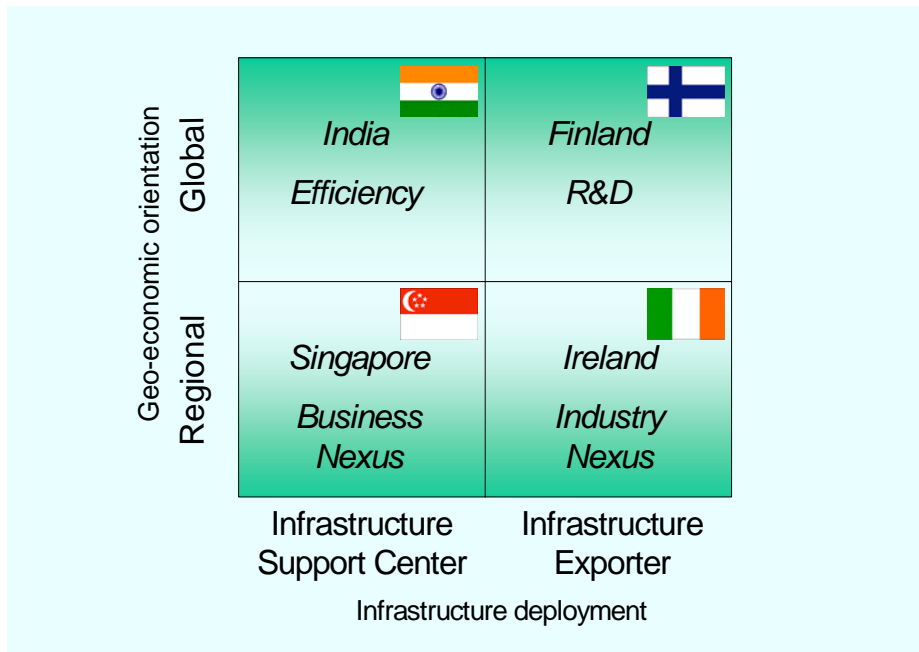


Figure 3. Positioning of Countries in E-Business Infrastructure

India provides an example of the Efficiency strategy where a country acts as a support center for particular kinds of e-business activities on a global scale. India is building capabilities for a range of IT-enabled services so that it can act as an outsourcing center for companies around the world. India offers many cost advantages as an outsourcing center but it also focuses on quality improvement. To compete globally as an outsourcing center it needs to focus on efficiency and be able to offer the highest quality and cost advantages in the global market.

Singapore's strategy is to act as a logistics and trading hub for e-business in the Asia-Pacific region. Because this strategy focuses on a specific business activity, trading and logistics operations, we call it the Business Nexus strategy. Singapore requires a comprehensive system of capabilities to support regional e-commerce. These capabilities include technical infrastructure elements but also expertise for carrying out financial and physical transactions. Competitiveness is created mainly through regional expertise rather than global cost efficiency.

A national e-business infrastructure strategy may also involve the export of technical infrastructure. Finland provides an example of an R&D based e-business infrastructure strategy that involves export of telecommunications equipment on a global scale. This strategy requires the capabilities of a knowledge leader in a given technology. Building global competitiveness in technical e-business infrastructure requires systems for accelerated R&D for example through university-firm collaboration.

An infrastructure exporter may also adopt a regional focus. Such a strategy is built around a specific industry such as the software and hardware industries in Ireland. We call this positioning Industry Nexus. Competitiveness for the regional e-business infrastructure provider does not necessarily require R&D leadership but rather the preconditions for industry competitiveness such as alliances with multinationals, foreign direct investment, and a large knowledge worker base. The Industry Nexus strategy is based on regional market expertise and locational advantages for the specific industry.

V. CONCLUSIONS

The emergence of global e-business presents new paths for development for emerging economies because the infrastructure requirements for successfully applying information technologies differ from those of the industrial age technologies.

- First, information intensive services do not depend on the physical infrastructure such as effective transportation networks that are essential for traditional manufacturing technologies. They represent a shift from physical assets to electronic and intellectual assets. As a result, the need for an educated labor force is even more important than before.
- Second, information technologies allow for the dispersion of economic activity. In manufacturing technologies production needs to be concentrated in central locations to achieve economies of scale. The production of IT-enabled services, on the other hand, can be dispersed across different geographic locations.
- Third, information technologies are not as capital intensive as manufacturing technologies. As a result, entrepreneurs in emerging economies can enter e-business-related industries with relatively small technology investments.

Successful national strategies are built by exploiting distinctive national factor conditions. Strategies are not only based on strengths but also on unique disadvantages and challenges to be overcome [Porter, 1990]. For example,

- Ireland used information and communication technologies to overcome its geographic distance from the rest of Europe.
- Indian firms used social networks and innovative financing strategies to overcome institutional obstacles for international expansion.
- Finnish firms strove for technological leadership to gain visibility in world markets.
- Singapore launched extensive national initiatives for promoting international trade to address the competitive challenge in manufacturing from its neighboring countries.

The skills developed in overcoming such obstacles can serve as an important basis for competitiveness.

The cases of the Four Tigers can be used to draw lessons for emerging economies to participate more effectively in global e-business and to close the digital divide. The following are our recommendations:

- Emerging economies may explore unique development paths opened up by alternative ways of applying new technologies.
- Emerging economies should first carefully consider the opportunities and requirements for applying information and communication technologies successfully and then develop their e-business infrastructure strategically.
- The Tiger strategies demonstrate alternative ways to configure resources for specific e-business activities.
- To adopt a particular e-business infrastructure strategy, emerging economies do not need high capabilities in all dimensions of e-business readiness. For example, several different types of alliances may be formed for knowledge creation.
- A high level of domestic technology adoption is not required for all strategies. Mechanisms for making capabilities routine depend on the situation in a country. Innovations may originate in universities, established firms, or start-up firms. Both local firms and multinationals may be involved in designing innovative business models to serve various market segments.

The Four Tigers serve as examples of distinctive e-business infrastructure strategies. In each case, national resources were mobilized and focused for building capabilities in a certain activity. Focusing on a specific e-business related industry is the first step in setting the process of capability improvement in motion. The resulting spillovers and complementarities in capabilities across industries then provide a foundation for long-term competitive advantage.

The strategic development of e-business infrastructure in emerging economies is an important way to address the digital divide and to create opportunities for accelerated development. Technology enthusiasts often speak of leapfrogging stages of development using information and communication technologies. However, such an approach suggests a set of pre-established steps in technological and industrial development. We suggest that development may be accelerated by identifying alternative paths for building technological capabilities. In Figure 3, we outlined four different paths to e-business infrastructure development that provide alternatives for emerging economies with varying factor conditions. The Four Tigers demonstrate that leadership in e-business infrastructure is possible even for small countries if they pursue focused strategies and use information technologies to leverage their human capital, institutional frameworks, geographic locations, and unique national visions.

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