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Authors

Kraemer, Kenneth L.
Dedrick, Jason

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NATIONAL POLICIES FOR THE INFORMATION AGE:

IT AND ECONOMIC DEVELOPMENT

**CENTER FOR RESEARCH
ON INFORMATION
TECHNOLOGY AND
ORGANIZATIONS**

University of California, Irvine
3200 Berkeley Place
Irvine, California 92697-4650

Graduate School
of Management
and
Department of Information and
Computer Science,
University of California, Irvine

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AUTHORS:

Kenneth L. Kraemer

Jason Dedrick

Center for Research on Information Technology and
Organizations.

Email: kkraemer@uci.edu and jdedrick@uci.edu

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ABSTRACT

This paper sets forth a new vision for national IT policy in both developed and developing countries. It argues that the coming wave in network computing presents many new opportunities for countries to promote greater IT use and to develop new IT industries. It develops a framework for national IT policy that will enable countries to catch the next wave in industry development and become a successful player in the global information economy. This new vision was developed from research conducted into the successes and failures of various countries by the authors and other scholars and practitioners.

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NATIONAL POLICIES FOR THE INFORMATION AGE: IT AND ECONOMIC DEVELOPMENT¹

Kenneth L. Kraemer and Jason Dedrick

I. INTRODUCTION

In recent years many countries have developed national IT plans for national information infrastructure, information industries and Internet diffusion. Implicit or explicit in these plans is the belief and the hope that they will stimulate productivity, economic growth and development. However, systematic evaluation of the plans indicates that generally they lack a clear, focused vision for the network era, an understanding of the policy instruments required for successful implementation of the plans, or resource commitments of the scale and scope required for success. Under the circumstances, governments would be better off to develop plans that are highly focused and targeted towards industry sectors where they have comparative advantage, and to work with private industry to pool resources towards common goals.

This paper sets forth a new vision for national IT policy in the information age for both developed and developing countries. The vision is that countries catch the next wave of IT industry and market development and become a leader in network-oriented information businesses. To achieve this vision, the government must enter into a new kind of partnership with industry that aims at achieving long-term cumulative benefits rather than short-term fleeting gains. The partnership should promote IT use by business, government and education; target appropriate IT sectors (software, services and

information content); develop national capabilities to support use and production of network computing technologies; and create global linkages to bring leading IT companies to the country and provide access for domestic companies to global markets. These policies need to be coordinated, and need to encourage cooperation among government agencies and the private sector in order to establish a role as a producer and user of network-oriented IT products and services.

This paper draws lessons from the successes and failures other countries studied by the authors, as well as country studies by other researchers (see Bibliography). It notes the coming wave in network computing and identifies opportunities for countries. Finally, it develops a framework for national IT policy that will enable countries to catch the next wave in industry development and become successful players in the global information economy.

II. LESSONS FROM INTERNATIONAL EXPERIENCES

When developing national information technology policies, it is valuable to study and draw lessons from the experiences of other countries around the world. The key is to find the common threads among highly diverse case studies that help explain why some policy approaches have succeeded while others failed. Often this analysis is oversimplified into dichotomies such as market versus plan, inward versus outward looking, or not so long ago, capitalist versus socialist. Another tendency is to get bogged down in fine details such as proper tariff rates or whether policies should distinguish between foreign-owned and national companies. However, recent studies of IT policies from a number of countries around the world indicate that a better set of criteria would

¹ This research has been supported by grants from the U.S. National Science Foundation and the NSF

be: (1) whether a particular strategy is aimed at creating linkages to global markets; (2) whether it creates national capabilities; and (3) whether it accurately targets industries in which a country is able to catch an emerging wave in technology and market demand, based on a realistic understanding of a country's strengths and weaknesses.²

The first two of these criteria for successful IT policies are easier to measure. Examples of policies aimed at *creating linkages to global markets* clearly include:

- Singapore's efforts to attract multinational disk drive companies and use those companies as a conduit to the global PC market (Wong, 1997);
- Taiwan's policies to identify market niche opportunities around the world in the PC industry and help local companies establish linkages to major producers (Kraemer et al., 1996); and
- Ireland's policies to attract multinational corporations (MNCs) to produce hardware and software for the nearby European market (Tallon and Kraemer, in press).

Examples of policies that *created national capabilities* include:

- Taiwan's establishment of government-affiliated R&D centers to develop technological capabilities needed by its entrepreneurial computer makers;
- Singapore's policies to train IT professionals and engineers needed by both producers and users of IT; and
- Hong Kong's development of a high-quality, low-cost communications infrastructure that now serves as a hub for hundreds of MNCs in the region.

Industry-University Cooperative Research Center in CRITO at the University of California, Irvine.

² These criteria are developed in Jason Dedrick and Kenneth L. Kraemer, *Asia's computer challenge: Threat or Opportunity for the U.S. and the World?* (New York and Cambridge: Oxford University Press, 1998). Other country-specific studies are listed in the bibliography used to develop this paper.

The third criterion, *targeting the emerging wave with industries that fit a country's strengths*, is more difficult. It is easy to identify a technology wave after the fact, but hard to determine in advance. Both Singapore and Taiwan staked their policies to the PC industry in the early 1980s, at a time when there were tremendous growth opportunities and little competition; earlier, Japan successfully targeted the consumer electronics industry, semiconductors, and mainframe computers as demand for these products was soaring. By contrast, countries such as France, Germany, the U.K., Brazil, India and Korea all targeted either mainframes or minicomputers just as the PC revolution was taking off (Dedrick and Kraemer, 1993b, 1998a, 1998b). It is very difficult to identify these new waves of technology as they are emerging.

Finding growth opportunities that fit a country's strengths and weaknesses is perhaps the hardest of all, as it requires the ability to dispassionately analyze one's own capabilities, and to understand what capabilities one can realistically hope to create. For instance, Taiwan understood that it could not hope to compete in mainframe computers. Instead, it targeted PCs and related components and peripherals that its small companies could produce competitively for the global market, and worked on developing related capabilities (Kraemer et al., 1996). By contrast, Korea has invested in the development of a national minicomputer, attempting to compete in a market dominated by a few multinationals. That computer has sold only a handful of units outside of the Korean government market and the business groups of the companies that produce it (Dedrick, Kraemer and Choi, 1995).

Countries need to pursue policies that gain leverage from their strengths and create the capabilities needed to use that leverage. So if a country has strengths that

apply well to the software and service industries, it would be best to promote those industries and develop the necessary infrastructure and skills needed to capitalize on the opportunities in those markets. Such a country would likely be wasting its money and energy trying to create all of the resources needed to support a disk drive or DRAM industry.

III. NEW OPPORTUNITIES IN INFORMATION TECHNOLOGY

So, a key task for policymakers is to look for opportunities in technologies and markets that already have proven their value, but are far from saturated. In the IT industry, there is a closely linked cluster of opportunities that fit this definition perfectly, with measurable immediate payoffs and tremendous longer-term growth potential. These opportunities also benefit from the fact that they do not require huge up-front investments, and do not depend on proximity to the extensive supplier base needed to support most hardware production. As such, they are a good fit for many countries that are not already major players in the well-established global production network. These opportunities center around:

- IT use
- Internet use
- IT production
- Production close to use, namely production of software, services and information content for both domestic and global markets.

IT Use

There is very strong evidence that investments in IT use have high payoffs at the national level in the form of economic growth and increased productivity. Economic studies at the firm level show that IT is positively related to economic growth, that gross returns to IT investments are in the range of 50% to 100% at the margin, and that returns to IT are greater than returns to non-IT capital such as plant and equipment (Dewan and Min, 1997; Lehr and Lichtenberg, 1997). In addition, recent economic studies at the country level estimate that the average gross returns from IT use in developed countries is 70.6% (Dewan and Kraemer, 1998; Dewan and Kraemer, in press; Wong, 1997). In other words, an increase in IT capital stock of \$100 million is associated with an average increase in annual GDP of \$70.6 million. And in the U.S., investment in IT use has contributed more than one third of the recent economic growth.

The significance of investment in IT use is heightened by the globalization of business that is occurring in the world in all industry sectors. Increasingly, products designed in one country are made in others with components from still other countries, and then marketed throughout the world. This global production system relies on IT to link it all together. Therefore, countries desiring to participate in the global production system must develop their own IT capabilities through both short-term and longer-term strategies.

Internet Use

There is also evidence that network computing increases the payoffs from IT use, and the power of network economies means that the value of IT use increases in proportion to the size of the network. To illustrate, a stand-alone PC is only useful for increasing personal

productivity, but when linked to a network it can become a tool for information sharing, communication, and collaboration within and among organizations.

When linked to the global Internet, the value of the PC is multiplied by the millions of people who can communicate and share information using the same protocols no matter where they are or what local network they belong to. Considering that the Internet has only been open to commercial use for a decade or so, and that the World Wide Web is even younger, it is clear that the potential value of belonging to this network is just beginning to be understood.

IT Production

In addition to IT use, there are considerable benefits at the national level from local *production* of computer hardware and packaged software. In fact the benefits from production are often more visible and easily measurable than those from use. The benefits from production include jobs ranging from unskilled assembly to highly skilled design and engineering. They also include participation in a dynamic, high-growth industry with strong export potential and creation of national technological capabilities.

Evidence of the value of IT production in the United States has recently been documented by a 1998 report by the U.S. Department of Commerce (DOC, 1998). The report estimates that IT industries (computer hardware, communications equipment, software and services) accounted for 7.5% of the U.S. economy and 15.8% of GDP growth in 1996. When adjusted for falling prices, the contribution is estimated to be even greater, accounting for 34.7% of GDP growth in 1996. It is also argued that IT production contributes to lower inflation rates, since a growing share of economic output is in an industry marked by rapidly falling prices. The report argues that actual inflation,

which was 2.0% in 1997, would have been 3.1% without the effect of the IT industry's declining prices. Finally, the IT industry employed 7.4 million workers in 1996 (6.2% of total employment), with an average annual wage of \$45,737, compared to \$28,000 for all private employees.

Outside the U.S., other countries have had equally impressive results from IT production. The IT industry is a major source of economic output, exports and jobs in countries such as Japan, Taiwan, Singapore, Hong Kong, China, Korea and Ireland, thanks mainly to opportunities created in the PC hardware industry beginning in the early 1980s (Kraemer and Dedrick, 1995; Dedrick and Kraemer, 1998a; Tallon and Kraemer, in press). Countries such as India, China and the Philippines are also finding opportunities in the software industry thanks to large supplies of programmers. It is not surprising that policymakers are attracted by the possibility of developing national computer industries, and that many developing countries (e.g., Brazil, Mexico, Malaysia, Thailand and China) have used various policy tools to encourage investment in IT production.

Creating a local IT industry is not a simple matter, however, especially for newcomers to the industry. While a number of new countries entered the industry during the PC revolution of the 1980s, other countries had little success, and some earlier industry participants, such as most of Europe, were squeezed out. Even Japan has never had much success in computers (as opposed to components) outside its own market. If anything, the opportunities for newcomers are more limited today. Industry segments such as microprocessors, operating systems and packaged business applications are virtually closed off because the standards are set by the leading players in the IT industry,

mainly U.S. companies such as Intel and Microsoft. Other segments of the hardware industry require large capital investments and economies of scale that few countries can hope to achieve. Moreover, many of these opportunities have already been preempted by earlier entrants such as Singapore, Hong Kong, Korea, Taiwan, Ireland and Israel.

Only a few newcomers with large domestic markets are likely to enter these industry segments, as China is doing by negotiating with multinationals for production and technology transfer in return for market access. A few others, such as Mexico, can take advantage of a unique location or special trade relations with the U.S., and can benefit from policies that encourage investment in hardware production. On the other hand, a number of countries are offering expensive incentives to attract foreign investment in hardware production, but even if they are successful, they are only creating decreasing returns businesses, with limited value added and high entry barriers for local companies to participate (Arthur, 1996; Dedrick and Kraemer, 1998a).

Finally, it is important to recognize that production benefits primarily one industry sector—the IT sector, whereas IT use can benefit all industry sectors. So if local production is promoted at the expense of domestic users, for example through import barriers that raise prices, the bargain is probably a bad one for the economy as a whole. Given the choice between promoting production or use, the findings of research argue for use, especially in countries that are not already part of the global production network of the computer industry. Fortunately, the choice is not that stark in most cases. In fact, there is a policy option that simultaneously encourages IT use and Internet use while also creating opportunities to develop a local industry—that is, production close to use.

Production Close to Use

If a country did nothing more than just find opportunities as a user of IT and networked computing, it would realize great benefits, and therefore policies to promote use make sense on their own merits. But the third element of this cluster of opportunities is equally exciting. The network computing era offers a whole range of opportunities to develop high-growth industries that ride this emerging wave in information technology.

First, it is worth considering the opportunities for production linked to domestic IT use, or production close to use. The fastest growing segments of the global computer industry for over a decade have been software and services (Table 1). Within the U.S., for example, these segments have also grown tremendously in employment while hardware industry employment actually has declined (Table 2).

Table 1. Computer industry growth rates, 1985-1995

Industry segment	CAGR (%)
Hardware	11.0
Software	15.9
Services	20.9

Source: McKinsey & Co. *The 1996 report on the computer industry*.

Table 2. Computer industry employment, 1985-1996 (Thousands)

Industry segment	1985	1990	1996
Hardware	350	294	234
Software and services	600	800	1,200

Source: Dedrick and Kraemer, 1998a; DOC, 1998, p. A1-10.

The software and services industries offer specific advantages over hardware production. While some parts of the software industry are dominated by multinationals, there are still many opportunities to develop niche products without competing directly with Microsoft, Oracle, SAP and the other large companies. For example, there are

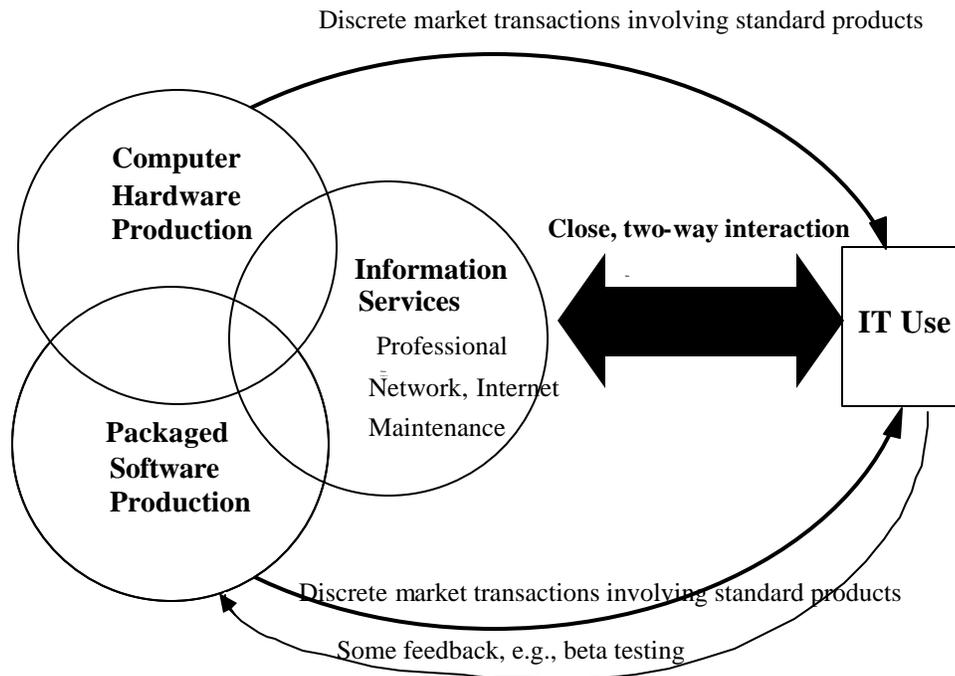
opportunities to do localization of imported products, to work with multinational corporations (MNCs) in developing software for global markets, and to develop specialized software for niches that are not satisfied by one-size-fits-all packages. These may be products that target local markets by meeting the needs of local language, culture and business environments. Other products for specialized vertical markets or for poorly served horizontal markets such as small and medium-sized enterprises (SMEs) can be developed locally and then exported. Some cases illustrate these opportunities:

- Irish companies, in cooperation with MNCs, are localizing software for markets in Europe and Latin America (Tallon and Kraemer, in press).
- New Zealand companies, in cooperation with local government, have developed packages for wool grading, irrigation and other agricultural applications.
- Singaporean companies, also in cooperation with the government, have developed software to speed customs and port operations (Kraemer et al., 1990; Wong, 1997).
- Brazilian companies have developed banking automation software to meet the unique demands of its financial markets. Now, in cooperation with the government, research institutes and universities are developing many new software products for export (Dedrick and Kraemer, 1998b).

The services business offers even more compelling opportunities, as services usually must be provided locally rather than being imported. But while information services are generally a local business, there are still export opportunities if a country can become a regional business center and provide services to other countries in its geographic region. Probably the greatest value of the services industry is that it requires

continuous interaction between local users and providers, and can benefit users as well as providers. Figure 1 shows how information services such as professional services (consulting, systems integration, outsourcing), network and Internet services, and maintenance services, serve as a link between production of computer hardware and packaged software and IT use. These linkages help local users apply the technology more effectively, and can create business and employment opportunities for local people. These businesses are appropriate for many countries because there are lower entry costs, so local companies can start small and grow at a pace that is supportable by their own finances and capabilities.

Figure 1. Information services as link between production and use



Source: Dedrick and Kraemer, 1998a.

The information services market is closely linked to local markets because vendors must work closely with clients to develop solutions to specific problems, through systems integration, custom programming, outsourcing, network services—and, more recently, Internet services, web page design and electronic commerce. These services may be provided by local firms or by subsidiaries of MNCs, but the work must be done locally by local people, who gain experience and skills in the process. There is potential for these services to be standardized into packages that can be exported, such as Singapore Network Services' Tradenet, Lawnet and MediNet systems.

It is also possible to provide services remotely for foreign customers, in effect exporting those services. For instance, Costa Rica has become a call center for U.S.-based PC vendors, Mexican companies have contracts with U.S. companies for Year 2000 projects, and a number of Caribbean countries have become data processing centers for all sorts of U.S. companies. The most obvious example is India, which provides programming services to multinationals such as Citibank, Hewlett-Packard and Microsoft, earning hundreds of millions in foreign exchange for the country (Dedrick and Kraemer, 1993b).

In the future these opportunities will continue to grow, but they will likely be dwarfed by the expansion of Internet-based business. The Internet is already becoming a platform for marketing physical products such as cars, computers, books, CDs and flowers, and services such as ticket sales for airlines and entertainment venues. A company such as Amazon (the Internet bookstore) or Dell Computer (the direct-sales computer company) can operate anywhere in the world that has the necessary information infrastructure, human resources, and business environment to support it.

The Internet will go even further to serve as a platform for entire information businesses. Companies will develop, market and distribute information products on the Internet, with no need for plants, warehouses or shipping companies. Books, magazines, music, video and new multimedia products will be sold over the Internet, with marginal production and distribution costs approaching zero. All a business will need is computers, high-speed Internet access, and creative people to be able to compete with even large established companies.

IV. OPPORTUNITIES IN THE NEXT WAVE

This cluster of markets and technologies is clearly definable today, and is wide open to any country that creates the right environment to nurture it. The model is the U.S., which is the leading user of IT both in size and sophistication, has capital markets capable of supporting companies with completely intangible assets, and has a regulatory environment that allows the free exchange of information and ideas. Smaller countries such as Israel, New Zealand, Singapore, and the Scandinavian countries are also highly advanced users of IT and have found opportunities as producers of hardware, software and services as well. Even developing countries have been successful in niche markets, such as Brazil in banking automation and India in custom programming.

The Policy Challenge: Relevant Lessons from Other Countries

Most of the countries that have been successful in developing IT industries over the last twenty years have followed positive policies and provided substantial incentives to target appropriate IT sectors, develop global linkages, create local capabilities, and promote IT use. Table 3 provides a summary comparison of the strategy and policies for three countries that

have been particularly successful and one that has not been successful.³ It shows that successful countries have:

- Targeted specific sectors for development and created industry clusters
- Proactively sought and promoted foreign and domestic investment
- Provided positive incentives, both for initial investment and for reinvestment
- Provided incentives for foreign MNCs to partner with domestic firms
- Provided incentives for private R&D investment, technical and managerial training, and developing foreign linkages
- Avoided coercive policies that require investment in exchange for market access or participation in government procurements
- Promoted computer use throughout the economy.

It is significant that the successful countries had coordinated government-wide strategies. They did not achieve success through piecemeal, ad hoc initiatives for telecommunications, procurement, small business promotion, multimedia and other IT-related policies. Instead, policies emphasized the long-term partnerships between government, MNCs, universities and local companies (both users and vendors), with the goal of developing capabilities and creating an environment needed to ride the then-emerging wave of personal computing.

³ Note that in the case of Korea, the lack of success is specifically in the computer industry, where its exports of PCs dropped from US\$1 billion in 1989 to just US\$200 million in 1995 (Dedrick and Kraemer, 1998a). Obviously Korea has been much more successful in semiconductors and consumer electronics.

Table 3. Comparison of strategy, policies and incentives for IT industry development in selected countries

Strategy, policies, incentives	Successes			Failure
	Singapore	Taiwan	Ireland	Korea
Targeting IT sectors	Targeted disk drive industry initially, moving upstream to semiconductors and downstream to content in the late 1990s	Targeted production of components and OEM production for the PC industry and now moving upstream to semiconductors.	Targeted assembly operations for MNCs in the 1980s and now moving to software localization, information services, and support in 1990s.	Targeted PCs as a means of creating demand for electronics production.
Developing global linkages	Attracted foreign investment. Provided grants, land, infrastructure and favorable tax treatment for 10 years, renewable for another 10 years for upgraded investments. Encouraged export production through special tax incentives for exports.	Became supplier of parts and components to foreign multi-nationals, gradually moving upstream to higher value-added and OEM production. Acer Computer now a Taiwanese multi-national operating in over 50 countries.	Attracted leading multinational firms in the computer hardware and software industry, performing low-cost manufacturing and software localization. Offered government grants, land and infrastructure, and low taxes. Additional incentives for exports.	Failed to develop linkages to global production system or MNCs. Tried to develop PC industry all alone.
Creating local capabilities	Government trained IT professionals to build and use IT systems. It also trained engineers, computer scientists and technicians for industry needs. Provided incentives to MNCs to upgrade production activity, spin off businesses to domestic SMEs, and upgrade capabilities of SMEs.	Government upgraded the capabilities of SMEs by education and training, creating research consortia, technology transfer from government research institutes, and shared market research. Currently developing software and information services firms through grants, loans, training and tech assistance.	Strong support for education and training on a broad basis has created a talented work force with technical, language and cultural skills at edge of European continent. Provided incentives to MNCs to upgrade technology and skills of domestic firms who were suppliers.	Failed to build long-term capabilities. Provided protection but not capabilities. Failed to build competitive domestic industry. Industry structure not flexible.
Promoting IT use and production close to use	Created a "culture" which made IT use and IT careers highly valued. Invested in government IT use. Provided incentives to private sector for use	Initially a laggard in IT use. Now promoting IT use and careers through exhibitions, fairs contests, and media. Promoting production close to use in software, services and Chinese information content.	Promoting production close to use in software, services and information content.	Failed to promote IT use among business and industry or the general population.

Today, a new wave is emerging in the information industries, oriented towards network computing and network-oriented businesses. However, the factors that will lead to successful government partnerships with industry have not changed. Experience shows long-term partnerships with industry were best enabled through:

- Financial and infrastructure incentives to attract foreign investment, such as lower corporate taxes; tax credits for R&D, capital investments and exports; building sites and infrastructure; and worker training programs (Hong Kong, Ireland, Singapore, Taiwan).
- Proactive search for particular firms that provide a hub for upstream and/or downstream activities, and for the needed complementary firms to create an activity cluster. Subsequent treatment of these firms as "clients" making long-term investments for company and country mutually beneficial (Ireland, Singapore).
- Consultation with private firms to understand their business in order to develop meaningful and effective long-term incentives (Singapore, Ireland).
- Cooperation with foreign firms to win competition within the firm for investments in the host country (Singapore).
- Incentives for foreign firms to partner with domestic firms, to upgrade their products for global markets, to link them to global markets, and to upgrade their technical and managerial capabilities (Taiwan, Singapore).
- Support for industry-university cooperative research, centers of excellence, technology transfer, and small business incubation (Brazil, Hong Kong Singapore).

It is also significant that the successful countries measured policies by whether or not they led to creation of an internationally competitive IT industry. When policies are measured by how many firms are attracted, or how many jobs are created in a particular state or city, or how much one company commits to spend on R&D, or how much it will subcontract to local companies, or whether an outsourcer will buy PCs from a local assembler, the impact of those policies is often not sustained.

This type of approach has been tried, for example, in Mexico in the 1980s, when the government required foreign computer makers to commit to targets for R&D, local content and exports. IT users bore the costs of these policies in the form of high prices and limited choice, and there was little resulting success in developing a domestic industry. When Mexico opened its computer market to foreign competition in 1990, most of the domestic producers disappeared, MNCs pulled out of relationships with local companies, and funding for local R&D projects dried up.

In contrast, beginning in 1980 Singapore targeted specific IT industry sectors that matched its existing capabilities in low-cost production of electronic and electromechanical devices. Singapore treated MNCs as partners, offering incentives for initial and continuing investments, helping them upgrade their production in Singapore, and using the success of early investors to attract other companies. By working closely with the MNCs, Singapore created enthusiastic partners who served as linkages to the global market. They also provided assistance to local companies to become suppliers to the MNCs in order to create an industry cluster for production of PCs, peripherals and disk drives. The result is a country of less than 3 million people being the world's fourth largest producer of computer hardware.

Singapore's policies have had the specific goal of creating capabilities needed for a globally competitive IT industry. MNCs brought in the most advanced production technologies and trained Singaporean engineers in state-of-the-art manufacturing skills. The government played its part by training thousands of IT professionals, building outstanding sea and air cargo facilities, developing a high-quality telecommunications system, and maintaining a safe, stable business environment. It also heavily promoted the use of IT in all government agencies and throughout the economy, making IT use part of the infrastructure to support economic growth. More than any other Asian country, Singapore has followed a "walking on two legs" policy,⁴ with equal emphasis on production and use. The result has been the highest levels of use in Asia, and a corresponding growth in production of software, services and information content.

Finally, it is significant that the successful countries engaged in government-industry relationships that provided synergy and did not require "unnatural acts" by either partner. Excessive government incentives to attract firms to places that don't make economic sense might attract a few firms initially but when the incentives stop the firms will pick up and leave for places with better incentives or places that simply make greater economic sense. Similarly, requiring firm investments in production or R&D in exchange for access to specific government procurements distorts both the procurement process and the business decisions. More importantly, it might result in haphazard business investments tailored to win specific procurements, rather than to fulfill a careful plan for industry development. The most successful partnerships are focused on industry development and identify high payoff areas, leverage

⁴ This term was coined by Robert Schware of the World Bank in a 1992 paper, "Software industry entry strategies for developing countries: A 'walking on two legs' proposition," *World Development*, 20(2), 143-164.

capabilities, fill in industry gaps, serve mutual interests and bring greater benefits to companies and countries.

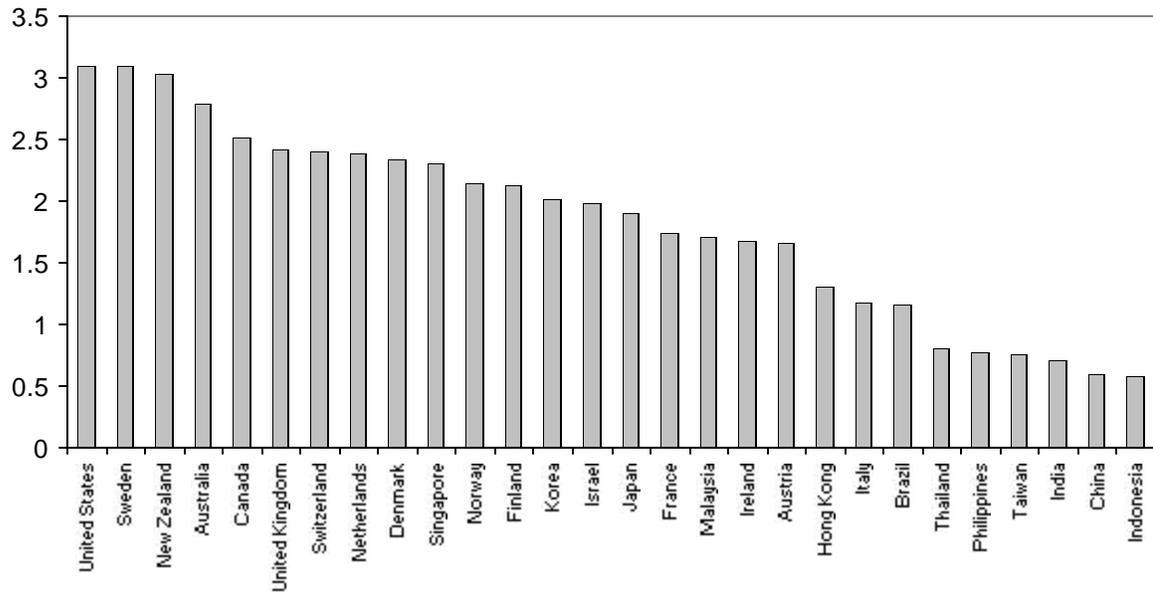
V. A FRAMEWORK FOR NATIONAL IT POLICY

We suggest a new vision, especially for developing countries and other countries that are not IT producers now: that they be on the forefront of the next wave in industry development, which is network-oriented information businesses. This means a focus on promoting IT and Internet use, production close to use, and network-oriented businesses. The next task is to develop policies and specific incentives and to implement them, keeping in mind that they must involve government, industry and university partnerships. Policies for the network-oriented information businesses must emphasize these key areas:

- Promoting IT use
- Targeting appropriate IT sectors within the country's capabilities
- Creating national capabilities
- Developing linkages to the global economy.

Promoting IT Use

There is a wide range in the level of IT use by countries, with developing countries lagging behind developed countries in quantitative terms (Figure 2). Along with the need to invest more in IT, there is also a need to move beyond the old models of using IT to automate existing processes and begin to use IT as a tool for transforming business, government and education. This means taking advantage of network economies by linking people and organizations through the Internet, and then using the capabilities of information networks to achieve economic and social benefits.

Figure 2. IT spending as a percent of GDP, 1995

Source: International Data Corporation, 1995.

One of the best ways to promote IT use is simply to not create barriers to use. Any government policy that makes computers more expensive will discourage use and reduce the possible benefits of IT. Government can do more than just get out of the way, however. It can also set an example by becoming a leading user in its own operations. Many government bodies are now setting up web sites where citizens can get information about services, download forms, gather data, and communicate with officials. Governments can encourage use of these services by providing Internet access in libraries, schools and other public facilities. A further step is to allow individuals and companies to transact business with the government electronically. This can involve things such as tax filings, customs documents, permit applications and much more. Another important way to promote use is through the schools. Putting computers and Internet access in school rooms, providing necessary support services and training

teachers in the use of IT in the classroom not only can improve education, but can also create a new generation of children who are comfortable with using the technology.

Targeting Appropriate IT Sectors

Countries that have been successful in developing an IT industry have targeted the sectors in which they wanted to develop the industry in recognition of their real and potential comparative advantage. Countries such as Taiwan, Singapore, Israel and Ireland identified their own strengths and weaknesses and made policies that created the right capabilities for their situation. However, based on even a cursory analysis of strengths and weaknesses, it is possible to draw some conclusions about what types of information industry activities make sense for countries that are farther from major markets or that have little experience in the industry. Good prospects would include any activity that requires skilled workers (who can be trained), production closely linked to niche markets, and any activity that can be linked to the global economy via communications networks. Bad prospects would include any activity that needs to be close to a large market, or requires proximity to a supplier base, or that can only be linked to global markets and production networks through transportation of physical products.

Taking these criteria into account, one can identify an initial list of activities that would make good prospective businesses:

- Localization and support of general purpose software
- Development of specialized software for vertical or niche markets for which there is local demand
- Services linked to local IT use, such as systems integration, outsourcing, and PC and network integration for local businesses

- Prototyping and testing of new network technologies
- Call centers
- Regional business centers
- Support for electronic commerce
- Internet content.

Another list can be drawn up of activities with poor prospects for developing countries and newcomers: virtually any kind of mass hardware production, including PCs, peripherals and components; semiconductor production; and general purpose packaged software (e.g., operating systems, office suites). These distinctions help to avoid policies that either target the wrong industries, or inadvertently create an adverse climate for the right ones.

The choice of more appropriate information industries also creates more opportunities for successful industry development throughout the country. While the hardware industry has traditionally thrived in an industry cluster such as the Silicon Valley, the advantage of network-oriented information businesses is that they can be highly distributed within a country. As indicated earlier in the discussion of Figure 1, information services are best done close to the end users. The key is to figure out the strengths of different states or localities and encourage the use of IT to enhance them. For example, Sapporo, Japan developed a plan for IT use that was uniquely suited to its remote location, climate and culture. Dubbed "Snowtopia," the plan called for focusing on the use of IT related to winter activities. This included the use of CAD, configuration software and EDI for design of winter fashions and production of clothing; the use of multimedia for promotion, registration and reporting of winter sporting events; the use of

telemonitoring and broadcasting for reporting of weather, road, and ski conditions; and so forth.

Because software and services are extremely malleable IT industries, they can be adapted to serve such local strengths and to develop commercial IT products that can be used in similar environments around the world. There are also prospects for information content, such as CD-ROMs that provide entertainment and education related to a country's unique characteristics. By making such distinctions, and hard choices about which prospects to pursue, policies can be developed that focus on creating and enhancing capabilities required to support the information industries which make sense for particular countries.

Creating National Capabilities

Countries must create national capabilities to support IT use and the growth of IT industries over the long run.⁵ The key assets required to compete in the network era are skilled people, a good information infrastructure, and an environment conducive to entrepreneurship and innovation. The types of people needed obviously include IT professionals such as software engineers, programmers, management information systems specialists and other technical specialists. They also include technologically

⁵ The emphasis in many national IT policies has been on a particular short-term outcome, such as creating new jobs, increasing exports, or attracting new investment. Those outcomes should be seen as the beneficial side effects of a sustained effort to create lasting capabilities. To use the analogy of a garden, those are the fruits or flowers of a successful gardener's efforts, but they cannot be created directly. Instead, a gardener must till and fertilize the soil, plant good seeds, ensure that there is sufficient sunlight and water, and nurture the plants as they grow. Most importantly, the gardener must have patience and realize that the most important activity is happening beneath the soil, and that results may not be obvious for some time. It took 15 years for Ireland, Singapore and Taiwan to develop their information industries, and they continue to evolve and change with new technologies and markets. In spite of the sense of urgency created by the rapid growth and changes in the information industries, countries need to follow the wise adage that says "make haste slowly." By trying to rush things, the temptation can be overwhelming to get some visible results quickly rather than to build for the long run.

savvy business people in both user organizations and in the IT industry. This combination of technological and business skills is sorely lacking in most countries, as people tend to train for and work in either technical or business careers.

What is needed for the future are innovative programs that provide training, mentoring, knowledge resources and other means to cross-fertilize the two fields. A number of universities such as Stanford, MIT, the University of California (Irvine), Hong Kong University of Science and Technology, Mexico's Monterrey Technical Institute and Brazil's Pontifica Catholic University, have developed entrepreneurship programs, technical MBAs, small business incubators for graduates, and other such innovative programs. In fact, many of the hottest Internet companies in the U.S. are based on technologies and business ideas developed within universities, including, for example, Yahoo! and Trilogy (Stanford), Netscape (University of Illinois) and Lycos (Carnegie Mellon). By energizing the educational system, a country can create the human resources needed to get the most value from its IT use and to build a strong IT industry.

Information infrastructure is equally important in the network era. A recent OECD (1996) report presents evidence that countries with the most competitive telecommunications sectors have the highest levels of Internet use. Telecommunications privatization and deregulation in places such as the U.S., the U.K., parts of Scandinavia, New Zealand, Singapore and Hong Kong have made them leading Internet users. But most countries still have room for increased competition and policies that encourage investments in high-speed infrastructure to support their growth into a major hub for regional and global network activities. The economic power of networking comes from

having millions of users connected. Small and geographically isolated countries can expand their markets dramatically by being connected internationally.

Creating an information infrastructure that is among the best in the world involves more than just getting more fiber optic cable in the ground, or satellites in the sky. It also involves avoiding the temptation to tax the Internet or to see electronic commerce as a new source of government revenues. In recognition of the importance of promoting IT use for economic growth, the World Trade Organization's members recently clinched an agreement to keep transactions on the Internet duty free ("Trade Talks," 1998). The U.S. Congress recently voted not to tax Internet transactions and is urging the states to follow suit. To a large extent, policies that encourage competition and minimize taxes and regulations on telecommunications are the most effective ways to create an environment conducive to network-era industries. In some cases, direct government investment is also appropriate, for instance in building a high-speed research network such as the original Internet and the new Internet II in the U.S. Here, government is supporting advanced R&D and also creating a structure for succeeding commercial investment.

In order to promote the entrepreneurship needed in an emerging industry, policies are needed to support the small and medium-sized enterprises (SMEs) that must provide dynamism and innovation in those industries. This can include mechanisms to provide venture capital, small business loans, management training for technically-oriented entrepreneurs, and market research services and overseas trade offices to help find export opportunities. Finally, it is necessary to create a regulatory and legal environment that supports innovative activities by protecting intellectual property rights and personal privacy, and by not trying to control the free flow of information on the Internet.

All of these policies would be aimed at creating a favorable business environment, developing infrastructure and human resources, encouraging global linkages, promoting innovation, and creating an image of a country as "the place" for network-oriented business activities.

Creating Global Linkages

Creating global linkages means attracting the best companies in the world to locate in a country and helping local companies find business opportunities either working with multinationals or selling directly to global markets. A new approach is needed to replace the rather defeatist approach of forcing foreign companies to offer a few crumbs to a country in exchange for market access. Instead, countries should be thinking about how to create an environment which will make them irresistible to multinational network computing companies (and virtually every major IT company is redefining itself in terms of network computing), and which will create a fertile ground for local companies to grow into globally competitive network computing companies in their own right.

To do so, countries should embrace free trade with true confidence in its people's intellectual and creative abilities. Anyone who speaks to Singapore's officials who have created and implemented that country's successful IT policies will be struck by the supreme confidence that they have in their tiny country's abilities to compete with the best in the world. Some may find that this confidence borders on arrogance, but it represents a history of solving problems and working in positive partnerships with multinationals to build the Singaporean IT industry. By contrast, the often defensive

attitudes of governments in India, Brazil, Korea and even Japan have helped isolate those countries from the global production networks of the IT industry.

One example of a confident free trade policy would be to sign on to international agreements that remove trade barriers for IT products and promote open and fair government procurement processes. This would have the benefit of forcing national governments to abandon inward-looking policies and develop new coherent strategies for the network era. An equally important benefit would be access for domestic companies to export markets in other countries. As a country evolves into a network computing leader, it will have skills and resources to compete in the many countries that are steadily opening their IT markets. Refusing to sign on to such agreements will leave the country isolated from those dynamic markets.

Commensurate with the shift toward creating a fertile environment for network computing would be policies that create real partnerships between the global multinationals, government, and local industry. Rather than trying to coerce multinationals to invest locally, the government should try to understand the forces that will naturally propel those companies to tap a country's capabilities. The recent and continuing history of the IT industry is one of focusing ever more on core business functions and outsourcing everything else to the best available source of capabilities. It is well known that companies such as Compaq, Dell and Hewlett-Packard outsource much of their production to Taiwanese companies. What is less well known is that they and others outsource functions such as service, support, and call center operations, often in countries such as Ireland, Singapore, Malaysia and even Costa Rica. Countries with a reasonably good infrastructure and multilingual population can easily take on such

functions, which create jobs and business for local companies. They can also find opportunities in more sophisticated activities such as network management, systems integration, support for electronic commerce, and specialized software development.

Government should work with multinationals to facilitate their use of local suppliers, and help local companies find opportunities in these natural niches. There are also many prospects for R&D as well as more basic research in IT use, network technologies, and other fields in which a country can be a leader. These could include research on small-business IT use, language translation tools for the Internet, management of virtual distribution networks for information products, and better tools for web site design and management.

VI. NEXT STEPS

To begin, a country must get the highest-level policy participation and buy-in to the vision for network-oriented businesses, and to the provision of resources for its implementation. Then an interagency body of high-level officials responsible for implementing the vision must be created to develop a national IT plan which specifies the role that each agency will play to implement the vision. The participating agencies would need to include those responsible for economic planning, industry development, trade and export promotion, science and technology investment, education for IT professionals and users, high-tech employment and training, and government use of IT.

A strong agency among these, or a new agency, must be given full authority to coordinate policies and actions across the government in relation to the vision for the information industries. This authority must include resource allocation, priority setting, implementation, and evaluation of agency performance. A strong coordination agency is

needed because the single greatest problem with the vast majority of IT plans is the lack of power to coordinate government agency policies and actions towards implementation of a vision. Singapore is an outstanding exception in that regard, but even it stumbled and had to reorganize its coordination mechanisms for its IT 2000 plan.

The coordination agency must be given a life span and an independent budget sufficient to secure cooperation by the other agencies within the government and to support partnerships with industry, research centers and universities outside the government. The coordination agency's funds generally should be used to secure cooperation, whether it is used to encourage a particular government agency's direction, cooperation between agencies, partnerships with industry, IT-oriented research and education in universities, or equity investment in pioneering firms.⁶ Finally, the national government must stay the course, modifying policies and actions found wanting, learning from mistakes, and always driving to achieve the vision.

VII. CONCLUSION

Many countries lack a successful IT industry, or an IT industry at all, yet they increasingly seek to develop some sort of national IT capability. In order to develop one, the government must have a vision that is anchored in the next wave of IT industry and market development. We have suggested that many countries have great prospects for becoming a leader in network-oriented information businesses. We have also suggested what it takes to do so, including:

⁶ Korea's first-five year plan for the National Administrative Information System was successful in securing cooperation because it provided \$200 million for projects that fit the plan, but failed when those funds were cut and agencies had to fall back on their own budgets. Similarly, Mexico's recently developed, excellent IT plan suffers from a lack of funds to secure interest or cooperation among government agencies in implementing it.

- Promoting IT use by business, government and education;
- Targeting appropriate IT sectors, which would include software, services and information content;
- Developing national capabilities to support use and production of network computing technologies;
- Creating global linkages to bring leading IT companies to the country and provide access to global markets for domestic companies.

To achieve long-term benefits, policies need to be coordinated and cumulative. They need to encourage cooperation among government agencies and the private sector in order to establish the country as a regional and global hub for network computing activities. Such a well-coordinated strategy, built upon a unifying vision of the country's role as a producer and user of IT products and services, will serve its long-term interests and help it become a world leader in the coming wave of network computing.

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