Chapter Six

MANY FACTORS SHAPE AND CHARACTERIZE A NATION'S APPROACH TO THE INFORMATION REVOLUTION

Many factors shape and characterize a nation's or region's approach to the information revolution. Some of these factors are *causative;* they are the underlying factors shaping a nation's or region's IR posture. Other factors are *resultant;* they help characterize a nation's or region's IR posture, but are effects, not causes. Together these factors distinguish one nation or region from other nations or regions insofar as the information revolution is concerned.[1]

SOME FACTORS ARE CAUSATIVE

Rich Nations Are Better Positioned Than Poor Nations to Exploit the Information Revolution

As with much else in life, rich nations are better positioned than poor nations to take advantage of advances in information technology and meet the challenges posed by the information revolution. Rich nations—i.e., nations with high gross domestic product (GDP) per capita—are likely to have[2]

- well-developed physical infrastructures (e.g., electric power grids and telecommunications networks), providing a strong foundation for IT applications and IR developments[3,4]
- well-educated populations with high literacy rates, providing the human capital required to readily exploit IT advances
- strong financial and institutional support for research in information science and technology, leading to a ready supply of

trained IT professionals and ready access to exploitable IT technologies

- legal structures permitting and enforcing rights to informational goods.

Poor nations—i.e., nations with low GDP per capita—are likely to be deficient in each of these areas.[5] This will impede their ability to exploit advances in information technology, thereby rendering it more difficult for them to meet the challenges posed by the information revolution.[6] Thus GDP per capita is probably the single most important determinant of a nation's IR posture.[7]

How a Society Deals with Change Is a Major Factor Shaping a Nation's IR Posture

The information revolution involves substantial change—in how people live and work, in how business is conducted and governance performed—ultimately affecting much of society. The manner in which a society deals with change is therefore another of the important factors shaping a nation's IR posture. There are two aspects to this:

- *A society's reaction to change.* Is it generally receptive to change or generally resistive to change? Does it see change as an opportunity or a threat?
- *A society's mechanisms for change.* Are these mechanisms predominately top-down or bottom-up?

There are many cultural factors, often rooted in history, that influence how a society reacts to change. Different combinations of factors can lead to similar end states. Resistance to change is frequently associated with a pronounced respect for authority, often found in strongly hierarchical societies. The predominant mechanisms for change in such societies are usually top-down.[8] Ready acceptance of change, on the other hand, is often associated with a comparative disregard for authority, more often found in nonhierarchical societies. Bottom-up mechanisms for change are more common in such societies.

The course of the information revolution in a society that is generally receptive to change and has many bottom-up mechanisms for change will be quite different from that in a society that is generally resistive to change and whose change mechanisms are primarily top-down. If nothing else, the information revolution should proceed much faster in the first society than in the second.[9,10]

Beyond such general cultural factors, there are a number of specific factors that affect a nation's ability to deal with change. These include the following:

- *Support or Compensation for Losers.* Change, especially major change in technology or economic organizations, generally produces winners and losers.[11] Often, the gains from change are spread thinly among the winners, while the losses are concentrated among a few losers who each lose a lot. The winners may not care enough or be well organized enough to lobby in favor of a generally beneficial technological change. But the losers have a lot at stake and often can find each other and organize to block technological change.

  Change will likely be easier in societies with good social safety nets, where provision is made for supporting or compensating those who are displaced by technological change.[12,13]

- *Labor Mobility*. Another characteristic that may be helpful in dealing with change is a high degree of mobility in the labor force. If a job disappears in one place, how easy is it for workers to pick up and move to another city where there may be opportunities?[14] This varies greatly from one society to another.[15]

- *Structure of Commercial Property Rights.* The structure of commercial property rights may have something to do with whether change is generally welcomed or not. What fraction of the population owns shares or is included in some form of profit sharing? Will many people benefit as a result of new technologies and their associated efficiencies? Or will these benefits be restricted to a narrow "owner" class?

- *The Consequences of Failure.* Almost inevitably, change involves risk. Willingness to run the risks of innovation or change will depend, at least in part, on the consequences of failure. In some societies, the legal, financial, and social consequences of failure

can be very severe; in such societies the risk-taking spirit is, to say the least, dampened.[16] In other societies, business failure is condoned; in these societies, risk-taking is much easier.[17] Because much of the information revolution is being driven initially by changes in the business and financial world, the degree of risk-taking mentality in a nation's business and financial community will be particularly important.[18]

- *The Power of Blocking Interests.* What does it take to change things, to build things, to knock things down? Are property owners free to do pretty much whatever they please with their property? Or do they need approval from planning councils, workers councils, environmental regulators, city planners, labor unions, etc.? How strong are inherently conservative institutions—e.g., labor unions? Is the process for getting required approvals timely, transparent, noncorrupt, and generally predictable—that is, can you usually guess what the outcome of the process is likely to be—or is it a matter of chance every time?

Governments and Laws Can Be Helpful or Unhelpful

The degree and nature of the control that a government exercises over the various segments of a society is another important factor shaping a nation's IR posture. Government control can have both positive and negative effects insofar as a society's propensity to change is concerned, depending on the nature of the control. Nations with limited government control are, generally speaking, much freer to change than nations with considerable government control. However, there are historical cases where a strong degree of government control has led to significant societal change (e.g., Russia under Peter the Great in the early 1700s, Singapore under Lee Kuan Yew during the period 1965–1990, and China under Deng Xiaoping in the 1980s).[19]

The nature of the legal regime is also important. For the IT sector of a nation to flourish, a country needs good laws regarding intellectual property, a sensible approach to contract law and a strong willingness to enforce contracts, and a smoothly working system for handling bankruptcy so that the inevitable business failures that go with any rapidly changing technology can be managed. Also important,

one would think, should be strong protections for freedom of expression.

The Structure of Capital Markets Is Also Important

The varying structures of capital markets in different nations represent another important differential determinant of the future course of the information revolution in those nations.[20] The availability of funding for new IT businesses and concepts and the manner of the funding process (i.e., the vagaries of getting funding, listings, capital, acquisitions, etc.) directly affect the growth and development of new IT industries in any given nation. This can be critical because new IT concepts and businesses are often antiestablishment by their very nature—they upset and challenge the old business models, monopolies, and ways of doing things—and yet money is a very establishment thing in most countries. The free and open flow of capital, the existence of seed and venture capital, and vibrant over-the-counter markets similar to NASDAQ (which give venture capitalists and startup employees an exit market) are critical enabling factors for the growth and proliferation of IT.

The ability of startups to get such funding differs greatly from one nation to another. Some nations aggressively use equity financing for startups. Other nations lack a strong equity culture and a secondary market, and rely much more heavily on debt financing. But debt financing requires a track record and punishes failure—both of which can be detrimental to startups.

These Causative Factors Can Play Out in Various Ways

These causative factors can play out in many different ways;[21] there are a large number of different possible combinations and many ways in which formulas can be devised attempting to predict a nation's performance in the information revolution.[22] In one of the more notable of these attempts, the United Nations Development Programme has recently created a "technology achievement index" as a "new measure of countries' ability to participate in the network age." This index focuses on four factors—creation of technology, diffusion of recent developments, diffusion of old developments, and

human skills—and classifies nations into four categories: leaders, potential leaders, dynamic adopters, and marginalized.[23]

OTHER FACTORS ARE EFFECTS, NOT CAUSES

These factors add richness to the description of a nation's IR posture and serve as ways of tracking its IR performance.

The Degree and Nature of IT Penetration into a Society and the Distribution of Its IT Activity Across the Technology, Product, and Service Spectrum Are Useful Descriptors of a Nation's IR Posture

The degree and nature of IT penetration into a society is obviously one of the key resultant factors characterizing a nation's IR posture and tracking its performance. There are many ways of describing this penetration, emphasizing different aspects of IT penetration, which includes both consumption (i.e., use) and production of IT-related items.[24]

In further characterizing the IT activity of a nation, beyond mere penetration rates, some have found it useful to distinguish among[25]

- the underlying *technology*
- hardware and software *products* developed from that technology
- *services* performed and delivered using those products.

All nations are not equally strong and active in all three of these areas. Some are very active in IT technology development. Others are active in IT (hardware or software) product development but rely on other nations to develop the underlying technology. Still others are very active in the performance and delivery of IT-enabled services but rely on other nations for both the underlying technology and the products. The pattern of distribution of a nation's IT activity across this technology, product, service spectrum is another useful descriptor of its IR posture.[26]

Measures of Information Work and Workers and of E-Commerce Are Also Important Descriptors

Much has been written about the rise in "information work" and "information workers," as an ever-increasing fraction of economic activity and the overall workforce in many nations.[27] The amount of information work and information workers in a nation is another important descriptor of its IR posture.

Much has also been written about the rise of electronic commerce as a major form of economic activity.[28] *Stage one* of e-commerce adoption usually focuses on cost reduction via increased efficiencies and effectiveness within existing business models. *Stage two* of e-commerce adoption involves revolutionary changes in the business models, often initiated by new, entrepreneurial companies.[29] E-commerce can be business-to-consumer (B2C) or business-to-business (B2B). The amount of e-commerce in a nation, measured (for example) as a portion of GDP, and its general nature (e.g., distribution between stages one and two, distribution between B2C and B2B) are other important descriptors of its IR posture.

The Presence and Number of IT Business Clusters Are Important Descriptors of the Vigor of a Nation's IR Posture

As noted above, stage two of e-commerce adoption involves revolutionary changes in the business models. This requires skills in innovation and business change. Based on recent experience, such skills are more likely to be found in "clusters"—geographic concentrations of interconnected companies and institutions in a particular field—than spread more or less evenly throughout a nation.[30,31] The presence and number of such IT business clusters in a nation are still other important descriptors of the vigor of its IR posture, particularly in the business and financial realm.[32]

The Amount of "Creative Destruction" Going On in a Nation Can Be an Important Descriptor of Its IR Posture

As Joseph Schumpeter originally postulated and others have elaborated, an essential accompaniment of major innovation in capitalistic societies is "creative destruction"—the perpetual cycle of destroy-

ing the old and less-efficient product or service and replacing it with new, more-efficient ones.[33] This creative destruction of old products and services is often, but not always, accompanied by the economic eclipse of the companies producing them. This process has played a central role in the development and application of information technology over the past few decades, so that the amount of such creative destruction occurring in a nation, particularly in its technology, business, and financial arenas, is another important descriptor of its IR posture.[34]

The Presence of New Political Actors and Changes in Governance Are Measures of IR-Induced Change in the Political Arena

The distribution of political power is changing throughout the world, as new nonstate actors are being empowered by the information revolution, in the business and social arenas as well as in the political realms itself, at the subnational, transnational, and supranational levels. Where this process is taking the world is unclear. Some say it portends changes in the role of the nation-state.[35] Others are not so sure.[36] Whichever view turns out to be correct, the presence of such new political actors in a nation, and their number, may be one measure of the degree to which change is occurring in its political arena.

Also, traditional mechanisms of governance (e.g., taxation, regulation and licensing) are becoming increasingly problematic, as the information revolution allows action beyond the reach of national and subnational governments.[37] At the same time, IT advances are enabling new mechanisms of governance, new modes for delivery of governmental services, new ways for governments to interact with citizens, etc.[38] Again, where these processes are headed is unclear. Nevertheless, another useful measure of change in a nation's political arena could be the degree to which the role and manner of governance has changed in response to such new pressures and opportunities.

The Movement of Talented, IT-Trained People Can Be a Useful Indicator of a Nation's IR Posture

The process of globalization has not only removed barriers to the movement of capital but to the movement of people as well, particularly talented, IT-trained people.[39,40] Such talented individuals—information technologists, software experts, those with a creative mind and an entrepreneurial bent, etc.—are in increasingly short supply in all of the major geographical centers of IR development throughout the world.[41] Other nations (e.g., India), somewhat out of the IR mainstream, have a plentiful supply of talented, IT-trained people but fewer indigenous opportunities in the new economy.[42] In response to this supply-demand imbalance, the movement of talented IT professionals between nations has been growing throughout the world: into some countries, not into other countries, and out of some countries. Accordingly, a nation's balance sheet insofar as this talent flow is concerned is another useful indicator of its IR posture.[43]

NOTES

[1]In much of what follows, we will speak in terms of "nations." However, most of what we say can also apply to regions both larger and smaller than nations.

[2]GDP per capita as a measure needs to be balanced by considerations of distribution. Countries with a reasonably high GDP per capita attained by virtue of the fact that a very small fraction of the population are extremely wealthy while the vast proportion are quite poor, will not fare well (e.g., because they will not have well-educated populations with high literacy rates and a supply of well-trained IT professionals, let alone an abundance of people with access to electric power grids). So an extreme variance of the GDP measure across a nation's population will limit its usefulness as a determinant of a nation's IR posture.

[3]As Bill Gates (among others) has pointed out, before one can cross the digital divide, one must cross the electricity divide. (See Verhovek, 2000.) According to UNDP (2001, p. 42), some 2 billion people, a third of the world's population, still do not have access to dependable supplies of electricity.

[4]A well-developed telecommunications network is indeed an asset, but it also imposes legacy costs that in many countries inhibit rapid change.

[5]The annual human development reports of the United Nations Development Programme provide copious statistics on all these items and many other relevant ones, for both rich and poor nations all over the world. See, for example, UNDP (2001).

[6]Difficult, but not impossible, as UNDP (2001, p. 1) asserts, stating: "The technology divide does not have to follow the income divide. Throughout history, technology has been a powerful tool for human development and poverty reduction."

[7]GDP per capita may be the most important determinant, but it is not the only determinant, as the remainder of this chapter will indicate—as do the cases of China and India, two nations with relatively low GDP per capita that are emerging as important IT users and producers (see Chapter Nine of this report and Hachigian and Wu, 2003).

[8]If the central leadership in such a society has sufficient authority to overcome societal resistance to change, significant top-down-driven change can be brought about. If the central authority is weak, however, top-down-driven change may be slow in coming. China is an example of the former case, Japan the latter. (Private communication, William Overholt, RAND.)

[9]All segments of a society may not be uniform in their acceptance of change. Some may be more receptive, some more resistive. Some may have many bottom-up mechanisms for change. Others may have primarily top-down mechanisms.

[10]Given the obvious importance of cultural factors in influencing a society's propensity to accept change, the literature on this subject is surprisingly thin. Lipset (1996) has looked at the American propensity for entrepreneurship and innovation from a comparative cultural perspective. There is also literature regarding cultural barriers to innovation in Japan. But beyond this, there does not appear to be any book or study dealing with the question systematically. (There are books dealing with other aspects of cultural influences on national behavior—for example, Fukuyama [1995], Harrison and Huntington [2000], and Throsby [2001]—but none dealing specifically with the way in which culture affects how a society deals with change.)

[11]What we usually call technological progress usually produces more winners than losers; that is why we call it "progress."

[12]These provisions could take the form of retraining programs, generous unemployment insurance, help in finding new jobs, portability of employment benefits, etc.

[13]It is possible for the social safety nets to be too good, however, so that displaced workers feel no need to find new jobs but remain on the dole for lengthy periods of time.

[14]A number of factors feed into labor mobility. Culture and tradition are important, of course. Size of the society and linguistic and cultural homogeneity also play a role. How far can you move without going to a distinctly different culture? Also significant can be the character of residential property rights. Can you sell your claim to one residence and buy a claim to a new one? Family structure and family employment patterns matter too. Do you have to find just one new job in a new city, or do multiple members of a family have to find employment?

[15]Europeans, for example, are notoriously immobile. Not only are they reluctant to move from one European Union country to another (understandable because of language and cultural differences), but they often resist moving within a nation to take a new job. American workers, in contrast, are much more mobile.

[16]Until very recently, for example, bankruptcy in Japan was pretty much the "kiss of death." Bankrupts felt shamed and ostracized. If your business failed, you had very little chance of attracting financing for a new venture, and you would probably have a hard time finding another job.

[17]The United States is one such society. Business bankruptcy is no longer seen as a moral failing in the United States. Even if an earlier enterprise failed, entrepreneurs are able to attract financing for plausible new ventures. Bankruptcy laws provide effective protection from creditors.

[18]As Joseph Schumpeter (1934) originally showed and others have elaborated—see, for example, Scherer (1984) and Shionoya and Perlman (1994)—individual (or, less likely, organizational) entrepreneurs taking risks in the expectation of financial rewards are the driving force behind most innovative changes in the business and financial world. Therefore, the more risk-takers and entrepreneurs there are in a nation's business and financial community, the faster the information revolution will progress in that nation.

[19]In each of these cases, a strong, authoritative leader forced modernizing change on his people: Peter the Great, to bring about the adoption of Western European ways in Russia; Lee Kuan Yew, to move Singapore, in his words, "from the Third World to the First"; and Deng Xiaoping, to introduce market forces into the Chinese economy. (See, for example, Lee, 2000.)

[20]These remarks are based on discussions during the November 1999 RAND information revolution conference. (See Hundley et al., 2000.)

[21]This listing is intended to cover the major causative factors that will shape a nation's or region's IR posture, but it is not intended to be exhaustive; other factors could also help or hinder the information revolution in a specific nation or region.

[22]During RAND's November 1999 information revolution conference, four groups of factors were identified as being drivers of or impediments of change in the poorer nations of the world: *culture*, *competence*, *capital*, and *control*, termed the "four Cs." Hundley et al. (2000, pp. 84–87) describes what is included in each of these four factors. These factors were discussed at the 2001 NIC/State Department conference on information technology in Africa (see NIC/State Department, 2002, pp. 10–11) and are referred to in Chapter Twelve of this report in discussing the information revolution in Africa.

[23]For a full description of the UNDP Technology Achievement Index and a tabulation of the initial results for 72 nations from all over the world, see UNDP (2001, pp. 46–63, 246).

[24]For example, Wolcott (1999), focusing on Internet penetration rather than on IT penetration construed more broadly, uses six factors to describe this penetration:

- *Pervasiveness.* What fraction of a nation's population uses the Internet?
- *Geographic dispersion.* How widespread geographically is Internet usage in a nation?

- *Sectoral absorption.* How many different sectors of a nation's society and economy use the Internet?
- *Connectivity infrastructure.* How robust is the physical infrastructure supporting Internet connectivity in a nation?
- *Organizational infrastructure.* How robust is the Internet Service Provider (ISP) market supporting Internet access in a nation?
- *Sophistication of use.* How sophisticated are the uses of the Internet in a nation?

Other authors use varying measures. For example, Larry Press ("Worldwide Information Revolution Demographics," paper presented at the November 1999 RAND/NIC conference) expresses IT penetration primarily in terms of the fraction of the population that has access to the Internet or uses a personal computer. Wolcott et al. (1997) express a country's IT capabilities—which are related to but not congruent with the degree of IT or Internet penetration—in terms of five factors: proximity to the technological frontier, depth of development, sophistication of use, pervasiveness, and indigenization. UNDP (2001, pp. 60–63) presents IT-related data on 162 nations that can be used to support the application of each of these approaches. OECD (2002) presents various measures of the "information economy" in a number of nations (mostly, but not entirely, European).

[25]Here we view *technology* as the idea or intellectual property behind a product that embodies it, such as wireless communication technology per se. A *product* is an entity involving hardware and/or software (such as a cellular telephone or a word processing program) embodying one or more technologies. *Services*, similarly, result from the application of technology but in the form of capabilities offered to users, usually in a form resulting from storage, access, and manipulation of information. A website that helps one locate the nearest music store might be such a service.

[26]See Hundley et al. (2000) and Anderson et al. (2000) for further elaboration on the technology, product, and service construct—termed there the "technology, artifact, and service" construct.

[27]Peter Drucker was one of the first to write extensively regarding information work and information workers; he termed them "knowledge workers." (See, for example, Drucker 1989, 1993.) Reich (1991) postulated that three broad categories of work are emerging: routine production services, in-person services, and symbolic-analytic services. The latter category, constituting "information work," represents an ever-increasing fraction of the whole in many nations.

[28]Peet (2000) surveys the state of e-commerce as of February 2000. Fan et al. (2002) focus on the impact of e-commerce on financial markets.

[29]These two stages of e-commerce were defined during discussions at the November 1999 RAND information revolution conference. (See Hundley et al., 2000, p. 27.)

[30]See Porter (1998) for a discussion of the dynamics of such clusters. Kotkin (2000) describes how they are changing the economic and social geography of the United States. Fairlamb and Edmondson (2000) identify a number of such clusters in Europe. Micklethwait and Wooldridge (2000), pp. 210–214, describe some of the characteristics of successful IT business clusters.

[31]This is not a new phenomenon. The industrial revolution started in similar clusters in England.

[32]Hillner (2000) identifies 46 such geographic clusters of IT activity around the world. She terms these geographic "hubs" rather than "business clusters," but the meaning is the same. UNDP (2001, p. 45) also contains a listing of Hillner's clusters, terming them "global hubs of technological innovation."

[33]See Schumpeter (1942), particularly pp. 81–86, for the original statement of the "creative destruction" thesis. Grove (1996) and Christensen (1997) present two of the most recent expositions of Schumpeterian creative destruction.

[34]While the Schumpeterian creative destruction process has played a central role in the development and application of information technology in the United States over the past few decades, other regions of the world may be able to shape their information revolution course in a different way, avoiding some degree of creative destruction. (Many Europeans are hoping to proceed in this fashion; see the discussion in Hundley et al., 2001.) Only time will tell if this is a real possibility.

[35]See, for example, Ohmae (1995) and Strange (1996) for presentations of this viewpoint.

[36]See Jones (2000) for a presentation of the opposing viewpoint: that the nation-state will continue much as it is today.

[37]This phenomenon is also highlighted in the proceedings of the November 1999 RAND information revolution conference (Hundley et al., 2000).

[38]RAND's 2001 conference on the information revolution in Europe included a considerable discussion of "e-government," the use of IT to change (and modernize) the mechanisms of governance. (See Hundley et al., 2002, pp. 35–43.) Kamarck and Nye (2002) present a number of additional views of democratic governance in the information age.

[39]In many if not most cases, talented IT professionals are drawn to one or another of the IT business clusters discussed previously. Nations that have vigorous IT clusters attract IT professionals from other nations; nations that do not have such clusters do not.

[40]Both Friedman (1999) and Micklethwait and Wooldridge (2000) discuss this movement of talented, IT-trained people in general terms, as one of the ongoing features of globalization. NIC (2001) discusses global migration trends more broadly, including the movement of high-tech professionals. ACM (2001) devotes an entire issue to the global IT workforce, including its movement between nations.

[41]U.S. IT companies have been complaining about a shortage of trained IT professionals for many years. (See, for example, Shiver, 2000.) Recently, German companies have joined the chorus as well. (See Meyer-Larsen, 2000, for a discussion of this and other aspects of the current German business climate.)

[42]Sender (2000) describes the "brain drain" of Indian IT professionals out of India into the United States.

[43]For some nations, data on this talent flow are readily available; for others, obtaining them is difficult. For the United States, the inward flow of IT (and other high-tech) professionals is tracked by the H1B visa program, which in the late 1990s was running at a level of more than 100,000 high-tech immigrants per year, and which increased to roughly 200,000 in 2001. *The Los Angeles Times* ("Where the U.S. Is Getting High-Tech Help," 2000) presents data on the countries of origin of these immigrants in 1999.