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A Market Based Framework for Developing National Information Infrastructure

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Introduction

The value of information technology infrastructure in business has been well documented over the past few years (e.g. Brancheau et al. 1996; Broadbent et al. 1996; Duncan 1995). It is understood to affect the firm’s process efficiencies (Keen 1991; Weill 1994) and to have strategic potential for the firm’s comparative performance in its industry (Keen 1991; Bracheau et al. 1996; Duncan 1995). It enables firms to economize on transactions through “virtual integration” (Miller et al. 1993) and to compete in markets that would otherwise be inaccessibile.

The concept and perceived value of a National Information Infrastructure (NII) arises from the corresponding need within and across national boundaries. As information technology expands a nation’s capacity for interconnectivity and integration of information, hitherto independent sectors such as education, health, social policy, commerce and trade, government, agriculture, communications, and science and technology, could be integrated nationally. A NII that allows members of the various sectors to share the same information and use the same resources may increase intellectual activity and consequently, economic productivity. By sharing resources, we may expect the cost of affected projects or services to be reduced while feasibility of new endeavors increases. Consequently, social services may be improved, growth within the economy is enhanced, and the nation flourishes. This synchronous development of a vision for integrated national services makes evident the importance and value of an integrated national information infrastructure.

The value of greater information integration across independent sectors has been identified by nations with highly developed economies such as the U.S. In economically less developed countries (LDCs), the need for NII is less obvious. It may be obscured by needs for more basic infrastructure (such as roads, electricity and water treatment networks), or it may simply not be in demand because the need for information occurring in service-based economies has not yet arisen. Yet if the NII can offer strategic economic benefits to a developed country, it may likewise offer means for more meaningful economic development in LDCs.

Since the concept of a national information infrastructure is very recent, very little has been published concerning how various social, economic, and political factors influence the development of a NII. Hardly any empirical research has been conducted to study the correlation or causal relationships existing between the development of a national information infrastructure and any one of these factors. However, a review of current literature suggests that there may be some relationship between these factors and NII development. Factors such as regulation of industry, economic development, political system and stability, and the nation’s literacy level all may influence the feasibility and, in the case of developed countries, may predict the history of NII development. Just as interesting is the question of whether—and how—NII may stimulate the growth of some or all of these factors.

This paper addresses the questions: What factors influence the development of an NII and in what ways may NII reciprocally catalyze economic, social, or political growth? Can these factors be used to identify the optimal strategy for developing the NII in a particular country? Part one explores the interaction of these factors with NII development. Part two presents a framework for developing the NII that results from an analysis of these factors.

Factors That Influence the Development of an NII

Factors that may have an impact on the development of an NII have been identified not only in the domain of government, but in social and economic domains as well. Economic development of the country (Palvia, 1997; Firestone, 1995), the political system (Palvia, 1997), regulation of industry (Palvia, 1997; Firestone, 1995; Jackson, 1995), and demographic and cultural characteristics (Palvia 1997) all can alter a nation’s capacity for IT infrastructure development. A nation’s social, economic, and political development are inter-related but uneven. Growth of one may positively stimulate growth of another, but each may also be limited by unique catalysts or constraints on growth (Palvia, 1997; Firestone, 1995; Jackson, 1995). In this section we discuss the inter-relations of industry regulation, economic development, national literacy, political stability, culture, and NII as depicted in Figure 1.

Regulation

Regulation is pivotal in determining the roles of the public sector and the private sector in the provision of information services. Governments impose regulation in the information sectors by enacting laws and establishing agencies that govern the
from information services because these services are largely social rather than economic. Therefore this paradigm advocates regulation to maximize the public good derived from information services and minimize the monopolistic behavior of pioneer providers of these services (Firestone, 1995; Jackson, 1995).

The competition paradigm, though acknowledging the need for ensuring public good, promotes the view that the most efficient delivery of information services is attainable through competition. In this paradigm, regulation is a deterrent to competition. Therefore proponents of the competition paradigm advocate the use of deregulation to enhance competition in the delivery of information services and hence accelerate the development of the infrastructure to supported these services (Firestone, 1995; Jackson, 1995).

**Economic Development**

Development literature identifies government as the key player in creating an environment conducive to investment in information infrastructure; creating the initiative for research and development of the technologies that constitute the information infrastructure, and promoting this infrastructure’s applications in the provision of both economic and social services. Further, governmental influence is identified as being necessary to ensure that information infrastructure services are extended to the areas and sectors inadequately serviced by the market-type economy (Jackson, 1995; Noam, 1995). The private sector is identified as being the key source of the investments in information infrastructure and playing a pivotal role in enhancing the efficient, effective and innovative provision of information services. Therefore private sector participation may enhance the efficient distribution of the information infrastructure resources to demand-areas within a country. The private sector is also credited with providing the fastest approach to expanding the information infrastructure in a country owing to its profit-centric objectives (Jackson, 1995; Swaroop 1994; Stone, 1993; Stewart-Smith, 1995; Ingram 1993).

Information infrastructure is expected to significantly impact the rate of economic development in any country. Easy and plentiful access to information enhances the quality and levels of services provided in a number of sectors –education, health, social policy, commerce and trade, government, agriculture, communications, and science and technology. The quality and level of services provided by these sectors in turn impact positively on the rate of economic development (Sadowsky, 1996; Antle, 1983; Romero, 1995, Saunders 1996; Leff, 1984; Stone, 1993; Wingrove, 1993). However, access to the information required to provide higher levels of quality service in these sectors depends largely on the nature of the NII. Therefore the NII is expected to correlate positively to economic development.

Economic development data seems to support this observation. Developed countries exhibit higher information infrastructure indices—as measured by the proportions of the population having direct access to telephones, television sets, radio sets, cable television, newspapers and periodicals, postal services, and the Internet—than do developing countries. They also exhibit more extensive communication networks—as measured by total length of telephone, television, Internet, and Electronic Data production, distribution, and reception of data. Laws establish who—government or the private sector—should provide what kind of information services. The sector allowed to provide these services then becomes responsible for developing the infrastructure needed to support the delivery of these services (Firestone, 1995; Jackson, 1995).
of the year 2000. The country aims at becoming the leading information society globally by ensuring that each of its citizens has

By the end of 1996, Singapore's gross domestic product stood at 132.6 billion dollars (The Economist Intelligence Unit, 1994). This data suggests that as a given country achieves higher level of economic development, it will require a more advanced information infrastructure to support the increased volume and complexity of the transactions taking place within its economy. Therefore the country's national information infrastructure develops in the same direction as the overall economic development of that nation.

Singapore is a unique example of a nation that has used information infrastructure to achieve tremendous growth in economic development. The island-state of 2.6 million people established the TradeNet system between 1985 and 1987 to link all organizations, both private and public, that participated in the shipping industry. This resulted in the creation of a standard national Electronic Data Interchange (EDI) infrastructure linking all kinds of business, government, research and educational organizations. By 1990 Singapore's port had grown to become the world's largest and busiest, both in gross tonnage and bunkering activities. It also had the largest and busiest airport in the region (King and Konsynski, 1995). This integrated network enabled Singapore to increase its efficiency and productivity, not only in the shipping sector, but also in all sectors of its economy. The net result was a growth in gross domestic product from 38.92 billion dollars in 1985 to 67.7 billion dollars in 1990. By the end of 1996, Singapore’s gross domestic product stood at 132.6 billion dollars (The Economist Intelligence Unit, 1997, 1995, 1991).

TradeNet has become the launch pad for a more ambitious project to create a true information state in Singapore by the end of the year 2000. The country aims at becoming the leading information society globally by ensuring that each of its citizens has direct access to an integrated national information infrastructure (Singapore Trade Development Board, 1996; Singapore Internet Next Generation Advanced Research & Education Network, 1997). Singapore’s success suggests that, because a more advanced NII supports a greater volume and complexity of transactions, the level of development of the national information infrastructure will influence the level of economic development within that country. The realization that each additional development in the NII leads to a greater than proportionate increase in economic development may enhance the strategic value of an NII in accelerating economic development in the less developed countries.

**Literacy**

Little has been published on the effects of demographics on the development of an information infrastructure. It is logical to believe that those demographic factors that determine the level of literacy and economic engagement of a nation’s citizens may directly impact the development of the NII. The general pattern observed in demographic data is that nations having higher literacy rates tend to have higher scores on information infrastructure indices. Further, such nations tend to have higher scores on economic development indices. For example, the nations having higher literacy rates also exhibit higher per capita income and employment rates (World Factbook, 1994). This data suggests that literacy promotes the engagement of the citizens of a particular country in productive economic activity. In so doing it enhances the nation’s gross domestic product which in turn impacts on the rate of economic development.

Viewed from the other perspective, higher levels of literacy are achieved when citizens have greater access to educational resources. With the advent in information technology it is possible to deliver high quality educational material over the telecommunications infrastructure, the broadcasting infrastructure, and the Internet. Countries such as Kenya and India are using their broadcasting infrastructure to deliver primary education and family planning and disease control education to their rural communities. Singapore is already linking all its educational institutions to the Singapore Internet Next Generation Advanced Research & Education Network with a view to providing education via this network. In Ohio, university libraries link via the OhioLink network to provide statewide educational resources to the college students, faculty, and researchers of Ohio. In these cases information infrastructure is used to enhance the levels of literacy. In so doing, it seems to accelerate the rate of economic development. It is logical to observe that there is a bi-directional positive relationship between the national information infrastructure and the country’s demographics (Government of India, 1995; Singapore Internet Next Generation Advanced Research & Education Network, 1997).

**Political System**

The political system of a country determines the country’s political stability. Political stability is the measure of the degree of turbulence in a country. Literature on economic development and international finance indicates that a particular country’s level of political stability directly influences the risk associated with investing in that country. The greater the degree of turbulence the more risky it is to invest in the country (Sadowsky, 1993; Ruth, 1996). Political stability also influences the level of engagement by local citizens in productive economic activity. In situations of high political instability, citizens retire their productive resources, transfer these resources to more stable political environments, or covert these resources into assets that will protect them against possible loss of life and wealth. The net result is a drop in economic productivity. Therefore it is logical to presume that as the level of political stability rises, so does the level of economic development. Since political stability directly
impacts the levels of investment, it also follows that the greater the political stability, the greater the investment in information resources hence the greater the development of the national information infrastructure.

It can be argued that political stability is a measure of the level of transparency in the governance system within a given country. Transparency refers to the degree of awareness by local citizens about all the key issues affecting the survival, performance, and well-being of the nation. When the larger majority of citizens are fully informed about these key issues and how they impact country’s future, there is a lower probability that the political decisions of any one group or sector will adversely affect the overall performance of the economy (Economic Commission for Africa, 1995). Therefore the greater the citizens’ access to information, the greater the transparency of that nation’s governance system and hence the greater the political stability. It follows, therefore, that the extent of development of the information infrastructure will influence the level of political stability within a given nation. Therefore there is a dual relationship between information infrastructure and the political system of a country.

Within a democratic system of governance, increased transparency forces the government to be more accountable to its citizens regarding issues of national and economic development (Economic Commission for Africa, 1995). In a bid to ensure its continued re-election, the government may seek to become more efficient in its allocation and use of resources. As resources get better used, the level of economic productivity may increase, while the risk associated with investing in the economy may decrease. Thus the net result may be a growth in the rate of economic development. Given that the NII may enhance transparency, it may indirectly enhance economic development by propelling the nation toward a better allocation and use of scarce resources.

**Culture**

Hardly any publication addresses the impact of culture on the development of information infrastructure. There is reason to believe that the culture(s) of a given nation will influence how readily it accepts new information technologies, information systems, and information infrastructure. This in turn will influence the rate at which the national information infrastructure develops (Palvia, 1997; Sadowsky, 1993; Ruth, 1996). From this reasoning we propose that the culture(s) of a nation indirectly influence the development of an NII in that nation by affecting the rate and level of acceptance of a) new information, b) new information systems and technologies, and c) new ways of using information.

In order to bring about meaningful economic development, the challenge for the LDCs is to concurrently develop their infrastructures to such levels as will capacitate their citizens to fully exploit the production resources within these countries. However, these countries lack the capital to develop these infrastructures. The costs involved in developing the infrastructure has proved to be prohibitively high for most LDC governments (Antle, 1983). A feasible and quicker solution may be to develop an NII that will deliver intangible infrastructure services such as education, health care, commercial services, and technological know-how to a wider population of citizens, regardless of their physical location in the LDC. The knowledge acquired by these citizens may then capacitate them to derive their own solutions to the tangible infrastructure limitations such as poor transport networks, and inadequate machinery. For example, they may obtain knowledge on where to source for cheap and reliable machinery and how to obtain financing for such machinery. They may also obtain knowledge on how to use locally available materials to develop or build cheap and reliable machinery, hence expanding their productive capacity. They may identify methods of collaboration with government and private organizations to develop transport networks, access to markets, access to energy, and access to material inputs. In so doing the citizens will be able to improve their productivity and increase their output far more quickly than they would should they wait on the government to develop all the needed physical infrastructure – schools, hospitals, commercial services organizations, roads, railroads, airports, and machinery for farming, fishing, food processing, food storage, forestry and mining – for them.

**Framework for the Development of an NII**

Borrowing from the theories of marketing and economics, a nation can be viewed as being a market for information resources and the NII a commodity traded in it. Therefore, the development of an NII can be seen in the light of introducing a new product to a given market. When launching a new product, the demand and supply for that type of product is taken into consideration since these measures influence the strategy to be used in the launch. While demand of NII is a function of the economic development, the demographics, and the culture of a nation, its supply is a function of both political risk, and regulatory policy. The greater the indices for economic development or demographics, the greater the demand for the NII, and; the more readily a nation’s culture(s) adapts to new information technology, and new ways of using information, the greater is the demand for the NII. Higher levels of political risk reduce the supply of NII. Likewise, a more rigid regulatory policy reduces the supply of the NII. This relationship is diagrammed in Figure 2.

By combining the various possible measures of demand and supply for the NII we obtain a framework that has four quadrants- DORMANT, GROWTH, MATURE, and AGED respectively (Figure 3). Each quadrant defines the NII “market” and thus determines the strategy to be used in developing the NII in that market.

A dormant NII market is one in which both demand for and supply of information services are low and is characterized by low scores on information infrastructure, economic development, and demographics indices. The strategy to employ in this situation is to “create a market”. This is achieved by addressing those factors that influence the demand for an NII. Because these
Given the expensive costs involved in establishing the information infrastructure, we propose that government take on the role of a facilitator, and delegate most of the development of the NII to the private sector. Therefore, the main tasks of the government becomes educating its citizens on the need for, and the benefits of using the NII to deliver government-provided services; and the creation of an environment conducive for private-sector investments in NII.

A growth market is one in which demand for information services is high but supply for the same is low. This means that an NII market already exists but it is not being adequately serviced because the capacity to supply the needed information services is lacking or not expanding as fast as the demand for these services. Therefore the strategy of developing the NII needs to “nurture the NII market” by addressing those factors that influence the supply of an NII. It may be achieved by adapting policies that allow for easier entry of competitors, quicker returns on investment, and greater insurance against political risk. In the growth NII market, the government plays the dual roles of facilitation and integration by establishing standards, promoting competition, and enhancing research, and fostering the development of a stable political environment. The development of the NII and provision for NII services is delegated to the private sector.

A mature market is one in which both demand and supply for NII are high and thus most citizens have direct access to a vast number of information services. However, there is dismal integration of these information services into a cohesive and seamless NII. Therefore the appropriate strategy is to “Integrate the market”. Market integration may achieved by having the government provide the strategic leadership on how the country should use its NII in order to enhance its global economic competitiveness. Further, increasing collaboration between the government and the private sector may be used to develop universal standard that would ensure the development of the required levels of integration. Therefore, in order to ensure that the NII adequately supports the needs of each sector, it is developed jointly by the government and the private sector. However, the private sector provides most of the information services and also takes over the larger proportion of research in the development of the NII.

An aged market is one in which supply for NII exceeds demand for the same. It is characterized by excess capacity resulting in aggressive competition between the providers of the NII services. The strategy is to “optimize the market”. Market optimization is achieved by letting government provide the vision on the future development of the NII. The role of government in this market is two fold -- globalize the NII by exporting excess NII capacity, and revamp local demand by identifying and promoting new uses of the NII. The role of the private sector remains the innovation and provision of NII services to other markets.

Conclusion

This paper has discussed issues pertinent to the development of an NII. It began by outlining factors that influence its development. It then addressed the framework for developing an NII. The paper observes that the bi-directional relationship between the NII and a nation’s economic development enhances the strategic value of the NII in the economic development of a nation. The NII may provide for a more effective and efficient means of allocation scarce national resources to the most competitive uses, thereby increasing economic productivity. Increases in productivity may then generate the capital needed to develop the basic infrastructure. By impacting the governmental and social aspects of the nation, the NII may also promote better governance and greater social good to the citizens of a nation. Therefore, although the NII may be as expensive to develop as any one basic infrastructure, its ability to generate greater ripple-effect benefits endows it with the necessary characteristics of serving as the key source of sustainable economic development.

References

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