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Discussing Issues of Information Technology in Country Development

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ABSTRACT

The development of countries with laggard economies is becoming a global concern. The harmful complications of poverty and illiteracy are beginning to show up outside those countries in violent forms. The precautions against this migration of harm are splitting the world apart at the same time as technology may become able to bring it together. Over the last few years, information technology (IT) has grown very fast and is still spreading into all aspects of life in developed countries. The recent research in those countries is bringing more evidence that IT is a leveraging tool for business and not a luxury.

This paper discusses the potential role IT could play in developing a country. We start by raising the awareness about the major factors of development of relevance to the thesis topic: natural resources, location, industrialization and education. We identify the two main approaches to development and point out the potential of each using cases of two exemplary

countries. Finally, we discuss the literature surveyed and the conclusions one could derive about the role of IT in country development.

INTRODUCTION

Under-development is becoming a worldwide threat. The recent world events proved that illiteracy and poverty could no longer be relieved by humanitarian aids from wealthier countries.

The developing countries' genuine need is assistance in creating sustainable and self-dependent economies. Another major change that took place over the last few years and which has affected every aspect of life is the fast growth of information technology (IT). IT employment is invading all types of businesses in the industrialized world and causing a major revolution into the traditional industrialization paradigm. While the positive effects of IT are increasingly showing up in the developed countries, a question arises: "Could IT facilitate leapfrogging and catching up by developing countries? Or have those countries still to take the same old path to development – through traditional industrialization?"

Developing countries need to boost their production and provide medical care and education for their citizens. While this mission seems impossible for local governments, IT is bringing hopes.

In a recent article of *BusinessWeek* (June 28, 2004), Prahalad – a leading management theorist who studies developing markets – said that the world's 4 billion poor could be considered as the world's biggest source of growth if they are not conceived as a burden.

Some of India's IT-based development initiatives are examples of such perspective. The essence of those initiatives is the importance of providing poor farmers with agriculture-relevant information, such as appropriate crops, fertilizers, seeds providers and potential buyers. Farmers were willing to pay small amount of money in exchange for this information. The huge mass of beneficiaries supported by appropriate governmental regulations encouraged investments of private companies. Investors are erecting portal web sites that resemble a virtual farmers' market. PCs and wireless communications facilitated the access even in distant rural areas. This innovation has eliminated the role of greedy middlemen. Farmers are investing their saved money to send their children to better schools where they can have high-quality education.

Anecdotal instances such as this illustrate the importance of this nascent field – but also its lack of maturity and attendant lack of hard data. Still, the foundation conceptual work has to be undertaken. This introduction illustrates the degree to which the basic issues have to be first discussed and agreed upon to pave the way for serious experimental investigations of the influence of IT on country development. This paper aims to contribute at getting the ball rolling by undertaking a synoptic discussion of the issues involved.

FACTORS OF DEVELOPMENT AND THEIR INTER-RELATIONSHIPS

Natural Resources

Natural resources are usually categorized as: depletable, renewable and expendable. The most vulnerable class is the depletable sort. Human intervention is believed to be the greatest cause of

depletion. If undiscovered, a deposit of natural gas can keep its stock unchanged for very long time. A theory of resource depletion would address several broad classes of questions to determine the policy of consuming a resource.

The simplest utilization of natural resources by the direct selling without any transformation process would be inefficient. A more effective utilization would be to convert the resources in some industrial process to come up with a product that has a higher market value. According to Onyemelukwe (1984), industrialization is the effective way to development but it takes more than material resource endowment to achieve appreciable industrial progress. The human factor – in terms of technical and organizational skills, political objectives and general attitude to development – is more crucial. This is why a country like Nigeria, with its enormous natural resources, is still struggling to achieve development while countries with much less resources, such as Switzerland and Japan, are enjoying a high level of development. Perlin (1989) brings the example of Darby's invention that saved England's industrialization when wood became scarce. Darby invented an alternative method to produce Iron based on coal instead of charcoal.

Location

The locational disparity between countries triggers economic flows. Accessibility rises as a relevant concern that can affect each flow direction. There are factors that affect the advantages or disadvantages of location disparity (Hanink, 1997):

a) Transportation. The continuous improvements of transportation methods with the accompanying decrease in transportations costs affect the size and directions of economic flows between countries.

b) Technology. The location's economic characteristic interacts with environmental factors to generate the location's quality. Technological changes have continuously altered locations' quality. Locations with high potential for certain activity get deprived from their advantage for other locations that gain higher potential with the emergence of a new relevant technology.

The effect of these factors is more crucial to highly-competitive economic activities such as agriculture. When Canada's agricultural land was losing its wheat cultivation advantage, the innovation of Canola seeds by Canadian researchers gave the same land another advantage for an activity that has lower level of competition. Canola seeds give 40% of their weight as the lowest saturated fat content cooking oil before the rest can be used for other purposes including: cosmetics, lubricants, pharmaceuticals, inks, plasticizers and fertilizer, as well as meal for livestock (Hanink, 1997). A relationship of location to natural resources can easily be recognized. The location of a country plays a role in the geological types and structures of the rocks and the variety of minerals it contains. Above all, human ingenuity drives minerals excavation and leverage of location quality.

Education

Education stems from culture, which Tylor defined as (Brameld, 1957:6): "that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society." Parkinson (1976) contends that among the different

factors of national development, such as capital, natural resources, foreign aid, international trade and government and social institutions, man is the most important factor. It is the man's vision that will decide to put all these factors into an effective play toward development. Man makes the decision of whether minerals and oil should stay underground or be excavated and used in some industrial process to produce useful products. Parkinson (1976) claims that all development studies hang on education, training and engineering of human resources.

Ginsburg *et al.* (1991) say that as societies develop, their needs change and existing educational systems do not address the new requirements. It becomes crucial to adjust the educational systems according to the new paradigm. As an example, the authors cite Merritt and Coombs' (1977) explanation of the educational change that took place in Europe and North America when industry shifted from cottage-based to enterprise-based. The new paradigm of industry required workers with such basic skills as reading, writing and arithmetic. The society also required soldiers who could handle more sophisticated hardware and electorates that would be literate and politically sophisticated.

Industrialization

Hewitt (1992) gives three definitions for industrialization. In the first definition, industrialization means the *production* of all material goods not grown directly on land. The second definition identifies industrialization as all economic *activities* in the sectors of mining, manufacturing and energy. Finally, he defines industrialization as a *process* within a society that organizes production with the support of technical and social change that sustains a continuous production capacity of a wider range of products.

Alemayebu (2000) discusses the barriers crippling the African countries from building their ambioned industrialization, despite their enjoyment of natural resources. He groups the barriers into four categories:

- Leadership Crisis.
- Adverse Physical and Climatic Condition.
- Inadequate Industrial Capacity.
- Industrial Pollution.

Avgerou (2000) contends that in the new knowledge-based industrialization *efficiency optimization* is the goal of the unprecedented innovation. He recognizes two rational courses: the scientific advancement and the quest of economic efficiency and growth. The two factors are compatible and re-enforce each other in a virtuous relationship. Evidences from industrialized countries lead to a conclusion that this relationship between the educational system and economic efficiency is sustaining those countries' development. Targeting only one side is insufficient; if not even harmful. An education-targeted development plan produces jobless knowledgeable workers who will seek better opportunities in other countries. The outcome of a national investment in human resources is being freely offered to rival countries.

UNIDO is the *United Nations Industrial Development Organization*. In its Industrial Development Report 2002/2003 UNIDO affirms that industrialization is important for economic

development. Furthermore, it describes education and research as “the long-run driving engine” for industrialization initiatives. According to UNIDO’s report, it is the lack of this driving engine that caused the failure of some countries’ development plans. A valid question is how to enter this virtuous cycle? Knowing that an IT infrastructure facilitates the establishment of some IT industry sub-sectors, improves the competitiveness of other industries and enhances the educational system, should this infrastructure be the starting point of development? But what if the previously mentioned barriers make this plan far from being practical? Is it more realistic to start with some resource-based industries – the traditional industrialization – and expand gradually to a point where laying an IT infrastructure becomes practicable?

The industrialization-education relationship is represented in Figure 1. In all diagrams, a solid arrow indicates causality with a continual subsequent effect, while a dashed arrow implies only a contributory effect. Both types of arrows carry no indication of the magnitude of the effect or the time lag between cause and effect.

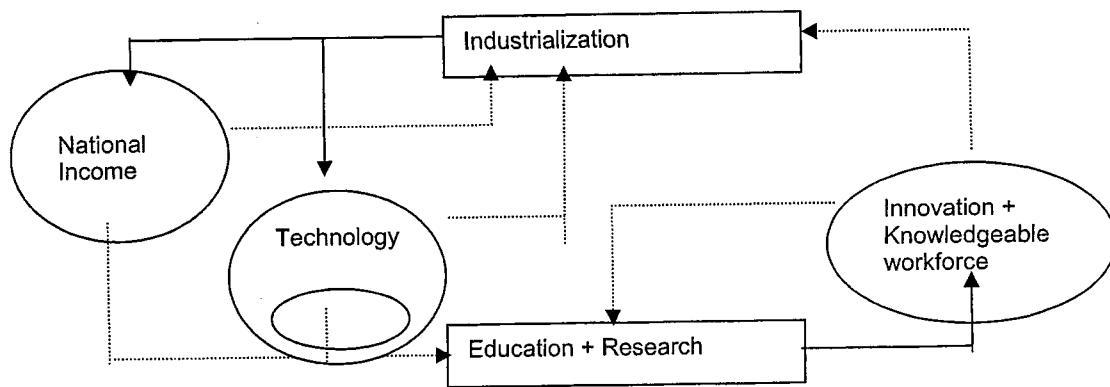


Figure 1: The industrialization-education relationship

THEORIES FOR INITIATING INDUSTRIALIZATION

A good development approach is one that involves economic activities with profit curves displaying steep gradients, but without compromising the social and environmental hazards. There seems to be a tendency to view industrialization as the best among choices. UNIDO advises to pay attention to fostering dynamic competitiveness. Only with the support of a strong policy an industrial capability can be built. UNIDO states: “ingredients of success are hardly a secret. What is difficult is to devise and implement practical strategies to suit the specific needs of particular developing economies.” Figure 2 illustrates the two main approaches to production through industrialization.

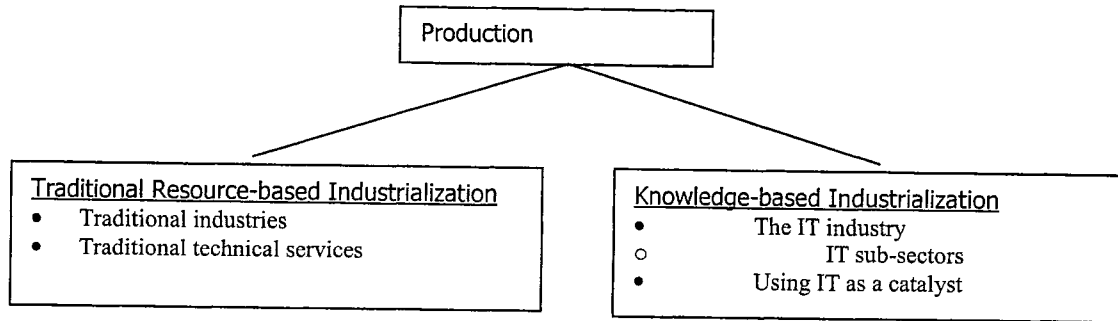


Figure 2: The approaches to production

While manufacturing represents the core of the resource-based production model, IT makes up the core of the emerging knowledge-based model. In both models we find a production process with the attendant technical services. What differs, though, is the relative location of the two activities and the diversity of providers. Traditional technical services cannot exist without a coexistence of local production. On the contrary, the locality of some types of IT technical services is unrestricted. The supply market for some services is becoming global, thus creating opportunities for suppliers from no-production regions to compete with the production region's domestic suppliers.

Traditional Industrialization

In the case of a traditional resource-based production the significance of the cycle presented in Figure 1 is weaker because there are fewer job positions that need knowledgeable workers. This approach is more dependent on the availability of cheap labor and/or natural resources. This was the approach that started the industrial revolution and the one later adopted by the "latecomers." The term "latecomers" describes the developing countries that after World War II have launched strategic plans for advanced development based on manufacturing. Storper *et al.* (1998) discuss two concepts that latecomers need to adapt in order to sustain their development process in competition with the pioneers. The two concepts are:

- 1) Continuous learning.
- 2) Routines and forms of coordination needed to achieve growth through learning.

The two concepts imply that latecomers have utilized the potential of resource-based industrialization to its maximum and if those countries are to keep their rate of economic growth they should switch to the knowledge-based industrialization. The differences between industrialized countries and latecomers imply different forms of learning. A realistic learning economy implementation by latecomers would be a continuous rapid mastery of the latest technologies and techniques (Storper *et al.*, 1998).

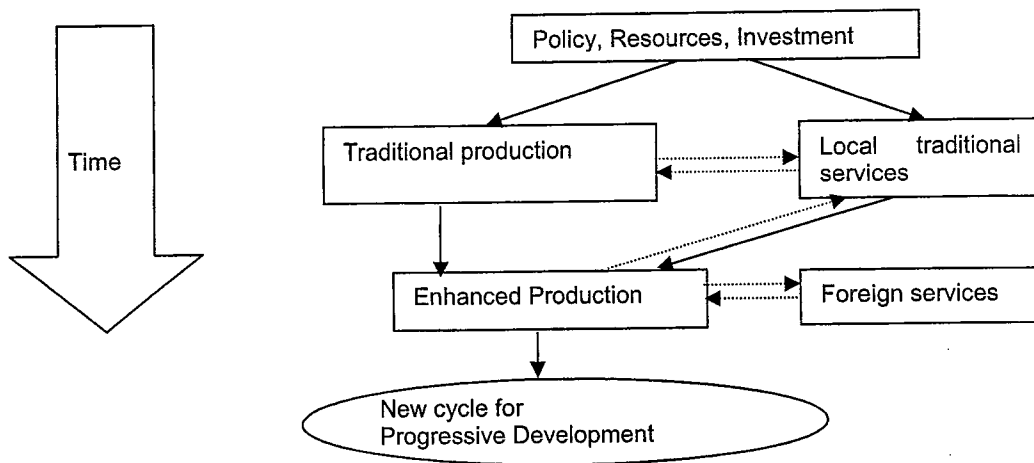


Figure 3: The development startup through traditional industrialization

Figure 3 illustrates the causality and sequence of events in a traditional industrialization approach. The type of resources available and financial investment determines the policy, the size of production and the supporting services. As time advances, productivity should increase through new experiences, new techniques, enhanced business procedures, etc. The policy should be revised frequently to accommodate changes in the local and global business environment.

Lessons from South Korea. Korea's manufacturing strategy had to rely on exportation because it lacked domestic demand. After only ten years of this policy application, Korea exports experienced a dramatic change. While the main limited natural resources – iron ore, tungsten, raw silk, anthracite and fish – formed 48% of its exports in 1961, textiles and garments alone formed 41% of its exports in 1970. Five years later Korea was able to replace its second ranked exports – plywood and wigs – by electronics and steel products (Mytelka, 1998).

The governmental control over firms' source of finance and domestic banking system, gave the government considerable influence over the strategies of private firms. The government then directed a strong export expansion in labor-intensive products and selective import of capital-intensive products. One of the government's goals was to achieve integration within industries such as electronics, shipbuilding, steel and automobiles (Mytelka, 1998).

The South Korean case is a success story of utilizing traditional industrialization for development. Almost fifty years ago, the development started with labor-intensive industries, such as textile, without reliance on IT. The development plan comprised a gradual transfer to capital-intensive and highly-profitable industries. The latter type of industries required more technology and more knowledgeable workers, which dictated the employment of IT in the production and services processes. Our concern is whether the South Korean approach to development is still practical in the current global business environment.

Knowledge-Based Industrialization

A knowledge-based industrialization approach requires an effective IT infrastructure to facilitate business operations and knowledge dissemination and learning. It also requires the establishment of the virtuous cycle between industrialization and education described previously. In its report for 2002/2003, UNIDO contends that some industrial-based development policies in the 1990s delivered short-term-living economic efficiency. Planners expected societal innovation and technological learning to follow, but for the most part that did not happen. The societal reform policy should be planned such that a domestic innovation and mastering of new technologies lead and supplement the industrialization efforts. Figure 4 illustrates the causality and sequence of events in a knowledge-based industrialization approach.

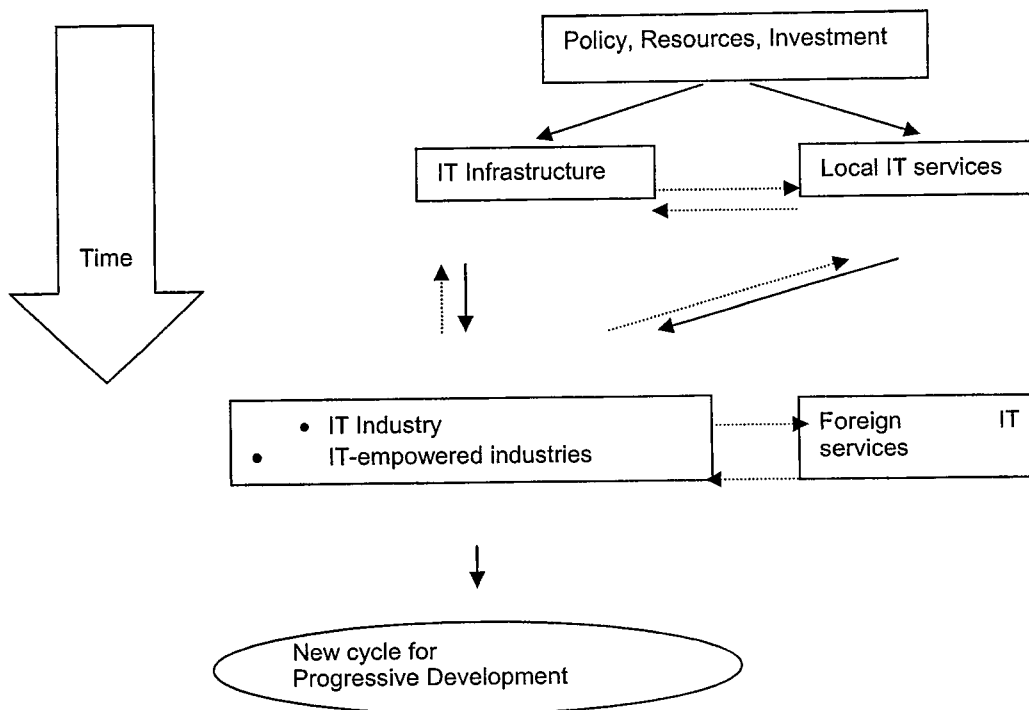


Figure 4: The development startup through knowledge-based industrialization

A country's ability to seize opportunities of IT exploitation requires governmental adoption of a national strategy that addresses:

- Telecommunications and access.
- Legal framework.
- Awareness rising among the population.
- Training and community involvement.

Developing countries that are displaying awareness and taking action in exploiting their potential in the IT industry are attracting multinational IT companies. The resources and investments of such corporations with supportive national policies provide the ignition stage of development as illustrated in Figure 4. Figure 5 clarifies the education-industrialization cycle with the opportunities that IT exploitation would open. The choice of opportunities to seek is a subject of investigation and decision making for the planners.

industry. This is an example of how certain strategies would work better for developing countries than for developed ones. Professional programmers in developed countries have low interest in adopting the open-source software strategy; but their counterparts in developing countries have a much higher interest. Shapiro and Varian (1999: 173-174) state: "The old industrial economy was driven by economies of scale; the new information economy is driven by the economies of networks ... we are on the same network if we use the same software and share the same files."

Services trade constitutes 20% of the total world trade. During the past 15 years services trade experienced almost similar growth as merchandise trade. The growth of this sector of trade is mostly due to the increase in IT use worldwide. The digitization of the business's processes in the services industry with the spread of the Internet have allowed companies worldwide to outsource activities and services to more cost-effective locations. These new business opportunities attract an increasing number of countries, including developing ones, to direct their efforts toward expanding their exports of IT-related services. The services trade statistics are highly motivating – Chapter 9 of the UN E-commerce and Development Report 2002. Between years 1990 and 2000 the world trade in services grew at an average annual rate of 6.6%. The growth rate within the developing countries was even higher, 10.1% over the same period. The developing countries' interest in this sector is also evident from their share in this sector's worldwide trade. This share has grown from 15.7% in year 1990 to 21.2% by year 2000.

Employing IT as a Catalyst. Abdul-Gader (1999) alleges that the ultimate goal of the multiple approaches to development is *productivity enhancement*. While traditional productivity enhancement dependent on labor and capital, current productivity enhancement is based on informational-oriented approach to the related issues. He refers to Porter's (1990) new explanation of the difference in competition forces between nations. Porter (1990) challenges the conventionally accepted competition factors such as cheap labor and plentiful natural resources. He additionally challenges classical economists on the exaggerated role they give to interest rates, exchange rates and government's deficits in determining nations' competitiveness.

For Porter (1990), competitiveness at the national level is *productivity*. National productivity depends on the nation's efficiency level (maximum ratio of output/input) and on both the quality and features of its products. A higher efficiency level tends to lower production cost, whereas both better quality and more features increase the price tag of the products. The result is more value to the output produced per unit of labor and capital. As the productivity of labor and capital increases, employees' wages and capital's returns will follow suit. High productivity levels and sustained productivity growth emerge from relentless innovations in: increasing production efficiency, raising product quality and adding desirable features.

Kudyba and Diwan (2002) categorized industry groups as either high, normal or low IT intensity. They sought to answer the question: "Does the ever-increasing investment in information technology result in increased productivity?" They also sought to test two hypotheses based on the relation between the three variables: output value, IT investment value and time.

- H1) The value of change in a firm's output as a result of a unit investment in IT is positive.
- H2) With time, the unit investment in IT will even cause greater value of positive change.

While earlier studies have concluded investment in IT has no positive effect on output, later studies had the opposite conclusion: IT investment has a substantial consequence to output. The results confirmed both H1 and H2 to be true. Additionally, the results of comparisons across the three industry groups (high, normal or low IT intensity) led to a third conclusion that higher IT-intensive group experience greater returns from investment in IT.

Lessons from India. A research paper by Nair and Prasad (2002) fits the aspects of the industrialization-education cycle while employing the IT industry option. It also shows that putting the plan into action is not as easy as it looks in description. Kerala is one of India's states that would have been one of the poorest countries in the world if it were separated from India. In 1999 Kerala had a per capita income of \$440 compared to \$31,910 in the U.S. Nevertheless, Kerala had some competitive characteristics:

- High literacy.
- Good education and healthcare system.
- Excellent telecommunications network.
- Good number of IT professionals.
- Three international airports.

Kerala's government started its IT-based development planning in year 1995 and the policy was announced in 1998. The state advisory council set a 1000-days time limit for achieving the policy goals through a collection of initiatives and projects.

The government's services task force identified and computerized the government's departments. Priority was given to highly public-interactive departments and those where revenue collection needed enhancement. The task force also established networked points for utilities' payments and launched public awareness programs. Another task force was assigned the mission of human resources development and IT dissemination. For this purpose an academic institution was established with a recognizable level of IT industry participation in curriculum design. The institute offered two types of programs: masters program in information technology and a short-term professional program. The institute also offered professional testing and accreditation services for the private training institutes. The third task force that was assigned the mission of promoting and facilitating the investment in IT industry issued a collection of incentives such as seven years sales tax exemption and purview of Pollution Contract Act. The success of Kerala's plan for technology-driven growth is an exemplar case to which implicit references are made in the discussion section that follows.

DISCUSSION AND CONCLUSIONS

In the literature surveyed, there was reference to neither location nor natural resources, acting separately or jointly, as initiating economic development. These two factors can act as supportive factors that would contribute to the competitive advantage when the true development-causing factors exist. On the contrary, the availability of natural resources could suppress the development of a country by lessening the incentives for the people to be hardworking and innovative (Zakaria, 2003).

Industrialization is still widely viewed as the most effective path to a sustainable development. A country should seek the most profitable industries for which it has capacity while controlling over any harmful externalities. Even moderate level industries carry some advantages. Firstly, it will create the social change within a non-industrialized community. Secondly, workers at all levels will start accumulating the experience needed for subsequent production enhancement and expansion. Thirdly, it would still offer some jobs and attendant benefits. When a developing country envisions an opportunity in resource-based industries, such an opportunity has to be seized with the adequate planning.

The industrialized countries, producing 74% of the world's manufactured products, increasingly realize the importance of adopting IT in business. There is a tendency to refer to knowledge and continuous learning as essential processes within the adoption of IT. Research brings more evidence how employing IT in the business' processes is increasing productivity. Productivity is improved by increasing the intellectual input, rather than capital or labor. "Improving productivity is not working harder; it is working smarter" (Cascio, 2003: 25). In 1929, the ratio of intangible business capital to tangible business capital was 30 to 70. In 1990, the ratio was 63 to 37 (Infosys Technologies' web-site, 2001).

The UN literature promotes IT as an essential prerequisite that developing countries should seek and acquire. It contends that IT could facilitate leapfrogging into development. As an example, wireless communications relieves a developing country from laying thousands of ground cables to enhance its communications infrastructure. Nevertheless, a smart choice of the sub-sector and an innovative policy of implementation are crucial factors for success. Only when the supporting services are available and communication costs are low will it be feasible to employ IT as a catalyst in other industries.

An IT-based strategy seems to have more capabilities to aid the development's social aspects such as enhancing education and health services. Such socially targeted activities will operate over the same infrastructure supporting the economic operations. Governmental services will be more efficient and better managed when delivered through computer systems. These services are not limited to health and education but could include even values such as strengthening democratization – one of Kerala's plan objectives.

The progress in building the information infrastructure in Kerala was successful; but sadly to the government, the whole plan did not yet reach the level of success that it hoped for. This disappointment was mostly on the front of the IT industry promotion and the IT-based

government's services. The researchers conclude that the government's excitement and ambitions were higher than its capabilities. The budget limitations crippled the large number of projects' ability and pace of implementation. It is important for the development plan to be realistic with a reasonable degree of innovation. Kerala's software exports were below its ambitions; but when compared to other states some even performed worse than Kerala. A third group of Indian states achieved a superior performance. It is worth noting how states with similar characteristics are performing differently due to disparity in their tactics.

The one reasonable question that comes to mind is: why are not all countries – including developed ones – taking steps toward exploiting such profitable IT industry opportunities? Is it a lack of vision or do some countries have constraints? For example, why has software production prospered in India but not in Italy or Germany? It is fallacy of composition to suppose that what is true for few would be true for all. As more countries embrace IT in their development plans, the competition will rise and the infrastructure investment could be jeopardized. Countries – or even states within a country as in the case of India – exhibit different potential for IT utilization.

Meadows (1996) examined the capabilities of two nations – India and the Philippines – that are emerging in the global software production market. He recognized that 62% (according to a 1990-1995 estimate) of the computer software and services market is English-speaking. This implies that English language capabilities should be nurtured among the assets of any country with interest in serving the software market. More research is needed to recognize other factors that affect developing countries' potential for exploiting IT opportunities.

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