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Khuong Vu

Embracing the ICT revolution to promote economic growth in developing countries: policy challenges

This paper focuses on the policy issues on embracing the ICT revolution to promote economic growth. The paper discusses the risk of targeting the ICT-producing sector as a strategic industry and analyzes the trade-off due to neglecting efforts to foster the diffusion of ICT throughout the economy. The paper concludes that promoting ICT diffusion throughout the economy should be more crucial than targeting the ICT-producing sector for a country to reap the benefits of ICT for economic growth. The paper then introduces economic frameworks which underlie an effective ICT agenda.

Keywords: dynamic model, economic growth, government, industry, Internet, revolution, risk.

I. Introduction

Together with the steam engine and electricity, ICT is generally acknowledged to be among the most important General Purpose Technologies (GPT), which are characterized by the following four characteristics according to Lipsey et al (in Helpman 1998, pp. 38-43):

- (i) Wide scope for improvement and elaboration;
- (ii) Applicability across a broad range of uses;
- (iii) Potential for use in a wide variety of products and processes;
- (iv) Strong complementarities with existing or potential new technologies.

These four characteristics imply that governments (at both national and local levels) can play a crucial role in enhancing the impact of ICT on economic development in a country. For ICT policy agendas, governments, especially in developing countries, tend to focus on their resources on two following major endeavors:

1. Targeting the ICT-producing sector as a "strategic" industry to heighten its formation and growth; and
2. Fostering the diffusion of ICT throughout the economy.

This paper discusses the risk of targeting the ICT-producing sector as a strategic industry and analyzes the trade-off that results from neglecting efforts to foster the diffusion of ICT throughout the economy. The paper then analyzes the economic issues underlying the

Khuong Minh Vu, Assistant Professor, PhD (Public Policy), Harvard University, USA.

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government ICT agenda framework designed to vigorously disseminate ICT throughout the economy. Finally, the paper highlights several Internet applications that can be effective in promoting economic growth at national and local levels.

II. Targeting the ICT Industry?

Enormous size and drastic growth in the global ICT market² have allowed several countries to achieve astounding success by proactively developing their ICT industry. The "East Asia Miracle" was shined by the success of governments in Japan, Korea, Singapore, and Taiwan in targeting the ICT-producing sector as a strategic industry and making their countries become large producers in the global ICT industry (Hanna et al, 1996). Recent success of Ireland and Costa Rica in developing their ICT sector further provided prominent examples.

For Taiwan and South Korea, the ICT hardware industry has become a predominant driver of economic growth thanks to their governments' strategic support of the industry's formation and development. The share of the ICT industry in GDP is about 16 percent for Taiwan and 13 percent for South Korea and the share of the ICT component in each country's overall export is between 30-40 percent for the former and 40-60 percent for the later, according to research conducted by the Deutsche Bank (2003)³.

The growth of Ireland's ICT sector, which has been largely driven by foreign direct investment (FDI), is a miraculous success. The country has been extremely successful in implementing its policy of "industrialization by invitation", which is used to selectively attract individual multinational corporations to the rapid growth ICT sector. For example, Intel, a computer chip producer, has invested approximately \$6 billion in its Ireland operation since 1989 and plans to spend between \$3.6-4 billion in new manufacturing facilities in Ireland in the next few years (mostly between 2004-2006)⁴. As a result, this small nation with less than 4 million people, became the eighth largest exporter of computer equipment and the fifth largest producer of software in the world in late 2000 (Tallon and Kraemer, 2003).

Costa Rica "has experienced a tremendous leap forward in the development of a technology and knowledge-driven economy" over the last decade, thanks to its strategic focus on the ICT industry as an engine of economic growth (Rodriguez-Clare, 2001). Since 1995, 32 foreign ICT firms have set up plants in Costa Rica, and these include Intel, Microsoft, Lucent Technologies, and Siemens; in 1999, computer chips (mostly Intel) accounted for 37 percent of Costa Rica's export, far exceeding the country's major traditional export products: bananas (10 percent of total export), coffee (5 percent) according to Accenture (2001).

The success stories of the ICT industry becoming a pillar of economic growth elsewhere have inspired the governments of many developing countries (including countries with very underdeveloped economies) to target the ICT sector as a strategic industry; for that purpose, subsidies and incentives are generously provided. For example, Uganda is a poor country with GDP per capita below \$300 and less than 2 telephones (including fixed line and mobile

² The global ICT market grew from \$1.3 trillion in 1993 to \$2.4 trillion in 2001 (WITSA, 2002).

³ Taiwan's total export in 2002 is \$ 130 while this figure is \$ 162.5 billions for Korea (ADB, 2003).

⁴ Intel company's website (www.intel.com, June 11, 2004).

phones) per 100 inhabitants, exporting less than \$700million per year, but aims to "promote [the] manufacture of ICT equipment locally" in its national ICT agenda⁵.

Unfortunately, in many cases, these subsidies lack a strategic deliberation, and it is likely that the subsidized ICT industry will fail in the global competition. Turkey, India, Brazil, and Mexico with poorly performing IT hardware industries regardless of heavy government support and protection are among the most obvious examples (Dedrick and Kraemer, 2000). Moreover, it is important to note that the ICT sector in a developing country can grow vigorously without government intervention. India's software industry serves as an excellent example of this: the industry, while receiving nearly no support and protection from the government has achieved dramatic growth; its exports rose from \$105 million in 1990 to \$6.2 billion in 2000 and \$9.2 billion in 2002, surpassing the major traditional sectors such as steel and automotive industries to become the country's largest value-added industry (Nasscom, 2003 and Kapur, 2002).

On the other hand, government investment in fostering ICT diffusion throughout the economy, or in a specific economic sector, can undoubtedly achieve efficiency gain, although the size of the gain may vary depending on market conditions and the economic sector's characteristics. Better use of ICT can help firms integrate more effectively into the global market and enhance their efficiency/competitiveness in the following three ways:

- ***Firms have better communication/interaction with their customers.*** Better communication and interaction with customers, both of which are enabled by an effective use of ICT, help a firm to better capture its customers' demand and monitor their satisfaction; as a result, the firm becomes more responsive to the market and can, therefore, produce products with a higher value or at a lower cost.

- ***Firms can achieve significant cost savings through e-commerce and ICT-enabled management techniques.*** Through e-commerce, a firm can identify the best possible suppliers for procuring equipment and materials at a lower price and/or higher quality (for example, table 1. below shows potential significant cost savings across sectors thanks to business-to-business e-commerce in the US). Furthermore, ICT can help a firm to better manage its inventory and operation, and in this way substantially lower the cost of production.

- ***Firms are capable to continuously enhance their growth and competitiveness:*** Mastering the use of ICT allows a firm to capture much better global market and technology trends and to grasp competitive intelligence more effectively. As a result, a firm can make investments to continuously enhance its growth and competitiveness in a wiser and timelier manner.

As such, promoting ICT diffusion promises enormous benefits for firm competitiveness and economic growth. Even for East Asia, where many countries have been so successful in developing their ICT-producing sector, ICT diffusion (through computerization and the Internet application) is still at the core of the growth and competitiveness of their economies (Yusuf and Evenett, 2002). In summary, it is imperative for governments to consider the

⁵ According to 'Uganda's working document for the second preparatory meeting for the world summit on the information society'; Geneva, Switzerland, February 2003.

opportunity cost of neglecting ICT diffusion when spending a significant amount of their scarce resources on subsidizing the ICT-producing sector.

This section looks examines a simple decision making model to search out relevant implications concerning government decisions in the choice of the two alternatives: subsidizing the ICT-producing sector and fostering ICT diffusion in the economy.

Table 1 – Potential Cost Saving From E-Commerce in the United States

Industry	Potential cost savings	Industry	Potential cost savings
Electronics components	29-39%	Aerospace machining	11%
Machining	22%	Chemicals	10%
Forest products	15-25%	Communications	5-15%
Freight transport	15-20%	Oil and gas	5-15%
Life science	12-19%	Paper	10%
Computing	11-20%	Health care	5%
Media and advertising	10-15%	Food ingredients	3-5%
Steel	11%	Coal	2%

Source: Goldman Sachs (1999), adopted from OECD (2000a, p60)

III.1. The Trade-off Model

Suppose that the government of a country considers spending an amount S of its scarce resource (a combination of financial and human resources) to subsidize an ICT-producing project. Because the global ICT market is very competitive, with rapid technological progress and constantly falling prices, the subsidized project cannot succeed with certainty. This alternative is considered with the following assumptions:

- The project succeeds with probability p ($0 < p < 1$) and hence its chance of failure is $(1 - p)$;
- If the project succeeds, the subsidy S will lead to a gain of gS^a , where g is a coefficient capturing the gain's magnitude ($g > 1$); S^a with $0 < a < 1$ indicates that the gain is a concave function of S , which is diminishing when S gets larger;
 - If the project fails, the gain is zero;
 - The subsidy S may lead to some externality for the entire economy regardless of whether the project succeeds or fails. Suppose that the externality can be estimated as eS^0 , where e is a coefficient (e could be positive or negative) and $0 < \theta < 1$; again, S^0 is a concave function indicating that the externality diminishes when S gets larger; one should find it plausible to assume that $e < a$ because the subsidy S is aimed to support the ICT-producing project and hence S has a higher degree of impact on the potential gain than on the externality.

On the other hand, the government can use the resource S to promote and deepen the diffusion of ICT throughout the economy or in a selected economic sector. This investment

will lead to an efficiency gain for the economy or the recipient economic sector. Suppose that

this gain is estimated as $\left(a + \frac{b}{Q}\right) S^\beta Y^*$, where

- a and b are positive coefficients: $a > 0, b > 0$;
- Q is the amount of resources that has previously been invested in similar efforts for promoting ICT diffusion in the economic sector Y^* ; Q is present in the formula to specify that if the economic sector Y^* has received a large amount of investment for ICT diffusion, the investment S may be less effective;
- Y^* is the size of the economic sector under direct influence the investment S,
- S^β with $0 < \beta < 1$ indicates that the efficiency gain is a concave function of S, which is diminishing when S gets larger. It is reasonable to assume that $\beta > a$ because S tend to have a higher degree of impact on the gain from ICT diffusion than on the potential gain of the subsidized ICT-producing project.

Thus, in order to embrace the opportunities brought about by the ICT revolution to promote economic growth, the government faces two alternatives: subsidizing the ICT-producing project and investing in promoting ICT diffusion for the entire economy or some selected economic sector. The decision tree for the government is shown below in figure 1.

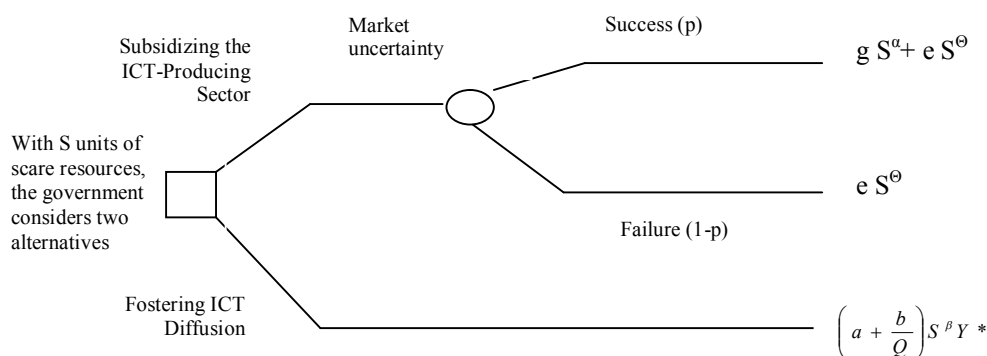


Fig. 1. Targeting ICT-producing Sector vs. Fostering ICT Diffusion

The government will decide to subsidize the ICT-producing sector if the expected gain from subsidizing the ICT-producing project exceeds the efficiency improvement gained from investing in ICT diffusion; that is,

$$[II-1] \quad pg S^{\alpha} + e S^{\theta} > (a + b/Q) S^{\beta} Y^* \quad (2.1)$$

Dividing both sides of inequality [II-1] by S^{β} yields

$$[II-1B] \quad [pg S^{\alpha-\beta} + e S^{\theta-\beta}] > (a + b/Q) Y^* \quad (2.1.1)$$

Let's consider the ratio

$$[II-2] \quad y = [pg S^{\alpha-\beta} + e S^{\theta-\beta}] / [(a + b/Q) Y^*] \quad (2.2)$$

(One might recall that $\theta < \alpha$ and $\alpha < \beta$ as discussed above; hence $\alpha - \beta < 0$ and $\theta - \beta < 0$).

The government's interest in subsidizing the ICT-producing project depends on the magnitude of the ratio γ and it will decide to subsidize the project if γ exceeds 1. Therefore, examining the impact of the interested parameters in formula [II-2] on the size of γ can help us to understand circumstances in which a subsidy from the government for the ICT-producing sector is justifiable or unjustifiable. The sign of the impact of the individual parameters is shown in Table 2.

II.2. Implications

Table 2 indicates that the ratio γ will be enhanced if

- The probability p for the subsidized ICT-producing project to succeed is high. This probability depends on a number of factors, including:
 - The strategy and strengths of the country's existing ICT industry;
 - The competitiveness of the country, especially its strategic location, business environment, and quality of human resource;
 - The market power of the company responsible for carrying out the project.

Table 2 – Impact of the Interested Parameters on the Ratio γ

Parameter	Definition	Impact on γ
p	The probability that the subsidized ICT-producing project succeeds.	+
g	The magnitude coefficient of the gain if the subsidized project is successful.	+
e	Externality generated by the subsidy to the ICT-producing project.	+/-
S	The amount of scarce resource used for the subsidy.	-
a	The rate of efficiency improvement, which is independent of the accumulated investment in ICT diffusion in the economic sector Y^* .	-
b	The rate of efficiency improvement, which is dependent on the accumulated investment in ICT diffusion in the economic sector Y^* .	-
Q	The accumulated investment in ICT diffusion in the economic sector Y^*	+
Y^*	The size of the economic sector, which receive the investment S for deepening ICT diffusion.	-

For example, Ireland and Costa Rica enjoy a probability of success in their strategic efforts in promoting the ICT industry due to the following advantages:

- The two countries have focused on FDI instead of domestic investment; moreover, they have targeted multinationals with superior market power such as Intel (which dominates the computer "brain" market);

- They have highly-educated labor forces, stable political systems, substantially improved business environment;
- Their locations are strategic: Ireland is in the center of Europe and Costa Rica is close to the United States.
- The magnitude coefficient of the gain g (if the project succeeds) is sizeable. This magnitude is measured in terms of export earnings, job creation, and value-added, which are generated by the project. Taiwan and Korea started investing in the ICT sector in the early 1970s, anticipating a colossal gain if they succeeded.
- The externality, which is represented by the coefficient e , is positive and large. The positive externality of the subsidized ICT-producing project could be generated in the following ways:
 - The project fosters the economy's integration into the global ICT market, which helps upgrade the country's ICT skills base and lowers the costs of procuring ICT products;
 - The project further motivates the country to embrace the opportunities brought about by the ICT revolution for promoting economic growth;
 - The government makes extraordinary efforts to improve the business environment to attract FDI into its targeted ICT-producing project, which benefits the entire business sector. The success of the project may substantially enhance the image of the country as a highly attractive investment location. Costa Rica has shown an exemplary case of externality generated by the country's strategic efforts to promote the ICT industry: its business environment and logistic conditions were also substantially upgraded to meet the requirements of the Intel project (HBS, 2002).

On the other hand, γ will be lessened if

- The constants a and/or b are sizeable; that is, the efficiency improvement induced by investment in ICT diffusion is potentially high;
- The accumulated investment Q to promote ICT diffusion in sector Y^* is still small; that is, if there is still a shortage of resources for promoting ICT diffusion in the economy, the government should use its scarce resources for this priority.
- The size of the economic sector Y^* , for which efficiency is enhanced thanks to the ICT diffusion induced by the investment S ;
- The externality, which is represented by the coefficient e , is negative and substantial. The negative externality could be caused by government measures such as high tariffs and FDI restrictions, used to protect the domestic ICT-producing sector; these hurt domestic users and hamper the development of other industries because of higher prices and a limited availability of ICT products.
- The amount S is large; that is, the government should be very cautious when it considers using a large amount of its scarce resources to subsidize the ICT-producing industry.

Let's consider a practical example on the trade-off decision to be made by a government. Suppose that the Vietnamese government considers spending its scarce resources (including financial and personnel resources) valued at \$10 million to support the software sector, anticipating that if the project succeeds, the sector will carve out an export market of about \$500 million, generating a net gain of \$20 million; the chance of success is 0.4 and the externality potentially generated by the subsidy is \$0.2 million. On the other hand, the government can spend the \$10 million to promote the diffusion of ICT in export industries, which altogether export about \$20 billion per year; suppose this investment enhances the efficiency of the export sector by 0.1 percent. What alternative should the government choose?

To provide the government with a solid answer, one needs to compute y , the ratio between the expected gains of subsidizing the software sector and promoting ICT applications in the export industries. The expected gain from subsidizing the software sector is $0.4 * 20 + 0.2 = \$8.2$ million, while the gain anticipated from promoting ICT applications in the export sector is $\$20,000 * 0.1$ percent = \$20 million. Therefore, the trade-off ratio y is equal to $8.2/20 = 0.41$, which is far below 1.0, the minimum level for the government to make a decision in favor of subsidizing the ICT sector. The government, therefore, should not spend the \$10million to subsidize the software sector; instead it should use that amount of resources to promote ICT diffusion in the export-oriented industries.

In summary, the government, facing resource constraints, must carefully consider the tradeoff between the two alternatives: subsidizing the ICT sector and fostering ICT diffusion in the economy.

The above analyses do not rule out the first alternative but suggest that the government must be very careful in making that choice. For supporting the ICT-producing, the government should heavily rely on market forces. A plausible approach for government intervention is to strategically attract select ICT multinationals that offer a good chance of success and the implementation of their projects can generate significant positive externality.

On the other hand, promoting ICT diffusion throughout the economy, or in selected economic sectors with large potential for efficiency enhancement through ICT applications, promises enormous gain. This alternative should, therefore, be a top priority for a government's ICT agenda.

The next section examines economic issues underlying a government ICT agenda framework to promote ICT diffusion through the economy.

III. Fostering ICT Diffusion

Chapter III has analyzed the determinants of ICT contribution to growth. The findings indicate that education, institution, openness, and English fluency are among the most important factors underlying the magnitude of ICT to economic growth. These findings imply that enhancing these four major determinants is an effective way to foster ICT diffusion and its impact on economic growth. However, to further deepen our knowledge of the policy issues, this section introduces a dynamic model examining the factors influencing the decision of a rational economic agent in making her investment in ICT.

III.1. The Dynamic Model

Let's consider a dynamic model⁶, in which the typical rational economic agent (which could be a firm, a household, or an individual) lives two periods, t and $t+1$. The model is characterized by the assumptions to be presented below.

1. The economic agent has a typical utility function $U(W_t)=W_t^\alpha$ where W_t is her wealth level in period t and $0<\alpha<1$. The wealth of the economic agent in period, in turn, depends on her *technological capacity*, M_t , which is a combination of her knowledge and all the resources shaping her technological capability. Suppose that the economic agent wealth is a function of M_t as follows: $W_t = aM_t+b$, where a and b are positive constants. The utility of the economic agent in period t , therefore, can be expressed as a function of her technological capacity level in that period as the following: $U(M_t) = (aM_t+b)^\alpha$. Therefore, her lifetime utility level can be computed as $U = U(M_t) + \frac{1}{(1+q)} U(M_{t+1})$, where q is the utility discount rate. In period t , the

agent cannot change M_t but can change M_{t+1} through her investment decision. Therefore, in order to maximize her lifetime utility level, the economic agent will maximize M_{t+1} .

2. In period t , ICT offers an investment opportunity for the economic agent, which generates benefit B for technological capacity in period $t+1$. However, the investment in ICT requires a fixed amount of technological capacity C . It is assumed that the ICT investment earn an excess return (as discussed in chapter IV). The benefit B , therefore exceeds $C(1+r)$, where r is the normal return rate from investment in traditional (non-ICT) technologies.

If the economic agent | bypasses the ICT opportunity and invests all her technological capacity M_t in traditional technology, earning the normal interest rate r , her technological capacity level in period $t+1$ will be $M_{t+1}=M_t(1+r)$.

If the economic agent decides to invest in ICT, the investment costs C units of technological capacity in period t and generates B unit of technological capacity in period $t+1$. However, the economic agent's level of technological capacity in period $t+1$, M_{t+1} , varies depending on the level of her technological capacity in period t , M_t , as follows:

- If $M_t > C$, she would invest in ICT anyways because her technological capacity level in period $t+1$ will be higher:

$$M_{t+1}=(M_t - C)(1+r)+B=M_t(1+r)+B-C(1+r) > M_t(1+r)$$

- If $M_t < C$, the economic agent needs to consider if she is better off to invest in ICT. If investing in ICT, she has to mobilize additional technological capacity in the market to cover the shortage ($C - M_t$). The rate of the technological capacity mobilized from the market R is generally higher than the normal return rate r , which the economic agent can earn from investment in traditional technologies. If the economic agent decides to invest in ICT, the level of her technological capacity in period $t+1$ will be $M_{t+1}=B-(C-M_t)\times(1 + R)$. Therefore, the economic agent will not invest in ICT if

⁶ My model is inspired by the model of investment in human capital introduced by Galor and Zeira (1993).

$$\begin{aligned}
 M_{t+1} | \text{invest in ICT} &< M_{t+1} | \text{not invest in ICT} \\
 \Leftrightarrow B - (C - M_t)(1+R) &< (1+r)M_t \\
 \Leftrightarrow M_t &< [C(1+R) - B]/(R - r)
 \end{aligned}$$

Denoting $X = [C(1+R) - B]/(R - r)$, then X and C are the two thresholds defining the economic agent's decision in making her investment in ICT:

- If $M_t < X$; the economic agent would not invest in ICT. Therefore,

$$M_{t+1} = M_t(1+r)$$

- If $X \leq M_t < C$; the economic agent would invest in ICT but she has to mobilize additional technological resources from outside for her investment. As a result,

$$M_{t+1} = B - (C - M_t) \times (1+R)$$

- If $M_t \geq C$; the economic agent will invest in ICT, and her investment is covered by her own technological capacity. Accordingly,

$$M_{t+1} = (M_t - C) \times (1+r) + B$$

The dynamic model capturing the relationship between M_{t+1} and M_t is shown below in figure 2. There are three equilibriums in the model: L, Q, and H. Among them, L and H are stable and Q is unstable. Furthermore, Q is the critical point defining the direction of the dynamics of the economic agent's technological capacity in the following ways:

- Above point Q, the technological capacity converges towards the High level at point H;
- Below point Q, the technological capacity converges towards the Low level at point L.

Suppose that M is the economic agent's technological capacity level in period t corresponding to the critical point Q. At this level, the economic agent invests in ICT but she has to mobilize some additional capacity from the market. Because Q is an equilibrium, $M_t = M_{t+1}$. That is, $M = B - (C - M) \times (1+R)$. Solving this equation for M yields

$$M = C - (B - C)/R \quad (3.1)$$

The model reveals an important issue: the economic agent may not be better off when investing in ICT if her technological capacity, M_t , is between X and M ($X < M_t < M$).

This finding implies that fostering investment in ICT alone is not the best way to promote ICT diffusion. A more effective way is to apply the measures that substantially increase the number of firms, households, and individuals who benefit from investing in ICT. In order to do that, the measures taken by the government must aim to reduce the critical level M , which are to be discussed in the following section. It is worth noting the example of a poorly-designed ICT policy, which is described by the curve XX in Figure 2. The policy increases the number of individuals (firms) investing in ICT in the short-term but this increase is unsustainable because the number of individuals (firms) benefiting from their investment in ICT decreases.

III.2. Policy Issues Drawn from the Model

The formula [3.1] indicates that M is positively correlated with B and negatively correlated with C and R . Therefore, a comprehensive way to lower the critical level M should be an effective combination of three main measures: 1) lowering C , 2) increasing B , and 3) reducing R .

1) *Lowering C , the cost of investment in ICT*

The cost of investment in ICT (and exploiting it afterwards) depends on the following factors:

- Prices of ICT equipment and services, which depend on market competition, tariff rate on ICT equipment, and the country's integration into the global ICT market;
- Quality and availability of telecommunication infrastructure, especially the bandwidth capacity for international access to the global internet backbone and the transmission capacity of the local communication networks.

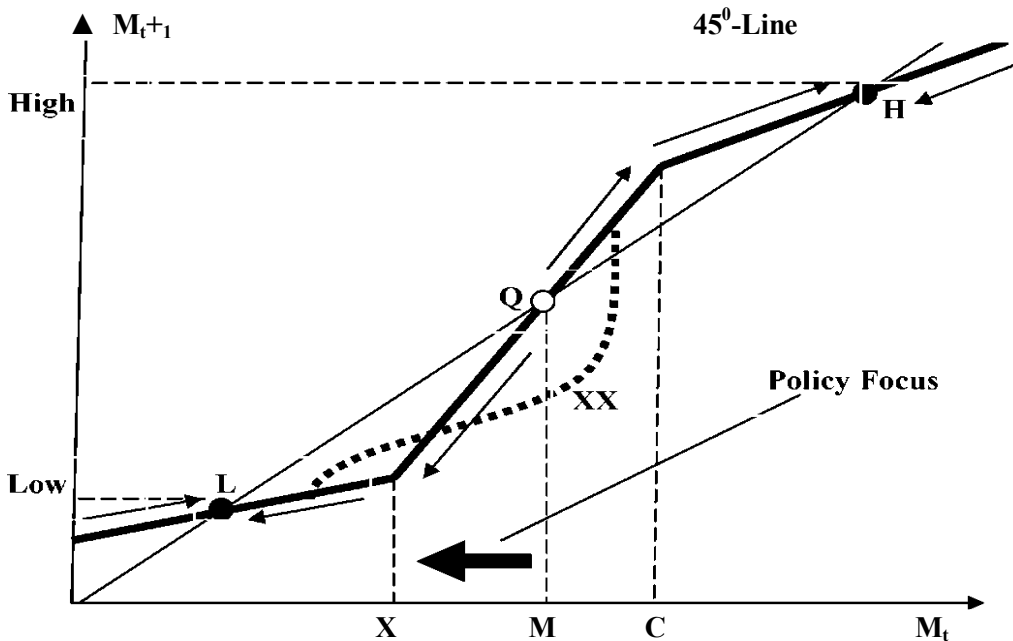


Fig. 2. Dynamic Model of the Technological Capacity

2) *Increasing B , the benefit of investing in ICT*

The benefit from investing in ICT is a function of the following factors:

- Quality of human resources, which relies highly on education. In addition, English fluency is an important aspect because the Internet--as an enormous source of extremely valuable information--is dominant by English;

- Openness of the economy and its integration into the world economy;
 - Quality of the overall business environment, which is shaped by macroeconomic conditions (transparency, rule of law, government governance and policy effectiveness) and the vibrancy of the business sector;
 - The depth of ICT penetration in the economy. The deeper the ICT penetration, the more firms and households will benefit from investing in ICT. Furthermore, the government can play a very important role in fostering the quality and wealth of on-line resources and services, from market information to e-government;
 - Complementary investments to be made. At the firm level, Brynjolfsson and Hitt (2000, 2003) find that investment in ICT leads to higher productivity for a firm if the firm also makes complementary investments in organizational change, such as supply change redesign, organization restructuring, and personnel retraining.
- 3) *Reducing R, the cost of mobilizing technological resource on the market* Firms, households, and individuals have to resort to the technological resources on the market when they need additional capacity to invest in ICT. The cost of these resources depends on the following factors:
- Quality and abundance of labor with ICT skills;
 - Costs, quality, and availability of ICT services, from consulting to training;
 - Cost of, and access to, bank loans and etc.

Again, it is worthwhile noting that, the insights drawn from the model are consistent with the findings in chapter III concerning the importance of education, openness, institutional quality, and English fluency as the key determinants in the magnitude of ICT contribution to economic growth.

III.3. A Framework for Government ICT Agenda

The discussions and analyses in the previous sections provide a framework for formulating an effective government ICT agenda to foster ICT diffusion throughout the economy. The framework consists of five main components: Concepts, Competency, Costs, Benefits, and Infrastructure Conditions (Figure 3). An effective government ICT agenda needs to strategically promote each of the five components and the interplay among them.

1) Concepts

The "Concepts" component concerns the fundamental knowledge of how a country can reap the benefits of the ICT revolution for economic growth and development. This component includes the followings:

- Policy makers should profoundly understand the potential applications of ICT and its impact on economic growth and development. Moreover, they should be well aware of the risk of a lack of strategic deliberation in providing the ICT sector with a significant amount of its scarce resource;
- Policy makers should comprehend the deep determinants of ICT diffusion, including the educational level and English fluency of the population, the openness of the economy, and institutional quality. Effective measures for promoting these determinants assure a fundamental enhancement in the country's capability to reap the benefits of the ICT revolution;

- Policy makers should be very cautious when considering market-distorting policies in their ambition to promote ICT diffusion. For example, low-cost PC purchase programs with heavy government intervention in the form of credit subsidies (currently underway in Thailand and soon to be launched in Vietnam) may cause a series of defaults and weaken the soundness of banking activities.

The centrality of the "Concepts" component in the framework makes two important points:

- It must be considered as the core of the framework for ICT policy development and it should be a top priority for the government to tackle in the formulation of its ICT agenda.
- The main focus of this component is policy makers at both the national and local levels. Once policy makers have adopted the right concepts, the government ICT agenda has a solid foundation for a successful implementation.

2) *Competency*

Human capital or the competency of population, especially the labor force, is the key factor in a nation's capacity for absorbing the penetration of ICT. The measures promoting the "competency" component include the followings:

- Introducing policies and mechanisms that help the educational sector to be a major focus of investment from both government and non-government sectors. In addition, the government should be proactive in reforming the educational sector with strategic investments to make it a major engine driving the economy towards a knowledge-based economy. Furthermore, the government should promote English fluency by endorsing and promoting the use of the language in a variety of educational and training programs;
- Providing extensive and generous support for ICT-related training and encouraging people to enhance ICT skills and their knowledge of ICT applications. Furthermore, life-long learning should be persistently supported because ICT, as well as other new technologies, continue to change at a rapid pace;
- Encouraging competition among localities in the depth and effectiveness of ICT diffusion and monitoring their ICT development over time. This promotes peer pressure, which is a powerful force that makes local governments more proactive in, and committed to embracing ICT for promoting the economic growth and development in their localities.

3) *Costs*

Costs are a major factor underlying variations in ICT diffusion. Even for wealthy OECD countries, the direct costs of ICT equipment and telecommunication services have also significantly affected their ICT diffusion, as pointed out by Pilat and Devlin in OECD (2004).

The policies addressing the "Costs" component include the followings:

- Opening up the domestic ICT market and fostering competition among ICT equipment vendors;
- Liberalizing the telecommunication sector through extensive and profound regulatory reforms designed to bring down costs and enhance the quality of service;

- Promoting the growth and vibrancy of ICT-related services, which help firms and households lessen the cost of investment in ICT.

4) *Benefits*

While there may be limitations in reducing the costs of acquiring and using ICT, the potential for increasing the benefits of investment in ICT is enormous. Therefore, enhancing the benefit of investment in ICT should be a major focus for a government in the implementation of its ICT agenda. The benefit of investment in ICT can be enhanced in the following ways:

- Persistently improving the overall business climate by promoting the openness of the economy and its integration into the global market, fostering competition among firms, enhancing the transparency and effectiveness of the regulatory framework, and upgrading the quality of governance;
- Providing incentives and creating solid foundations for the development of e-commerce ;
- Making extensive investments in e-government, which allows the citizens to reap significant benefits when dealing with the government on-line;
- Promoting Internet-enabled services, especially those provide information and consulting services critical for firms to enhance their global integration and competitiveness;
- Promoting networking and cooperation; in particular, launching Cluster Initiatives (CIs) that strengthen bonding and cooperation among firms, business associations, and local governments;
- Providing incentives for complementary investments, which allow firm to reap higher benefits from investing in ICT.

5) *Infrastructure Conditions*

Telecommunication infrastructure significantly affects both the costs and benefits of investment in ICT and, therefore, the diffusion of ICT. For example, Internet applications can be more prolific, and the Internet user can reap more benefits from the Internet at a lower cost (for less time) if the country is equipped with a high bandwidth capacity, which determines the quality and speed of Internet access.

The policies for upgrading telecommunication infrastructure conditions include the following:

- Making/supporting strategic investments in telecommunication infrastructure, especially the bandwidth capacity of connection to the global Internet backbone, and the transmission capacity of national long-distance telecommunication networks.
- Promoting the quality and pervasiveness of access to ICT services, especially the Internet. In particular, governments should be proactive in providing financial incentive, professional guidance and training for Internet Cafes/E-centers, especially in remote areas.
- Reforming the existing regulatory framework related to telecommunication infrastructure development and operation to make it more suitable for rapid changes induced by the ICT revolution and globalization.

IV. Utilizing the Internet for Promoting Economic Growth

Competition and knowledge are among the major factors that drive economic growth. Intense and healthy competition puts pressure on firms and governments to be more visionary and innovative, and forces them to make better use their scarce resources to achieve their goals. Knowledge, nurtured by rich and timely information and deepened by intensive communication, allows firms and governments to formulate solid strategy and capability in global competition. The Internet offers unprecedented opportunities for promoting economic growth through fostering competition and knowledge.

Because the prosperity of a nation depends on its microeconomic foundation, which is determined by the vibrancy and economic success of its states/provinces (Porter, 1998), promoting local economic development is a vital element in national economic development strategy. This section presents a framework for utilizing the Internet to promote local economic growth.

The economic growth of a locality can be fostered through four main channels⁷:

1. Strengthening the concepts of economic development, which include attitudes towards business and economic development, vision, commitment, awareness of competitive position relative to peers, and economic development strategy (in the diagram, this channel is labeled as “**Concepts**”).
2. Enhancing the competency of local governments, business people, and the workforce, which depend on level of education, access to information, and the quality of knowledge-based services (this channel is labeled as “**Competency**”);
3. Encouraging connections to the world to promote openness, learning, and adoption of best development practices (this channel is labeled as “**Connections**”); and
4. Promoting business cooperation/networking and public-private partnership (this channel is named as “**Cooperation**”).

The framework has Internet applications at its core, and these are designed to strategically and continually enhance the effectiveness of the actions along the four channels: Concepts, Competency, Connections, and Cooperation (Figure 4). A brief discussion of how Internet applications can be highly effective in each of the four channels is presented below.

1) Concepts

World development in the past few decades has shown that ***a nation, as well as a locality, will progress faster if it has a clearer vision of its future and a deeper understanding of its current situation relative to its peers.***

The "Concepts" component includes several elements: attitudes of local government and businesspeople towards business and economic development, a vision of the locality about its future, a local economic development strategy, and competitive information and benchmarking indices. Internet applications can help advance these elements as follows:

⁷ In developing this 4Cs framework I was influenced by the 3Cs framework introduced by Rosabeth Moss Kanter in her book *"World Class: Thriving Locally in the Global Economy"*, New York: Simon & Schuster, 1995.

- On-line surveys of firms and government executives can identify the mainstream of their attitudes towards business and economic development. If mainstream attitudes are unfavorable for market development (for example, they place importance on government protection or subsidies, embrace rent-seeking, disgrace competition, etc), they could be a major obstacle to local competitiveness and development. A sound economic development agenda for a locality must effectively address this problem;
- The local government's website should strongly promote its vision, making it clear and motivating to all its citizens, and enhancing the commitment of the people to its development goals;
- Local economic development strategy should be formulated in in-depth consultation with experts, both nationally and internationally, through the local government's website and proactive on-line communications/forums;
- The national government or an independent organization supported by it should create a website capturing comparative information of the visions and development dynamics of its states or provinces/cities, ranking their competitiveness on all important dimension of development, and benchmarking them with their international peers. This could produce tremendous peer pressure, which would cause local governments and businesses to be more innovative and committed in their endeavors to advance local development.

2) *Competency*

Internet applications can enhance the competency of a locality in the following ways:

- e-government: well-designed and highly interactive government websites can substantially improve the quality of government services and foster the participation of citizens and the business sector in formulating and implementing the local economic development agenda;
- e-learning: on-line education should be promoted as a major way for people to improve their education and knowledge. The government should proactively support the growth of on-line education;
- Exploiting the Internet: the Internet is a mine of valuable information. This raw asset, however, needs some refining to make it truly helpful to ordinary people and firms. The government should support the services that exploit and process information from the Internet, making it into the valuable knowledge that is highly demanded by people and/or firms.

3) *Connections to the World*

There are two prominent programs that can significantly foster the connection of a locality to the world: these which are the Sister City Program (promoted by the US International Sister City and the World Bank) and the World Bank-initiated Competitive City Forum. In particular, the sister city program has proven its strong correlation with the openness and economic success of participatory cities in the developing world (Table 3).

Internet applications can add significant values to the two programs in the following ways:

Розділ 2 Інноваційні процеси в економіці

- The two sister cities have a website to gather support of the citizens and businesses from the two cities and promote activities that strengthen mutual understanding and relationship between the two cities.
- The competitive city forum should have a website with comparable information on its over 100 participatory cities. Benchmarking, competitiveness indices, best practices, and interactive communication will make the forum much more alive and proactive in promoting the development in its member cities.

4) Cooperation.

Internet applications are critical for the success of Cluster Initiatives (CIs), which have proven to be a highly successful way for fostering strategic cooperation among firms and government authorities in a locality. A CI aims to foster strategic cooperation among the five main constituents of a cluster (government, firms, financial institutions, research community, and institutions for cooperation) in the three major policy areas: Regional SME policies, Investment attraction policies, and Science and Innovation policies (Solvell et al, 2003).

Table 3 – Sister City Partnership and Growth Performance⁸

Country	Average GDP Growth* (Period)	Population in 2000* (million)	Number of Sister City partnerships with US cities**	
			Total	Per 10 million people
Japan	8.6% (1953-1973)	127	227	17.9
Taiwan	8.5% (1952-1998)	22	48	21.8
Korea	8.2% (1965-1997)	47	33	7
China	8.1% (1979-2000)	1,262	160	1.3
India	4.3% (1965-1997)	–	0	0
	6.0% (1990-2000)	1,016	13	0.1
Bangladesh	3.9% (1965-1997)	131	00	0.0
Sri Lanka	4.6% (1965-1997)	19		0.0

Sources: My calculation based on:

*WB Development Indicators 2001 (CD ROM) and Pent World Table (version 5.6)

** Sister City International (SCI) website (www.sister-cities.org, July 23, 2003)

Each CI may develop a highly effective website to analyze the benefits of local clustering and the main challenges facing their strategic cooperation. The website is also a good place for all the constituents to proactively participate in formulating the local economic development agenda and in raising their concerns over any problems emerged in its implementation. The

⁸ This table is from my report for the World Bank “City Partnership for Development: A First Phase Evaluation Report of the Haiphong-Seattle Partnership”, July 2003

website is also effective for promoting the image of the locality⁹ as an excellent place for investment because of its clear vision and the solid commitment and cooperation among all its stakeholders in fostering the local economic development.

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⁹ The Global Cluster Initiative Survey (GCIS) in 2003 identified around 500 CIs around the world.

Розділ 2 Інноваційні процеси в економіці

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Khuong Vu. Embracing the ICT revolution to promote economic growth in developing countries: policy challenge

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Хонг Ву

**Використання революції ІКТ у напрямку економічного зростання країн,
що розвиваються: політика змін**

У даній роботі аналізується вплив використання інструментів ІКТ (інформаційних і комунікаційних технологій) на стимулювання економічного зростання. Зокрема, у статті досліджуються питання пов'язані з ризиком таргетування сектору ІКТ, як стратегічно важливого, і можливими економічними наслідками у разі проникнення сектору ІКТ в усі сфери господарської діяльності. У роботі стверджується, що проникнення (впровадження) сектору ІКТ в усі галузі народного господарства принесуть безсумнівно більший економічний ефект, ніж його цільове використання у поточній перспективі.

Наведено економічну модель, що враховує ефективність використання ІКТ у стратегічних планах держави. В роботі пропонується створити всередині країни ринки для розвитку ІКТ технологій і прослідкувати за дотриманням добросовісної конкуренції в цьому сегменті ринку. На основі створеного ринку ІКТ пропонується вдосконалювати бізнес середовище і управління, через стимулювання електронної комерції та електронного управління. Очікуваними витратами проекту вважаються затрати на фінансування реструктуризації телекомунікаційного сектору і підвищення якості послуг в сфері ІКТ. Запропонований механізм вдосконалення послуг ІКТ хоча й передбачає певні затрати, але очікуваний економічний ефект від вдосконалення сервісної складової в структурі валового доданого продукту набагато вищий.

Використання ІКТ пов'язане з економією транзакційних витрат і зменшенням ризику

Розділ 2 Інноваційні процеси в економіці

недосконалої конкуренції. Зокрема в роботі приводяться приклади мінімізації транзакційних витрат у зв'язку із застосуванням електронної комерції в США. Електронна комерція майже повністю виключає можливість узурпації ринку окремими покупцями чи продавцями. Фактор ІКТ розглядається як один з визначальних у формуванні ефективності й конкурентоздатності окремих фірм. Розроблена економічна модель дозволяє оцінити ефект ІКТ та економічне зростання як окремих регіонів, так і країни в цілому. Представлена модель враховує динамічний характер технологічних змін у виробничому середовищі, а також можливості цілеспрямованого й найбільш швидкого використання технологічних досягнень завдяки ІКТ.

Особлива увага в роботі приділена аналізу економічних проблем пов'язаних з розробкою та керуванням програмою ІКТ з метою її найбільш швидкого поширення в економічній системі. В завершення роботи приводиться декілька прикладних Internet можливостей, які можуть бути ефективно використані для стимулювання економічного росту на мікроекономічному й регіональному рівнях.

Ключові слова: динамічна модель, економічне зростання, Інтернет, промисловість, революція, ризик, уряд.

Підготував:

О. Кубатко

Khuong Vu. Embracing the ICT revolution to promote economic growth in developing countries: policy challenge

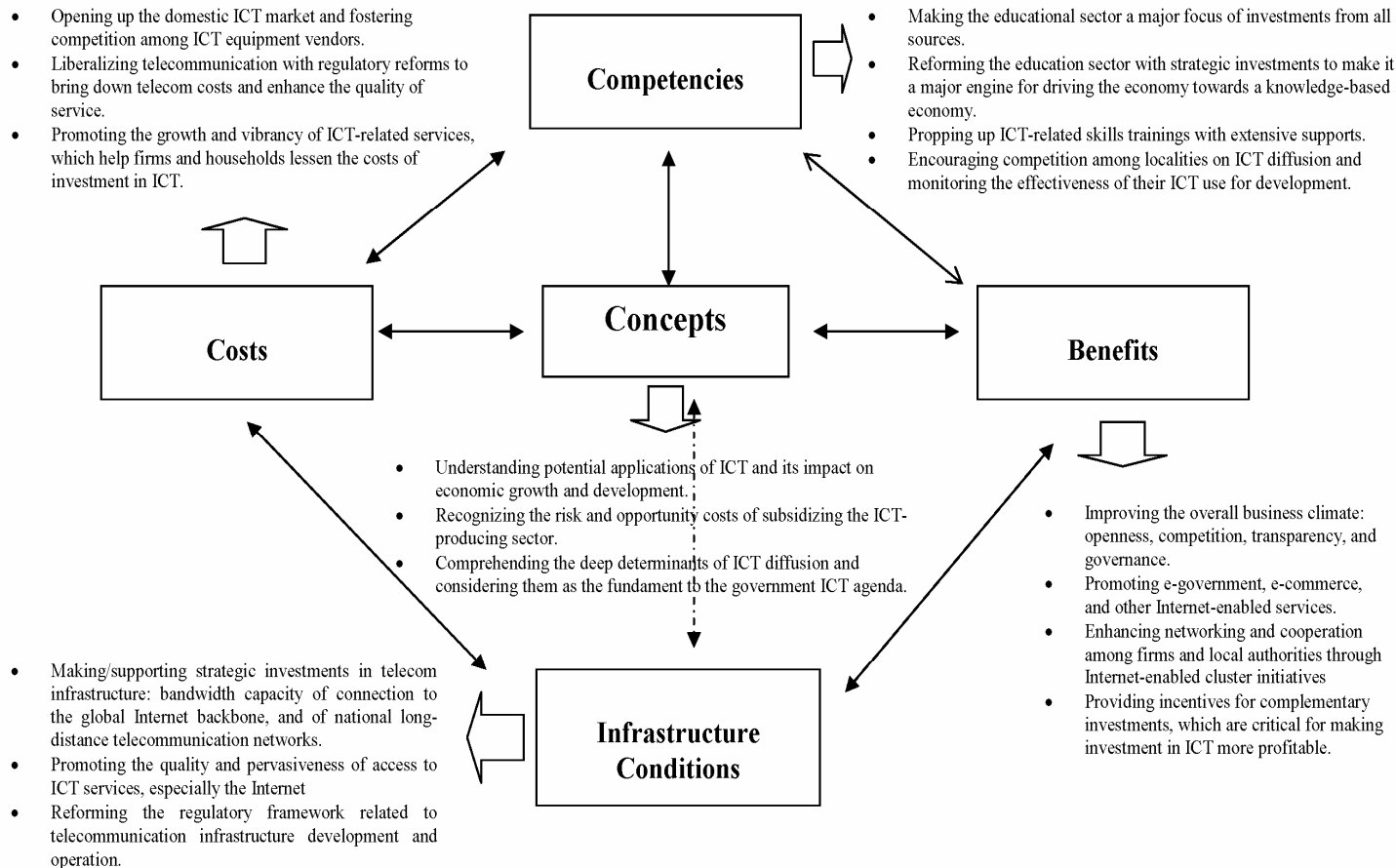


Fig. 3. A Framework for Government ICT Agenda

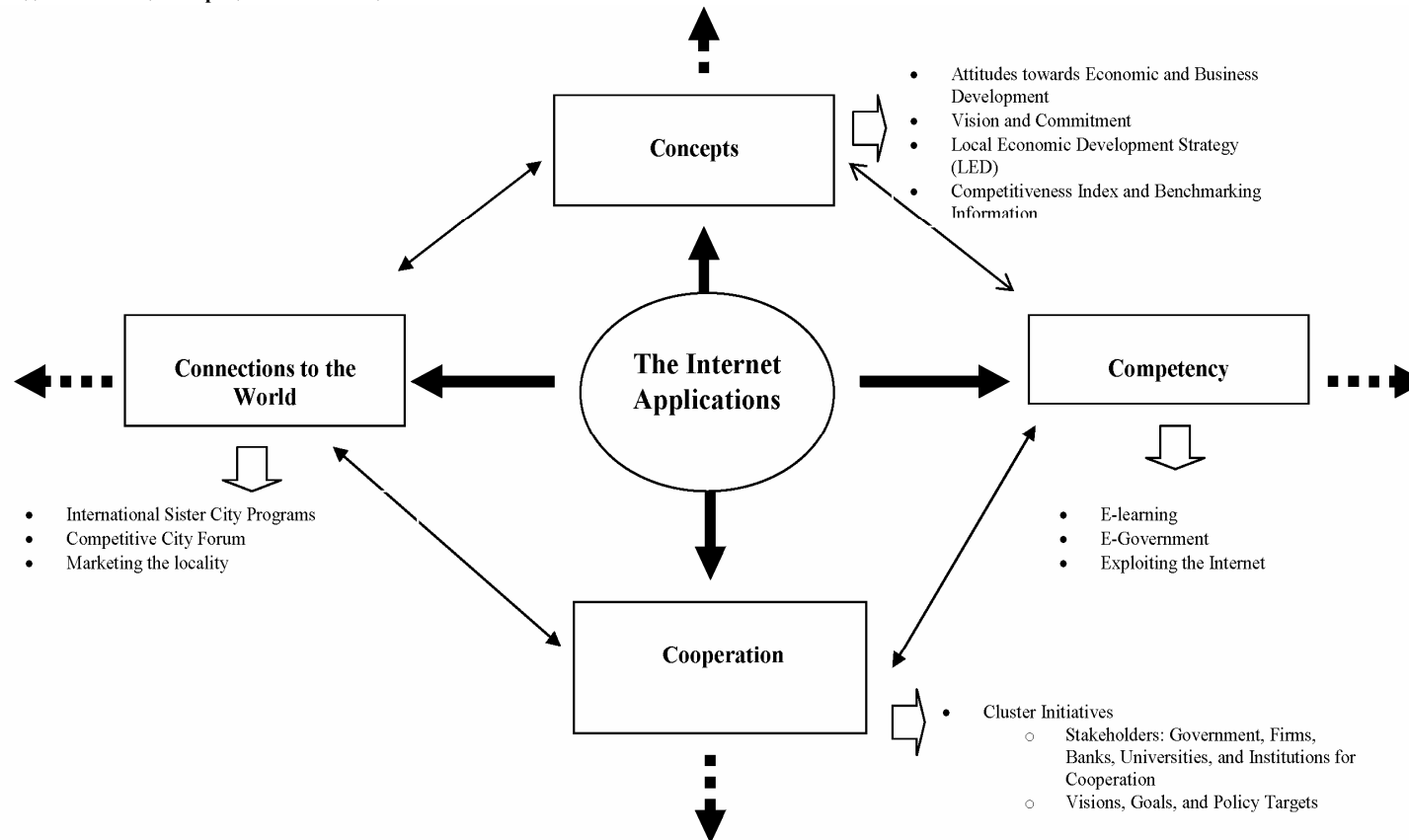


Fig. 4. Utilizing ICT to Promote Local Development in a Developing Country