Challenges and Issues of ICT Industry in Developing Countries

Based on a case study of the barriers and the potential solutions for ICT deployment in Iran

Pujan Ziaie
Department of Computer Science
Technical University of Munich (TUM)
Munich, Germany
ziaie@cs.tum.edu

Abstract: The impact of information and communication technologies (ICT) on enhancing the quality of services and decreasing the overall costs has been the focus of numerous studies in the last two decades. The introduction and employment of ICT in developing countries, however, has not been as fast and effective as in developed nations. In this paper, a case study is conducted regarding the existing issues and potential solutions for the ICT industry in Iran, as an example for a developing country. The study is based on interviews with a number of IT professional and government authorities. Additionally, the relevant literature to this topic is reviewed to generalize and extend the scope of the findings. This exploration is intended to identify the pertinent issues and challenges in developing countries and propose a fine-grained framework to encompass corresponding aspects and potential solutions.

Keywords: ICT, developing countries, Iran, IT services, e-government

I. INTRODUCTION

ICT solutions, if applied wisely, can increase the success of organizations and the efficiency and transparency of governments [1]. Generally speaking, developed countries have facilitated the vast potential of ICT and the Internet in every stratum of society. This has led to extraordinary results in reducing costs and increasing the life standard of their citizens. Yet many developing or less developed countries, particularly those with a low value for their corruption perceptions index (CPI), still cannot leverage all the potentials of ICT due to various reasons. Some of which include legal deficiencies, poor technical infrastructure, social barriers or lack of skilled human resources.

It has been argued that ICTs in general, and information systems research in particular, can increase the productivity [2] and expedite the development process in the developing countries [3]. There is lack of research that focuses on examining the factors that influence ICT project success on enterprise or government levels in developing nations [4]. Based on the recent findings, however, it has been shown that a majority of e-government projects that were initiated in developing countries have failed due to reasons such as gaps between the deployed technology and the realities of context [5]. There has been several valuable studies on relevant issues pertaining to e-government or e-commerce in countries like Sri Lanka [6], Jordan [7], Iran [8], India [9], sub-Saharan Africa [10] or Saudi Arabia [11]. Each has brought a new perspective on some of the complications and deficiencies in certain contexts. The focus of this study is on ICT barriers and issues on a broader scale conceptualized with a generalized perspective. For this purpose, first the common issues and solutions are identified within the borders of the Islamic Republic of Iran. The results are then used to extend the current theoretical framework to generalize the relevant findings in the broader context of developing countries.

Consistent with many other underdeveloped or developing countries, lack of documentation and structured information repositories is prevalent. In such situations, experienced individuals are deemed as one of the most valuable sources of knowledge. For this reason, facts and speculations were gleaned through qualitative in-depth interviews [12]. The interviews were conducted with five individuals who either had expertise on the topic or possessed decision making power in the political system in ICT-related fields. Among the interviewees were university professors, members of the presidential advisory team on technological issues and members of the Supreme Council for Informatics. The objective of these open-ended and semi-structured interviews was to seek plausible answers or explanations to the following questions:

RQ1: What factors influence or hinder the deployment of ICT in developing nations; particularly in Iran?

RQ2: What are the salient aspects of the problems in deploying ICT?

RQ3: What are the possible or potential solutions to overcome the existing complications/issues?

The outcome of the interviews were analyzed and sorted into different categories and similar clusters. Four distinct categories were identified based on the collected information: 1) Legal infrastructure, 2) shortage of human resources 3) technical deficiencies and 4) political complications. It is clear that providing a single theoretical perspective and a holistic explanation for the barriers and issues in this wide context is

rather unlikely. This study is not intended to be a comprehensive list, but to shed light on complications and intricacies of this matter. The results shall provide some awareness and insight for researchers and scholars to give further consideration to multilevel factors and interdependent issues.

The remainder of this paper is organized into three sections: Firstly, the identified issues and deficiencies are listed for different categories. Then, possible solutions are discussed for each category. Finally, the conclusion including the limitations and practical implications are discussed. The results may provide an agenda for policy and decision making, as well as outline essential shortages and risks for potential investors.

II. ICT: Current Situation and Related Aspects

In this section, the accumulated information from the conducted interviews is sorted into four categories: legal, human resources, technical and political. Each category encompasses related issues and impediments in developing countries in general and in Iran in particular.

A. Legal

Developing countries, as late adopters of technology [13], often do not have the necessary rules and legislation to resolve technology-related issues. This leads to complications when verdicts should be reached on disputes pertaining to privacy, content ownership, security breaches, etc. In order to address this inadequacy, the legislation body should either adopt and customize rules and policies from developed countries or develop its own regulations. Another common problem in developing countries is the slow trial process. In some cases, pursuing a simple legal suite might take up to a couple of years. Furthermore, in countries with a lower corruption index, the outcome of a trial might be easily manipulated by one of the parties. This is a serious concern, especially when the government or one of its institutions happens to be a stakeholder. This absence or inefficiency of legal support also imposes a high risk for external and internal investments. In Table I a summary of legal issues is provided.

TABLE I. Legal issues

Judiciary and legislative issues	
Lack of law enforcement	Slow trial process
Insufficient IT-related legislation (e.g. to protect copyright or IPR)	Immunity of system/authorities against trail

B. Human resources (HR)

In those developing countries that enjoy and rely on natural resources such as oil or diamond, the value and importance of human resources is often neglected or underestimated. Instead of acquiring the necessary knowledge to develop technology and foster innovation, such systems tend to acquire ready products or technologies. Possessing high-tech technologies and facilities sometimes creates the illusion of independence and modernization, which intensifies the ignorance towards human resources including experts and the elite, culminating in a faster and wider brain drain. Without knowledgeable human resources as holders of tacit knowledge [14], the "indigenous capacity for societal transformation" [15] will not be fulfilled and the country turns into an unwise consumer of foreign products, which in the long run increases its dependence on technology-providing nations. Moreover, without the necessary knowledge, the acquired technology is often deployed in ineffective ways [16].

Another crucial problem to be tackled is an inappropriate academic curriculum or ineffective educational programs. Science and technology education plays a decisive role in sustainable development [17]. Taking the rapid technological advances and the emergence of new paradigms, certain flexibility toward shaping and reengineering the established educational programs is required. Table II summarizes the salient issues relating to human resources in developing countries.

TABLE II. HR-related issues

Issues relating to human resources	
Brain drain	Unawareness of the importance or lack of human resources
Inapt education or academic curriculum	Underestimating the significance of tacit knowledge

C. Technical

Technical infrastructures, especially electricity and communication networks, are essential prerequisites for ICT deployment and development. For example, Basant el al. [9] identify power disruption as one of the primary reasons for depressing adoption and returns to ICT expenditures in India. Poor communicational infrastructure such as internet bandwidth and penetration can also hinder effective application of ICT in general and make a reliable and fast access to web and online resources difficult. Furthermore, developing countries sometimes have a larger rural population (in percentage) when compared to developed countries. This imposes additional difficulties in providing technical infrastructure to support initiatives on a national scale [18].

Procurement of high-tech facilities and certain technologies is another common impediment for ICT-related advancements. The acquisition and deployment of technology can be slowed down by legal, financial and personal constraints. Patenting and aggressive intellectual property rights (IPR) strategies, especially for those countries that respect international laws and agreements, can restrict their access to critical technologies [14].

TABLE III. Technical issues

Technical infrastructures and technology procurement	
Lack of reliable infrastructure	Absence of infrastructure in rural areas
Patents and IPR	Information loss or leak
Information leak	Being prone to cyber attacks
Depending on other powers for procuring technology	

Also, incomplete deployment of ICT systems (due to the lack of knowledge or expertise for example) may result in loss of data (e.g. when no sufficient backup systems are installed) or information theft. Especially for confidential government-related information, the leakage of data may have severe security consequences. Besides, shifting to information systems for critical processes without the necessary protective measures puts a country at the risk of cyber-attacks [19]. In Table III the salient technical issues are listed.

D. Political

In line with patent-related constraints that were mentioned in the previous section, global as well as internal politics play an important role in knowledge transfer and technology acquisitions [20]. On a global level, for example, international sanctions and boycotts are sometimes put into practice. Such decisions, regardless of the fairness, effectiveness or appropriateness, have a drastic impact on the accessibility of certain technologies or knowledge for those nations that are subjected to such verdicts.

Internal politics can also have a major influence on the direction and depth of technological advancements. Countries that are involved in international conflicts or disputes may pass restrictive bills to fight against the perceived conspiracies. For example, in 2006, Iranian parliament passed a new law restricting the Internet bandwidth to 128kb/s for private users. The decision was based on the assumption that upon providing a higher bandwidth, the enemies of the state would have a convenient communication channel to poison the minds of Iranian citizens with counterfactual propaganda. Another politically enforced restriction is based on religious arguments. For example, in Saudi Arabia, the impending introduction of television in the 60s was ferociously opposed by religious clerics [21]. The same opposition occurred in 2005 when mobile phones with embedded cameras were introduced. In Iran, although often tolerated and not widely practiced, possessing a satellite receiver and watching unauthorized TV channels is still a prosecutable act. Censoring some Google services in China [22] or filtering social media during the recent uprising in many Arab countries [1] including, for example, Egypt and Tunisia [23], are other well-known examples of the influence of internal politics on ICT.

The unfamiliarity of authorities (higher-management) with complications and ICT projects was also mentioned as an important counterproductive factor when managing big projects. This unawareness leads to underfinancing of projects or setting unrealistic deadlines. As a result, projects either fail to be completed or the outcomes are drastically different from the defined goals.

Also, decision makers in more corrupt developing countries may deem information transparency, an inherent consequence of introducing ICT, as a threat to their very existence [24]. This paranoia makes such regimes reluctant to fully adopt ICT for government-related systems and processes. Without the support of the highest authorities, the full capacity of ICT can never be achieved. In such cases, a paradigm shift in the mind of the leaders is necessary. Before this change in mentality, any other measures might prove impractical or counterproductive. Lastly, many developing countries are deprived of technology transfer in critical areas such as nuclear research. This technology monopoly that is imposed upon developing to control their military advancements or adventures prohibits the use of many useful technologies that can be applied in other areas to enhance living standards. In Table IV a summary of the political issues are listed.

TABLE IV. POLITICAL ISSUES

Impediments based on political or ideological reasons	
Sanctions	Religion-based restrictions
Ideology-based restrictions	Ignorance about transparency
Technology monopoly	Lack of support from highest political authorities
Unfamiliarity of higher authorities with ICT-related complications	

In the next section, possible solutions to tackle the mentioned impediments or deficiencies are provided and discussed.

III. MEASURES TO INCREASE THE EFFECTIVITY AND SUCCESS OF ICT

Based on the interviews and the existing body of literature, measures are proposed with regard to different aspects of ICT-related issues. It should be noted that there are two prerequisites that should be met, before any measures or solutions can prove effective. Firstly, ICT shall not be deemed as a threat to the existence of the regimes [25]. This requires a change in the mentality of the highest authorities and leaders. Without the support of the political decision makers, any effort to facilitate and deploy ICT would be in vain. Secondly, as for any similar efforts in other contexts and industries, a strong, swift, and unbiased judiciary system is necessary to foster a safe and sound environment for investors and business holders. In addition to these critical success factors, social and cultural facts and realities should not be ignored. Otherwise the introduced technologies or features will either be ignored, or be used in a harmful or inefficient manner and not in the way that was originally intended (see [11] as an example in the context of Arab countries).

A. Legal infrastructure

New technologies and systems demand new regulations. These regulations can best be achieved by adapting the existing evolved regulation in developed countries. In addition to having proper rules and an acceptable legal basis, the corresponding decision makers and law enforcers including, for example, judges, officers and lawyers should have a general understanding of ICT as well. This can be achieved by either changing the curriculum and introducing ICT-related courses, or having an additional training program to acquaint them with a rudimentary knowledge of ICT and its application.

[1] known as Arab Spring

B. Human resources

The problem of scant human resources can be approached and tackled from different angles. One resolution would be to provide attractive conditions within the country to prevent or slow down the existing brain drain in many developing countries. In addition, several exchange programs and agreements need to be conducted to ease the flow of knowledge from developed countries. Other measures to train and educate experts, such as online educational programs or hiring foreign specialist can also be taken. Restructuring the old curriculums of schools and university to address current issues and advances is another important factor in preparing future generations to confront and respond to the realities and complications of the new digital world.

C. Technical infrastructure

In order to improve the technical infrastructure, investments in communication and other technical infrastructure are necessary. Private sector can be invited and encouraged to take part in building new infrastructure or improving the existing ones. Furthermore, new technologies and systems should be wisely acquired with regard to the available infrastructure to minimize the costs and to refrain from fruitless investments.

One common approach is to employ open source technologies (software, hardware or algorithms). Using (customizing or extending) open source products helps countries overcome patent-related issues and also use existing code to build their applications upon as opposed to developing them from scratch. A word of caution here is necessary: the technology and know-how to manage the development of open source products is not a trivial procedure and states or government should not feel completely independent from foreign technology and know-how by solely availing themselves of open source technologies. For example, the pride of having a "national operating system" based on Linux does not obviate the need for the supporting hardware and hidden dependencies to those countries that invented the concept of open source and initiated the development of open source systems including Linux in the first place.

D. Policies and strategies

Particularly in the domains of e-commerce and e-government, clear policies and strategies on a national level are needed. Without a specific and well-designed frame of action, the inevitable sporadic and ad-hoc behavior would result in inconsistencies and misalignments. For this reason, developing a framework consisting of guidelines, instructions and recommended standards is necessary. Moreover, transparency of information should be promoted and fostered. This might require a change of mentality towards privacy (on the individual level) and security (on the national level). Such changes take time and, therefore, swift and authoritative behavior should be avoided.

The policy towards globalization should also be clearly defined and codified. In Iran, for example, globalization is regarded by some powerful parties as a threat to national and religious identity. In such cases, unless there is a change of attitude in communicating with the rest of the world, employing ICT for international interactions and transactions would not be an easy task.

E. Content generation

In line with information transparency and knowledge distribution [26], it is of utmost importance to provide new content and make them available on public media or the Internet. Encouraging and fostering a culture for creating and sharing information not only contributes to acquiring and distributing knowledge, but also helps preserving the culture and history of a nation. In Muslim countries such as Iran, Pakistan or Arab states, generating religious content would also familiarize the more traditional strata of society (e.g. clerics) with the benefits of technology and the Internet.

Figure 1 provides a summary of the proposed measures to increase the success of deploying ICT on a national level.

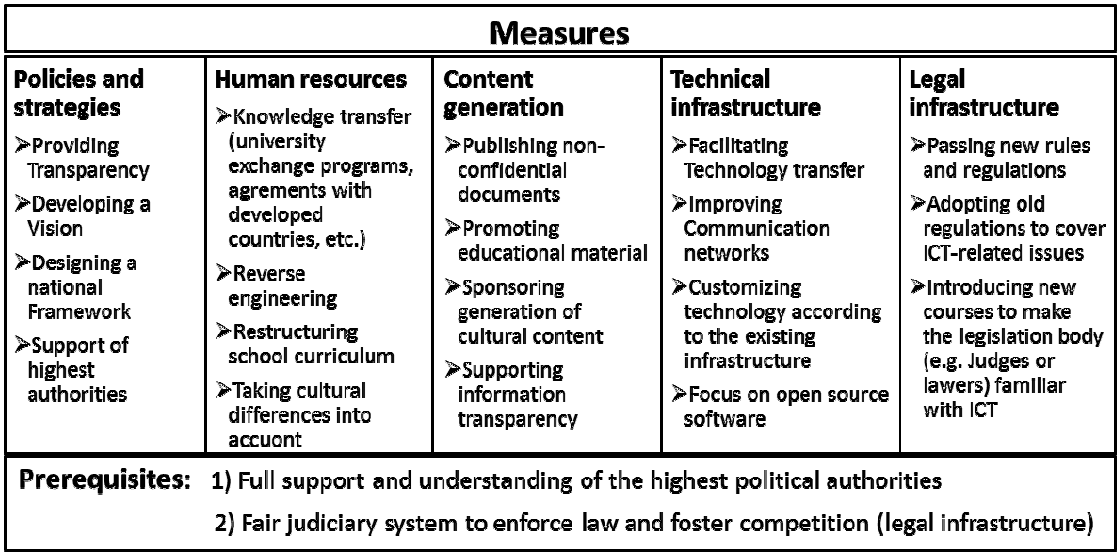

Figure 1. The proposed measures for increasing the success of ICT deployment

IV. CONCLUSION

In this paper, based on the existing body of literature and comprehensive interviews with activists, decision makers, and experts in the field of ICT in Iran, typical issues and deficiencies as well as possible solutions were identified and generalized for developing countries. The notion of a "developing country" was loosely defined to make the statements generalizable. This loose definition may result in invalidity of some of the statements.

It should also be noted that understanding ICT and the pertaining innovations and advancements should be studied in relation to the corresponding social context [26]. In this work little attention was paid to specific social factors to keep the issues and solutions as general as possible. Keeping this in mind, every innovation and technology adoption should be performed aligned with the socially embedded view of these innovations [27], which may be markedly different in different countries. The policies, regulations, and culture of consumption may drastically differ when we compare Sub-Saharan countries, the Arab world, and other developing countries such as Iran, Brazil, Malaysia or Eastern European states.

Internet filtering [28], as an important impediment for knowledge distribution and information transparency were not addressed explicitly, since the degree and focus of filtering differs considerably in different developing countries. Scholars are encouraged to take this factor into account, when studying a specific context.

Also, the mutual effect of ICT and transparency should be pondered carefully. Usually, ICT fosters a culture of transparency, and a culture of transparency encourages the deployment of ICT. If the political system of a country does not appreciate transparency, it can complicate the vast employment of ICT.

ACKNOWLEDGEMENT

A special thank you to Professor Dr. M. Khansari, Professor Dr. H.R. Rabiee, Professor Dr. M. Sepehri Rad and Mr. A. Saeedi for their invaluable help and insight.

REFERENCES

[1] D. Gichoya, "Factors affecting the successful implementation of ICT projects in government," *the Electronic Journal of e-government*, vol. 3, pp. 175-184, 2005.

[2] S. Commander, R. Harrison, and N. Menezes-Filho, "ICT and productivity in developing countries: new firm-level evidence from Brazil and India," *Review of Economics and Statistics*, vol. 93, pp. 528-541, 2011.

[3] G. Walsham and S. Sahay, "Research on information systems in developing countries: Current landscape and future prospects," *Information Technology for Development*, vol. 12, pp. 7-24, 2006.

[4] M. Atsu, F. K. Andoh-Baidoo, B. Osatuyi, and K. Amoako-Gyampah, "Examining the Success Factors of ICT Projects in Developing Nations: A Case Study of AB Networks," *AMCIS*, p. 795, 2009.

[5] D. Dada, "The failure of e-government in developing countries: A literature review," *The Electronic Journal of Information Systems in Developing Countries*, vol. 26, 2006.

[6] M. Kapurubandara and R. Lawson, "Barriers to Adopting ICT and e-commerce with SMEs in developing countries: an Exploratory study in Sri Lanka," *University of Western Sydney, Australia*, 2006.

[7] D. D. Navarra, "The architecture of global ICT programs: a case study of e-governance in Jordan," *Information Technology for Development*, vol. 16, pp. 128-140, 2010.

[8] M. Fathian, P. Akhavan, and M. Hoorali, "E-readiness assessment of non-profit ICT SMEs in a developing country: The case of Iran," *Technovation*, vol. 28, pp. 578-590, 2008.

[9] R. Basant, S. Commander, R. Harrison, and N. Menezes-Filho, "ICT adoption and productivity in developing countries: new firm level evidence from Brazil and India," *IZA Discussion*, 2006.

[10] T. Schuppan, "E-Government in developing countries: Experiences from sub-Saharan Africa," *Government Information Quarterly*, vol. 26, pp. 118-127, 2009.

[11] S. S. Al□Gahtani, "Computer technology adoption in Saudi Arabia: Correlates of perceived innovation attributes," *Information Technology for Development*, vol. 10, pp. 57-69, 2003.

[12] J. M. Johnson, "In-Depth Interviewing," *Handbook of Interview Research: Context and Method*, pp. 103-119, 2002.

[13] E. Berman and S. Machin, "Skill-Biased Technology Transfer: Evidence Factor Biased Technological Change in Developing Countries," 2009.

[14] D. Ernst and B. Å. Lundvall, "Information technology in the learning economy: challenges for developing countries," in *Globalization, Economic Development and Inequality*, ed, 2004, p. 258.

[15] S. Fukuda-Parr and C. Lopes, *Capacity for development: new solutions to old problems*: Routledge, 2012.

[16] S. Omidinia, M. Masrom, and H. Selamat, "Review of E-Learning and ICT Infrastructure in Developing Countries (Case Study of Iran)," *American Journal of Economics and Business Administration*, vol. 3, pp. 120-125, 2011.

[17] G. M. Alam, "The role of science and technology education at network age population for sustainable

development of Bangladesh through human resource advancement," *Scientific Research and Essays*, vol. 4, pp. 1260-1270, 2009.

[18] B. Gupta, S. Dasgupta, and A. Gupta, "Adoption of ICT in a government organization in a developing country: An empirical study," *The Journal of Strategic Information Systems*, vol. 17, pp. 140-154, 2008.

[19] M. Gercke, "Understanding Cybercrime. A Guide for Developing Countries," *International Telecommunication Union (Draft)*, vol. 89, p. 93, 2009.

[20] C. Ciborra, "Interpreting e-government and development: Efficiency, transparency or governance at a distance?," *Information Technology & People*, vol. 18, pp. 260-279, 2005.

[21] M. M. Kraidy, "Saudi Arabia, Lebanon and the changing Arab information order," 2007.

[22] C. Thompson, "Google's China Problem (and China's Google Problem)," *The New York Times*, vol. 23, 2006.

[23] P. N. Howard, S. D. Agarwal, and M. M. Hussain, "When do States disconnect their digital networks? Regime responses to the political uses of social media," *The Communication Review*, vol. 14, pp. 216-232, 2011.

[24] S. Kalathil, "Dot. com for dictators," *Foreign Policy*, pp. 43-49, 2003.

[25] J. E. Relly, "Examining a model of vertical accountability: A cross-national study of the influence of information access on the control of corruption," *Government Information Quarterly*, 2012.

[26] C. Avgerou, "Information systems in developing countries: a critical research review," *Journal of Information Technology*, vol. 23, pp. 133-146, 2008.

[27] J. Braa, O. Hanseth, A. Heywood, W. Mohammed, and V. Shaw, "Developing Health Information Systems in Developing Countries," *The Flexible Standards Strategy. In press, MISQ, Special Issue on IT and Development*, 2007.

[28] F. Shirazi and K. Greenaway, "Examining Validity Claims for Internet Filtering in Islamic Middle Eastern Countries: A Critical Discourse Analysis," in *Americas Conference on Information Systems*, 2009, p. 794.