WELCOME TO WJSTSD

We are pleased to present the first special issue of World Journal of Science, Technology and Sustainable Development (WJSTSD) after 6 years from its inauguration in 2004. WJSTSD is a multidisciplinary international refereed journal on issues that will be central to world sustainable development through efficient and effective technology transfer, the challenges these pose for developing countries, and the global framework for dealing with science and technology.

SPECIAL ISSUE

The theme of this special issue of WJSTSD is “ICTs, Technological Change and Development in the Developing World”. In its conceptualization it sought to give voice and visibility to the realities and experiences of the developing world. More particularly, this compilation showcases and analyses the special circumstances of developing countries endeavouring to escape the bowels of economic depression by embracing and employing ICTs.

This special issue of the journal is ambitious in its intent. The geographic breadth stretches across the world with contributions representing the outcome of many comprehensive research programmes undertaken in Africa, Asia, Europe, Americas and the Middle East. The countries represented here have populations ranging from 165,000 to 10.6 million inhabitants. The plurality of issues interrogated reminds the reader of the complexity of the subject matter under investigation and the multifariousness of the concept development itself.

CONTENTS OF SPECIAL ISSUE

In the first paper in the special issue, Rossitza Rousseva contends that despite the extensive studies on latecomer software development activities, the issue of technological capability has often been peripheral to the discourse. She argues, therefore, that any assessment of the development of latecomer software industries ought to investigate the technological capabilities which the latecomer companies have been able to accumulate. Her work endeavours to fill the gaps, by outlining the “specifics” in analyzing technological capabilities in latecomer software sectors, in particular.
The shift from resource and manufacturing-based to a knowledge and information-based global economy has led to an array of new challenges and opportunities. Increasingly ICTs are perceived as effective tools in promoting knowledge creation and sharing. Michelle M.S. Phang and Soon-Yan Foong are particularly concerned about the specific impact of the paradigmatic shift in the global political economy (GPE) on the accounting profession in Malaysia. They argue that the accounting professionals in particular, are challenged to broaden their scope of knowledge and skills to remain competitive. However, the field does not lend itself to the ready embrace of ICTs especially in developing countries, as highlighted by the Malaysian example.

Rigobert’s piece on Education in St. Lucia highlights the difficulties confronting small island developing states (SIDS) as they endeavour to situate ICTs at the core of the education system. The example of St. Lucia is particularly telling, reflecting traditional impediments associated with small size and resource shortages, for example, but compounded by other socio-psychological, cultural and political issues that contribute to the risk aversion and technophobia that characterize that society. As St. Lucia seeks to diversify its economy away from agriculture to a service-based economy, it has become necessary to equip the next generation with the requisite e-skills to help propel that country into the e-age. The chapter highlights the socio-economic costs of the delay in the full incorporation of ICTs in the pedagogic process.

Similar to Rigobert’s research, Williams E. Nwagwu investigates the information and learning needs of youth in Uzoagba rural community in southeastern Nigeria. In doing so Nwagwu used data collected from 220 and 250 male and female youth through Focus Group Discussion (FGD) and a questionnaire survey respectively. The first category investigated includes those under 12 where education, health/HIV/AIDS and income dominate. Another is the group of those above 12 where the issues that dominate their needs are income/employment and education. Nwagwu’s results show that youth want to remain healthy to develop their personal efficacy through education and then be usefully integrated into wider social and economic life. Meanwhile, they are concerned about how to participate in generating income to achieve this ultimate aim, and to assist their families and community.

The paper by Ramlan and Musa Ahmed assesses the impact of ICTs on Malaysia’s aggregate output between 1965 and 2005. They argue that ICTs are directly related to aggregate output in Malaysia, with income per capita proving to be an important economic stimulant.

The piece by Stefanovic, Matijevic and Devedzic highlights the specific experience of Serbia with respect to ICTs and development. The specific challenges of the ICT sector in particular are highlighted. The authors conclude that Serbia continues to lag behind the developed countries due in large measure to inadequate financial resources being devoted to the ICT sector.

Polenakovik and Pinto focus on the utilization of ICTs with SMEs in particular. The concern is to raise the level of investment in that sector with a particular thrust towards R&D. Some of the recommendations include the establishment of science parks, and providing attractive tax incentives geared towards jump starting the SME sector.

CONCLUSION

We hope that the outcome of this special issue will help to outline the major issues that frame the current state of the different
aspects of ICTs, Technological Change and Development in the Developing World, and contribute to a better understanding of the important role that ICTs can play in achieving sustainable development across the world. Of particular concern is the problem of the digital divide in Africa, which is but an additional variant of its socio economic challenges and warrants a greater and immediate response from the global community.

Finally, we would like to congratulate the authors for their valuable contributions and it is hoped that the ensemble of papers presented in this special issue will help to stimulate debate amongst scholars, researchers and policymakers that will ultimately lead to a more integrated and multi-disciplinary approach to policy design. We are especially grateful to all reviewers for graciously offering their invaluable comments, suggestions and criticisms which greatly enhanced the quality of this issue of WJSTSD.

BIOGRAPHY

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The need to scrutinise latecomer software development activities and investigate technological capabilities

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Abstract: Software development activities have been identified as a ‘window of opportunity’ for latecomer companies. Based on a critical literature review, this paper argues that studies are yet to scrutinise the exact nature and extent of the capabilities, which the latecomer companies have been able to develop. The main proposition advanced by this research is that the analyses need to investigate the technological capabilities, which the latecomer companies have been able to accumulate. This study outlines the specifics in analysing technological capabilities in latecomer software companies and improves our understanding about the complexity in developing software industries in latecomer context.

Keywords: software industry; latecomers; technological capabilities.

INTRODUCTION
In the last two decades a group of studies has been emphasising that the Information Technologies (ITs) open opportunities for leapfrogging by latecomer companies (Soete, 1985; Steinmueller, 2001). It has been observed that the availability of skilled human capital creates a base for development of IT industries by latecomer countries. The software sector is, in principle, a low-capital but knowledge and skill-intensive industry, and the international market for software is big and growing (OECD, 2004; Steinmueller, 2004). Due to their higher contribution to economic growth the development of software and other high-tech industries has the potential to foster economic development in latecomers (Kuznets, 1957).

A number of latecomers have attempted to develop software sectors in the last decade. Different countries followed different paths: development of the latecomer software sectors in some latecomers is foreign-led, in some it is indigenous-based; some latecomer software sectors are predominantly outsourcing-driven, some develop own software activities; some latecomer software sectors are export-driven, others remain domestic-oriented. The research is burgeoning following

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the recent expansion of software development activities undertaken by latecomers (Arora et al., 2001; Arora and Gambardella, 2005b; Carmel, 2003; Commander, 2005; Correa, 1996; Heeks and Nicholson, 2002; Tschang, 2003). Studies focus on different variables reflecting the development of latecomer software sectors, like the range of products and services offered, market orientation, models of development (e.g., outsourcing-driven, development of own products and services, domestic-oriented vs. export-driven, etc.), revenue, growth, skills and abilities, etc.

Despite the extensive studies on latecomer software development activities the focus has seldom been placed explicitly and systematically on the issue of technological capability, as the critical literature review in this paper reveals. The limited number of studies that did so have either not been well-recognised, or have some limitations. It is the aim of this paper to raise this issue and emphasise that if they are to assess the development of latecomer software industries, the studies need to investigate the technological capabilities, which the latecomer companies have been able to accumulate. This paper outlines the specifics in analysing technological capabilities in latecomer software industries.

The paper is structured as follows. Section 2 outlines the importance of capabilities as major drivers for development of latecomer software development activities. Section 3 gives an overview of the concept of technological capabilities building. Section 4 presents a critical review of the existing literature on capabilities in latecomer software industries. Section 5 describes the specifics in analysing technological capabilities in the latecomer software industries. Finally, Section 6 draws conclusions and outlines directions for further research.

**CAPABILITIES: MAJOR DRIVERS FOR DEVELOPMENT OF LATECOMER SOFTWARE INDUSTRIES**

The software sector is skill-intensive, and the availability of qualified technical personnel and capabilities for software engineering are critical for its development (Arora et al., 2001; Arora and Gambardella, 2005b; Athreye, 2005; Commander, 2005; Correa, 1996; Heeks, 1996; Heeks and Nicholson, 2002; Steinmueller, 2001). Critical importance is ascribed to computer engineering education. Availability of qualified human capital is, indisputably, a critical prerequisite for the development of the software sector.

Software production, by definition, is an innovative activity because it aims to produce new products or new ways of executing known tasks and functions (Torrisi, 1998). To undertake software activities, companies need the capabilities to innovate. However, the development of innovation capabilities is neither automatic nor certain. The literature on technological capability reveals that innovation capabilities develop gradually towards the later stages of cumulative and gradual efforts aimed at increasing technological sophistication (Figueiredo, 2001). Applied to the software sector, this suggests that successful development of software activities requires accumulation of technological capabilities for software production in latecomer firms – this accumulation is not an automatic process activated merely by the presence of technically qualified human capital. Therefore, the issue of technological capability development has to become a focal point both for companies engaged in software development activities, and countries that are aiming to develop their software sectors to harness their potential for fostering economic development.

Despite extensive study of software development activities in latecomers, there has
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seldom been explicit and systematic focus on the issue of technological capability, as the literature review in this research reveals. The existing studies either focus on skills rather than capabilities or analyse the capability issue by focussing on certain capabilities without building a systematic framework for analysis of software technological capability and only one study develops a framework for software technological capability, which is valuable but has certain limitations. The current research places the issue of technological capabilities as the focal point of the analysis and develops a framework for analysing the development of technological capabilities in latecomer software companies. The following section gives a brief overview of the concept of the technological capabilities building. Section 4 provides a brief overview of the literature on capabilities in latecomer software sectors, followed by a section on the complexity of applying the concept of technological capability building to the case of the software sector.

BUILDING TECHNOLOGICAL CAPABILITIES: AN IMPERATIVE FOR LATECOMER COMPANIES

A number of scholars agree that, to be successful and sustainable over time, technological development in a latecomer or less-advanced context needs to involve technological capabilities building (Bell and Pavitt, 1993; Dutrenit, 2000; Figueiredo, 2001; Hobday, 1995a, 1995b; Hobday and Rush, 2007; Kim, 1997a, 1997b, 1998; Kim and Nelson, 2000; Lall, 1992; Marcelle, 2004; Rousseva, 2008; Scott-Kemmis and Chitrapas, 2007). Technological capabilities building involve a deliberate process of learning and technology upgrading by the latecomer companies directed at the accumulation of knowledge and skills and their commercial application.

Technological capabilities can be defined as encompassing “the great variety of knowledge and skills which firms need so that they can acquire, assimilate, use, adapt, change and create technology” (Ernst et al., 1998, p.17). It should be noted that this is “a broad definition, which goes beyond engineering and technical know-how and includes organisational know-how” (Ernst et al., 1998, p.17).

A firm’s technological capability is built upon multiple components that individually and collectively shape the rate and direction of the development of technological capability. Building technological capability is, in essence, a process of accumulation of a wide array of capabilities and subsequent deepening and broadening to achieve mastery over new technologies. While deepening the technological capabilities, the latecomer companies pass through subsequent stages of technological sophistication, which can be pictured as a ‘technological ladder’ (Hobday, 1995a, 1995b). In this sense, we can portray the process of technological capabilities building as a subsequent process of developing capabilities with a higher level of technological sophistication.

Research in technological capabilities building (Bell and Pavitt, 1993; Figueiredo, 2002; Hobday, 2000; Kim, 1997b) have emphasised that it is crucial to distinguish between production and innovation capabilities, as these reflect completely different sets of accumulated skills by the latecomer companies. Developing production capabilities involves accumulating skills and abilities to operate new technologies (e.g., to produce products and deliver services based on technologies produced elsewhere), while building innovation capabilities is a far more cumbersome task. To build innovation capabilities the latecomers need to deepen their knowledge and understanding.
about the new technologies, to the extent that they will be able to change and modify the new technologies and, eventually, to introduce new technologies. In this sense, the innovation capabilities are qualitative different in nature as they signify that the latecomer companies have gone beyond the stage of replication and minor adaptations, and have become capable of introducing technological innovations on their own.

Innovation capabilities are difficult to develop and their development is far from automatic or certain (Bell and Pavitt, 1993; Dutrenit, 2000; Figueiredo, 2001; Hobday 1995a, 1995b; Hobday et al., 2004; Kim, 1997a, 1997b, 1998; Kim and Nelson, 2000; Lall, 1992; Marcelle, 2004; Rousseva, 2008; Tsekouras, 2006). Innovation capabilities develop on the basis of production capabilities, but go further as a result of active and purposeful accumulation of technological knowledge to go beyond production capacity and develop capabilities to change and modify technologies.

EXISTING LITERATURE ON CAPABILITIES IN LATECOMER SOFTWARE COMPANIES

The seminal works of Schweber (1989, 1992), Correa (1996), and Heeks and Nicholson (2002) have outlined capabilities as a critical factor in enabling latecomer software companies to enter international markets. Some of the recent studies investigating the remarkable expansion of indigenous software development activities in a number of developing countries, like India, China and Brazil (see for example among many others, for all developing countries (Carmel, 2003; Arora and Gambardella, 2005b; Commander, 2005; Minevich and Richter, 2005), for India (Arora et al., 2001; Athreye 2005; Desai, 2005; Tschang, 2001); for China (Saxenian, 2005; Tschang and Xue, 2005), for China vs. India (Contractor, 2004; Tschang, 2003), for Brazil (Behrens, 2005; Botelho et al., 2005), etc) also have mentioned capabilities as an important driver in development of the latecomer software industries. However, most of these studies focus on software engineering capabilities without disentangling the capability issue. They are referencing capability but actually they analyse either skills for software engineering or for capabilities without placing them within the capability building framework. There are, however, several important exceptions, which are considered below.

In discussing the development of the Romanian software sector Grundey and Heeks (1998) employ a theoretical framework based on the concept of technological capabilities, and provide a taxonomy of software technological capability. This study is a valuable contribution, as it outlines different software production activities representing different stages on the technological ladder, which are required to perform more sophisticated software production. It outlines the activities underlying production and non-production software capabilities and provides a comprehensive analysis of the progression from simple software production, to software redesign, and skilled software production (Grundey and Heeks, 1998, p.11). It classifies software activities on seven levels: levels one and two include non-production activities, and level three and onwards outline the production activities.

This paper focuses only on software production activities in Grundey and Heeks’s (1998) model. Level three represents production of copies of existing software products; level four includes adaptation, without production (e.g., creating a situation-specific application from a package); level five is simple software production (e.g,
creating a new set of interfaces for users, creating a program to move data between applications, creating a small utility program, customising an existing program to user needs); level six involves software redesign (e.g., redesigning a program to meet local user needs, redesigning a program to meet regional/global user needs, minor process change such as modifying the software production process); level seven, the highest level in the classification, represents skilled software production: local product innovation (e.g., developing a new program to meet local user needs), international product innovation (i.e., developing a new program to meet regional/global user needs), major process change (i.e., redesigning the software production process), and process innovation (i.e., designing a completely new software production process).

Grundey and Heeks’s (1998) model offers a comprehensive account of the wide variety of software activities. However, it includes both non-production and production activities. As the aim of the analysis of technological capabilities in this paper is to capture the level of technological sophistication of software production in companies, it is appropriate to focus on level five and upwards. These levels of the classification are incorporated into the framework for this research. The framework of technological capability building highlights that technological capabilities develop along the breadth and depth, i.e., they have different technological sophistication (e.g., routine, intermediate, advanced) and they incorporate a range of capabilities associated with each of these levels of technological sophistication (e.g., testing, engineering, design, R&D). Grundey and Heeks’s model (from levels five onwards in particular) depicts the different levels of technological sophistication of the software technological capability that can be defined as a “software development technological ladder”, but does not analyse the wide array of capabilities underlying these activities. In this sense, there is a need to explore the capabilities that allow latecomer companies to execute the activities referred to, and to build technological capability. In order to have more practical value, analyses should scrutinise the component elements of technological capabilities underlying the development of software technological capability. In Grundey and Heeks’s study the theoretical framework is not tied directly to the empirical section, which explores, predominantly, the institutional foundations (and their transformation), and only briefly touches on the development of software activities in the latecomer software sector in Romania; thus, it does not provide a clear description of how to apply the proposed framework.

Tschang (2001) provides an extensive software development model. He employs a typology of software development activities in the software development lifecycle that corresponds to successive/different phases in the product lifecycle. The model outlines five major software development activities, which parallel four product development phases:

1 New product development phase
   1.1 Conceptualisation: requirements analysis, and design
   1.2 (Initial) software engineering: system analysis and software engineering, coding and programming, and testing

2 Installation phase
   2.1 Customisation

3 After sales phase
   3.1 Maintenance: operations and servicing
4 ‘Expiration’ phase

4.1 Product code updating/versioning/improvement.

Tschang focuses on the intersection between the software development lifecycle and the software product lifecycle. He also highlights that the identified activities in the software development cycle are associated with different value additions for the company. However, the model does not tackle the issue of the technological sophistication required for software development activities it identifies, neither does it investigate the links of these activities to outsourcing. Also, as the author acknowledges, further work is needed to break the model down into products and services, to determine different individual activities and skills needed for each type of activity and to distinguish different types of activities and firms.

Tschang identifies a set of skills that latecomer software companies need to develop (Tschang, 2001, pp.19–20). They are classified into two major groups: product development skills and business development skills. In Tschang’s framework, there are four categories within product development skills:

1 basic technical skills such as coding and programming languages

2 system skills, including project management, requirements analysis and systems analysis

3 advanced or high technical skills, including mathematical abilities and other fundamental (scientific) knowledge used in science and innovative product development

4 innovative technical skills, which are the creative, interdisciplinary and other skills needed for new product innovation.

Under business development skills the author identifies two groups of skills:

- entrepreneurial skills, including various management and networking skills, e.g., sourcing of venture capital, managing a start up, forming alliances, etc.

- other conceptual skills, including new products requirements analysis, knowledge of market and customer needs, and innovative and creative abilities.

Tschang is helpful in identifying the capabilities that latecomer software companies need to muster and there are similarities and differences between his framework and the framework developed in this paper. The list of technical skills developed by Tschang provides a relevant account of the technical capabilities involved in software production but it is not specific in identifying advanced and innovation capabilities.

The list of business skills provided by Tschang (2001) is generic and does not take account of the specificity of technological development in a latecomer context, or the specific organisational capabilities mentioned by several studies of latecomer company development. From the technological and the organisational point of view, Tschang (2001) outlines skills rather than capabilities, an approach that has some conceptual limitations. This paper outlines the array of technological capabilities that reflect both the specifics of software production, and the works in the technological capability building and business literature. This study, therefore, attempts to provide more practically-oriented advice and a better representation of the array of capabilities needed by latecomer software companies in order to develop technological capability.

In a later study (Tschang, 2003), Tschang focuses explicitly on the capabilities of latecomer software sectors, examining the case of the Indian and Chinese sectors, and provides a list of items, namely, individual technical skills, process maturity, management
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Capability, technology, revenue model and product marketing capability. Despite being relevant to, and informative about, the state of development of a latecomer software sector, this list addresses individual technical capabilities and technology but does not distinguish between the technical capabilities needed for software production (e.g., capability for software engineering, design, etc.). It also leaves out a substantial number of important capabilities, e.g., capabilities required to monitor technological development and identify potential niches, capabilities for strategic thinking, linkage capabilities, capabilities to establish a dynamic organisational learning environment, etc. Further, from a technological capability point of view, this model provides a mix of capabilities (see above) and performance indicators (e.g., revenue model), without being exhaustive or clear about how these are derived (although most are indeed relevant).

In addition to Grundey and Heeks and Tschang, a fairly recent book by Arora and Gambardella (2005b) analyses the underpinnings of the successful development of the software sectors in several latecomer countries, among them India, China and Brazil. Alongside specific developments in individual countries, the study attempts to identify the driving forces of the development of latecomer software sectors. Capabilities emerge as important drivers underlying the success of these latecomers, as emphasised in the individual country chapters (see (Athreye, 2005)) in particular; also (Botelho et al., 2005; Tschang and Xue, 2005); and the conclusions in Arora and Gambardella (2005b).

Despite this recognition and highlighted importance, the studies in Arora and Gambardella (2005b) provide neither a detailed nor a unified framework for analysing capabilities (the study of Athreye analyses capabilities and is discussed below). In the individual chapters, the analysis of capabilities in Arora and Gambardella (2005b) is combined with many other factors affecting industry development, and it is the sources of the incubation of capabilities that are the focal points of the analysis, rather than the actual capabilities (with the notable exception of Athreye’s contribution, which is discussed below). Similarly, despite emphasising the importance of firms’ capabilities, the conclusions focus on the sources of firms’ capabilities rather than on the capabilities themselves (Arora and Gambardella, 2005a). It is an advantage that this study has analysed the sources of capabilities, as it started unpacking the capability box. Nevertheless, an explicit framework considering the specifics of technological capabilities building in the software sector and a connection with the literature in the field of technological developments in latecomer contexts are both lacking in most of this study.

Within the collection edited by Arora and Gambardella (2005b) and Athreye (2005) devotes the greatest specific attention to capabilities development. Although it does not provide an analytical framework or systematically explore the issue of technological capabilities building, it does capture and portray the underlying idea of technological capability building in latecomer software companies. Exploring the development of the Indian software sector and the factors contributing to its successful development, Athreye (2005) observes that it is the evolutionary development of capabilities that underpins the Indian success. The study reveals that Indian companies entered the international market by providing basic programming skills, but that over time they developed capabilities for software process management and, in a few cases, expertise in specialised domains. Athreye concludes
by emphasising that the Indian model is a specific example; its success lies in the winning combination of developing different variants of the outsourced service model and evolving organisational capabilities for software process control and large-scale labour management (Athreye, 2005, p. 36). In this sense, it can be perceived as a specific and exceptional case of a latecomer software sector development.

Athreye’s focus on outsourcing of software products and services is just one of the paths open before the latecomer software companies, as a range of paths, including outsourcing or developing own products and services for domestic or international markets, are open to latecomers, as discussed below. In the case of Multinational Enterprise (MNE) outsourcing, capabilities building will be heavily influenced by learning spillovers from the MNE. Different paths may require different capabilities, which latecomer companies need to master, as this paper highlights. For example, outsourcing might require a set of skills that are limited and significantly narrower than the set of skills required for companies to produce their own products and services. In this sense, the question about technological capabilities in latecomer software companies is unresolved.

This critical review of the studies on capability building in latecomer software sectors highlights a major gap in our understanding about capability building in latecomer software sectors. Despite the recognition that capabilities are of critical importance for the development of latecomer software activities, a framework for analysing systematically the software technological capability and its component elements and the specifics of investigating software technological capability are still absent.

The following section attempts to fill the gaps and complete the research begun by the authors discussed above, with particular focus on the analysis of accumulation of software technological capabilities in the latecomers.

**SPECIFICS IN ANALYSING TECHNOLOGICAL CAPABILITIES IN LATECOMER SOFTWARE INDUSTRIES**

To have the capacity to investigate software technological capability the analysis has to incorporate the main ideas in the field of technological capability building. Therefore, it has to investigate both the level of technological sophistication of innovation capabilities, which the latecomer companies have managed to develop, and the underlying capabilities. It also has to take into account the specifics of technological development in the latecomer context and the specifics in analysing the development of latecomer software development activities. This paper discusses the specifics of analysing technological capabilities in latecomer software industries: it focuses on the latter two points and touches upon the former two.

Exploring the technological capabilities in a latecomer software industry presents a challenge. So far, studies analysing the process of technological capabilities have been predominantly focused on the industrial sectors, studying the development of the electronics industry (Gee and Kuo, 1998; Hobday, 1995b; Kim, 1997b; Mytelka and Ernst, 1998), textiles (Gee and Kuo, 1998; Lall, 1987), steel industry (Figueiredo, 2001; Lall, 1987), telecommunications (Marcelle, 2004), and so forth. As the predominant part of the studies have been directed at exploring technological capabilities in industrial sectors, the analytical framework developed in the field so far reflects the specifics of the industrial sector as contrasted with the service sector and, additionally, specific features of industrial activities such
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as photolithography in the context of electronic integrated circuits. A study investigating technological capabilities in a latecomer software industry needs to take into account the specifics of the software industry, which are discussed below.

This research identifies two major features that are particularly relevant in analysing the accumulation of technological capabilities in latecomer software companies. These are, in particular,

1 degree of innovativeness
2 breadth and depth of technological capabilities.

First, the degree of innovativeness inbuilt in software technological capability may vary. As noted earlier software production is inherently an innovation activity (Torrisi, 1998). However, it must be underlined that the degree of innovativeness and the significance of novelty, which governs the extent of innovation capability needed, varies among different software projects, and this holds both for advanced and latecomer software companies. Software services involve certain innovative components, as they include innovativeness of design arising from the unique qualities of every software ‘expression’. But even within software services the degree of innovativeness varies. Software services, such as re-coding legacy applications into more modern computer languages, data migration, or resolution of specific incompatibilities among similar systems, for example, involve a relatively small innovative component compared to software services associated with re-design. Creating software products involves an even greater, and often more significant innovative, component than software services, as it is associated with creating ‘best of breed’ software products and is comparable to frontier technological developments in that domain, which requires a high level of innovative capability. Therefore, development of software products represents the highest level of technological sophistication, while software services involve innovative component, which is lesser compared to software products and varies further according to the nature of software services. Hence it is important to consider the degree of innovativeness inbuilt in software production.

Before differentiating the degree of innovativeness in latecomer software production further, we should clarify what we mean by innovativeness. Innovativeness is usually measured with reference to novelty in the world market. Based on this logic, only products that are successful in international markets have high levels of innovativeness. However, a latecomer company may develop a product in the domestic market that targets local customers’ needs and is innovative. Furthermore, innovativeness is also associated with the commercial value produced. It is generally believed that commercialisation in the international market has the potential to reap higher profits than commercialisation in the domestic market. But this may not always hold. For example, a company may attain greater commercial value by creating an innovative product that meets the needs of a large number of customers in the domestic market (e.g., payroll and tax record keeping systems reflecting local regulations) compared with a company that develops a niche product for a limited number of customers in the international markets. This duality creates problems in assessing innovativeness inbuilt in the software production. As the latecomer markets are usually less sophisticated compared to the international markets (unless the former are dominated by MNEs), we can assume that products and services offered by latecomer software companies in the domestic market are with less technologically sophisticated compared to products and services offered by latecomer...
software companies in the international markets; nevertheless, the analysis need to investigate the level of technological sophistication and the degree of innovativeness of the products and services offered in the domestic market.

In analysing the software activities undertaken by latecomer companies it is important to consider the degree of innovativeness they encompass and the degree of sophistication of innovation capabilities deployed. When studying the degree of innovative efforts associated with producing particular software products or services, it is necessary to distinguish between minor, moderate and major innovation, which, respectively, are associated with the capabilities for minor, moderate and major innovation. This can be viewed as the “software development technological ladder”.

This distinction follows the classification of the software technological capability developed by Grundey and Heeks (1998) and corresponds to the activities classified in levels five to seven in their classification (Figure 1 in the Appendix). Simple software production, i.e., software activities such as creating a new set of interfaces, data migration, creating small utility programs and/or modifying existing programs to meet user needs, involves a small innovative component and signals the existence of capabilities for minor innovation. Software redesign activities, such as redesigning a program to meet local user or regional/global user needs (i.e., customisation and/or localisation), and minor process change (i.e., modifying the software production process), demonstrates the indicate capabilities for moderate innovation. Skilled software production activities, such as local product innovation (i.e., developing a new program to meet local user needs), international product innovation (i.e., developing a new program to meet regional/global user needs), major process change (i.e., redesigning the software production process).
production process), and process innovation (i.e., designing a completely new software production process) suggest the capabilities for major innovation. The classification of the technological sophistication of the software development activities in Figure 1, i.e., the software technological capability or the software development technological ladder, in minor, moderate and major categories reflects the basic, intermediate and advanced categories in the framework of technological capability.

A proportion of activities such as re-coding, data migration, resolving incompatibility, etc., can be expected to account for a significant share of the software services offered by latecomer companies. On the other hand, the presence of more innovative activities, such as the creation of packages or sophisticated customised services, despite their small share in latecomer software developments, signals the existence of potentially significant innovation capabilities in latecomers. For example, if many latecomer software development activities are directed at offering services in the domestic markets and there is also a growing share of outsourced services for international markets, this indicates the existence of capabilities for minor and, eventually, moderate innovation; India has specialised in offering software services in the international market and, if we apply the classification of the degree of innovativeness to the range of software development activities that Indian software companies offer according to the literature (Arora et al., 2001; Athreye, 2005; Desai, 2005), this reveals the existence of capabilities for minor, moderate and, in a limited number of cases, major innovation. China and Brazil have developed software products and services for their domestic markets (Behrens, 2005; Botelho et al., 2005; Saxenian and Quan, 2005; Tschang and Xue, 2005), which suggest capabilities for moderate and major innovation. Further, in-depth case study and comparison-based analyses are needed to reveal the achievements and problems involved in the development of technological capabilities in the latecomers. These should be done by comparing companies within a single country and comparing companies in different countries, to capture company- and context-specific issues.

The second specific for analysing technological capabilities in latecomer software companies, concerns the breadth and depth of capabilities. The discussion about degree of innovativeness inbuilt into software technological capability implies breadth and depth of the technological capability. Capabilities develop sequentially and higher technological sophistication usually entails deeper (i.e., more sophisticated) capabilities and a wider range of (i.e., broader) capabilities, as highlighted in technological capability building literature.

Provided that the nature of innovation is similar across sectors, the capabilities literature suggests that major innovation requires the execution of a greater variety of, and also more complex, software development activities compared to the capabilities required for moderate and minor innovation. For example, creating a product innovation involves broader and far more complex capabilities than software redesign or simple software production. Similarly, capabilities for moderate innovation entail a wider variety and more complex software activities compared to the capabilities required for minor innovation. Thus, software redesign (e.g., redesigning a program to meet local or global user needs or minor process change), for example, requires greater capabilities than the simple software production of new interfaces, small utility programs or programs for data migration, or modifications to existing
programs, etc. Therefore, a higher degree of innovativeness entails broader and more complex capabilities, i.e., the breadth and depth of capabilities increases with innovativeness.

CONCLUSIONS AND DIRECTIONS FOR FURTHER RESEARCH

Despite the recent burgeoning research on development of latecomer software industries, critical questions remain unanswered. Based on a critical literature review, this paper argues that studies are yet to scrutinise the exact nature and extent of the capabilities which the latecomer companies have been able to develop. The main proposition advanced by this research is that if they are to assess the latecomer software development activities, the studies need to investigate the technological capabilities which the latecomer companies have been able to accumulate. This study outlines the specifics in analysing technological capabilities in latecomer software industries and thus improves our understanding about the complexity in developing software industries in latecomer context. The current enquiry lays the foundations of the analysis of technological capabilities in latecomer software industries and it will be further coupled with a separate paper disentangling a wide array of capabilities, which the latecomer software companies need to muster to be able to develop software activities based on indigenous resources (Rousseva, 2007). These two papers provide examples to support the ideas they develop. Nevertheless, further in-depth, case study and comparison-based analyses are needed to reveal the achievements and problems in the development of technological capabilities in latecomer software companies. These should be done by comparing different companies in one country and comparing companies in different countries to capture both company- and context-specific issues.

ACKNOWLEDGEMENTS

This research is the result of a research project ‘TechCapaBuild’ supported by the Marie Curie Individual Fellowship within the 6th Framework Programme of the EU. I express my gratitude to Ed Steinmueller and an anonymous referee for their comments on an earlier version of this paper. I am solely responsible for omissions and the usual disclaimer applies.

BIOGRAPHY

Rozsitza Rousseva is an Assistant Professor in the Delft University of Technology, The Netherlands, and was a researcher at UNU MEERIT. She has a background in technology and innovation management, and science and technology policy. Her areas of expertise are innovation management, knowledge management, capability development, strategic intent, ICT sector, with special focus on EU and new member states, and emerging economies. Her research specialisation is in development of software industries with special focus on capability accumulation and innovation activities in latecomer software companies.

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The need to scrutinise latecomer software development activities


NOTES

1 It should be noted that the degree of innovativeness inbuilt in software production varies and this point is explicitly discussed in outlining the specifics involved in analysing software technological capability (Section 5).

2 Studies of technological development in latecomers reveal that to be able to develop innovation capabilities the latecomers have to engage in a deliberate effort of technological capability building. It is not impossible that a brilliant software solution might be developed by a ‘lone inventor’, but this is more likely in advanced-context companies than latecomers. Studies on technological capabilities in latecomer software companies are limited, and no such cases have been identified.

3 The current enquiry adopts the following main propositions from the literature on technological capability building:

- latecomer technological development has specific features
- every sector has sector-specific features and trajectories of technological development
- technological capability is comprised of a wide array of component capabilities and expertise
- technological capabilities develop gradually by passing through subsequent stages of increase in technological sophistication of the accumulated capabilities
- analyses have to investigate both the level of technological sophistication of the technological capabilities (e.g., basic, intermediate, advanced), and the underlying component elements
- the accumulation of technological capability requires accumulation of technological and organisational capabilities
- learning and capability development efforts in the company are a major driver for innovation and technological upgrade.
INFORMATION COMMUNICATION TECHNOLOGIES (ICTs) AND KNOWLEDGE SHARING: THE CASE OF PROFESSIONAL ACCOUNTANTS IN MALAYSIA

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Abstract: Based on the knowledge sharing model by Nonaka (1994), this study examines the relative efficacy of various Information Communication Technologies (ICTs) applications in facilitating sharing of explicit and tacit knowledge among professional accountants in Malaysia. The results of this study indicate that ICTs, generally, facilitate all modes of knowledge sharing. Best-Practice Repositories are effective for sharing of both explicit and tacit knowledge, while internet/e-mail facilities are effective for tacit knowledge sharing. Data warehousing/mining, on the other hand, is effective in facilitating self learning through tacit-to-tacit mode and explicit-to-explicit mode. ICT facilities used mainly for office administration are ineffective for knowledge sharing purpose. The implications of the findings are discussed.

Keywords: ICTs; information communication technologies; knowledge sharing; explicit knowledge; tacit knowledge; professional accountants.

INTRODUCTION
The speed of technological changes over the last decade has had a profound effect on business enterprises around the world. The widespread diffusion of computer technology and the greatly enhanced computing and networking capabilities have significantly modified the nature of work as well as information flows around and within organisations. These changes have important implications for the professional service providers, such as the accounting profession.

Traditionally, the accounting profession focuses mainly on providing financial reporting, auditing and taxation services. With advances in technological innovations and the use of increasingly smart and specialised software applications that

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support the automation of many accounting, auditing and taxation tasks, much of the laborious and mundane accounting-related tasks have been eliminated (Elliott and Jacobson, 2002). Consequently, the traditional services provided by the accounting profession, such as financial accounting, auditing and taxation services are now commoditised and heading for marginalisation. Nonetheless, the shift from the resource- and manufacturing-based economy to the knowledge-based economy has led to an array of new challenges and opportunities for the accounting profession. These new opportunities and challenges often involve the provision of services that require a growing diversity of knowledge and skills. The accounting professionals are, therefore, challenged to broaden their scope of knowledge and skills. Only services of those professional accountants with a wide array of corporate expertise are increasingly being demanded for a growing range of professional job assignments.

As the role of an accountant evolves from that of a bean counter to that of a strategic business advisor, the nature of his or her tasks is becoming more and more strategically focused. The range of services offered by the accounting profession also proliferates to include information systems work, risk analysis, assurance services, electronic commerce and strategic business advisory services. Hence, possession of a broader and varied set of skills and competencies becomes a necessity for the long-term survival of the profession. The new information professional must be prepared to identify and create decision useful information, arrange its availability when needed for decisions, and design feedback loops to ensure the continued readiness and effectiveness of the systems (Elliott and Jacobson, 2002). In other words, professional accountants must improve their individual abilities to identify, acquire and utilise the accumulated knowledge more effectively. Since professional accountants are often assigned to job assignments that frequently vary in terms of task complexity, the ability to share clientele-or industry-specific knowledge, experience and insights is crucial for effective task performance, and knowledge management is of special relevance and importance to accounting firms for managing their capability to create and diffuse knowledge within the firms.

In addition to the rapidly changing and increasingly competitive business environment, the expanding disclosure and compliance requirements (i.e., new accounting standards and regulatory environment), as well as the growing diversity in information and service demands for business advisory and risk analysis, are leaving the professional accountants with little choice but to broaden and enhance their skills and knowledge to sustain their competitive advantage. To improve the quality, efficiency and effectiveness of their services, professional accountants must resourcefully identify, acquire and utilise knowledge. Information Communication Technologies (ICTs) could be effective tools to facilitate knowledge acquisition and sharing.

With ICTs, it is now economically feasible for professionals to collect and share valuable information, knowledge and ideas across functions, divisions and geographical boundaries (Boland et al., 1994; Davenport and Prusak, 1998; Fowler, 2000; Olson et al., 1993). ICTs provide the essential technical infrastructure for promoting and managing knowledge management activities (Bolisani and Scarso, 1999). Numerous studies have explored the relationship between ICTs and knowledge sharing (Bolisani and Scarso, 1999; Hendriks, 2001; Luan and Serban, 2002; Roberts, 2000; Johnson, 2003; Robertson et al., 2002; Song, 2002; Sproull and Kiesler, 1986). However, the effectiveness of ICTs in supporting knowledge creation and sharing depends largely on the nature of knowledge needed to be acquired
or transferred. ICTs in most organisations are used to support the capture, storage, retrieval and distribution of explicit knowledge, but relatively little attention is directed to tapping the tacitness of knowledge critical for successful performance of most unstructured tasks. As the relative effectiveness of various ICT applications in facilitating sharing of explicit and tacit knowledge among members of an organisation or a network of organisations has not been adequately investigated, especially among professionals in the developing countries, this study examines the state of ICT adoption among professional accountants and investigates the relative efficacy of various ICT applications in facilitating sharing of explicit and tacit knowledge among these professionals in Malaysia. In view of the pending threats from liberalisation of the professional services sector, the findings of this study may aid the choice of ICT for effective facilitation of the required mode of knowledge sharing that would lead to acquisition of the knowledge and skills necessary for successful task performance among professional accountants.

The reminder of this paper is organised as follows: Section 2 provides a review of the relevant literature on the applications of ICTs in knowledge management and the various modes of knowledge sharing; Section 3 explains the methodology and the sample examined; Section 4 presents the results and discussion and Section 5 provides the conclusions and highlights the implications of the findings.

**LITERATURE REVIEW**

**Knowledge sharing**

Review of knowledge management literature generally indicates a lack of consensus on the definition of knowledge. Nonaka (1991) and Nonaka and Takeuchi (1995) define knowledge as justified personal belief towards the truth. Knowledge has also been defined as mix of experiences and insights (Davenport and Prusak, 1998) and methodologies and know-how (Wiig, 1993). Bolisani and Scarso (1999) consider knowledge as a combination of information, ideas, procedures and perceptions that guide a person’s actions and decisions. As such, knowledge is generated when we can connect, relate and establish meaning of the information obtained for subsequent action.

**Tacit and explicit knowledge**

The sharing of knowledge among employees is a vital component of any knowledge management activities (Cabrera and Cabrera, 2002; Jarvenpaa and Staples, 2000; Nahapiet and Ghoshal, 1998; Wasko and Faraj, 2000). Nonaka’s (1994) knowledge sharing model, as shown in Figure 1, identifies four modes of knowledge sharing: socialisation, externalisation, internalisation and combination. This framework is based on the dichotomy between tacit knowledge and explicit knowledge as well as the distinction between individual knowledge and collective knowledge. Nonaka considers the conversion process as a ‘knowledge spiral’ in which tacit and explicit knowledge interacts and interchanges into each other in a never-ending spiral.

Socialisation is the sharing of tacit knowledge such as mental models and technical skills between individuals (Nonaka, 1994; Nonaka and Konno, 1998; Seufert et al., 2003). According to Nonaka and Konno (1998), tacit knowledge is shared through joint activities such as spending time together and being in the same environment. Informal networks are especially crucial for this process. Externalisation is the conversion of tacit knowledge into explicit knowledge, involving the transformation of one’s idea, experience or insight into readily understandable form or formal models (Bolisani and Scarso, 1999;
Nonaka and Konno, 1998; Seufert et al., 2003). Combination is the conversion of explicit knowledge into more systemised or complex sets of explicit knowledge (Nonaka and Konno, 1998; Seufert et al., 2003) to make it more usable. Internalisation is the conversion of explicit knowledge into tacit knowledge (Nonaka and Konno, 1998; Seufert et al., 2003). When explicit knowledge is internalised into an individual’s tacit knowledge, a shared mental model is formed within the firm, thereby starting a new spiral of knowledge conversion. As the interaction among these four processes iterates, it facilitates the exchange, refinement and extension of organisational knowledge base.

**ICT and knowledge sharing**

In the early 1990s, knowledge management focused primarily on the management of data resources (Petrides, 2002). Consequently, many believe ICTs are nothing else but a tool for formatting, filtering and summarising data into information. Today, the creation, transfer and management of knowledge are regarded as the central issues in knowledge management, and the role of ICTs has become more than that of just capturing data. A vital role is ascribed to ICTs as a technical infrastructure to facilitate information handling (Hedelin and Allwood, 2002) and knowledge sharing (Rumizen, 1998) due to the very nature of those technologies in coordinating and promoting communication. Previous research in knowledge management has acknowledged the critical role of ICTs in knowledge management. Ware and Degoey (1998) included workflow tools for knowledge dissemination. Loudon and Loudon (1997) identified computer-aided design system for knowledge creation and groupware for knowledge sharing. Ruggles (1997) included internet forum for knowledge transfer and Davenport and Prusak (1998) suggested data mining applications for knowledge discovery. Other studies (Flanagin, 2002; Lueg, 2001; O’Leary, 1998) also addressed the potential benefits of ICTs as facilitators of knowledge management. These studies are consistent with most of the other information systems literature that indicate ICTs are an important enabler in knowledge management (O’Dell and Grayson, 1998; Ruggles, 1998; Yeh et al., 2006). Therefore, an essential component of knowledge management infrastructure
Information Communication Technologies (ICTs) and knowledge sharing

will be a system that will not only collect, organise and disseminate data, but will also facilitate exchange of information, insight, experience, idea and knowledge.

The ability of ICTs to support knowledge management in a meaningful manner depends on the basic nature of knowledge. In general, ICTs have two capabilities for managing knowledge, codifying knowledge and creating networks. For the most part, ICTs focus on applications to support the capture, storage, retrieval and distribution of explicit knowledge, and relatively less attention is directed to tapping the tacitness of knowledge. Indeed, when ICTs were first used in accounting information systems, which generally involve extremely explicit rules and procedures, ICTs were used very much for automating various accounting processes (Bloodgood and Salisbury, 2001). ICTs are used to make explicit knowledge readily available from databases that may be accessible by decision support systems and expert systems. This approach of ICT application leverages on the knowledge of the firms by making explicit knowledge even more explicit and more transferable. On the other hand, it is difficult to extract, codify and disseminate tacit knowledge, as tacit knowledge is highly personal as it embeds in the human brain. Consequently, efforts to use ICTs to support tacit knowledge sharing can be costly and ineffective. ICTs alone will not be able to capture the conditions required to share tacit knowledge fully and effectively. This suggests that ICTs may only be useful for the exchange, coordination and articulation of explicit knowledge, particularly when team members are geographically far apart. The information richness theory (Daft and Lengel, 1986) asserts that the appropriate choice and use of media is heavily dependent upon the fit between tasks and media. Hence, ICT applications, such as e-mail, internet, and intranet, are considered as a relatively lean media because even though they provide a channel for asynchronous interactions, they are limited to the written words only. Therefore, to make tacit knowledge more explicit, using a lean ICT can result in a loss of critical components of the tacit knowledge (Bloodgood and Salisbury, 2001). This type of ‘less rich’ ICTs is potentially useful for the exchange of explicit knowledge but may be inappropriate for the transfer of tacit knowledge. Roberts (2000) adds that ICTs only facilitate communication but it cannot replace face-to-face contact among individuals, which is often a prerequisite for the successful transfer of tacit knowledge.

However, other research studies on the choice and use of media have rejected the idea that a particular media should be chosen based on its rich or lean properties alone (Lee, 1994; Ngwenyama and Lee, 1997). Several empirical studies have found that the actual media choice and use are inconsistent with the information richness theory (Yates and Orlikowski, 1992; Markus, 1994). Lee (1994) highlights that individuals do not passively receive data from others, instead, they actively interpret data to produce meaning that makes sense in their own perspectives. Hence, the richness afforded to a particular type of ICT application is highly dependent on the interaction between the ICT, the individual and the organisational context in which it is applied. Moreover, with the advancements in ICTs, individuals may use a variety of ICT applications such as e-mail, chat room, bulletin boards and discussion group to communicate information, share knowledge and combine efforts across time and space barriers (Carneiro, 2001). With the technological push arising from more contemporary ICTs, such as groupware technologies, video conferencing, expert databases and synchronous collaboration tools, ICTs could not only harness the tacit knowledge exchange but also retain, at least partially,
its richness. ICTs can be used to catalogue employees with critical tacit knowledge and enable communication between those who need the knowledge and those who have the knowledge. Instead of codifying tacit knowledge, firms can make use of the networking capabilities to bring people together in sharing tacit knowledge without having to make it explicit. In this way, they may share tacit knowledge across distance in a virtual community. Through groupware applications and intranets that typically include features such as shared databases, collaborative spaces, advanced communication features, electronic yellow pages, automated knowledge maps and expertise databases, it is becoming easier to locate or connect people who either might offer or provide the relevant or required knowledge.

These earlier studies generally focus on the relevance of ICTs in supporting or facilitating knowledge sharing. However, these studies do not specifically examine the relationship between type of ICT application and mode of knowledge sharing. Since the type of tacit or explicit knowledge needed for effective performance of tasks varies with the task complexity, an understanding of the relationship between type of ICT application and mode of knowledge sharing would provide insight into the appropriate matching of the type of ICT application with the type of knowledge needed to be shared in a particular task setting.

**RESEARCH METHOD AND DESIGN**

**Research instrument and data collection**

This study used a structured questionnaire consisting of multiple-item measures to collect the required data for analysis. The items used to measure each variable were adapted from prior studies. The items for measuring knowledge sharing were adapted from Nonaka et al. (1994), and appropriate changes in wordings were made to suit the context familiar to the accounting professionals. The items for measuring various ICT applications were also adapted from prior studies (Hedelin and Allwood, 2002; Loudon and Loudon, 1997; Ware and Degoey, 1998). The questionnaire was first pre-tested on a few practitioners and accounting academics to ensure that the questions asked were unambiguous and the items for measuring each construct were appropriate for the accounting setting. Responses to the questionnaire were made on a five-point Likert-like scale, ranging from 1 to 5.

The respondents were members of the Malaysian Institute of Accountants (MIA). The criteria used for the selection were: first, they were working in Kuala Lumpur or its vicinity at the time of the mail survey, and second, each respondent must have had been working in his or her current organisation for at least six months to ensure that he or she had a reasonable period to experience or to comprehend the knowledge-sharing practices of his or her organisation. Out of the 1000 copies of the questionnaire mailed, only 120 completed questionnaires were returned for analysis, despite reminders and follow-up calls being made in an attempt to increase response rate. The low response rate of about 12% was expected for mail questionnaire survey in Malaysia. The independent-samples t-tests did not indicate any significant differences between the early respondents and the late respondents.

**Definition and measurement of constructs**

**ICT facilities and perceived effectiveness**

Numerous studies have addressed knowledge management processes. Ruggles (1997) identifies the processes in knowledge management as knowledge generation, codification, and transfer. Marquardt (1996),
however, divides knowledge management into four processes; acquisition, creation, transfer and utilisation, and storage. On the other hand, O’Dell (1996) separates knowledge management processes into identify, collect, adapt, organise, apply, share, and create. Among these processes identified, knowledge-sharing-related activities, such as transferring (O’Dell, 1996), disseminating (Wiig, 1993) and distributing (Liebowitz, 2000) are important because firms can only realise the full value of knowledge when it is shared and used. Knowledge sharing is an iterative process whereby individuals within a firm share tacit and explicit knowledge (Nonaka and Takeuchi, 1995). Seven key ICT facilities were identified from prior studies (Hedelin and Allwood, 2002; Loudon and Loudon, 1997; Ware and Degoe, 1998) as proxies of ICT support for knowledge-sharing activities in organisations. The ICT facilities examined in this study were: Intranet, Internet/e-mail, Tele/Video conferencing, best-practice repositories, help desk/directory of expertise and data warehousing/mining. Respondents were first required to rate the extent of accessibility to each ICT facility on a five-point scale, ‘1 = Rarely’ and ‘5 = Always’. Since unused or under-utilised ICT facilities cannot be an effective support tool, respondents were also required to indicate their perceived usefulness of each ICT facility to support knowledge sharing. The ICT support variable was then computed as a weighted score by multiplying the rating score for ICT accessibility and that for ICT perceived usefulness.

**Modes of knowledge sharing**

The knowledge-sharing model by Nonaka (1994) provided the basis for measuring the modes of knowledge sharing. This model has been widely used in earlier studies (Becerra-Fernandez and Sabherwal, 2001; Lee and Choi, 2003; Sabherwal and Baccera-Fernandez, 2003). This study adapted the multiple items validated by Nonaka et al. (1994) to assess the four modes of knowledge sharing by making changes to wordings to suit the accounting profession setting. All items were rated based on the five-point scale, with ‘1 = Rarely’ and ‘5 = Always’. The Cronbach’s Alpha coefficients computed for items measuring the four modes of knowledge sharing were acceptable (Nunnally and Bernstein, 1994) and they ranged from 0.80 (Internalisation mode) to 0.77 (Socialisation mode).

**RESULTS AND DISCUSSION**

**Demographic profile of respondents**

The profile of respondents is summarised in Table 1. About 49% of the respondents were male and 51% were female, with slightly more than half of the respondents aged 34 and below. The respondents were generally well educated with approximately 64% of them possessing a Bachelor’s Degree and about 20% possessing a Master’s Degree. Besides being members of MIA, approximately 42% and 35% of the respondents were also members of UK-based professional bodies and Australia-based professional bodies, respectively. Employees of consulting and public accounting practices constituted about 37% of the total sample and those from the commerce and industry sector constituted about 48% of the total sample. Approximately 49% of the respondents held middle-level managerial positions and about 14% of the respondents were at the senior management level, with job designations such as partner, general manager and executive director.

**ICT accessibility, perceived usefulness and support**

The mean scores and standard deviations of the accessibility, perceived usefulness and support of the seven ICT facilities are presented in Table 2. The mean scores for ICT accessibility indicate that internet/e-mail
Table 1  Respondents’ demographic profile

<table>
<thead>
<tr>
<th>(a) Gender</th>
<th>No. of respondents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>58</td>
<td>48.7</td>
</tr>
<tr>
<td>Female</td>
<td>61</td>
<td>51.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>119</strong></td>
<td><strong>100.0</strong></td>
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<table>
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<tr>
<th>(b) Age</th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>34 and under</td>
<td>67</td>
<td>56.3</td>
</tr>
<tr>
<td>35–44</td>
<td>47</td>
<td>39.5</td>
</tr>
<tr>
<td>45 and over</td>
<td>5</td>
<td>4.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>119</strong></td>
<td><strong>100.0</strong></td>
</tr>
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</table>

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<tr>
<th>(c) Academic qualification</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Bachelor</td>
<td>68</td>
<td>63.6</td>
</tr>
<tr>
<td>Master’s</td>
<td>21</td>
<td>19.6</td>
</tr>
<tr>
<td>Others</td>
<td>18</td>
<td>16.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>107</td>
<td>100.0</td>
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<tr>
<th>(d) Professional qualification</th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>MIA members with UK-based qualifications</td>
<td>49</td>
<td>41.9</td>
</tr>
<tr>
<td>MIA members with Australia-based qualifications</td>
<td>41</td>
<td>35.0</td>
</tr>
<tr>
<td>MIA members with other qualifications</td>
<td>27</td>
<td>23.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>117</td>
<td>100.0</td>
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<table>
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<tr>
<th>(e) Monthly income</th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>Less than RM3000</td>
<td>8</td>
<td>7.8</td>
</tr>
<tr>
<td>RM3001–RM5000 per month</td>
<td>34</td>
<td>33.0</td>
</tr>
<tr>
<td>RM5001–RM10,000 per month</td>
<td>50</td>
<td>48.5</td>
</tr>
<tr>
<td>More than RM10,000</td>
<td>11</td>
<td>10.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>103</td>
<td>100.0</td>
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<tr>
<th>(f) Industry sector</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Commerce and industry</td>
<td>57</td>
<td>47.5</td>
</tr>
<tr>
<td>Public accounting and consultancy</td>
<td>44</td>
<td>36.7</td>
</tr>
<tr>
<td>Others</td>
<td>19</td>
<td>15.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>120</td>
<td>100.0</td>
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<tr>
<th>(g) Job position</th>
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<tbody>
<tr>
<td>Executive and Supervisory</td>
<td>39</td>
<td>35.4</td>
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<tr>
<td>Managerial</td>
<td>54</td>
<td>49.1</td>
</tr>
<tr>
<td>Senior management</td>
<td>15</td>
<td>13.6</td>
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<tr>
<td>Others</td>
<td>2</td>
<td>1.8</td>
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<tr>
<td><strong>Total</strong></td>
<td>110</td>
<td>100.0</td>
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<tr>
<th>(h) Working experience</th>
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<th></th>
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<tbody>
<tr>
<td>2–4 years</td>
<td>9</td>
<td>7.5</td>
</tr>
<tr>
<td>5–10 years</td>
<td>59</td>
<td>49.2</td>
</tr>
<tr>
<td>More than ten years</td>
<td>52</td>
<td>43.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>120</td>
<td>100.0</td>
</tr>
</tbody>
</table>

1USD = RM3.50.
Information Communication Technologies (ICTs) and knowledge sharing

The ICT facilities that were least common were Tele/Video conferencing and data warehousing/mining. The mean scores for perceived usefulness of these seven types of ICT facilities similarly show that internet/e-mail and intranet were perceived as the two most useful tools for knowledge sharing, while Tele/Video conferencing and help desk/directory of expertise were the least useful for knowledge sharing. Best-practice repositories, data warehousing/mining and groupware were perceived as only fairly useful for knowledge sharing. To measure the ICT support, the product of the rating scores for accessibility and perceived usefulness of each ICT facility was computed. Consistent with the rankings for ICT accessibility and ICT perceived usefulness, the mean scores for ICT support indicate that the two most effective ICT support facilities were internet/e-mail and intranet. Best-practice repositories, groupware and help desk/directory of expertise were perceived as only fairly effective, while Tele/Video conferencing was the least effective tool for knowledge sharing.

Firm size is an important factor influencing the corporate knowledge management initiatives. For example, the Big 4 audit firms and their affiliated consulting arms have generally established policies with regard to their knowledge management initiatives. These international firms have invested fairly substantially in knowledge management related information technology to leverage their knowledge-based resources. Their knowledge management systems often consist of some hybrids of databases, bulletin boards and discussion forums. The smaller accounting firms, on the other hand, do not have established policies on knowledge management. Similar phenomenon is observed for non-accounting firms in which the other professional accountants are employed.

### Relationship between ICT and mode of knowledge sharing

The correlation matrix of type of ICT support and mode of knowledge sharing is presented in Table 3. The relationships between the overall composite measure of ICT support and the four modes of knowledge sharing were all positively significant, with the strongest association being observed between the overall ICT support

### Table 2 Means (and standard deviations) for ICT accessibility, ICT perceived usefulness and ICT support

<table>
<thead>
<tr>
<th>ICT facility</th>
<th>ICT accessibility</th>
<th>ICT perceived usefulness</th>
<th>ICT support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intranet</td>
<td>3.86 (1.42)</td>
<td>3.55 (1.27)</td>
<td>3.71 (1.29)</td>
</tr>
<tr>
<td>Internet/e-mail</td>
<td>4.47 (0.96)</td>
<td>4.18 (0.93)</td>
<td>4.34 (0.87)</td>
</tr>
<tr>
<td>Tele/video conferencing</td>
<td>2.40 (1.44)</td>
<td>2.64 (1.37)</td>
<td>2.49 (1.29)</td>
</tr>
<tr>
<td>Best-practice repositories</td>
<td>3.12 (1.17)</td>
<td>3.13 (1.14)</td>
<td>3.09 (1.06)</td>
</tr>
<tr>
<td>Help desk/directory of expertise</td>
<td>3.02 (1.26)</td>
<td>2.97 (1.12)</td>
<td>2.98 (1.10)</td>
</tr>
<tr>
<td>Data warehouse/mining</td>
<td>2.85 (1.25)</td>
<td>3.00 (1.17)</td>
<td>2.90 (1.10)</td>
</tr>
<tr>
<td>Groupware</td>
<td>3.05 (1.57)</td>
<td>3.01 (1.34)</td>
<td>3.02 (1.40)</td>
</tr>
</tbody>
</table>

Scale for ICT accessibility: 1 = Rarely, 5 = Always.
Scale for ICT perceived usefulness: 1 = Not at all useful, 5 = Very useful.
Scale for ICT support: 1 = Not at all effective, 5 = Very effective.
and knowledge sharing through the combination mode (explicit-to-explicit). However, the overall composite measure of knowledge sharing was only positively associated with six out of the seven types of ICT support facilities. The six types of ICT support facilities were: best-practice repositories, data Warehousing/Mining, Intranet, Internet/e-mail, Tele/video conferencing and help desk/directory of expertise. Groupware was the only type of ICT support facility that was not significantly related to any mode of knowledge sharing.

Further analysis of the correlations reveals that the socialisation mode of knowledge sharing (tacit-to-tacit) was positively associated with best-practice repositories, internet/e-mail and data warehousing/mining. Externalisation mode (tacit to explicit) was significantly associated with best-practice repositories, Internet/e-mail and data Warehousing/Mining. Combination mode (explicit-to-explicit) was significantly associated with all types of ICT support facilities except for Internet/e-mail and groupware.

Table 3 Correlation matrix for type of ICT support and mode of knowledge sharing

<table>
<thead>
<tr>
<th>Type of ICT support</th>
<th>Mode of knowledge sharing</th>
<th>Overall knowledge sharing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Socialisation</td>
<td>Externalisation</td>
</tr>
<tr>
<td>Intranet</td>
<td>0.141</td>
<td>0.139</td>
</tr>
<tr>
<td>Internet/e-mail</td>
<td>0.262</td>
<td>0.005**</td>
</tr>
<tr>
<td>Tele/video conferencing</td>
<td>0.151</td>
<td>0.115</td>
</tr>
<tr>
<td>Best-practice repositories</td>
<td>0.317</td>
<td>0.001**</td>
</tr>
<tr>
<td>Help desk/directory of expertise</td>
<td>0.080</td>
<td>0.403</td>
</tr>
<tr>
<td>Data warehousing/mining</td>
<td>0.218</td>
<td>0.023**</td>
</tr>
<tr>
<td>Groupware</td>
<td>-0.078</td>
<td>0.421</td>
</tr>
<tr>
<td>Overall ICT</td>
<td>0.236</td>
<td>0.017**</td>
</tr>
</tbody>
</table>

*Significant at 0.10 level.
**Significant at 0.05 level.

Internalisation mode (explicit-to-tacit) was significantly associated with best-practice repositories, data Warehousing/Mining, Intranet and help desk/directory of expertise. Only two types of ICT support facilities, namely best-practice repositories and Data Warehousing/Mining, had significant positive associations with all the four modes of knowledge sharing. The types of ICT support that facilitated sharing of tacit knowledge (through socialisation and externalisation modes) between individuals were best-practice repositories, internet/e-mail and data warehousing/mining. The types of ICT support that facilitated sharing of explicit knowledge (through combination and internalisation modes) between individuals were best-practice repositories, data warehousing/mining, Intranet, and help desk/directory of expertise. Tele/video conferencing facilitated only explicit-to-explicit knowledge sharing (combination mode) and not explicit-to-tacit (internalisation mode).

Table 4 summarises the regression results of each of the four modes of knowledge
Table 4  Regression results of mode of knowledge sharing on types of ICT support

<table>
<thead>
<tr>
<th>Type of ICT support</th>
<th>Socialisation</th>
<th>Externalisation</th>
<th>Combination</th>
<th>Internalisation</th>
<th>Overall knowledge sharing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Std. B</td>
<td>t</td>
<td>Std. B</td>
<td>t</td>
<td>Std. B</td>
</tr>
<tr>
<td>Intranet</td>
<td>0.041</td>
<td>0.36</td>
<td>0.031</td>
<td>0.28</td>
<td>0.124</td>
</tr>
<tr>
<td>Internet/e-mail</td>
<td>0.179</td>
<td>1.83*</td>
<td>0.179</td>
<td>1.80*</td>
<td>-0.027</td>
</tr>
<tr>
<td>Tele/video conferencing</td>
<td>0.020</td>
<td>0.20</td>
<td>-0.017</td>
<td>-0.17</td>
<td>0.068</td>
</tr>
<tr>
<td>Best-practice repositories</td>
<td>0.290</td>
<td>2.48**</td>
<td>0.291</td>
<td>2.46**</td>
<td>0.204</td>
</tr>
<tr>
<td>Help desk/directory of expertise</td>
<td>-0.172</td>
<td>-1.46</td>
<td>-0.112</td>
<td>-0.94</td>
<td>-0.063</td>
</tr>
<tr>
<td>Data warehousing/mining</td>
<td>0.216</td>
<td>1.83*</td>
<td>0.158</td>
<td>1.32</td>
<td>0.337</td>
</tr>
<tr>
<td>Groupware</td>
<td>-0.220</td>
<td>-2.07**</td>
<td>-0.226</td>
<td>-2.10**</td>
<td>-0.232</td>
</tr>
</tbody>
</table>

$R^2$ 0.198 0.175 0.218 0.042 0.235
Adj. $R^2$ 0.141 0.117 0.163 0.032 0.181
$F$ 3.492 3.00 3.947 4.40 4.311

*Significant at 0.10 levels.
**Significant at 0.05 levels.
***Significant at 0.01 levels.

Table 5  Regression results of mode of knowledge sharing on overall ICT support effectiveness

<table>
<thead>
<tr>
<th>Type of ICT support</th>
<th>Socialisation</th>
<th>Externalisation</th>
<th>Combination</th>
<th>Internalisation</th>
<th>Overall knowledge sharing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Std. B</td>
<td>t</td>
<td>Std. B</td>
<td>t</td>
<td>Std. B</td>
</tr>
<tr>
<td>ICT support</td>
<td>0.236</td>
<td>2.43**</td>
<td>0.222</td>
<td>2.28**</td>
<td>0.305</td>
</tr>
</tbody>
</table>

$R^2$ 0.056 0.049 0.093 0.042 0.091
Adj. $R^2$ 0.046 0.046 0.084 0.032 0.082
$F$ 5.883 5.176 10.22 4.40 9.796

*Significant at 0.10 levels.
**Significant at 0.05 levels.
***Significant at 0.01 levels.

sharing on the seven types of ICT support, while Table 5 presents the regression results of each of the four modes of knowledge sharing on the overall composite measure of ICT support. In general, the regression results are consistent with the coefficients in the correlation matrix presented in Table 3, suggesting that ICT support is crucial for the overall knowledge sharing, as well as for each individual mode of knowledge sharing. Best-practice repositories facility was consistently and positively associated with not only the overall knowledge sharing, but also to each of the four modes of knowledge sharing, internet/e-mail facility, on the other hand, was positively associated with...
the overall knowledge sharing and only the two knowledge-sharing modes that relate to sharing of tacit knowledge. Similarly, data warehousing/mining was also positively associated with the overall knowledge sharing, and two of the four modes of knowledge sharing; Data Warehousing/Mining had no significant relationship with tacit-to-explicit knowledge sharing (Externalisation mode) and explicit-to-tacit knowledge sharing (Internalisation mode). Contrary to Loudon and Loudon (1997), groupware facility, which is used quite extensively in organisations for office administration, was found to be negatively associated with not only the overall knowledge sharing but also with each of the four modes of knowledge sharing.

The regression results support the general hypothesis that ICT support promotes knowledge sharing; greater ICT support would lead to greater sharing of knowledge. This study found that ICT support generally facilitated all modes of knowledge sharing. ICTs are critical for codifying explicit knowledge and therefore, it is not surprising to find that ICT support contributed most significantly to knowledge sharing under the combination mode (explicit-to-explicit). Best-practice repositories provide the tools to codify past events, experiences and knowledge, and this type of ICT facility was found to be highly associated with effective sharing of both tacit and explicit knowledge. On the other hand, the sharing of tacit knowledge through socialisation and externalisation modes involves dissemination or sharing of knowledge in a less formal manner, such as through interactions among individuals, and internet/e-mail facility, which enables dissemination of ideas and experiences, was found to correlate significantly with these two modes of knowledge sharing. Data warehousing/mining facility stores historical raw data and was found to mainly facilitate individual self exploration and learning, as suggested by its significant impact only on tacit-to-tacit knowledge-sharing (socialisation) mode and explicit-to-explicit knowledge-sharing (combination) mode. Other ICT applications, such as intranet, tele-video conferencing, help desk/directory of expertise and groupware are used often to facilitate office administration and hence, have little impact on any mode of knowledge sharing. The results, however, indicate that ICT support only explains a small variance in knowledge sharing. Therefore, initiating knowledge sharing entirely through ICT support can be a risky proposition (Davenport and Prusak, 1998), because ICT support is only one of the important enablers (O’Dell and Grayson, 1998; Ruggles, 1998; Yeh et al., 2006) in knowledge management. ICT only provides the basic physical infrastructure for knowledge management and to promote knowledge management activities; there are other organisational or task-related variables that may play an even more important pivotal role in initiating knowledge creation and sharing (Bolisani and Scarso, 1999; Coakes, 2006).

CONCLUSIONS AND IMPLICATIONS
This paper examines how certain key ICT facilities could effectively support or promote knowledge sharing of explicit and tacit knowledge among professional accountants in Malaysia. This study adopts a process-oriented approach by using Nonaka’s (1994) knowledge-sharing model. The results indicate that effective ICT support is critical for promoting knowledge sharing and certain ICT facilities tend to promote certain types of knowledge sharing more effectively. Best-practice repositories are effective in promoting both explicit and tacit knowledge, while internet/e-mail facility is more appropriate
for sharing of tacit knowledge. ICT applications that are used largely to facilitate office administration are generally not effective tools for knowledge sharing.

The preparation and provision of financial accounting information very frequently involve compliance of extremely explicit rules and procedures and ICT support is generally effective in making explicit knowledge readily available in databases for decision-making by using the decision support systems or the expert systems. Through ICT support, firms can quite easily leverage on the knowledge possessed by making such rules and procedures (explicit knowledge) even more explicit and more transferable. In the more complex task settings, however, it is the individual tacit knowledge or expertise rather than the explicit rules that differentiates task success from task failure. Hence, as the level of skills required for task performance advances, the efficacy of the various ICT support in an organisation would vary and a more discriminatory use of ICTs for knowledge sharing would be more cost-effective and efficient.

The findings of this study should be interpreted with caution, in view of the fact that this study only focuses on the effect of ICT support on knowledge sharing among professional accountants in Malaysia. Although professional knowledge is a source of competitive advantage and is of paramount importance to professional accountants in performing their task effectively, the results may or may not be generalisable to other professions or occupations. Nevertheless, the findings of this study may provide a better understanding of the efficacy of the various ICT facilities in promoting explicit and tacit knowledge sharing and hence, could enable the management to appropriately align the ‘right’ technology to the intended type of knowledge needed to be created and shared for successful task performance under different task complexity settings.

**BIOGRAPHY**

Soon-Yau Foong, PhD, is currently an Accounting Professor at the Graduate School of Management, Universiti Putra Malaysia. She is a professionally qualified accountant from the UK and has published research papers in a number of international and national refereed academic journals, as well as in the proceedings of national and international conferences. Her research interests include intellectual capital measurement and reporting, knowledge management and management accounting systems.

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**REFERENCES**


(E)-DUCATION IN ST. LUCIA:
MYTH OR REALITY?

Gale T.C. Rigobert*
The University of the West Indies (UWI), Trinidad and Tobago

Abstract: There is an ongoing debate on the economic viability of Small Island Developing States (SIDS) in the emerging e-economy. The centrality of ICTs in the current development discourse, suggests that countries have little choice but to embrace ICTs as a pivotal element in their development strategy. As St. Lucia seeks to diversify its economy away from agriculture to a service-based economy, it has become necessary to equip the next generation with the requisite e-skills to help propel that country into the e-age. The paper interrogates the socio-economic implications of the relatively slow uptake of ICTs in secondary schools on the island.

Keywords: ICTs; information communications technologies; Caribbean; St. Lucia; (e)-ducation; development; SIDS; small island developing states.

INTRODUCTION
The post-independence euphoria, in St. Lucia, as elsewhere in the third world, was soon tempered by the realisation that political autonomy and economic growth were not automatic. As a small developing island-state, St. Lucia struggled with what was an appropriate model for its development. Its insertion into the International Division of Labour (IDL) as a producer of primary commodities to serve the ‘needs’ of the mother country lingered into independence, and indeed the post independence era.

Historically, St. Lucia has relied heavily on the production of primary commodities (tobacco, followed by sugar and more recently bananas) as the mainstay of its economy. The erosion of preferential trade arrangements under the various Lomé agreements has had an adverse effect on the St. Lucian economy: the liberalisation of trade has exacerbated sliding commodity prices on the international market; declining terms of trade and the drastic drop in the volume of production has seen the income generated by that sector halved over the last 5–10 years. Economic diversification, therefore, has become critical for survival.

The government has sought to stem the negative economic impact of liberalisation by seeking alternative economic activities to generate the much-needed foreign exchange. The initial response of the St. Lucian government has been to expand the tourism and financial sectors, with the hope that these sectors would help bridge the financial shortfall. But tourism too, brings with it its fair share of challenges. Given the verticalisation of the global industry, increasingly national governments are left with shrinking shares of the profit generated.

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As this industry becomes more globally competitive, governments are being forced to offer investors more attractive cocktails of incentives, which means reduced tax earnings for the government. Moreover, the massive capital leakages through repatriation of profits, for example, mean that the expected multiplier effect of the tourist dollar is not being realised.

Additionally, given that the tourism sector requires more semi-skilled and skilled workers, the absorption rate of those previously employed within the agricultural sector is (s)low. The government is left to resolve a huge unemployment problem, which is not helped by the many who graduate from high school and tertiary institutions every year, with few or no job opportunities available to them.

The increasing use and absorption of ICTs in the global economy signalled new hope for countries of the region, which like St. Lucia, were beginning to feel the brunt of economic decline associated with declining commodity prices on the global market. For many in the region, ICTs offer an opportunity to circumvent the encumbrances associated with small size and poor resource endowment. ICTs, it is hoped would offer ailing economies the opportunity to diversify away from the production of primary commodities, to the production of high-value added goods and services.

It is little wonder, therefore, that the government of St. Lucia, like many in the Third World, became very excited about the ICT revolution and the promised benefits. The St. Lucian government hoped that the ICT revolution would resolve the historical problems associated with underdevelopment. Additionally, the government was encouraged by the notion that ICTs offered SIDS the opportunity to leapfrog development. Indeed, St. Lucia welcomed the opportunity to utilise its greatest resource, its people, in its efforts to trigger economic growth and development.

However, immediately, another reality struck, that its people had to be equipped with the requisite skills to enable their full and productive participation in the emerging global knowledge or information economy. Eventually, it became obvious that in an effort to tackle the human resource problem effectively, urgent attention had to be given to the education system and a (re)evaluation of the curriculum.

TECHNOLOGY AND DEVELOPMENT

The term development entered the English Lexicon and was widely used in academic and political circles in the post 1945 era. ‘Development’ was viewed as a socio-economic project to alleviate the woes of the newly independent countries of Asia, Latin America, Africa and the Caribbean. These former colonies, having recently gained their independence from their Colonial masters, endeavoured to achieve national development. In the latter part of the 1940s and early 1950s, the causes of relative poverty and underdevelopment rose to the top of the global political agenda, championed in part by the United Nations (UN) and its agencies. Since that time countries have used a range of strategies to help attain higher levels of growth and development.

The relationship between technological development and socio-economic growth has long been a subject of debate within the Social Sciences. The transformative nature of technology has been central to the development discourse. As the newly independent states of the third world sought to become ‘developed’ they were fed a constant staple of ‘technology driven’ economic growth models. Essentially, the West had benefited tremendously from the Industrial
Revolution, with Europe leading the pack, and the rest were required simply to emulate that success. Much of the literature (whether it is the neo-liberal, convergence thesis, the techno-optimistic or techno-deterministic discourse) seems to suggest an automaticity associated with technological change. However, the literature on technological change and development rarely engaged with the issue of what ‘technological change’ really means for development in peripheral countries, particularly, SIDS.

Notwithstanding this, still, the path to development in the current techno-economic paradigm is very much defined by the innovation, use and application of modern ICTs. As the global economy has evolved to reflect that development, countries can ill-afford to neglect ICTs as a central component of any development strategy.

St. Lucia, a small island economy (like many others in the region) has struggled to find an appropriate model for growth in the face of tumultuous changes both intra-nationally and in the global political economy. ICTs have been trumpeted as the new hope for those previously trapped in the bottom stratum of the global economy. St. Lucia has embarked upon policy initiatives that seek to trigger the requisite changes so as to facilitate its (re)-positioning in the world. The Education sector has been earmarked as the starting point of that endeavour, beginning with integration of ICTs in Schools.

Hence the paper assesses the socio-economic implications of the relatively slow uptake of ICTs in secondary schools in the Small Island Developing State of St. Lucia.

**REGIONAL E-DUCATION INITIATIVES**

The increasing use of ICTs in education is revolutionising pedagogic approaches to learning and teaching. As the world entered the information or knowledge era, all that was needed, assumedly was ‘grey matter’ – raw brains. That grey matter, however, needed to be schooled in a particular way, to enable their effective participation in the global knowledge and information economy. It is that realisation, which in part informed the global move towards incorporating ICTs in schools, both as part of a new pedagogic approach and curriculum offering.

The desire of governments in the region to utilise technology for pedagogic purposes has found expression in The EduTech 2000 Initiative; The FastForward Initiative and establishing of the University of Trinidad and Tobago (UTT); and the OECS Education Reform Project. But sustainability of these initiatives such as Trinidad and Tobago’s Secondary Education Modernisation Program (SEMP), St. Lucia’s EDUTECH and TVET projects remain a concern.

**OECS education reform**

The global economy has been described as a knowledge-based economy. The governments of the region recognise that to participate effectively in the new economy, its people need to acquire skills well beyond the traditional basic literacy and numeracy skills. The rationale for the development of ICT learning outcomes is reflective of technological developments and the required competencies in the new techno-economic paradigm. Much of the impetus for curriculum change and the incorporation of ICTs has been championed by The Organisation of Eastern Caribbean States (OECS) Secretariat.

The Draft ICT Policy for the OECS states explicitly, “the benefits of making ICT an integral part of educations systems today cannot be overemphasised”. The OECS initiated curriculum change in the region,
with the view to making ICTs an integral part of modern day pedagogy at the primary and secondary levels of the education system. This is reflected in the various policy initiatives at the regional level much of which has been spearheaded by the OECS Education Reform Unit.

The ICT Plan for OECS education systems set out some very specific objectives. They are to,

- Promote the harmonisation of activities, approaches and standards in the educational uses of ICT within the Education System.

- Encourage the principals, teachers and students within the education system to use ICT, meaningfully, to enhance the teaching-learning process.

- Ensure that there exists equitable access to ICT resources by all students and teachers within the Education system.

- Demonstrate the Ministry of Education’s (MOE) commitment to ensure that all students and teachers attain the skills necessary to be considered computer literate.

- Ensure that all school leavers are provided with the required ICT skills for employment or entry to specialised training in the Information Technology field.

- Foster the concept of Life-Long Learning among students and teachers and also within the general populace of each OECS territory.

- Provide greater professional development opportunities for all ICT educators in the OECS.

- Create a cadre of ICT educators with the requisite skills and competencies to use and promote ICT as a tool in the enhancement of the teaching/learning process.

- Make provisions for the continuous upgrade of the ICT skills of educators.

- Encourage and facilitate the use of the internet as a research and communication tool among students, parents, teachers, principals, other MOE officials and members of the community.

- Provide the avenue for increased electronic networking and collaboration of educators and students in the OECS region.

- Facilitate the implementation of information systems that enhance efficiency within administration.

- Encourage partnerships between the various stakeholders in the Education Sector in undertaking IT related ventures.

- Make provisions for the frequent upgrade of all ICT tools including software used for educational purposes.

- Increase the awareness of intellectual property and copyright laws with respect to the use of software and information in general.

These objectives, at first glance are very ambitious, though, perhaps necessary. The limited success, 7–8 years since the implementation of the policy, is perhaps a function of the plurality of the intent (as expressed in the objectives above).

The objectives have also found expression in requisite competencies for effective and meaningful participation in the e-economy. The OECS identifies these as becoming increasingly relevant in today’s work climate. They are:

- inductive thinking
- generalist (broad) competencies
- ICT competencies enabling expert work
- decision-making
• handling of dynamic situations
• teamwork competencies
• communication competencies.

These competencies require explicit, consistent, targeted policy intervention. The countries of the OECS having recognised the necessity for curriculum change and innovation have, therefore, embarked upon various reform measures.

**The National impetus**

Historically, St. Lucia has faced acute shortages of highly skilled personnel. Hence, the island faces significant challenges in responding to the demands of the knowledge economy ('digital economy'). This is particularly evident in the education sector, where more needs to be done to address the current techno-deficit.

As St. Lucia seeks to diversify its economy away from a heavy reliance on raw material production, it has become necessary to equip the next generation with the requisite e-skills to help propel that country into the information and knowledge age. A key concern is the extent to which the government has been able to incorporate ICTs as a primary pedagogic tool, and whether ICTs form a critical or substantive part of the curriculum offering.

St. Lucia’s IT in Education initiatives have been informed largely by the OECS draft Policy on the integration of IT in Schools. In 2002, the MOE embraced the OECS Education Reform Policy, adapting it to its needs, reflected in its draft policy on the integration of ICT in education: proposed policies. The island’s program was directed at secondary schools in the first instance, with the intention of rolling it out into Primary Schools eventually.

The draft policy document explains the rationale for integrating ICTs into schools. It alludes to the changing nature of the global political economy, triggered by the ICT revolution, which has been fuelled by globalisation and the ease of exchange across borders, cultures and people. Moreover, knowledge and information have become critical factors of production in the current techno-economic paradigm.

The policy states explicitly,

"Knowledge-based industries require an educated labour force of computer-literate individuals who themselves understand and can harness the power of ICT. In response to the demands for producing such a labour force, many countries have changed the objectives of their education system and have directed much of their attention to the development of ICT skills in schools."

The draft policy goes on to explain the anticipated benefits and potential of ICTs. For example, ICTs have the potential to improve student’s learning by enhancing the pedagogic process; develop teachers’ professional capability; and strengthen institutional capacity.

All 18 secondary schools on the island participate in the CXC IT program and are equipped with computer labs (see Table 1), though at varying degrees of functionality in terms of networking and quality of equipment. In addition, at this level there are various types of labs: for instance, there are labs devoted exclusively to the CXC IT program; those are for internet navigation and general research and then there are those that are part of a Learning Resource Centre (LRC).

**The myth exposed**

The potential of ICTs to jump-start ailing economies has risen to the top of the global political agenda. However, despite the new
optimism that pervades much of the discourse on ICTs and development, many of the historical barriers that have thwarted the best developmental efforts of developing nations, continue to pose a tremendous challenge to the full employment and attendant benefits of ICTs (Rigobert, 2006a, 2006b).10

Barriers to e-ducation in St. Lucia

1. The lack of human resources

Sourcing teachers with the requisite e-skills is proving difficult. This issue is further compounded when in search of teachers with the combined teacher training education and e-skills.

2. Techno-phobia and aversion to new ICTs

One of the greatest challenges to the integration of ICTs in schools is the lack of enthusiasm (especially on the part of the more mature teachers), techno-phobia and a seeming aversion to the new technologies. Teachers tend to be lukewarm or timid about the introduction of ICT as the new mode of delivery. They do not have the requisite e-skills to enable them to maximise ICTs as pedagogic tools.

3. The lack of financial resources

This has proven to be a monumental challenge to the government. In the midst of an economic crisis, prioritisation often means cuts in expenditure in seemingly less important areas. Often, it is initiatives such as the computerisation of schools that suffer. The Minister of Education lamented that “ICTs in schools” had yet to attract the level of budgetary allocation that was critical to the technological transformation envisaged.11

4. The absence of multiple sources of funding

The shortcoming delineated at number two, is further exacerbated because of the schools’ heavy reliance on the government for funding. Sources of external funding are limited and sporadic.12

5. Limited ‘places’ in schools

Owing to the financial constraint alluded to above, secondary schools, such as the St. Joseph’s convent, were being forced to restrict the number of students who opt to ‘take’ IT as an examinable subject at CXC/CAPE. This reflects the extent to which the schools are unable to respond to the rising demand for IT.

6. The cost of ICT hardware and software

The exorbitant cost of ICT hardware and software is proving to be prohibitive. Small islands states like St. Lucia with limited budgets can ill-afford to meet that cost.13 Additionally, families cannot readily afford to equip the home with a PC to augment whatever training or interest the youth may have in ICTs.

7. The relative absence of a holistic methodology for the integration of ICTs in schools

The Minister of Education, Hon. Arsene James,14 alluded to this difficulty. This view is also reflected in part in the Draft policy.15

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Snapshot of ICT resources in schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>School type</td>
<td>Number</td>
</tr>
</tbody>
</table>
| Primary schools | 86 | • 20 Schools have labs  
| Secondary schools | 18 | • Roughly 10 PCs per school  
| | | • All have labs  
| | | • Roughly 20 PCs per school |

St. Lucia Ministry of Education (MOE).
8 Intra-National Divide: connectivity issues
Still many schools, especially those in the rural districts have difficulties with networking and connectivity. Though, admittedly, this may not be confined strictly to the urban-rural dichotomy, and may have more to do with economic circumstances.

9 Maintenance
Many of the schools can ill-afford the exorbitant maintenance charges. Repairs and upkeep of the equipment are proving to be a tremendous challenge. Very often the schools do not have the in-house resources and are forced to outsource the maintenance of the equipment.\textsuperscript{16}

10 Old or obsolete hardware
Computers in many of these schools are well over three to five years old, which further compounds the maintenance challenge denoted earlier.\textsuperscript{17}

11 Absence of national ICT-awareness
While the government and certain pockets of the society have a general appreciation for ICTs, there are still too many corporations, institutions, organisations that have yet to embrace ICTs as key factors of production. In the least, the hope is that ICTs would be seen as enablers, with the potential for enhancing productivity and efficiency and ultimately increasing profitability.

Although the experience varies from island to island, generally, the governments of the region are yet to invest sufficiently in the education sector to trigger a qualitative improvement in the graduates that flood the market at the end of each academic year. The challenges highlighted in the case of St. Lucia suggest that the integration of ICTs in schools is an uphill challenge, and corrective measures need to be consistent and targeted. This of course requires massive investment of capital which perhaps is not as readily available as one might hope.

Moreover, while up until now the focus has been on endogenous impediments, one has to be cognizant of the exogenous factors, the workings of global capitalism that in part have informed this intra-national problematique.\textsuperscript{18}

**POLICY RESPONSE: RECOMMENDATIONS**

Skills and resource deficiencies present two of the greatest challenges to the IT in education initiatives championed by the Ministry of Education in St. Lucia. Additionally there is yet a mass embrace of ICTs as a significant component of organisational development and general business practice. The private sector is yet able to revolutionise its business procedures and processes to reflect paradigmatic changes in the global business environment. That hesitance can prove costly, especially to small and medium enterprises that may be further marginalised in the national and global economies if they do not embrace e-business. There may be very well substantiated socio-cultural reasons for this. Hence, policy formulation and implementation must be rooted in socio-cultural analysis if it is to be successful. There can be no economic analysis that is not steeped within the cultural context of the evolving economy or nation.

The skepticism reflected needs to be tackled head-on. Organisations – both within the public and the private sector – that adhere to traditional processes and procedures must be given incentives that encourage them to make that shift from the old – to the new paradigm of business. The government’s efforts to do so, which seem limited, are not helped by the apparent dearth of 'success' stories that could encourage those yet to do so, to incorporate ICTs in the organisational system. Moreover, given the time lag between implementation and real gains (increased
efficiency, enhanced productivity, rising profitability) institutions are slow to embrace ICTs. It is often perceived as an unnecessary capital investment with little or no benefit in the near future. Moreover, the relative absence of a supporting regulatory and financial environment does little to lure institutions into the e-world! Hence, the evident risk aversion and the hesitation of entrepreneurs to redefine business models to reflect the centrality of ICTs. This is most evident in SMMEs.

Therefore, the question remains, is St. Lucia moving towards becoming an information or knowledge society? Is there a rising demand for graduates with the requisite e-skills? Have e-skills become one of the key competencies that employers require?

**Recommendations**

1. Identify a consistent, reliable source of funding to finance and sustain e-education initiatives.
2. Devise a coherent pedagogic methodology for incorporating ICTs.
3. Initiate ‘bridging’ opportunities, to link graduates with e-skills to potential employers so that they can be incorporated/absorbed into the workforce.
4. Engage stakeholders (private and public sectors) and indeed the wider population, with a view to sensitising them about the merits of incorporating ICTs into their organisations/institutions and everyday activities. In some cases graduates with e-skills are not afforded the opportunity on their jobs to utilise their e-skills. Some organisations, institutional structures, processes and procedures are still dated.
5. Reduce the cost of ICT hardware and software, making them more affordable for working class families.
6. Create more opportunities for integrating ICT into the curriculum, by equipping teachers with the e-knowledge to facilitate learning and teaching in the information age. (For example, initiate curriculum change at the Teachers Training College, with ICTs at the core.)

**CONCLUSION**

Since its independence in 1979, St. Lucia has been an agrarian economy. Today, St. Lucia, like several Caribbean countries is heavily reliant on agricultural production and services, especially tourism. The dismantling of the preferential trade arrangements articulated under the various Lomé conventions has exposed St. Lucia to the vagaries of the international market and rendered it volatile and vulnerable to external shocks in the global economy (the negative effects of which are evident in the current financial and economic crisis, for example). The changing tide in the global political economy towards free market economics has meant that St. Lucia no longer benefits from the relative insulation offered by the UK specifically and more generally the EU, and as such is being pitted against bigger more richly endowed economies, with obvious economic implications. The commodity crisis triggered by this wave, has seen the income generated by the sale of primary commodities halved. The attendant economic crisis that this has sparked throughout the Windward Islands has left governments scrambling for viable alternatives.

The advent of new ICTs has ushered in new hope for countries such as St. Lucia that do not benefit from rich natural resources or economies of scope and scale. The developmental potential of ICTs it is hoped will help propel small vulnerable economies like St. Lucia unto the growth
path. However, much of that developmental potential can be tapped into only when some very important prerequisites are met. Increasingly, the youth are being called upon as the new vehicle for the future, as they are best poised to acquire the requisite e-skills to participate more meaningfully in the national economy, and by extension the global e-economy.

However, St. Lucia has had very limited success in fully incorporating ICTs into the education system, and ensuring that the workforce of the future is well e-equipped to participate fully in the e-economy. The findings suggest that the paradigmatic underpinnings and justifications for policy change in the education sector are not well ventilated or appreciated. Technology integration in schools appears to be a priority and is central to the objectives necessary for a new and innovative approach to teaching and learning on the island. Every so often, there is mention of the potential of ICTs, but that rhetoric has yet to be translated into any real policy initiative that attracts the requisite budgetary allocation. Which sometimes raises the question how much of a priority is it really?

The paper reveals, therefore, that there are some serious challenges to be overcome should St. Lucia wish to transform its human resources so as to realise the goal of effective participation in the new global e-economy.

REFERENCES


OFFICIAL DOCUMENTS


NOTES

1 The OECS was established on 18 June 1981 by the Treaty of Basseterre. One of its primary objectives is to promote co-operation among the Member States at the regional and international levels. The OECS comprises nine member states, namely, Antigua and Barbuda,

BIOGRAPHY

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Commonwealth of Dominica, Grenada, Montserrat, St. Kitts and Nevis, St. Lucia and St. Vincent and the Grenadines.


3 The 15 objectives can be found at Draft ICT Policy. OECS Draft ICT Policy: Strategies for Implementing ICT Policies in the Education Systems of the OECS (January 2003).


5 The Ministry of Education (MOE) is currently working on an updated draft policy that seeks to replace the old one. The new policy it is anticipated will be more tailored-made to the specificities of St. Lucia. At the primary school level, therefore, the thrust to have computer labs has had to come from the schools themselves. Only a small number of primary schools have computer labs. Others have incorporated IT technology in smaller Learning Resource Centres (LRCs) in their libraries or classrooms. The MOE is now embarking on a multi-million dollar programme to outfit primary schools on the island with computer labs. This is still at the planning and evaluation stages.

6 See Draft Policy Document for the Integration of ICTs in the School System, pp.1, 2.


8 Many of the PCs have been donated by Corporate Sponsors, with Cable and Wireless being the largest donor to date.

9 There is great variation in the quantity and quality of hardware available at the Secondary Schools. The more modern schools built within the last five (5) years or so, tend to have more labs, are networked and better equipped.

10 See for example, Rigobert (2006a).

11 Interview with Minister of Education, Hon. Arsene James, 2007.

12 The St. Lucia Chamber of Commerce, Industry and Agriculture; St. Lucia Hotel and Tourism Association (SLHTA), the St. Lucia Small Business Association (SLISBA); and the St. Lucia Manufacturer’s Association (SMA); The National Skills Development Center; and The Poverty Reduction Fund and the Basic Needs Trust Fund are some of the institutions that have in the past constructed Computer Labs for various Schools and Resources Centers in several communities. (Draft Policy for the Integration of ICTs in the Education System, Government of St. Lucia).

13 Draft Policy for the Integration of ICTs in the Education System, Government of St. Lucia, notes on p.3, that,

“The introduction and sustainability of ICT in the education system are also expensive. The capital cost of the equipment needed to begin the process is obvious. A little less obvious is the high level of recurrent costs associated with the effective use of ICT, which results in a more accurate analysis of the total cost of ownership. Every attempt must therefore be made to optimise the benefits of such large investments, and to develop cost effective implementation, integration and maintenance procedures.”

14 Interview with Minister of Education, 2007.

15 “These initiatives, however, have been implemented in the absence of a carefully thought-out national plan with guiding policies and strategies”, Draft Policy for the Integration of ICTs in the Education System, Government of St. Lucia, p.2.

16 The Ministry of Education has three (3) IT technicians who are largely responsible for the maintenance of computers in the schools on the island.


WEBSITES


INFORMATION AND LEARNING NEEDS OF YOUTH IN A RURAL COMMUNITY IN NIGERIA

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University of Ibadan, Nigeria

Abstract: Understanding learning and information needs of youth could provide planners with information required to address the needs of youth in a community. Using data collected from 220 and 250 male and female youth through Focus Group Discussion (FGD) and a questionnaire survey respectively, this study investigated the information and learning needs of youth in Uzoagba, a rural community in southeastern Nigeria. Two categories of youth could be identified based on their information practices. They are those under 12 where education, health/HIV/AIDS and income dominate. Another is the group of those above 12 where the issues that dominate their needs are income/employment and education. In summary, youth want to remain healthy to develop their personal efficacy through education and then be usefully integrated into wider social and economic life. Meanwhile, they are concerned about how to participate in generating income to achieve this ultimate aim, and to assist their families and community.

Keywords: information and learning needs; youth; participatory gender-oriented study; southeastern Nigeria; Di Nwanna.

INTRODUCTION AND BACKGROUND

This report documents a participatory gender-sensitive assessment of information and learning needs of youth in Uzoagba, a rural community in old Owerri in Southeastern Nigeria. The report is an excerpt from a larger study, which focused on the impact of the practice of Di Nwanna, a traditional marriage rite observed in the community and its neighbours, on the reproductive health of adolescent girls (Nwagwu, 2006). The result of the larger project showed that girls suffered all the disadvantages arising from the traditional practice, a disadvantage that could be corrected through the understanding of the learning needs of the youth in the community.

There exists a vast literature on gender equity in human society and the need to address them (March et al., 1999; Guijt and Shah, 1999). A wide consensus of opinions suggest that the best way to address unfair gender relations and promotion of equity relevant to the day-to-day lives of people is to create spaces for males and females to engage in meaningful exchange of ideas and knowledge (UNESCO, 2002). The UN Convention on the Rights of the Child (1989) has made calls for children and young people to participate in debates...
and decisions made concerning their well-being, their education and their communities. These calls are necessitated partly by a growing recognition of children’s rights to express themselves, participate and be heard in general. In developing policy to support and facilitate young people’s participation, key issues remain unresolved. Should initiatives be directed at children and teenagers, encouraging their civic interests and participatory skills before they are old?

In line with these observations, this paper is intended to develop a clear understanding of information and learning needs and activities of male and female youth in the community, and what they consider needed to improve their individual efficacy. Community in this study is conceptualised as a complex social system rather than a homogeneous group of people to obtain a detailed understanding of the range of information needs of the subjects (Kertzer and Fricke, 1997).

Going by what is available in the literature on information practices in Nigeria (Oshiname, 2007), the information needs of youth, and particularly in the rural areas, have scarcely been investigated by researchers. This implies that planning and other activities that affect the welfare of the rural youth have been carried out without adequate understanding of their priorities. Yet, the youth are the future of the society. If organising human society would mean preparing the youth for future roles, then planning authorities should integrate information priorities of youth in their plans and programmes. Otherwise the configuration of the future society will be incongruent with the development stature of the youth who ought to be managers of the new society.

Rather than defining a very specific age range within which one must fall to be considered in this study as youth, focus is on the unmarried males and females between the ages of 7 years and 30 years. We defined youth this way because the larger study showed that the tradition of Di Nwanna was most indulged in by the unmarried. For a clear understanding of the situation, we divided the whole age groups into three: 7–12 years, 13–19 years and 20–30 years. Although the 7–12 age group is not usually included in the category of youth, but rather children, it was deemed important to consider the information needs of this age group because this category was significantly and adversely affected in the findings in the larger study. The second age category defines those who are generally known as adolescents while the older group 20–30 consists of persons who are actually adults. The overall well-being of the youth is shaped by many factors, which range from the social, economic, cultural and political conditions of the wider society, to those that characterise the living situation of an individual adolescent. On the basis of inferences from the result of the larger project and our interactions with various categories of people in the community, we anticipated that educational opportunities, HIV and diseases, employment and poverty, and income generation activities would dominate issues in the minds of the youth. But, the extent of manifestation, relationship and variation of these variables among the various gender and age groups as well as how the youth meet the information requirements associated with these issues need to be empirically established.

**METHODOLOGY**

This study adopts a participatory manner to appraise the information and learning needs of the youth using FGD strategy, a qualitative research technique. In addition to the FGD, a brief questionnaire, which included both closed and open-ended questions, was designed to collect information for further validation of the findings of the focus
groups. Finally, throughout the research process, the issues raised were informally and formally discussed with the participants, facilitators and experts to ensure that they addressed the objectives stated. This triangulation is believed to be particularly very necessary when using predominantly qualitative methods, which often allow for subjectivity (Babbie and Mouton, 1998).

The focus group design

FGD is a way of engaging people in a discussion, listening to them and then learning from them (Morgan, 1998). They provide a forum where participants can share experiences, ideas, attitudes, and together explore a particular topic that concerns them from several viewpoints. When correctly facilitated, FGD encourages learning as Participants see the same issue from different perspectives (Babbie and Mouton, 1998).

For the FGD sessions, we formed three groups — one female group, one male group and one mixed group for each of the three age categories, and the detail of the discussion was moderated by the perceived information needs of the community. This approach allowed for testing for different responses from the specific gender groups, as well as gender interactions within the mixed group, following a standard focus group plan. Each group had two trained facilitators, one to facilitate in the group and the other to take detailed notes of the discussions. To qualify as a facilitator, one must be at least 18 years of age, be confident to talk in a group, and relate well with people, and must be able to take or translate notes in English.

The questionnaire design

After the synthesis of the FGD, a questionnaire consisting of a mix of closed and open questions to address the same issues was administered to all the respondent groups that cut across, by a little margin, those involved in the FGD. In addition, the questionnaire provided basic demographic information about the respondents: age, education level, and employment status and then covered information needs and current sources of information. The project coordinator administered the questionnaire.

Sample selection

In the focus groups, youth were recruited to participate in the study based primarily on their willingness to do so. For the younger age groups, the headmasters and principals of schools in the community were informed about the project, and asked to select participants in the specified age categories to be invited. For the other categories, people who visited our project site, or expressed interest in the project, as well as the subjects from whom data was collected in the larger survey, were invited to participate. On each of the eight days during which the FGD was conducted, additional participants were also invited to join in cases where the numbers were still low. It was ensured that 220 participants were invited for each of the age groups as well as for the gender groups, both in the questionnaires and in the FGD. Altogether, 220 participants took part in the FGD while 250 participated in the questionnaire survey. The responses of the participants in each group were synthesised and classified accordingly. Results of the study were presented by using frequency distributions both in tabular and in graphical formats. The overlap in the responses means that the total percentages for any of the groups need not necessarily add up to 100%.

Findings

The findings from focus groups are presented for each of the three age groups. Altogether, the FGD exercise was
spread over a period of eight days and a total of three sessions involving one age and gender group at a time were held per day. Thereafter, the data from the questionnaire were collated using basic statistics to clarify, and help maximise the triangulation.

**FGD findings**

The total sample for the FGD cut across three age categories and with three groups in each of the age categories. The pattern of distribution of the respondents is shown in Table 1. Altogether, 62.17% of the participants were females and 37.83% were males. Table 1 shows that many of the male participants invited did not attend, indicating that there was less willingness from the males to join in the research. The participation of the 13–19 years age group is also observably somewhat less than that for the other two groups. This might probably be due to previous frequent invitation of this age group to many different meetings in the course of the larger project. The age range across all the groups was 10–30 years. The average age for the age group below 12 years was 11.5 years, 14.6 years for the 13–19 years age group, and 21 years for the 20–30 years age group.

**Information and learning needs of age group 7–12 years**

All the respondents below 12–years old reported that their greatest expressed information need is pregnancy. Altogether, information sources available to them, however, included family (43.23%) and friends (21.34%), schools (20.19%), TV (8.9%) and churches (5.26%). A very few mentioned computers (1.10%), none mentioned the internet and none of them was computer literate.

There was an interesting difference between the gender groups, with the boys group listing very different kinds of information needs from the girls and the mixed groups. The opinions of the girls’ group included issues on HIV/AIDS (32.23%), careers (19.19%), children’s rights (18.19%), school information (13.14%), health (12.98%) and education (4.27%). According to some of the girls:

“I am afraid of HIV/AIDS because I do not know whether they are telling us the truth. People have died in this village due to HIV/AIDS and I am afraid.

I want to know more about this world, so that I can be knowledgeable. I want to know what is happening in the world in Africa and in Nigeria, to know about other countries and their problems, the problems we are facing in our school”.

The younger boys-only group listed school subjects (59.9%), computers (32.19%) and sports (29.1%).

Each participant was asked whether he or she had ever used a computer. In the 12 years and under group, It was found that only 12.5% had used a computer previously.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Aspects of personal demographic information about the respondents</th>
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<tbody>
<tr>
<td>Age category (years)</td>
<td>N</td>
</tr>
<tr>
<td>&lt;12</td>
<td>64</td>
</tr>
<tr>
<td>13–19</td>
<td>94</td>
</tr>
<tr>
<td>20–30</td>
<td>62</td>
</tr>
<tr>
<td>Total</td>
<td>220</td>
</tr>
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</table>
The 12 years and under age group were further asked whether they thought boys and girls used computers differently. Some interesting responses emerged from the discussions with examples of how computers are used the same and differently being given.

“Girls use the computers for typing, boys will use it for business matters.

Boys and girls want different careers so they want to use it for different reasons.

Girls will type, boys will use it to play – puzzles and love letters”.

This is an interesting dynamic that could be explored further to see if the pattern occurs with different groups of respondents or if it was rather peculiar with this particular group.

*Information and learning needs of 13–19 years age group*

Within all the three groups in this age group, there was a consensus that computers are important and that computers can help in learning, even though they neither had access nor are they computer literate. Computers were seen as important for communication, studying, finding information on the internet, “to know what is happening in the world”, and learning basic skills like reading, and for entertainment. The discussion about topics to learn provided a wealth of information and a wide variety of responses. Since this was expected when designing the research, ranking exercises was included in the design of the focus groups so that a prioritised list of information needs could be found. For the boys-only group, income, discipline at school were ranked the most important issues they were currently facing. For the girls-only group, older males dating younger girls and teenage pregnancy were noted as most important.

For the mixed gender group, education, income, poverty and unemployment, poor health facilities, sexual abuse/teenage pregnancy and HIV/AIDS/STD were priorities. Having identified and ranked current issues, each of the groups was asked whether they have the information they think they need and where they can get it. There was a general consensus in all the groups that quite a lot of information is available from various sources, including the media, promotional materials, parents, teachers, books, clinic and church. Interesting in this report is the discussion around what information is not available that participants feel that they need. Unfortunately, both the girls-only and boys-only groups did not seem to fully understand these questions. However, the girls-only group did note a need for medical expertise and information about AIDS and early sexual initiation while the boys want information about how to become economically comfortable. For the mixed gender group, their opinions seem to reflect issues around education and income.

The main issues for the 13–19 years age group seem to be: how to be successful in life, self-esteem and confidence, being financially secure, how to stay healthy, personal safety and security. When asked whether boys and girls would face the same issues, there were some differences across the groups and the need to openly address gender issues came through very strongly.

With the girls-only group, in particular, there was a lot of anger expressed, largely in response to the high incidence of sexual assault. Some of the responses were:

“Boys like crime, they like material things.

Boys would not like for abuse to be over, because they commit sexual abuse, 90% of them.

Boys like to hit their girlfriends to prove power.”
No, boys would not like punishment at school because they like to control the teachers”.

In general, the boys-only group thought that most of the issues were faced by both genders. This included AIDS, unemployment and pollution. However, specific issues were noted as being especially problematic for women. For example:

“Poverty is mainly faced by women because they have to struggle to care for their children.

Homelessness affects both, but women face homelessness especially badly”.

The mixed gender group had an interesting discussion about their needs, and the list of needs was almost the same for both genders. However, there was also an opinion that pregnancy affects women and only impacts a little on the man, and that men run away from most of their responsibilities.

**Information and learning needs of 20–30 age group**

This group recognised the importance of computers and their roles in learning. The reasons for considering computers as crucial ranged from employment, and communication to education. Some other interesting responses included that computers would help “open your mind”, “make you think and give you ideas” and “give you a better skill”. These three examples of responses provide some evidence of the willingness of the respondents to engage with issues relating to the computer. The enthusiasm notwithstanding, only 3.7% of the members of this group have any computer literacy while much less than this, about 2.2%, have ever used the computers on their own. Lesser number of people has internet literacy (2.1%), although none of them has any regular access. Ironically, a relatively higher number of them (4.7%) reported having used information obtained from the internet or having used the internet to send messages to their relations who are not at home (4.5%). Those who have used the internet travelled to Owerri township, about 10 km from the village. According to them, the distance is not even as much a problem as that of absence of power supply, or, the internet café is filled up with people or that there is no connectivity. One of the participants who always passes the night in the city each time he required internet access also reported being discouraged, in addition, by the unwillingness of the café operators to give him or her the desired assistance, because of his very low computer literacy level.

The discussions around learning needs and problems generated various responses from the various groups. For the women-only group, poverty, lack of housing and education were noted as most important. For the men’s group, unemployment, crime, education, poverty, and income-generating activities were seen as most important. For the mixed group, issues seen to be of high importance included HIV/AIDS, unemployment, teenage pregnancy, illiteracy, lack of educational facilities and inadequate income-generating activities. Ranking these issues more broadly, the main issues for this age group are unemployment (poverty, income, job and career information), education (and illiteracy) and health/HIV/AIDS. When asked whether the same issues are more likely to be faced by men and women, it was found that the women-only group have the strongest opinion with respect to gender issues. Responses from this group included: “Women are most affected by unemployment”, “Men are more relaxed when they are unemployed than women”. Both the men only group and the mixed gender group felt that the same issues were faced by men and women.
Beyond the group responses, the study also investigated the perception of the individuals regarding their personal information needs. To address this, the participants were given a slip of paper and were asked to anonymously record their most important personal needs. The responses were classified as (Figure 1): employment related, rape, abuse, life skills (includes sex-related information but not abuse and rape), education, environment, housing, infrastructure and services, computer access and training, lack of unity among the youth, crime, lack of information generally and teenage pregnancy.

Others include HIV/AIDS, funding for education, community development and school attendance. However, income and HIV/AIDS are the major issues that border the youth the most, followed by education and crime. Respondents also showed some concern about how to develop their communities as well as employment matters. Issues that appear to be of least importance by general rating include rape and abuse, probably because this would be an issue of concern to females mainly.

For the separate groups, the result shows some gender disparities in the perception of individual information needs. Education, HIV/AIDS, life skills, abuse and teenage pregnancy are the four most crucial information needs of females while issues about community development and unity among the youth border them the least. Other issues that featured very prominently in the information needs of the females include school attendance, marriage and violence.

For the males, Figure 2 shows that their information needs differ markedly. How to earn income tops the list of their needs followed by employment, education and life skills. Others are HIV/AIDS, computer access and training, community development and environment. A few issues featured exclusively in the information needs of the girls, such as teenage pregnancy, school attendance, violence and rape. On the other hand, some issues such as community development and unity among the youth featured exclusively in the boys’ information needs but not in the girls.

Figure 3 shows the age category distribution of the responses of the youth; there exists evidence of variation in the information needs of the youth probably more than could be visualised in the gender categorisation. Employment is the most crucial
information need of those aged above 18 years old age, followed by income and life skill. Issues such as unity among youth and rape as well as abuse and teenage pregnancy are at the bottom of their information needs. For those who are between 13 and 17, HIV/AIDS ranks first in the information needs followed by education and marriage. Rape, environment and unity among youth constitute the least three factors. Finally, for those youth less than 12 years of age, HIV/AIDS and education as well as teenage pregnancy and school attendance rank the first four factors on which youth need information, while environment, crime and community development are the least three factors.

Questionnaire result

Altogether, 250 copies of the questionnaire were completed. When the data in the questionnaire were analysed, it was found that 20.4% of the respondents were secondary school students, 55.9% were not in school and 1.2% have tertiary education, 27.5% did not indicate their educational status. Of the whole sample, only 3.8% reported that they have used a computer previously.
When these figures were disaggregated, the result remains similar for gender, although men seemed to have a slightly higher percentage in the tertiary education category (66.7%) compared with 60% for women. For the sample as a whole, 43.2% are unemployed, 6.2% have full-time employment, 14.8% part-time employment, 6.5% are self-employed and 19.3% fell into the ‘other’ category, which included volunteer work and students.

**Employment status of participants by gender**

Disaggregating employment level by gender shows clear gender differences. The proportion of males (7.6%) and females (4.9%) in full-time employment in the community are very low, and males reported having more access to part-time employment (21.21%) than the females (19.1%). Even in the self-employment category, women (29.12%) have less access to jobs than the men (32.0%), and they also reported to be jobless (34.88%) more than the men did (14.11%). Respondents were asked in an open-ended question if they thought computers were important and why they thought so. All respondents noted the importance of computers, for various reasons, including job searching, information, education, enhancement of efficiency and communication.

**Most important information needed**

The respondents were further asked to rank a list of information we provided according to their importance. Over seven out of every ten respondents reported that they want information on education as shown in Figure 4. More importance is attached to sociocultural news than local (6.7%) although local news appear more important to them than national news (6.7%) and government news (2.7%). But, the youth would prefer to have information about employment (31.5%), healthcare (19.1) and prices of goods (16.8%). A comparison of men and women shows that more men (75.2%) than women (69.1%) want educational information and national news (24.6%) and (0.9%), respectively. Furthermore, men reported needing information about employment (43.0%) more than the women (19.2%) who, however, seemed to be more interested in healthcare and prices of goods information (21.2%) and (22.9%) than the men (1.4%) and (2.9%), respectively.

**Most important sources of information**

Table 2 shows that television is considered both by the whole sample and by the gender groups as the most important source of information, although women appear to consider the source more important than the men.
Radios and newspapers are the next important sources of information to all the groups, but they serve men more than the women.

Pamphlets, friends/relatives and community meetings follow but men seem to consider pamphlets as an important source more than the women, while women see their friends and relatives as well as community meetings as more important sources of information. None of the respondents mentioned computers of internet as a source.

**DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS**

The objective of this paper is to assess the information and learning needs of male and female youth in Uzoagba community to generate information that could assist in planning. Having examined the different information and learning priorities of youth across age and gender criteria, it is adequate to tease out the information priorities of the categories. The details of the issue indicate that differences were greater across the different age groups than the gender groups, and we summarise this in Table 3. The need for gender-related discussions was evident specifically in the 13–19 years age group where the girls expressed strong feelings towards men. Gender differences were also found with respect to employment status, with women showing much higher levels of unemployment than men.

Table 3 shows that education appears in all the age group categories. An overall classification of these needs fits into the following two main categories, namely

i) **Those under 12**: In this group, education, health/HIV/AIDS and rights/abuse dominate the needs.

ii) **Those above 12**: The issues that dominate the needs of this group are: income/employment (job searching, career information and entrepreneurship), health (HIV/AIDS, general well-being),

<table>
<thead>
<tr>
<th>Information source</th>
<th>Whole sample (%)</th>
<th>Men (%)</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio</td>
<td>32.3</td>
<td>34.5</td>
<td>28.9</td>
</tr>
<tr>
<td>Television</td>
<td>43.6</td>
<td>46.5</td>
<td>49.9</td>
</tr>
<tr>
<td>Newspaper</td>
<td>22.1</td>
<td>21.1</td>
<td>11.1</td>
</tr>
<tr>
<td>Pamphlets/ Magazine</td>
<td>18.4</td>
<td>19.1</td>
<td>17.1</td>
</tr>
<tr>
<td>Clinical health</td>
<td>5.9</td>
<td>4.9</td>
<td>11.1</td>
</tr>
<tr>
<td>Place of worship</td>
<td>5.2</td>
<td>4.6</td>
<td>6.3</td>
</tr>
<tr>
<td>School teacher</td>
<td>2.9</td>
<td>3.6</td>
<td>9.7</td>
</tr>
<tr>
<td>Community meeting</td>
<td>12.9</td>
<td>17.1</td>
<td>23.2</td>
</tr>
<tr>
<td>Friends/relatives</td>
<td>16.2</td>
<td>18.8</td>
<td>32.2</td>
</tr>
<tr>
<td>Workplace</td>
<td>0.9</td>
<td>2.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Cinema</td>
<td>0.2</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Exhibition</td>
<td>2.1</td>
<td>1.9</td>
<td>2.4</td>
</tr>
<tr>
<td>Adult education</td>
<td>1.9</td>
<td>2.1</td>
<td>1.3</td>
</tr>
<tr>
<td>Political leaders</td>
<td>1.2</td>
<td>0.9</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Table 2 | Important information sources
education (school-related information, access to further and higher education, information about educational opportunities, information about funding for educational opportunities, what education will help one become) and life skills (decision-making, safe sex, how to keep healthy, how to look after and protect one, how to be successful and how to be financially capable). One theme, namely employment/income, appears central.

Some questions need to be addressed in this report. Why does education cut across the information needs of all age and gender groups? Why do education, health/HIV/AIDS and sexual abuse constitute major issue for the under 12 youth? Why does employment and income-related matters seem to be more a pronounced need for those youth more than 12 years old? The fact that education is a stronghold of modern development (Ahmed and Nwagwu, 2006), and that it influences earning in the formal sector (Juma, 2003) is a common knowledge among the young and old. Incidentally, educational opportunities are not easily accessible to those who need them in many rural communities, while those who have access study under conditions that are below standard. The additional focus of the under 12 on HIV/AIDS and sexual abuse/pregnancy are indicators of likelihood of insufficiency of HIV/AIDS awareness information activities in the community as well as their expression of concern for the negative impact of the disease on their development.

Like in most rural communities in Nigeria, the youth in this community see themselves as people who ought to participate in the generation of income required to run both their individual lives and the community. Simply, youth, whether schooling or not and whether males or females are concerned with how to participate in income generation. They are concerned with livelihoods — capabilities, assets and activities, which people need to be economically successful. Further studies will be required to unearth how this finding relates to other observed areas of needs of the youth. For instance, how does youth participation in income generation in the community relate to the escalation of the problem of HIV/AIDS in the rural communities? Further studies are also required to design adequate models of youth participation in community development adopting culturally sensitive methodologies. It is also important to research into and fine-tune non-income measures of

Table 3  Summary of needs and sources by age groups

<table>
<thead>
<tr>
<th>S. No.</th>
<th>12 years and below</th>
<th>13–19 years</th>
<th>20–30 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FGD</td>
<td>Individual voting</td>
<td>FGD</td>
</tr>
<tr>
<td>1</td>
<td>Education</td>
<td>Health, HIV/AIDS</td>
<td>Income/employment</td>
</tr>
<tr>
<td>2</td>
<td>Health, HIV/AIDS</td>
<td>Pregnancy</td>
<td>Education</td>
</tr>
<tr>
<td>3</td>
<td>Rights, abuse</td>
<td>Education</td>
<td>Life skills</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Computer training</td>
<td></td>
</tr>
</tbody>
</table>
children’s well-being within specific cultural contexts on the basis of which their sexual and other behaviours could be more realistically modelled.

ACKNOWLEDGEMENT

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BIOGRAPHY

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NOTE

Di Nwanna is a form of marriage apprenticeship rite indulged in by cousin-relations who are not expected to marry each other or indulge in sexual intercourse, by traditional laws and customs. It was aimed at equipping young girls to cope with the demands of marriage, which they entered at a very early age immediately after menarche. The new forms and structure of the practice in the modern times and the consequences for the sexual and reproductive health of the girl child was the focus of the larger project funded by MacArthur Funds for Leadership Development 2005–2006 (04 83064 000 GSS).
The impact of ICT in Malaysia: a simultaneous equations approach

Jorah Ramlan* and Elsadig Musa Ahmed

Multimedia University, Malaysia

Abstract: This study measures the impact of ICT on Malaysia’s aggregate output in the period 1965–2005. It closes a gap in existing literature by using the 3SLS technique on a country specific study. Telecommunication penetration rate is used as a proxy for ICT and analysed in both macro-economic and micro-economic perspectives. The findings of this study suggest that there is a causal relation between ICT and aggregate output in Malaysia and that the MSC and the privatisation policy of the telecommunication sector, are found to be indifferent to achieving expected economic growth in Malaysia.

Keywords: ICT; Malaysia; economic growth; SEM; simultaneous equations method.

Introduction

The remarkable progress in ICT witnessed in the past decade has made an increasingly profound impact on economic activity and the way people work, communicate, and spend time across countries around the world.

Over the last decade several methods have been used to analyse the impact of ICT on growth. Most studies analyse only one aspect of this nexus at a time, which is the macroeconomic aspect or the microeconomic aspect of the relationships.

Identifying the sources of economic growth appears to be an on-going research following the works of Solow (1956) and Romer (1986). Empirical studies on economic growth by De Long and Summers (1991, 1993) address the specific issue of equipment investment and its impact on economic growth. The development of ICT saw many studies augmenting the ICT-growth nexus model to include intangible variables and employing more sophisticated estimation techniques in the 1990s period. However, the results of the impact of ICT on growth still remain controversial. For example, Pohjola (2001) uses data covering the period 1980 to 1995 for 39 countries and employs the OLS method of estimation. He finds that the effect of ICT on growth is not significant, except for developed Organisation for Economic Cooperation and Development (OECD) countries where

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ICT has a significant positive effect on growth. Stiroh (2002) examined the impact of ICT on economic growth in the USA and concluded that there is evidence of ICT contribution to economic growth. Jeong and King (2001) examine the ICT-growth nexus using aggregate data covering the period 1980 to 1995 for Korea, and control for a number of ICT variables such as broad ICT investment, narrow ICT investment, and non-ICT investment. They obtain a positive and significant impact of ICT on growth. Beil et al. (2003) reported on the impact of telecommunication investment on economic growth for the USA based on the Granger-Sim Causality test, while Dedrick et al. (2003) provide relevant references to studies relating to Information Technology (IT) and economic performance.

Issues relating to the telecommunication sector are significant in these studies as telecommunication is acknowledged to be concomitant to the development of ICT. Roller and Waverman (2001) endogenised telecommunication investment in their macroeconomic model to determine the impact of this variable in a micro-economic environment based on the SEM. Their study on OECD countries indicates a significant impact of telecommunication investment on economic growth. Sridhar and Sridhar (2004) reported similar results in an almost identical study conducted on developing countries. The use of the Simultaneous Equations model has been applied to studies on income and population growth (Valdes, 1997), the determinants of economic growth (Broeck and Binder, 2005), the impact of FDI, IT and economic growth in the Middle East and North Africa (MENA) region (Hassan, 2005), and the preparedness of a country to exploit the capabilities of ICTs (Kauffman and Kumar, 2006).

The purpose of this study is to determine the impact of telecommunication investment, as a concomitant to ICT development, in a macro- and micro-economics perspective, taking into consideration the MSC and privatisation policy, which is unique to Malaysia compared to other developing countries. This paper examines the factors that contribute to the impact of ICT on economic growth in the OECD countries (Roller and Waverman, 2001) and selected developing countries (Sridhar and Sridhar, 2004) and compares them with Malaysia.

Changes in Malaysia’s economic policy from import substitution to export oriented signify the ability to embrace technology and changes in order to achieve higher economic development. The privatisation policy in Malaysia, which started in the 1980s, indicates a change in the market structure for public goods. Telecommunication was the first economic sector that underwent this exercise. The development of the MSC in the mid 1990s indicates the government’s vision of the significance of IT, specifically, ICT, and to promote this technology as its engine of growth.

This paper is organised as follows: Section 1 is an overview of ICT and economic growth in Malaysia; Section 2 describes the data set and a descriptive analysis of the data; Section 3 presents the methodology and estimation procedures; Section 4 reports the results; and Section 5 provides the conclusion.

**ICT and economic growth in Malaysia**

Malaysia’s economic progress is an outcome of a basic policy framework and industrialisation strategies since independence. The history of Malaysia’s Economic Policy framework and Industrial Development Strategies started in 1955 in the Report on the Economic Development of Malaya by the International Bank for Reconstruction

The Malaysian economy was governed by the New Economic Policy (NEP) from 1971 to 1990 as contained in the First Outline Perspective Plan 1971–1990 (OPP1). The Second Outline Perspective Plan (OPP2), covering 1991 to 2000, was formulated based on the National Development Policy. Vision 2020 was launched in order to attain a fully developed and industrialised nation status. It is, essentially, a long-term vision (1991 to 2020) encompassing broad policy direction (Ramlan, 2001). Although the three documents vary in terms of time and focus, the main objective remains the same, that is, to establish a progressive, prosperous and united nation. These objectives imply achieving a dynamic and sustainable rate of economic growth.

Telecommunication and privatisation policy: a brief overview

Malaysian telecommunication was previously highly regulated, but since the inception of the NEP in the 1970s the Government of Malaysia has made an effort to liberalise the telecommunications industry. With the privatisation of the government telecommunications department in 1987 and the formation of the National Telecommunications Policy (NTP) in 1994 the market appears to have been fully opened (Table 1). The economic Master Plan for the telecommunications industry provides guidelines for competition, interconnection charges, tariff rates, network development, etc. At the end of 1995, all operators signed interconnection agreements with Telekom Malaysia to provide seamless communication without regard to carrier, yet most carriers have not signed agreements among themselves. Telekom Malaysia is Malaysia’s largest telecommunications service provider.

The computer and software markets are fully deregulated, though restrictions do exist on participation in government bids, and equity restrictions on setting up manufacturing facilities.

The Multimedia Super Corridor (MSC): a brief overview

The MSC was conceptualised in 1996 to focus on multimedia and communications

<table>
<thead>
<tr>
<th>Area of competition</th>
<th>Current status of competition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic leased lines</td>
<td>Competition but Telekom Malaysia dominant</td>
</tr>
<tr>
<td>International leased lines</td>
<td>Competition but Telekom Malaysia dominant</td>
</tr>
<tr>
<td>Domestic VSAT</td>
<td>Monopoly</td>
</tr>
<tr>
<td>International VSAT</td>
<td>Fully competitive among Intelsat providers</td>
</tr>
<tr>
<td>Domestic telephony</td>
<td>Competition but Telekom Malaysia dominant</td>
</tr>
<tr>
<td>ISDN/Switched digital services</td>
<td>Competition but Telekom Malaysia dominant</td>
</tr>
<tr>
<td>International frame relay</td>
<td>Competition and foreign firms in market</td>
</tr>
<tr>
<td>Mobile data</td>
<td>Highly competitive</td>
</tr>
<tr>
<td>Mobile paging</td>
<td>Highly competitive</td>
</tr>
</tbody>
</table>

Source: Information Technology in Malaysia – privatisation and deregulation
products, solutions, services, and research and development (Ramlan, 2001). The implementation of the MSC is divided into three phases from 1996 to 2020. In Phase 1 the objective is to develop the designated area. In Phase 2, the objective is to develop a web of similar corridors in Malaysia and to establish a global framework of cyber laws, with at least four intelligent cities to be linked to other global cities worldwide. In Phase 3, the objective is to enable the intelligent cities to evolve into one MSC. An International Cyber Court of Justice will be established in the MSC and 12 intelligent cities will be linked to the global information highway.

The objectives of the MSC appear to align with the national economic plan of Vision 2020. This is reflected in the establishment of seven Flagship Applications. These applications are to initiate and create a multimedia utopia for producers and users of multimedia technology. The Flagship Applications are as follows:

- Electronic government
- Multipurpose card
- Smart schools
- Telehealth
- R&D clusters
- E-business
- Technopreneur development.

New legislation was introduced to support the development of the MSC and includes the following:

- Computer Crimes Act 1997
- Digital Signature Act 1997
- Telemedicine Act 1997
- Communication and Multimedia Act 1998
- In addition, the Copyright Act 1987 was amended to take account of recent developments in ICT.

The expansion of the MSC includes establishing MSC Cyber city and Cyber centre is reported to serve as the physical location and environment to catalyse and support the growth of ICT and ICT-enabled industries and, in tandem, extend the benefits of ICT to the local community. Under Phase One of the MSC, five Cyber cities have been developed in the country. They are Cyberjaya, Technology Park Malaysia, Universiti Putra Malaysia – Malaysian Technology Development Corporation (UPM-MTDC), Kuala Lumpur City Centre (KLCC) and KL Tower. Cyberjaya has been designated as the national ICT capital. The MSC is also made up of companies which qualify for MSC-status, and are protected by the MSC’s Bill of Guarantees.

The development of the MSC appears to be significant in promoting sustainable economic growth as it involves the use of capital, labour and technology, which are fundamental to economic growth. The evolving economic policy, specifically the privatisation policy, appears to contribute to ICT development and economic growth in Malaysia. However, due to data restriction, the impact of these developments has yet to be ascertained. This is the caveat in this study.

**DATA**

This study is conducted for the period 1965 to 2005. The starting date is the conception of Malaysia as a sovereign country with the inclusion of the territories of Sabah and Sarawak in 1963, and the exclusion of the territory of Singapore in 1965. Data for this study were obtained from the World Development Indicators (World Development Indicators, 2004),
The impact of ICT in Malaysia: a simultaneous equation approach


The data required for the empirical implementation of the Simultaneous Equations Model are: real gross domestic product, real capital stock, total labour force (as a proxy for the stock of human capital), telephone mainlines waiting list per capita, telephone service price, imports of telecommunication equipment (as a proxy for real investment in telecommunication infrastructure), number of telephone mainlines per capita (as a proxy for the stock of telecommunications infrastructure), time trend, and dummy variables for the MSC project and the privatisation policy for Telecom Malaysia. In order to incorporate the effect of the MSC, a dummy variable is used to represent the establishment of the MSC; thus, MSC = 1 for the period 1996 to 2005 and MSC = 0 for the period 1966 to 1995. The privatisation of the telecommunication sector is reflected by a dummy variable in order to determine its significance on telecommunication investment on economic

<table>
<thead>
<tr>
<th>Table 2 Data description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
</tr>
<tr>
<td>GDP</td>
</tr>
<tr>
<td>K</td>
</tr>
<tr>
<td>HK</td>
</tr>
<tr>
<td>Pop</td>
</tr>
<tr>
<td>PR</td>
</tr>
<tr>
<td>SRpm</td>
</tr>
<tr>
<td>WLpc INV</td>
</tr>
<tr>
<td>1813.146</td>
</tr>
<tr>
<td>T</td>
</tr>
<tr>
<td>D1</td>
</tr>
<tr>
<td>D2</td>
</tr>
</tbody>
</table>

For D1, MSC = 1 for the period 1996 to 2005, and MSC = 0 for the period 1965 to 1995.
For D2, Policy = 1 for the period 1986 to 2005, and Policy = 0 for the period 1965 to 1985.
growth; thus, the privatisation policy = 1 for the period 1987 to 2005, and the privatisation policy = 0 for the period 1966 to 1986. Table 2 shows the data description and the relevant statistics for the data.

Preliminary analysis indicates that the growth rates for per capita GDP have decreased significantly from 1966 to 2005. This might be due to several economic shocks throughout the period caused by commodity crisis and financial crisis. This result is reflective of the growth rate for telephone mainlines per 1000 inhabitants for the same period. Table 3 indicates that the acceleration rate for telephone mainlines has increased significantly for the period 1966 to 2005; almost double that of per capita GDP in the same period. This might result from the surge in telecommunication infrastructure development as the country shifted from an industrial to a technology oriented economy, to achieve sustainable economic growth.

**SIMULTANEOUS EQUATIONS APPROACH**

A simultaneous equation approach will be used based on Roller and Waverman (2001) and Sridhar and Sridhar (2004). The initial model was used to analyse a group of OECD countries and selected developing countries. This model is also significant for single country analysis. In the case of Malaysia, the development of the MSC and changes in economic policy relating to the telecommunication sector indicate a unique situation which warrants country specific analysis to determine the impact of telecommunication investment on economic growth. Deregulation of the telecommunication sector gave rise to the advent of new telecommunication companies providing products and services. Several studies relating to ICT and economic growth in Malaysia have been published. Huff (2001) analysed globalisation and the internet by comparing the Middle Eastern countries with Malaysia. Lee and Khatri (2003) analysed nine Asian countries based on the growth accounting method and concluded that the growth in Asia during the 1990s is mainly from capital deepening. Awang (2004) analysed the impact of human capital and technology in Malaysia’s economic development, and Elsadig (2006) analysed ICT and economic growth in Malaysia’s manufacturing sector, based on the growth accounting method.

The contribution of this study is to close the gap in existing studies using 3SLS to estimate the simultaneous equation functions, which is econometrically efficient compared to other methods.

**Table 3**  Growth rates and average acceleration rate for per capita GDP, and telephone mainlines for Malaysia: 1966 to 2005

<table>
<thead>
<tr>
<th>1966</th>
<th>2005</th>
<th>Average acceleration rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDPpc</td>
<td>4.84</td>
<td>2.95</td>
</tr>
<tr>
<td>Mainlines per 1000 inhabitants</td>
<td>-3.61</td>
<td>-3.48</td>
</tr>
</tbody>
</table>

GDPpc is per capita Gross Domestic Products.
to General Method of Moments. This will determine the causality effect between ICT and aggregate output. This study will also close the gaps in Roller and Waverman (2001) and Sridhar and Sridhar (2004) in a country specific study for a developing country. Furthermore, this study also contributes to the existing literature on country specific studies.

In order to incorporate an ICT component into this approach and to improve the model for single country study, the improvised model is as follows:

- **Aggregate production function:**
  \[ \text{GDP}_t = \varepsilon(K_t, HK_t, T_t, t) \]
  where \( \text{GDP} \) is national aggregate economic activity, \( K \) is gross fixed capital, \( HK \) is stock of human capital, \( T \) is information and communication technology, and \( t \) is exogenous time trend.

- **Demand for telecommunication infrastructure:**
  \[ D_t = f(P_t, TP_t, X) \]
  where \( D \) is demand for telecommunication infrastructure, \( P \) is income per capita, \( TP \) is price of telephone services, and \( X \) is other exogenous variables.

- **Supply for telecommunication investment:**
  \[ S_t = g(TP_t, WL_t, Z) \]
  where \( S \) is telecommunication investment, \( TP \) is the price for telephone service, \( WL \) is waiting list per mainline, and \( Z \) is other exogenous variables.

- **Telecommunication infrastructure production function:**
  \[ dT_t = h(TI_t, P_t, W) \]
  where \( dT \) is changes in ICT growth rate, \( S \) is telecommunication investment, \( P \) is income per capita, and \( W \) is other exogenous variables.

In order to examine the impact of the MSC and telecommunication policy, this paper introduces two models; Model 1 is estimated without the MSC and policy variables, and Model 2 is estimated with MSC and policy variables. The estimation procedures are as follows:

**Model 1**

\[
\begin{align*}
\ln GDP_t &= \alpha_0 + \alpha_1 \ln K_t + \alpha_2 \ln HK_t + \alpha_3 \ln PEN_t + \alpha_4 \ln TI_t + \varepsilon_1 \\
\ln (PEN_t + WL_t) &= \beta_0 + \beta_1 \ln INC_t + \beta_2 \ln L_t + \beta_3 \ln TR_t + \varepsilon_2 \\
\ln TIt &= \chi_0 + \chi_1 \ln PEN_t + \chi_2 \ln TR_t + \chi_3 \ln WL_t + \varepsilon_3 \\
\ln PEN_t &= \delta_0 + \delta_1 \ln TI_t + \delta_2 \ln INC_t + \varepsilon_4
\end{align*}
\]
where $PEN$ is the change in the penetration rate of telephone mainlines per 1000 people, $TI$ is telecommunication investment, and $INC$ is income per capita.

**Model 2**

\[
\ln GDP_t = \alpha_0 + \alpha_1 \ln K_t + \alpha_2 \ln HK_t + \alpha_3 \ln PEN_t + \alpha_4 \ln TI_t + \epsilon_1
\]  

(1')

where $GDP$ is gross domestic products, $K$ is capital, $HK$ is total employed labour force, $PEN$ is penetration rate for telephone mainline per 1000 people, which is proxy for ICT, and $TI$ is imports of telecommunications equipment, which is proxy for stock of telecommunication investment.

\[
\ln (PEN + WL)_t = \beta_0 + \beta_1 \ln INC_t + \beta_2 \ln L_t + \beta_3 MSC + \beta_4 ln TR_t + \epsilon_2
\]  

(2')

where $PEN$ is penetration rate of telephone mainlines per 1000 people, $WL$ is the waiting list for telephone lines applications, $INC$ is income per capita, $L$ is total employed labour force, and $MSC$ is a dummy variable representing the MSC.

\[
\ln TI_t = \chi_0 + \chi_1 \ln PEN_t + \chi_2 \ln WL_t + \chi_3 \ln TR_t + \chi_4 \ln PCY_t + \epsilon_3
\]  

(3')

where $TI$ is the demand for telecommunication investment, $PEN$ is penetration rate of telephone mainlines for per 1000 people, which is a proxy for ICT, $TR$ is the revenue from telecommunication services, $WL$ is the waiting list for telephone lines, and $PCY$ is a dummy variable representing the telecommunication privatisation policy.

\[
\Delta \ln PEN_t = \delta_0 + \delta_1 \ln TI_t + \delta_2 \ln INC_t + \delta_3 MSC + \delta_4 \ln PCY_t + \epsilon_4
\]  

(4')

where $PEN$ is the change in the penetration rate of telephone mainlines per 1000 people, $TI$ is telecommunication investment, $INC$ is income per capita, $MSC$ is a dummy variable representing the MSC, and $PCY$ is a dummy variable representing the telecommunication privatisation policy.

**RESULTS**

Table 4 provides a summary of the results for the simultaneous equation functions. The estimation results for the production function for both models indicate that capital, labour, and telephone penetration rate have a positive impact on economic output, while imports of telecommunications equipment have a negative impact on output. This is not unusual for a production function as imports are expenditure, thus indicating an inverse relationship on aggregate output.

The demand function estimation results for Model 1 indicate that the income elasticity is 2.740, and price elasticity is -2.149. These results correspond with basic economic theory. In Model 2, the income elasticity is 3.855, and the price elasticity is -1.825. The MSC variable indicates that it is not significant, and suggests an adverse effect on demand for telecommunication services.

The results for the supply function indicate that the price elasticity is positive, 0.013, in Model 1 and negative, -1.571, in Model 2. This deviation from the economic theory suggests flaws in the telecommunication sector, which might require government intervention. The dummy variable, which reflects the privatisation policy, indicates a positive elasticity of 5.041 in Model 2. This is in line with results from Sridhar and Sridhar (2004) who commented on the significance of market structure in developing countries.

The telecommunication growth function estimates the relationship between telecommunication investment and penetration rate of telecommunication service. The elasticity
Table 4  Telecommunication and economic growth in Malaysia: simultaneous equations method using 3SLS: 1965 to 2005

<table>
<thead>
<tr>
<th>Equations</th>
<th>Variables</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate production function</td>
<td>Constant</td>
<td>8.409</td>
<td>9.771</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(6.722)</td>
<td>(8.630)</td>
</tr>
<tr>
<td></td>
<td>Capital</td>
<td>3.495</td>
<td>2.984</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(6.534)</td>
<td>(7.691)</td>
</tr>
<tr>
<td></td>
<td>Employed labour force</td>
<td>1.234</td>
<td>1.302</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(21.886)</td>
<td>(20.035)</td>
</tr>
<tr>
<td></td>
<td>Tel. mainline</td>
<td>0.181</td>
<td>0.171</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(7.928)</td>
<td>(8.286)</td>
</tr>
<tr>
<td></td>
<td>Tel. investment</td>
<td>-0.022</td>
<td>-0.019</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-2.818)</td>
<td>(-2.442)</td>
</tr>
<tr>
<td></td>
<td>R-squared</td>
<td>0.99</td>
<td>0.99</td>
</tr>
<tr>
<td>Demand function</td>
<td>Constant</td>
<td>-13.932</td>
<td>-3.255</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-6.691)</td>
<td>(-0.470)</td>
</tr>
<tr>
<td></td>
<td>Per capita gdp</td>
<td>2.740</td>
<td>3.855</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(14.784)</td>
<td>(6.845)</td>
</tr>
<tr>
<td></td>
<td>Employed labour force</td>
<td>-0.200</td>
<td>-1.488</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-0.930)</td>
<td>(-2.010)</td>
</tr>
<tr>
<td></td>
<td>Revenue per mainline</td>
<td>-2.149</td>
<td>-1.825</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-3.325)</td>
<td>(-2.205)</td>
</tr>
<tr>
<td></td>
<td>MSC</td>
<td>-</td>
<td>-0.168</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(-1.363)</td>
</tr>
<tr>
<td></td>
<td>R-squared</td>
<td>0.96</td>
<td>0.96</td>
</tr>
<tr>
<td>Supply function</td>
<td>Constant</td>
<td>9.313</td>
<td>-10.602</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5.973)</td>
<td>(-0.786)</td>
</tr>
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<td></td>
<td>Waiting list</td>
<td>-4.330</td>
<td>10.689</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-4.935)</td>
<td>(1.246)</td>
</tr>
<tr>
<td></td>
<td>Revenue per mainline</td>
<td>0.013</td>
<td>-1.571</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.051)</td>
<td>(-1.618)</td>
</tr>
<tr>
<td></td>
<td>Tel. mainline</td>
<td>1.835</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>(23.434)</td>
<td>(-0.281)</td>
</tr>
<tr>
<td></td>
<td>Policy</td>
<td>-</td>
<td>5.041</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1.685)</td>
</tr>
<tr>
<td></td>
<td>R-squared</td>
<td>0.93</td>
<td>0.70</td>
</tr>
<tr>
<td>Telecommunication growth function</td>
<td>Constant</td>
<td>-13.566</td>
<td>-19.130</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-18.253)</td>
<td>(-10.353)</td>
</tr>
<tr>
<td></td>
<td>Telecommunication investment</td>
<td>0.127</td>
<td>-0.220</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(8.269)</td>
<td>(-1.867)</td>
</tr>
<tr>
<td></td>
<td>Per capita income</td>
<td>1.955</td>
<td>2.819</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(20.877)</td>
<td>(10.020)</td>
</tr>
<tr>
<td></td>
<td>MSC</td>
<td>-</td>
<td>-0.376</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(-1.916)</td>
</tr>
<tr>
<td></td>
<td>Policy</td>
<td>-</td>
<td>0.886</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2.497)</td>
</tr>
<tr>
<td></td>
<td>R-squared</td>
<td>0.96</td>
<td>0.95</td>
</tr>
</tbody>
</table>

Figures in parentheses are t-ratios. Model 1 is estimated without dummy variables, and Model 2 is estimated with dummy variables.
for telecommunication investment is 0.127 and –0.220 for model 1 and Model 2, respectively. Income elasticity is positive in both models at 1.955 and 2.819 for Models 1 and 2, respectively. All variables in both models are significant although some might not be essential to telecommunication growth.

CONCLUSION

The result of this study indicates that ICT is directly related to aggregate output in Malaysia. There is a causality effect between ICT and aggregate output. As output per capita and telecommunication investment affect telecommunication growth this, in turn, fosters the growth of output. As a producer and user of ICT products and services, both, telecommunication and manufacturing sectors complement each other in the contribution to aggregate output. However, this is not a restriction but an incentive for other economic sectors to convert to ICT as a means of enhancing productivity.

Income and price of telecommunication services have an impact on the demand and supply of telecommunication infrastructure. This suggests that the demand for telecommunication services will increase when income increases, and demand for telecommunication services will decrease when the price of telecommunication services increases. The supply function, on the other hand, indicates that supply of telecommunication services increases when the price of telecommunication services increases. This is consistent with the theory of demand and supply. The telecommunication growth rate function indicates that telecommunication investment has a positive impact on penetration growth rate, suggesting that an increase in telecommunication investment will increase telecommunication penetration growth rate. The MSC and privatisation policy variables are significant to the model but not essential to economic growth.

This paper concludes:

• there is causal relationship between ICT and aggregate output

• Malaysia as a producer and user of ICT products and services may benefit more from proper management of investment in telecommunication equipment and infrastructure

• the MSC and the telecommunication privatisation policy are favourable to telecommunication infrastructure and services providers but not to consumers of telecommunication services

• the role of the government and private sectors in ICT development should be re-evaluated for effectiveness and efficiency purposes

• further research is warranted to determine the spillover effects involving adaptation to ICT on economic growth.

BIOGRAPHY

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Hassan, M.K. (2005) FDI, Information Technology and Economic Growth in the MENA Region, 10th ERF Paper, University of New Orleans, USA.


NOTES

1 ICT is defined as Information Technology (IT) plus Telecommunication Equipment and Services. The IT, in turn, refers to a combined industry, which includes IT hardware (office machines, data processing equipment, and data communications equipment), IT software, and IT services (WITSA, 2000).

2 www.msc.com.my

3 www.msc.newsupdate.my

4 There are ten items in the Bill of Guarantees. The MSC-status companies are divided into three categories; businesses, incubators, and higher education organizations.
ICT INDUSTRY IN SERBIA: CONDITION AND IMPROVEMENT BY QMS

Miladin Stefanovic*
University of Kragujevac, Serbia

Milan Matijevic†
University of Kragujevac, Serbia

Goran Devedzic‡
University of Kragujevac, Serbia

Abstract: The paper presents current level of the Serbian Information and Communication Technology (ICT) industry, global parameters of ICT in Serbia, as well as some economic indicators. Existing problems and suggest actions necessary for improvement of IT in the Serbian industry are also defined. One approach to improvement of Serbian ITC industry is adopting a general framework policy for the integration of the acquis in the field of quality, standards and technical regulations, developing an updated national Quality Plan for the ICT. This paper will also present development and implementation of Quality Management System (QMS) in Serbian ICT sector.

Keywords: ICT industry, QMS; quality management system; global parameters; economic indicators; SLOC; capabilities; infrastructures; standards; ISO; developing countries.

INTRODUCTION

While the development of the ICT in developed countries has been widely documented, its diffusion in developing nations has generally not been well researched. The effect of ICT on companies (in both developed and undeveloped countries) and successful businesses has been marked as very important by many different studies and reports in the past (European Union, OECD, 2002; Northern eDimension Action Plan (NeDAP) and European Commission, 2003; Hagel and Brown, 2001). Companies in developing countries cannot isolate...
themselves from changes occurring due to development of ICT in developed countries. On the contrary they need an extra effort to improve condition in their ICT sector and explore different approaches (Nair and Prasad, 2002; Winley et al., 2007; Ziadi and Kuofie, 2006). The objective of undeveloped countries was to understand the factors that help to accelerate, or which may retard, the development of the ICT in countries at different stages of economic and social development. Serbia is a developing country but, nevertheless, it has experienced many unique problems during the past decade. The major problem has been the economic transition very much alike to the processes that successfully finished in most countries of Eastern Europe. During the last few years, Serbia has changed its economic model and started to improve its ICT sector. One of the major tasks has been an evaluation of the level of ICT industry. The first attempts were made by the Serbian ICT Society, in November 2003 (Serbia, Department for science, technology and development, Government of Serbia, 2002). This research mainly analyses conditions of the ICT sector as a base for ICT development in the Serbian industry. Since many studies show positive and significant impacts from ICT investments at the country level, the Serbian government, in 2001, listed ICT development as the national priority in the long-term plan of development of the Serbian Economy. Successful experiences of less developed countries that invested in their ICT industry, such as India (Nair and Prasad, 2002) and Costa-Rica, are a great example.

In this paper, we will present current level of the Serbian ICT industry, global parameters of ICT in Serbia and some economic indicators. Then, we define existing problems and suggest actions necessary for improvement of IT in the Serbian industry. There are many different approaches in improving of ICT education (Lynch and Szorenyi, 2005), financial investments (Sihvonen, 2006), improvement of quality (Dutta, and Sekhar, 2004). One approach of improvement of Serbian ICT industry is adopting a general framework policy for the integration of the acquis in the field of standards and technical regulations. Developing an updated national Quality Plan for the ICT and other industries. This paper will also present development and implementation of QMS in Serbian ICT sector.

**GENERAL PARAMETERS OF ICT IN SERBIA**

It is very important that ICT become basic infrastructure for many companies in Serbia. In companies where ICT supports business processes, design and decision support, we notice increase of productivity and other positive economic indicators. General estimations stated by Serbia, Society for Information Technology (2003) are:

- 1,350,000 computer users and more than 600,000 computers
  - 4,00,000 business computers
  - 2,00,000 home computers
- 5,00,000 Internet users:
  - 5,000 web sites
  - 200 web stores.

Serbia has a population of 10,655,774 people, where 67.7 computers come on each 1,000 individuals and where 50 Internet connections come on each 1,000 individuals. Different research projects have (Serbia, Society for information technology, 2003, 2004; Stefanovic’ et al., 2005) come to the same conclusion that the Internet service market of will be in expansion for a long time in Serbia and Southeastern Europe. Possibilities for sale of Internet services for the Serbian ICT industry is presented in Table 1.
The leading factor in reengineering and improvement of information systems in the Serbian industry is its domestic ICT sector.

According to research of Stefanović et al. (2005) Serbian information and communications industry consists of:

- over 1408 companies – predominantly small and medium privately-held companies (In Serbia, there are 835 companies developers software and there are 573 hardware manufacturers)

- the ownership structure of IT companies in Serbia is as follows: 95% are domestic companies, 3% are with mixed ownership and 2% are foreign companies,

- Strong information departments in large business entities with dominant development orientation,

- Universities and institutes with dominant focus on education in the field of ICT and implementation and development of ICT.

ICT industry’s share in the gross domestic product of Serbia is 0.55% and its share of employment is 0.49%.

Advantages of the Serbian ICT industry are:

- quality of human resources
- competitively low costs.

Business analysis of the ICT industry is presented in Tables 2–6.

Number of companies in computer and related activities and number of companies in production of computing machines as well as import and export figures are presented in Table 2. It is obvious that Serbia has much larger import then export. Table 3 presents structure of companies in ICT sector by number of workers. Generally most of the companies have less then 5 workers and only 6 more then 100 workers (it is clear that Serbian companies do not have human resources for managing of large scale projects). Tables 4 and 5 give detailed information about increase of import in period of 2000 and 2003. Table 6 present ICT macro indicators and share of ICT in national economy.

Many analysis show that the Serbian ICT industry has better results than other industrial branches. But there are number of problems in the Serbian ICT sector. The Serbian ICT sector mostly consists of small and medium size companies. According to research of Stefanović et al.

---

**Table 1** Minimal possible sale of Internet services (in US$) (Serbia, Society for Information Technology, 2003)

<table>
<thead>
<tr>
<th>Market</th>
<th>Sale in 2002</th>
<th>Sale in 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serbian</td>
<td>8.0</td>
<td>25.0</td>
</tr>
<tr>
<td>Other republics of Former SFRJ (Slovenia, Croatia, Bosnia and Herzegovina, Macedonia)</td>
<td>1.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Other Eastern European countries</td>
<td>3.0</td>
<td>6.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12.0</strong></td>
<td><strong>33.0</strong></td>
</tr>
</tbody>
</table>

---

**SERBIAN ICT INDUSTRY**

The leading factor in reengineering and improvement of information systems in the Serbian industry is its domestic ICT sector.

According to research of Stefanović et al. (2005) Serbian information and communications industry consists of:

- over 1408 companies – predominantly small and medium privately-held companies (In Serbia, there are 835 companies developers software and there are 573 hardware manufacturers)

- the ownership structure of IT companies in Serbia is as follows: 95% are domestic companies, 3% are with mixed ownership and 2% are foreign companies,

- Strong information departments in large business entities with dominant development orientation,

- Universities and institutes with dominant focus on education in the field of ICT and implementation and development of ICT.

ICT industry’s share in the gross domestic product of Serbia is 0.55% and its share of employment is 0.49%.
(2005) these companies are mostly oriented toward smaller projects, or they attach their business activities to larger business partners from abroad (Europe, USA).

Many highly qualified experts in the filed of information technology have left their companies and university centres and moved to the Western Europe and USA. That migration of highly qualified experts started in the first part of the 1990’s and culminated in 1999. Unfortunately, Serbian economy is suffering as this migration is still happening. Some analysis show a lack of

<table>
<thead>
<tr>
<th>Table 2 Structure of ICT – 1 January, 2004 (Serbia, Society for Information Technology, 2004)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Computer and related activities (nace:110072)</strong></td>
</tr>
<tr>
<td>Total No. of companies</td>
</tr>
<tr>
<td><strong>Production of computing machines (nace:041230020)</strong></td>
</tr>
<tr>
<td>Total No. of companies</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>Total No. of companies</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3 Structure of employees (Serbia, Society for Information Technology, 2004)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Computer and related activities nace:110072</strong></td>
</tr>
<tr>
<td>Total No. of empl.</td>
</tr>
<tr>
<td><strong>Production of computing machines nace:041230020</strong></td>
</tr>
<tr>
<td>Total No. of empl.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>Total No. of empl.</td>
</tr>
</tbody>
</table>

<table>
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<th></th>
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</thead>
<tbody>
<tr>
<td><strong>computer and related activities (nace:110072)</strong></td>
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<td>No. of companies</td>
</tr>
<tr>
<td><strong>Production of computing machines (nace:041230020)</strong></td>
</tr>
<tr>
<td>No. of companies</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>No. of companies</td>
</tr>
<tr>
<td><strong>Production of computing machines (nace:041230020)</strong></td>
</tr>
<tr>
<td>No. of companies</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>No. of companies</td>
</tr>
</tbody>
</table>
ICT industry in Serbia: condition and improvement by QMS

There some other parameter characteristic of the Serbian ICT companies:

- Different levels of production capacities.
- Young inexperienced development teams.
- There are enough resources only for few platforms (Microsoft) because Serbian ICT companies are mostly small firms. This fact dictates that those companies should have very narrow specialisation, or that they have to cooperate among themselves.
- Telecommunication infrastructure is not very well developed.

Perspectives:

- Increasing export of software and services
- Development of infrastructure for modern economy.

<table>
<thead>
<tr>
<th>ICT macro indicators</th>
<th>Total income (millions $)</th>
<th>Share in gross domestic product (%)</th>
<th>Total No. of employees</th>
<th>Total No. of employees in Serbia (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information technologies</td>
<td>$54</td>
<td>0.55</td>
<td>15,000</td>
<td>0.98</td>
</tr>
<tr>
<td>Telecommunication industry</td>
<td>$40</td>
<td>0.41</td>
<td>3900</td>
<td>0.29</td>
</tr>
<tr>
<td>Telecommunication traffic</td>
<td>$306</td>
<td>3</td>
<td>13,500</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Computer and communications technologies, the two elements of the ICT are transforming national and global societies and economies into information-driven societies and economies. Presently ICT account for more than 5% of the global GDP and much more in industrialised countries. According to Table 6 Serbian’s ICT has less than 5% of Serbian GDP.

**ECONOMIC INDICATORS**

Some economic indicators can describe position of the Serbian software development industry. This industry should play important role in development of ICT solutions for the Serbian industrial and other sectors.

One important economic parameter is GDP/h (Gross Domestic Product per employee per hour–Table 7) It shows (as well as data in Table 8) that GDP in Serbia is very

| Table 5 Import/export (Serbia, Society for Information Technology, 2003) |
|--------------------------|--------------------------|
| Computer equipment (car.tar. 8471) | Total Serbia |
| Import | Export | Import | Export |
| 2000 | 50,451,821 | 2,805,921 | 3,356,294,222 | 1,561,366,100 |
| 2001 | 74,798,055 | 4,26,003 | 4,307,417,184 | 1,725,204,322 |
| 2002 | 135,785,186 | 2,920,715 | 5,637,968,429 | 2,080,709,855 |

| Table 6 ICT macro indicators (Serbia, Society for Information Technology, 2003) |
|--------------------------|--------------------------|
| ICT macro indicators | Total income (millions $) | Share in gross domestic product (%) | Total No. of employees | Total No. of employees in Serbia (%) |
| Information technologies | $54                       | 0.55                                | 15,000                 | 0.98                                |
| Telecommunication industry | $40                       | 0.41                                | 3900                   | 0.29                                |
| Telecommunication traffic | $306                      | 3                                   | 13,500                 | 0.9                                 |
low compared to the ones from the EU and other countries (using information from different reports (Stefanović et al. 2005; e-Business Watch, 2003; Europe, OECD, 2004)). This is the main reason for migration of experts.

The migration of experts in the field of ICT is a huge problem for Serbia and Montenegro. Middle age experts mostly migrated to developed countries.

The European Union borders the Serbian’ North. So large numbers of experts use short distance and large demand for educated ICT experts and migrate to the EU. Large number of institutes, universities, developed centres and IT sectors have lost their development and research teams. So companies in Serbia do not have significant human resources to start with information system reengineering or development of their own solutions. Those companies do not have financial resources to buy standardised solutions. Another characteristic is that development teams are compound of young people without experience.

This is the reason why number of errors in software development process, in Serbia, is relatively high. Therefore, a price of a line of code is relatively high compared to wages and other economic parameters (Tables 9 and 10) (e-Business Watch, 2003; Europe, OECD, 2004; Stefanovic’ and Arsovski, 2004).

Other reason is absence of developed and implemented quality system. Even the larges companies do not have quality systems. Some of them even do not have inner procedures or conventions.

Table 7  GDP per employee per working hour

<table>
<thead>
<tr>
<th>No.</th>
<th>Country</th>
<th>GDP/h ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Luxemburg</td>
<td>48.09</td>
</tr>
<tr>
<td>2</td>
<td>Norway</td>
<td>39.12</td>
</tr>
<tr>
<td>3</td>
<td>Belgium</td>
<td>37.77</td>
</tr>
<tr>
<td>4</td>
<td>France</td>
<td>36.06</td>
</tr>
<tr>
<td>5</td>
<td>Switzerland</td>
<td>35.27</td>
</tr>
<tr>
<td>6</td>
<td>Japan</td>
<td>35.20</td>
</tr>
<tr>
<td>7</td>
<td>Germany</td>
<td>35.15</td>
</tr>
<tr>
<td>8</td>
<td>Denmark</td>
<td>34.66</td>
</tr>
<tr>
<td>9</td>
<td>USA</td>
<td>32.27</td>
</tr>
<tr>
<td>10</td>
<td>Austria</td>
<td>32.09</td>
</tr>
<tr>
<td>36</td>
<td>Venezuela</td>
<td>5.18</td>
</tr>
<tr>
<td>37</td>
<td>Czech</td>
<td>5.04</td>
</tr>
<tr>
<td>38</td>
<td>Poland</td>
<td>4.94</td>
</tr>
<tr>
<td>39</td>
<td>Turkey</td>
<td>4.21</td>
</tr>
<tr>
<td>40</td>
<td>Russia</td>
<td>3.78</td>
</tr>
<tr>
<td>41</td>
<td>Columbia</td>
<td>2.57</td>
</tr>
<tr>
<td>42</td>
<td>Thailand</td>
<td>2.54</td>
</tr>
<tr>
<td>43</td>
<td>Filipinas</td>
<td>1.33</td>
</tr>
<tr>
<td>44</td>
<td>Indonesia</td>
<td>1.25</td>
</tr>
<tr>
<td>45</td>
<td>China</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>Serbia</td>
<td>2.97</td>
</tr>
</tbody>
</table>
These problems are multiplicities in the phase of software testing and documenting. It is important to mention that, generally speaking, small number of companies in the Serbian industry use standard JUS ISO/IEC 12207 from 1997, which supports the software life cycle.

**PROBLEMS IN ICT INDUSTRY AND POSSIBLE ACTIONS**

There are many different technical limiting factors that often preclude communities to enter in the ICT revolution are essentially two: an outdated infrastructure to support reliably adequate speed data, and the arbitrary high cost of the services. These technical limitations could be overcome by considerable financial investments. But there are many underlying problems such as the lack of sufficient well qualified human resources able to handle new systems and technologies. It is obvious that education system should educate better trained professionals for new jobs. This problem could be solved by improvement of education system. This approach as well demands time and financial resources.

ICT industry in Serbia is faced with many other problems (similar to all developing countries). According to the analysis comparing ICT sector (on sample of 93 ICT companies in Serbia; companies stated their major problems), Serbia is way behind developed countries of the European Union. Serbia is even behind neighbouring countries. Low level of investment, low number of employees in domestic ICT sector, weakness of ICT sector are characteristics of the Serbian ICT industry.

According to the analysis Stefanović et al. (2005) and Stefanović and Arsovski, (2004) following problems appear (Figure 1):

a Economic and legal issues:
   - Unfair competition of foreign company
   - Unfair competition in public purchases (and absence of mechanisms for confirmation of tenders)

---

**Table 8** Wages of employees in software development and software maintenance

<table>
<thead>
<tr>
<th>No.</th>
<th>Country</th>
<th>Development ($)</th>
<th>Maintenance ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Switzerland</td>
<td>48,869</td>
<td>48,869</td>
</tr>
<tr>
<td>2</td>
<td>USA</td>
<td>46,550</td>
<td>43,495</td>
</tr>
<tr>
<td>3</td>
<td>Germany</td>
<td>42,058</td>
<td>34,848</td>
</tr>
<tr>
<td>4</td>
<td>England</td>
<td>38,785</td>
<td>38,179</td>
</tr>
<tr>
<td>5</td>
<td>France</td>
<td>36,750</td>
<td>41,250</td>
</tr>
<tr>
<td>6</td>
<td>Canada</td>
<td>35,156</td>
<td>33,846</td>
</tr>
<tr>
<td>7</td>
<td>Australia</td>
<td>34,940</td>
<td>30,644</td>
</tr>
<tr>
<td>8</td>
<td>Netherlands</td>
<td>33,994</td>
<td>47,069</td>
</tr>
<tr>
<td>9</td>
<td>Austria</td>
<td>33,000</td>
<td>33,000</td>
</tr>
<tr>
<td>10</td>
<td>Brazil</td>
<td>20,032</td>
<td>20,032</td>
</tr>
<tr>
<td>11</td>
<td>Italy</td>
<td>17,655</td>
<td>17,655</td>
</tr>
<tr>
<td>12</td>
<td>Columbia</td>
<td>16,000</td>
<td>16,000</td>
</tr>
<tr>
<td>13</td>
<td>Estonia</td>
<td>12,000</td>
<td>8000</td>
</tr>
<tr>
<td>14</td>
<td>Mexico</td>
<td>10,843</td>
<td>13,292</td>
</tr>
<tr>
<td>15</td>
<td>Serbia</td>
<td>6500</td>
<td>7000</td>
</tr>
<tr>
<td>16</td>
<td>India</td>
<td>3638</td>
<td>4316</td>
</tr>
</tbody>
</table>
### Table 9  Number of errors on 1000 lines of code

<table>
<thead>
<tr>
<th>No.</th>
<th>Countries</th>
<th>No. of errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>USA</td>
<td>1.6</td>
</tr>
<tr>
<td>2</td>
<td>Japan</td>
<td>1.8</td>
</tr>
<tr>
<td>3</td>
<td>England</td>
<td>2.1</td>
</tr>
<tr>
<td>4</td>
<td>Germany</td>
<td>2.2</td>
</tr>
<tr>
<td>5</td>
<td>Israel</td>
<td>2.3</td>
</tr>
<tr>
<td>6</td>
<td>Italy</td>
<td>2.5</td>
</tr>
<tr>
<td>7</td>
<td>France</td>
<td>2.5</td>
</tr>
<tr>
<td>8</td>
<td>Switzerland</td>
<td>2.5</td>
</tr>
<tr>
<td>9</td>
<td>India</td>
<td>2.6</td>
</tr>
<tr>
<td>10</td>
<td>Greece</td>
<td>2.8</td>
</tr>
<tr>
<td>11</td>
<td>Norway</td>
<td>3.6</td>
</tr>
<tr>
<td>12</td>
<td>Ireland</td>
<td>3.7</td>
</tr>
<tr>
<td>13</td>
<td>Canada</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>Serbia</td>
<td>4.6</td>
</tr>
</tbody>
</table>

### Table 10  Price per line of code – (LOC – Line of Code) documented and delivered

<table>
<thead>
<tr>
<th>No</th>
<th>Country</th>
<th>Price of supported LOC ($)</th>
<th>Price of documented and delivered LOC ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Switzerland</td>
<td>1.6</td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>Germany</td>
<td>1.3</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>Japan</td>
<td>1.2</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>Denmark</td>
<td>1.1</td>
<td>19</td>
</tr>
<tr>
<td>5</td>
<td>USA</td>
<td>1.1</td>
<td>18</td>
</tr>
<tr>
<td>6</td>
<td>France</td>
<td>0.8</td>
<td>13</td>
</tr>
<tr>
<td>7</td>
<td>England</td>
<td>0.7</td>
<td>11</td>
</tr>
<tr>
<td>8</td>
<td>Israel</td>
<td>0.6</td>
<td>11</td>
</tr>
<tr>
<td>9</td>
<td>Italy</td>
<td>0.6</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>Canada</td>
<td>0.6</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>Ireland</td>
<td>0.6</td>
<td>10</td>
</tr>
<tr>
<td>12</td>
<td>Greece</td>
<td>0.4</td>
<td>6</td>
</tr>
<tr>
<td>13</td>
<td>Serbia</td>
<td>0.4</td>
<td>5</td>
</tr>
<tr>
<td>14</td>
<td>India</td>
<td>0.3</td>
<td>5</td>
</tr>
</tbody>
</table>
• Owner transformations in the industry
• Software legalisations
• Absence of a law for electronic signatures and other regulations and accompanied papers
  Lack of financial resources
• Necessary support of the government in development of:
  o ICT, special software industry; this industry is export oriented and should be declared as one of the priorities of the political economy
  o Develop and implement concept of scientific – technical parks (good examples are India, Ireland, Israel)

b Problems in ICT sector:
• Absence of stimulation in fiscal politics for intensive development of ICT
• Inappropriate loan politics of banks for ICT projects
• Absence of necessary support
• For Serbian ICT industry in promotion on the foreign market
  Human resources:
  • Migration of educated experts, caused by the current economics
  • Inadequate age structure of employees caused by migration of young experts
  • Absence of qualified teachers in the education process; inappropriate curriculums and un-harmonisation of curriculums with the Bologna declaration
  • Inappropriate stimulation in politics of employment of young experts
• Small number of experts employed in IT centres in different companies (in Serbian companies IT sectors have 2-3 times smaller number of employees, compared to the similar industries and companies in the European Union)

c Problems attached to infrastructure:
• Inadequate telecommunication infrastructure (Serbia has high-cost and low quality telecommunication services).
• Low level of quality systems (very few companies in the ICT sector have developed and implemented quality systems. Research was performed on larges Serbian ICT companies Digit, Spinnaker ComTrade, SAGA, Informatika AD). This problem was elaborated and partially solved in project described above.
• Development of infrastructure IS have to have priority e Hardware problems:

![Figure 1](image-url) The major problems in Serbian ICT industry (% answers)
d Hardware problems:
- Usage of low configuration working station
- Usage of low configuration servers
- Usage of low configuration network components

Software problems:
- Lack of appropriate products due to high cost
- Lack of integrated software solutions (Large number of companies have ‘information islands’ instead of integrated solutions)
- Large number of companies have their information systems developed based on prior legacy platforms, DB solutions and development tools
- Usage of their own solutions – usually this solutions are not quality ones
- Lack of financial and human resources for implementation of complex, integrated IS (made by domestic or foreign companies)
- Very low percent of presence of complex solutions (ERP, SCM, CRM and EDI)
- Lack of developed methods, methodologies and approaches for reengineering of information systems in the Serbian industry, respecting specific situation of the Serbian metal processing industry.

f Problems in education of e-business: Lack of education of IT managers
- Lack of expert preparation for implementation of digital signature
- There is a low level of implementation of different standards for data exchange (XML) and standard software development tools
- Low level of quality web hosting for e-sores and support of e-business.

There are many possible actions that could improve present condition in ICT industry in developing countries:
- Implementation of politics and actions for stimulation of ICT development
- Support for development and design of few ICT products
- Support for domestic software development industry
- Development of Quality Policy for ICT sector
- Improvement of education on all levels
- Government should make tax stimulations for employment of young experts in the field of ICT, reduction of taxes on projects oriented on development and implementation off ICT
- Support for development of e-business environment
- Development of telecommunication infrastructure
- Development of methodologies, methods, approaches and patterns for information system reengineering.

Some of possible actions are connected with significant financial investments and long time for implementation (improvement of infrastructure, education (Lynch and Szorenyi, 2005), financial support (Sihvonen, 2006; Bagchi and Putnam, 2004). Some other actions are accompanied with government interventions and development of general ICT framework. Development of Quality Policy for ICT sector on the other hand does not demand high financial investments or eider long time. Since quality of products and/or services is directly proportional with the quality built into
every step of development process (Berg, 2006). Improvement, development and implementation of Quality Policy for ICT could produce significant benefits at reasonable cost or benefit ration. Of course many other approaches could be employed to improve ICT industry in Serbia, such as: education in order to overcome skilled manpower shortage or improvement of infrastructure. But this paper discusses improvement by strengthening of quality management, because this approach does not need large amount of financial investments or long time. According to different experiences and clear.

There are various different standards for making formalised QMSs and each company has to perform an individual effort to support their development and production (Hagel and Brown, 2001). In paper the focus will be on QMS made for ICT industry.

Different countries have different results in this field (some of them are neighbouring country or countries all over the world). According to Bulgaria, Bulgarian ICT Cluster, (2006) Bulgaria has 87 firms having achieved the ISO 9001 standard. Bulgarian ICT organisations have recognised Capability Maturity Model Integration as a reference model for their software process improvement programs.

Today, a majority of the companies in India have already aligned their internal processes and practices to international standards such as ISO, Software Engineering Institute - Capability Maturity Model (SEI - CMM (USA, Naval Centre for Cost Analysis)), Six Sigma, etc., which has helped establish India as a credible sourcing destination. According to Dutta and Sekhar, (2004) as of December 2005, over 400 Indian companies had acquired quality certifications with 82 companies certified at SEI CMM Level 5.

Dutta and Sekhar (2004) stated that the quality practices in IT industry could evolve through three distinct stages:

- The first stage was the creation of basic processes to handle all activities relating to order fulfillment (Implementation of ISO 9000 standards). This ensured consistent and orderly execution of customer engagements and provided a framework for measurable improvement.
- The second stage was associated with a focus on software engineering, which was often achieved by companies aligning their QMS with the CMM framework.
• The third stage was driven by the desire to institute processes, metrics and a framework for improvement in all areas including those relating to sales, billing and collection, people management and after sales support and all accompanied processes.

The stages have not been strictly linear, as organisations have continued to build on accomplishments even as they moved on to the next stage. For instance, organisations certified to the ISO 9000 family are migrating to the new ISO 9001:2000 standards. Organisations assessed on the CMM framework are aligning their QMS to the new CMMI framework (Dutta and Sekhar, 2004).

Since the gap between Serbian ICT industry and ICT industry in Europe is wide one possible approach for improvement of ICT sector is development of quality infrastructure to support ICT and to support rapid improvement of quality in ICT industry by integration of many aspects of three stages approach in quality improvement through strategy and quality policy.

European Agency for Reconstruction and AFNOR started project “Strengthening Quality Management, Capabilities and Infrastructures in SCG”, project beneficiary was Union of Serbia and Montenegro (SCG). The project covered Serbia, Montenegro and Bulgaria as well. Quality policy was implemented in Serbian ICT industry, tourism in Montenegro and textile industry in Bulgaria. The mission of project is to develop competitiveness in the ICT sector in Central and Eastern European countries by promoting proven methodologies for establishing and continually quality improving adequate work processes.

The overall objectives of this project are as follows:

• Assisting the government in adopting a general framework policy for the integration of the acquis in the field of standards and technical regulations. Developing an updated national Quality Plan for the ICT industry (for Serbia).

• Strengthening the Federal Office for Standardization (SZS), in order to support the integration of European and International standards into national standards collection and to increase their diffusion in the industry.

• Establishing the conditions for future international recognition of tests and calibration results, as well as certificates by restructuring the National Accreditation Body (JUAT).

• Implementing a strong and recognised national metrology institute, and establishing the conditions for international recognition of the calibration and measurement certificates.

• Developing selected certification bodies with the capacity of establishing the Notified Bodies necessary for the implementation of the NA Directives. Developing selected testing and calibration laboratories to improve confidence in test reports and to ensure the traceability of measurements conducted in SCG.

These steps must ensure strengthening quality management, capabilities and infrastructures in Serbia and further more to define integrated Quality Policy for ICT sector.

Case study: development and implementation of QMS

One of the most important element is definition and implementation of politics and action plan of quality in companies that represent different branches (ICT in Serbia, tourism in Montenegro and textile industry in Bulgaria). The main goals of these plans are:
Table 11  Strategy – goals matrix

<table>
<thead>
<tr>
<th>Goals</th>
<th>Improvement of marketing activities</th>
<th>Improvement of sale conditions</th>
<th>Continuous improvement of quality</th>
<th>Orientation to better post-sale activities</th>
<th>Management of expenses</th>
<th>Improvement of education processes</th>
<th>Purchase of modern hw/sw</th>
<th>Improvement of planning process</th>
<th>Improvement of measurement process and monitoring</th>
<th>Improvement of resources management</th>
<th>Implementation of modern methods</th>
<th>Improvement of conditions of work (salaries)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase number of customers</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Increase of sale</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Increase of quality</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Increase of technological level</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Definition of terms</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Improvement of processes</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Increase of motivation level</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Increase of level of knowledge</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>
• Useful results for companies, which will improve quality of products, processes and services
• Development of Quality Policy for ICT sector
• Contribution to improvement external and inner characteristics of all interest parties (ICT industry).

The strategy - goals matrix for implementation of QMS in ICT company is presented on Table 11. This strategy goal matrix contains many goals and strategies that are covered with three stage model for ICT industry.

The ultimate, indirect beneficiaries of the project is the industry and consumers of the Serbia and Montenegro, who will benefit from modernised quality infrastructures able to support the competitiveness of the industry and to ensure compliance of products with essential requirements. Improvement of quality and implementation of QMSs in ICT industry and ICT sectors in other industries should improve condition of IT in Serbian companies. This project is still in the progress in the phase of implementation of Quality Policy in ICT industry.

In this paper we selected one company from ICT sector from Serbia-Digit - Belgrade. DIGIT company from Belgrade is recognisable on Serbian service market of IT (Information Technology) by usage of modern technology (brand name) and build in this technology in integrated products (ERP solutions, networks, services and training). Company is working as stock company for 14 years and now it is in mature phase.

Domestic market has following characteristics: foreign competition with higher quality of products and services; increase sale of product substitutes from Far East; changing in demands and habits of customers; leading experts are leaving domestic companies. Those are the reasons why selected company needs system approach to develop effective and efficiency development policy in order to achieve our strategic goals and become leader in our filed.

Project of implementation of QMS could be presented in following phases:

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Time (month)</th>
<th>Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Analysis of present condition</td>
<td></td>
<td>KONS</td>
</tr>
<tr>
<td>2</td>
<td>Training for QMS</td>
<td></td>
<td>KONS</td>
</tr>
<tr>
<td>3</td>
<td>Development of QMS documentation</td>
<td></td>
<td>PRK</td>
</tr>
<tr>
<td>4</td>
<td>Implementation of QMS documentation</td>
<td></td>
<td>PRK</td>
</tr>
<tr>
<td>5</td>
<td>Inner audit</td>
<td></td>
<td>KONS</td>
</tr>
<tr>
<td>6</td>
<td>Certification</td>
<td></td>
<td>KONS</td>
</tr>
<tr>
<td>7</td>
<td>Maintenance and improvement of QMS</td>
<td></td>
<td>PRK</td>
</tr>
</tbody>
</table>

PRK: Manager responsible for quality.
KONS: Consultants.
2 Selected methods

- Monitoring of current stage
- Development of QMS documentation
- Implementation of QMS documentation
- Inner audits
- Certification
- Maintaining and improvement of QMS.

3 Action plan

<table>
<thead>
<tr>
<th>Actions and steps</th>
<th>1. year</th>
<th>2. year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring of current stage</td>
<td>Apr.</td>
<td>Mar.</td>
</tr>
<tr>
<td>Certification</td>
<td>Dec.</td>
<td></td>
</tr>
<tr>
<td>Maintaining and improvement of QMS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4 Results and evaluation approach:

o Project results:
  - Improvement of process quality – 6%/year
  - Improvement of quality of service – 7%/year (level 3 CMM – The process is documented, standardised and integrated.)
  - Certification for having better starting position in public tenders and marketing promotion
  - Number of errors per SLOC is decreased for 27% (level 2 CMM – counting source lines of code).

o Evaluation approaches:
  - method of expert evaluation
  - compare planned/rerealised.

This approach contributes to improve extern and inner characteristics of ICT industry. Defined Quality Policy and implementation of quality system in ICT sector produce significant results. There were 47 ICT companies that improved their performances by implementing quality policy for ICT sector. Average improvement of process quality is 5%/year, improvement of quality of service is 6%/year and reduction of errors per SLOC was 20%.

Quality Policy for ICT sector will produce the following outcomes:

- Increased productivity/decreased cost
- Increased competitiveness
- Increased ‘on-time’ deliveries
Increased employment in software and ICT industries
Increased software exports
Aligning QMS with CMM
Improved competitiveness of local industry, especially SMEs, through the use of ICT
Improved quality of ICT industry managers, professionals and workforce.

The principal target group for this program is ICT industry, ICT training institutions and ICT-related professional associations. All of them have road for improvement of their quality and competitiveness.

CONCLUSION

According to the analysis of ICT industry, Serbia is behind developed countries of the European Union, developed countries of Far East and USA.

The main reason for this situation is specific economic situation and insufficient financial resources for ITC sector, and small and underdeveloped ITC sector. According to the analysis following problems appear in: economic and legal issues, human resources, problems attached to infrastructure, hardware problems, software problem, and problems in education of e-business.

On the other hand we can define list of actions: implementation of politics and actions for stimulation of ICT development; Support for development and design of few ICT products, support for domestic software development industry; development of Quality Policy for ICT sector; improvement of education on all levels; government should make tax stimulations for employment of young experts in the field of ICT, reduction of taxes on projects oriented on development and implementation off ICT; support for development of e-business environment; development of telecommunication infrastructure; development of methodologies, methods, approaches and patterns for information system reengineering.

One possible approach for improvement of ICT industry is implementation of quality policy. There are different stages and approaches in implementation of quality in ICT, starting with ISO standards, QMS and migration toward CMM. This paper presents Quality Policy implemented in Serbian ICT industry in order to present integrated approach and to cover aspects from different stages in order to rapid improve quality and shorten needed time.

The ultimate, indirect beneficiaries of improvement and development of Quality Policy in ITC sector will be the industry and consumers of the Serbia, who will benefit from modernised quality infrastructures able to support the competitiveness of the industry and to ensure compliance of products with essential requirements. Improvement of quality and implementation of QMSs in ICT industry should improve condition of ITC companies in Serbian and make step toward aligning quality policy with CMM. Case study that covered 57 companies shown significant results: improvement of process quality – 5%/year; improvement of service quality – 6%/year; certification for having better starting position in public tenders and marketing promotion; number of errors per SLOC is decreased for 20%. It is clear that implementation of QMS and Quality Policy in ICT industry could lead to significant improvement on considerably low costs. Integrated approach will ensure useful results for companies, which will improve quality of products, processes and services., development of Quality Policy for ICT sector and contribution to improvement extern and inner characteristics of ICT industry.
ACKNOWLEDGEMENTS

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BIOGRAPHY

M. Stefanovic received his PhD on Department of Industrial Engineering, Faculty of Mechanical Engineering University of Kragujevac, Serbia. He is currently Assistant Professor on Department of Industrial Engineering. His current research interests include web services, information systems and CIM systems. He is member of IFIP Council TC3 – Education.

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REFERENCES


WEBSITE

The National Innovation System and Its Relation to Small Enterprises: The Case of the Republic of Macedonia

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Abstract: Authors summarises the research conducted for the needs of a EU-funded project to assist the Ministry of Economy of the Republic of Macedonia to develop a strategy and programme to stimulate the development of SMEs during the period 2007–2010. The research reviewed the current status of the National Innovation System (NIS), its key elements and inter-relationships. It assessed the government strategies and policies that are targeting the above-mentioned NIS elements. This paper culminates in a series of recommendations for policy intervention that can be considered for the SME development programme.

Keywords: NIS; national innovation system; STI; science, technology and innovation; R&D; research and development; SMEs; small and medium-size enterprises.

INTRODUCTION

It is now widely acknowledged that Science, Technology and Innovation (STI) are key factors in building competitive, knowledge-based economies. The creation, diffusion and exploitation of scientific and technological knowledge are key means of enhancing economic growth and productivity, thereby contributing to enterprise competitiveness. Moreover, ‘science’ and ‘technology’ are different but mutually reinforcing bodies of knowledge, created by very different institutions and actors. Although they share features such as a dependence on imagination and creativity in the solution of problems and cumulative accumulation of knowledge, they are also different (Metcalf, 2000).

In reality, however, modern science and technology are becoming increasingly interdependent. New developments in science
open-up new opportunities for technology and vice-versa, with the consequence that many firms are increasingly involved in pure scientific research. This is increasingly encouraging public-private partnerships.

Turning to the issues of ‘innovation’, this involves more than just knowledge of science and technology per se and requires us to distinguish an invention (formulation of a working idea for a product or process) from an innovation (application of that idea to the economic process). Innovation is the successful application of a new idea, often involving new technologies or applications. Among other things, it delivers better products and services, cleaner and more efficient production processes and better working models. For firms, it means higher growth and greater profitability. For society, innovation is critical to greater productivity, competitiveness and prosperity.

For innovation to take place, it is necessary to know what potential users demand in a product and how much they are willing to pay. The production process must be organised, the inputs must be acquired and the activity managed. In other words, ‘entrepreneurship’ is required to bring together the market opportunities with the scientific and technological opportunities. Innovations tend to be incremental improvements in current practices and products; however, a small sub-set is ‘radical’ in nature, opening-up new fields or opportunities. The wider application of an innovation happens through a process of ‘diffusion’ so it is essential for firms to sustain their innovative trajectory, rather than simply seek one-off innovations. In this context, the target of policies designed to unleash innovation is opportunities, incentives, resources and management capabilities.

Finally, the ‘absorptive capacity’ of SMEs is of importance, as it influences economic growth and employment. The absorptive capacity refers to the ability to create new knowledge through investment in such new knowledge and the ability to identify the most appropriate technology to be assimilated from existing ones available to firms. It is especially important to both countries and firms that may be lagging, such as small countries such as the Republic of Macedonia, that generally do not produce the technology that they exploit. For the absorptive capacity to be effective, it is necessary for firms to

- have an existing capacity for change (a stock of knowledge within the firm)
- integrated research organisations (mobilisation, coordination and integration of knowledge between firms, research institutions and universities)
- human capital (adequate quantity and quality of scientists and engineers engaged in research engaged in production of goods and services).

This paper represents a summary of the research conducted for the needs of an EU-funded project to assist the Ministry of Economy to develop a strategy and programme for SMEs for the period 2007–2010 (Polenakovik, 2006; Pinto, 2006). The main findings are presented below, leading to a series of policy recommendations.

**LITERATURE REVIEW**

Innovation systems theory defines ‘systems’ in terms of a number of ‘actors’ and stresses that the relationships between them and system performance is often determined by the weakest link in the chain. This means that policy interventions should focus on the weaknesses. Systems theory also suggests that individual policy instruments applied in isolation are unlikely to have a dramatic impact on overall system performance. In complex systems there are likely to be many weak links and accurate targeting of an individual weak link will only produce incremental improvements unless
other weak links are also addressed. The policy implication is that there is a need for a broad range of policy instruments, rather than a focus on any one aspect. This also suggests the need for frequent experimentation and evaluation of single instruments and combinations of instruments, with the results being continually fed into the policy formulation process. Figure 1 presents a simple innovation system comprising four interdependent sectors, taken from Guy and Nauwelaers (2003). There are interacting groups of actors defined in terms of the public and private sectors and their roles as ‘knowledge creators’ or ‘knowledge users’. Each sector is also characterised by a dominant issue in STI, such as:

- The supply of and demand for qualified human resources (Social and Human Capital).
- The knowledge base (Research Capacity).
- The ability to innovate (Technology and Innovation Performance).
- The capacity of markets to absorb and diffuse innovations (Absorptive Capacity).

There has been a shift in our understanding of the relationships between STI and their link to economic development. There is increasing discussion about National Innovation Systems (NIS – see Figure 2), incorporating the key actors and activities in the knowledge production and absorption processes necessary for innovation to take place. It is also increasingly acknowledged that economic growth and competitiveness are founded on well-functioning NIS in which all actors, both market and non-market institutions, need to perform well. This applies to research and higher education institutions, businesses, the public sector, as well as households as consumers of sophisticated goods.

Such innovation systems exist at different levels: global, regional and local networks of firms and clusters of industries. These systems may, or may not, be confined to a

![Figure 1](image)

**Figure 1** Issues, actors and activities in a simple STI system

*Source: Guy and Nauwelaers (2003)*
country’s borders but national characteristics and frameworks play a key role in shaping them. The concept of NIS is, thus, a tool for analysing country specificities in the innovation process in a globalised economy, as well as a guide for policy formulation. It highlights interactions and interfaces between various actors and the workings of the system as a whole, rather than the performance of its individual components (OECD, 1999). NIS thus focuses on three complementary approaches at the micro, meso and macro levels.

There are a number of features of South East European (SEE) countries that constrain STI policies (Uvalic, 2005):

- **Budgetary constraints.** Highly restrictive fiscal and monetary policies during the process of transition to the market economy have severely limited public expenditure on STI, R&D and Communication and Information Technologies (CIT).

- **Low level of development.** Economic recovery has yet to compensate for the very substantial falls in output experience during the early years of transition. Most SEE countries had yet to reach the levels of GDP existing in 1989 and their GDP typically corresponds to no more than 30% of the EU average.

- **Industrial restructuring.** Whereas the EU is moving from a post-industrial to a knowledge-based economy, over the last 15 years SEE countries have experienced a process of de-industrialisation and a shift to subsistence agriculture.

- **Social costs.** The official unemployment rates are the highest in Europe; poverty has increased; there is greater inequality

![Figure 2](image-url)
of income distribution; and massive levels of emigration.

- **Imbalances in external accounts.** The increasing trade deficits have been partly covered by capital inflows from abroad in the form of international assistance and remittances.

- **National investment and savings.** These are so low that capital for investment purposes has come mainly from abroad; however, Foreign Direct Investment (FDI) inflows remain quite low compared to CEE countries.

A key issue in the STI debate is the necessity to monitor and evaluate the performance of specific countries in terms of their STI progress. In this context a key development has been the creation of benchmarking tools, such as the scoreboards (see OECD, 2005; EU, 2005a). The European Innovation Scoreboard (EIS) is an instrument developed by the EU to evaluate and compare the innovation performance of the member states. The latest EIS report (EU, 2005b) includes innovation indicators and trend analyses for the 25 EU member states, as well as for Bulgaria, Romania, Turkey, Iceland, Norway, Switzerland, the USA and Japan. The revised list of indicators and the methodology capture additional dimensions of a country’s innovation performance. Based on their Summary Innovation Index, the EU countries can be divided in four groups (EU, 2005b):

- Switzerland, Finland, Sweden, Denmark and Germany make up the group of ‘leading countries’.

- France, Luxembourg, Ireland, UK, Netherlands, Belgium, Austria, Norway, Italy and Iceland all belong to the group of countries showing ‘average performance’.

- Countries that are ‘catching up’ include Slovenia, Hungary, Portugal, Czech Republic, Lithuania, Latvia, Greece, Cyprus and Malta.

- Countries that are ‘losing ground’ include Estonia, Spain, Bulgaria, Poland, Slovakia, Romania and Turkey. Had it been included, almost certainly the Republic of Macedonia would have found itself in this group.

**METHODOLOGY**

In order to review the current status of the NIS, its key elements (Social and Human Capital, Research Capacity, Technology and Innovation Performance, and Absorptive Capacity) and the relations between them, extensive field work was conducted during June-September 2006 with objective of assessing government strategies and policies targeting key elements of the NIS.

During the research the authors reviewed existing information related STI issues at the national level (laws, regulations, reports, etc.), as well materials produced by international organisations such as donors. Additionally, more then 25 national and international experts were interviewed in order to take into consideration the ‘key’ players in the Republic of Macedonia relating to STI issues. Attention was paid to both STI knowledge creators and users. During the analysis the interactions and interfaces between various actors and the workings of the system as a whole, as well as the performance of its individual components were reviewed. It should be mentioned at this stage that the same actor may represent two different aspects at the same time: for example, universities may be simultaneously both ‘knowledge creators’ and ‘knowledge users’. All interviewed ‘key players’ were asked to assess their institutions’ STI practices, including problems and future plans and all participants reacted positively to this type of analysis.
THE CURRENT SITUATION IN THE REPUBLIC OF MACEDONIA

Research and Development (R&D) expenditures

The overall conclusion of the current status of STI in the Republic of Macedonia is that it has been largely marginalised in the fifteen years since the country became independent. The percentage of Gross Domestic Product (GDP) devoted to the R&D in 2003 was only 0.22%, compared with neighbouring countries such as Serbia 0.32%, Bulgaria 0.5%, Croatia 1.10% and Slovenia 1.53%. Moreover, although in above-mentioned countries this percentage has been constantly increasing, the equivalent figure in the Republic of Macedonia was 0.44% of GDP in 2000, 0.32% in 2001, 0.26% in 2002 and 0.22% in 2003. Indeed, it was only in 2004 that this trend was reversed (0.25% of GDP), as illustrated in Table 1.

Of greater concern is the fact that R&D expenditures are primarily on either higher education (60.2%) or the governmental sector (34.1%), with only 5.7% coming from the business sector, compared with the EU practice where the latter participates with 65.3% (see Table 2). In all other countries mentioned, as well as neighbouring countries, the business sector invests significantly more in R&D. This low level of investment in R&D by the private sector is explained by the fact that after 1990 there were significant losses in the Yugoslav and East and Central European market, and numerous large industrial complexes disintegrated, leading to large numbers of bankruptcies and layoffs. Many of the largest companies, often with their own R&D departments, disappeared and their technical staff had to carve out new economic roles for themselves.

In order to analyse the NIS, all the ‘key players’ have be assessed as per Guy and

<table>
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<tr>
<th>Table 1</th>
<th>R&amp;D expenditure as a percentage of GDP for selected countries</th>
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<tbody>
<tr>
<td></td>
<td>2000</td>
</tr>
<tr>
<td>Macedonia</td>
<td>0.44</td>
</tr>
<tr>
<td>Croatia</td>
<td>1.23</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>0.52</td>
</tr>
<tr>
<td>Romania</td>
<td>0.37</td>
</tr>
<tr>
<td>EU-15</td>
<td>1.94</td>
</tr>
</tbody>
</table>

Source: Eurostat report (2005)

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Structure of R&amp;D expenditure by sectors for selected countries (2000)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Business sector</td>
</tr>
<tr>
<td>Macedonia</td>
<td>5.7</td>
</tr>
<tr>
<td>Croatia</td>
<td>45.1</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>20.5</td>
</tr>
<tr>
<td>Slovenia</td>
<td>56.3</td>
</tr>
<tr>
<td>Greece</td>
<td>28.5</td>
</tr>
<tr>
<td>EU-15</td>
<td>65.3</td>
</tr>
</tbody>
</table>

Source: Eurostat report (2005)
Nauwelaers (2003), but in the case of the Republic of Macedonia, it is evident that Ministry of Education and Science (MoES) is, in fact, the pre-eminent actor as far as STI issues are concerned. Before proceeding with the analysis of each sector and the relationships between the sectors, a brief assessment of the public and private sector actors is carried out.

**Public sector ‘actors’ for STI issues**

There are two types of actors in the public sector:

- Those responsible for STI policy creation such as:
  - Government
  - Ministry of Education and Science (MoES)
  - Macedonian Academy of Science and Arts (MANU)
  - Others such as professional associations, independent union for education, science and culture, etc.

- Those responsible for implementing STI policy (e.g., MANU, public scientific institutions, higher education institutions, innovation and technology transfer centres, State Office of Industrial Property (SOIP), etc.)

**Institutions responsible for STI policy**

Governmental bodies currently do not take sufficient account of the importance of the scientific and R&D sector during the processes of making key decisions. With the exception of the MoES, and to some extent the Ministry of Agriculture, ministries rarely seek to use the full scientific and R&D potential available.

The MoES is responsible for policy development and monitoring of implementation of activities relating to science and R&D, however, it is evident that it has failed to assist the Government of the Republic of Macedonia to recognise that science and R&D are among the key strategy priorities essential for long term economic development of the country. The MoES’s activities are currently largely restricted to co-financing activities such as:

- Developmental and innovation projects (up to 30% of total cost)
- 45 scientific journals per year
- Publication of ca. 200 scientific books per year
- Participation in ca. 50 domestic scientific conferences
- Participation in international conferences, seminars, etc. (500 people)
- International study visits for ca. 100 young scientists
- About 300 research projects in 2003 and some 186 projects in 2004.

The effects of these scientific and R&D-related activities on the national economy are not clear since there is no direct relationship between investment and economic impacts; hence the independent evaluation.

MANU is the primary national institution to promote the development of science, research, innovation and new technologies, both in the country and internationally. However, MANU is facing serious problems such as lack of funding, low level of human capital, outdated equipment, etc. with the consequence that it is not in a position to fulfil its role satisfactorily.

Other organisations, such as the Association for Popularization of Technical Culture, Independent Union for Education, Science and Culture, etc. have neither the interest nor the capacity to handle STI
issues. The Associations for Popularization of Technical Culture lack both human capital and facilities. Although they organise competitions at the primary and secondary school levels, they are unable to nurture talented young people. The core difficulties faced by the Union for Education, Science and Culture concern salaries and working conditions, with the consequence that it has failed to develop STI activities.

**Institutions responsible for implementation of STI policy**

MANU implements its activities through five departments (Linguistic and Literary Sciences; Social Sciences; Mathematical and Technical Sciences; Biological and Medical Sciences; and Arts) and five research centres (Research Centre for Genetic Engineering and Biotechnology, Research Centre for Energy, Informatics and Materials, Centre for Strategic Research, Centre for Linguistics and the Lexicographical Centre). The first two centres are internationally recognised for their research, but there is an overlap in the focus of the other three centres and other scientific institutions, such as the Institute of Economics, Institute for Sociological, Political and Juridical Research, Institute for Macedonian Language and Institute for Macedonian Literature. MANU’s difficulties are compounded by the fact that researchers and scientists are not always allowed to apply for MoES research projects.

Thirteen public scientific institutions are active in the country: 10 within the University Ss. Cyril and Methodius and three within the University St. Kliment Ohridski. These institutes are members of the public universities but, with few exceptions, are unable to provide graduate and postgraduate education, since their main activity is research. Only the Institute of Earthquake Engineering and Seismology and, to some extent, the Hydro-biological Institute have been able to establish themselves at the international level. The institutes in the biotechnology area (Institutes for Veterinary Science, Agriculture and Tobacco) have met some success in developing new products and processes but because of the low level of support from the Ministry for Agriculture for their work, the results remain unsatisfactory.

Three public universities in Skopje, Bitola and Tetovo educate some 45,000 students. Although they combine education with science and research, the level of contact with industry is insufficient. Research and scientific papers are used by the scientific and research staff primarily for the purpose of career development. The weak link between the universities and the economy has been noted in the past and continues to be an issue.

The State Office of Industrial Property (SOIP) is responsible for the IP protection system in the country. Analysis by the SOIP shows that the industrial property rights are improving (see Table 3). The SOIP is promoting creativity and innovation through initiatives such as the International Intellectual Property (IP) day, the Patent of the Year, Makinova, participation in international exhibition of ideas/inventions/new products, etc.

The human capital involved in STI activities needs to be taken into consideration. A major indicator is the Full Time Equivalent (FTE) involved in STI; in other words, the ratio of the number of full-time researchers relative to the total work force in the country. Other relevant pieces of information include the distribution of researchers in the public and private sectors, their gender, maturity, and researchers’ citation index. The FTE index in the Republic of Macedonia is 1.7. This is not
only significantly lower than the EU average (5.68) it is also below that of neighbouring countries such as Bulgaria (4.63), Slovenia (4.64) and Greece (3.30). Moreover, the distribution of researchers between higher education, governmental bodies and business sector is of concern. The Republic of Macedonia has a comparatively lower number of R&D staff in the business sector (5.4%) as can be seen in Table 4. The main reasons include the fact that the majority of businesses are in very bad shape and have limited financial muscle to devote to R&D investment and research staff. To this must be added the belief of the managers that they can manage without R&D staff. They fail to understand the nature of the relationship between R&D investment and company competitiveness and profitability. In the Macedonian R&D sector, 53.4% of researchers are female, a significantly higher percentage than in the EU and neighbouring countries (e.g., Portugal – 46.6%, Spain – 35.4%, Greece 40.9%, Slovenia – 35.8%, Bulgaria 45.5%, Romania – 42.8%); however, a pressing issue is the fact that this human capital rapidly ageing. Although data are scarce, the fact that those

Table 3  Intellectual Property rights (2001–2005)

<table>
<thead>
<tr>
<th>Year</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of patent applications</td>
<td>125</td>
<td>241</td>
<td>435</td>
<td>452</td>
<td>436</td>
</tr>
<tr>
<td>National</td>
<td>65</td>
<td>44</td>
<td>47</td>
<td>44</td>
<td>53</td>
</tr>
<tr>
<td>Foreign</td>
<td>60</td>
<td>197</td>
<td>388</td>
<td>408</td>
<td>383</td>
</tr>
<tr>
<td>Total number of trademark applications</td>
<td>1186</td>
<td>1035</td>
<td>993</td>
<td>1056</td>
<td>1050</td>
</tr>
<tr>
<td>National</td>
<td>440</td>
<td>411</td>
<td>478</td>
<td>458</td>
<td>433</td>
</tr>
<tr>
<td>Foreign</td>
<td>746</td>
<td>624</td>
<td>515</td>
<td>598</td>
<td>617</td>
</tr>
<tr>
<td>Total number of industrial design applications</td>
<td>80</td>
<td>41</td>
<td>71</td>
<td>47</td>
<td>60</td>
</tr>
<tr>
<td>National</td>
<td>75</td>
<td>29</td>
<td>45</td>
<td>31</td>
<td>47</td>
</tr>
<tr>
<td>Foreign</td>
<td>5</td>
<td>12</td>
<td>26</td>
<td>16</td>
<td>13</td>
</tr>
</tbody>
</table>

Source: SOIP, annual report 2006

Table 4  Number of R&D staff (per 1000 working force) and their distribution

<table>
<thead>
<tr>
<th>Country</th>
<th>FTE</th>
<th>Business sector</th>
<th>Government sector</th>
<th>Higher education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macedonia</td>
<td>1.70</td>
<td>5.4</td>
<td>29.5</td>
<td>65.1</td>
</tr>
<tr>
<td>Finland</td>
<td>13.77</td>
<td>56.9</td>
<td>12.3</td>
<td>29.8</td>
</tr>
<tr>
<td>Sweden</td>
<td>10.10</td>
<td>60.6</td>
<td>4.9</td>
<td>34.5</td>
</tr>
<tr>
<td>EU-15</td>
<td>5.68</td>
<td>49.7</td>
<td>13.4</td>
<td>34.5</td>
</tr>
<tr>
<td>Greece</td>
<td>3.30</td>
<td>15.20</td>
<td>13.60</td>
<td>71.00</td>
</tr>
<tr>
<td>Slovenia</td>
<td>4.64</td>
<td>33.6</td>
<td>32.3</td>
<td>30.7</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>4.63</td>
<td>6.4</td>
<td>40.2</td>
<td>53.1</td>
</tr>
</tbody>
</table>

Source: Eurostat report (2005)
defending their PhD Theses are typically in their 35s and 40s, combined with the very low level of young scientists entering R&D institutions because of Government budget restrictions and the process of external (leaving the country) as well as internal ‘brain drain’ (leaving R&D institutions because of low salaries, prospects and equipment), are some of the indicators of the maturity of scientific human resources.

Another determinant of the quality of R&D staff is the number of published papers in international journals. The situation in the Republic of Macedonia is very disappointing. The index of published papers per million inhabitants for the year 2004 is 39 compared with Switzerland (1757), Sweden (1598), Denmark (332), Finland (1309), EU-15 (673), Slovenia (726), Greece (458), Bulgaria (182) and Romania (84).

No discussion of R&D human resources would be complete without reference to the problem of the ‘brain drain’. Significant numbers of the brightest and most able young researchers are leaving country in the hope of finding better work and living conditions. Young scientists should be encouraged to exchange experiences with their international colleagues, but they should also have an incentive to remain/return to their country of origin. Incentives are required to achieve this whilst, at the same time, recognising that the freedom to travel should not be restricted.

**Assessment of private sector ‘actors’ for STI issues**

The private sector is the key driver of economic development. Unfortunately, in the last 15 years, the link between R&D and the business sector has been tenuous at best. Private companies have failed to show interest in participating in the creation of STI policy, although in reality neither Government nor academia have provided a challenge to the business sector to get involved in STI policy development.

The most active business association are the Macedonian Economic Chamber of Commerce and Association of Chambers of Commerce; however, neither has yet initiated a project related to R&D and innovation. Some activities, such as standardisation, quality improvements, clustering, etc., are primarily donor-driven and designed to enhance the competitiveness of domestic firms, but these have not had a specific STI focus.

Macedonia boasts many professional associations, such as various engineering association, physicians’ association, etc. These frequently deal with issues relating to science and its application in practice. The most notable body in this respect is the Association of Inventors, an organisation that is directly involved in STI issues by promoting innovations, organising manifestations and workshops on STI topics.

R&D expenditure by firms is typically considered a cost, without due consideration of the long-term effects of innovative products, processes and services resulting from R&D activities. According to data from the Central Registry only two small, 21 medium and 31 large enterprises actually invested in R&D activities. The total sum amounted to 1.7 million Euros in 2003 and even less in 2004 (1.24 million Euro). These figures illustrate low priority currently accorded to R&D by the business sector.

Private universities also form part of the private sector ‘actors’. Private faculties and universities were started six years ago and are growing rapidly. Those that have been accredited include the University of South East Europe (Tetovo), the European University (Skopje), the American College University (Skopje), the New York University (Skopje), the
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Faculty of Business Economics (Skopje), etc. A common characteristic is the fact that they are primarily oriented towards education rather than R&D. A notable exception is the University of South East Europe, where the Centre for Business Development (a branch of the E-Biz project sponsored by USAID) is seeking to close the gap between academia and business by transferring know-how from the university to the local economy.

Assessment of STI activities

In order to raise awareness of the importance of STI issues, it is necessary to work with various key actors, using different approaches. The dominant actors are clearly the universities but despite some notable examples of good practice, they have not performed particularly well in raising public and business awareness of STI issues.

Through the MoES, government is the major investor. In recent years the need to increase awareness of STI issues, and modernise the educational curriculum, especially in the area of entrepreneurial learning, has become obvious. Much of the effort in relation to the educational institutions has actually been driven by foreign institutions and donors. For example, the most important project relating to entrepreneurial education was initiated by the European Training Foundation (ETF) when the Republic of Macedonia was given the opportunity to become part of the regional project on entrepreneurial learning.

In the preceding 15 years, universities have been seeking to offer education programmes that are integrated with the needs of the high technology industry as well as the wider socio-economic environment. Furthermore, universities are aiming to take a lead role in relation to the economic development of the country. This is difficult to achieve. Universities continue to struggle with many basic problems, such as outdated curricula and old fashioned teaching methods that are still not in line with the requirements of the Bologna process; there is insufficient coordination between faculties; they have redundant equipment and facilities; the salaries for teaching staff remain unattractive; there are limited employment opportunities for young teaching and research staff, etc. The lack of linkage between universities and the business sector, combined with an absence of employment opportunities for qualified staff, intensify the ongoing brain-drain.

Nevertheless, in recent years universities have started to restructure their curricula according to the principles of Bologna declaration and European Credit Transfer System. Steps have also been taken to stimulate cooperation with the business sector. Although the Republic of Macedonia has 67 university level faculties and institutes, only 15 have established courses on Entrepreneurship and Small Business Management, half of which are elective.

The science-business interface is a key part of the Guy and Nauwelaers (2003) matrix. Perhaps the most heavily criticised aspect of STI in the Republic of Macedonia is the lack of know-how and technology transfer to the business community. ‘Knowledge creators’ should be willing to transfer their knowledge to the ‘knowledge users’. As far as the knowledge users are concerned, the most important issue is the absorptive capacity of the business sector. Firms should be open to new ideas, know-how, technology and processes but this is failing to happen. Several activities are being implemented to increase the absorptive capacity of domestic companies and, again, this is mainly a donor-driven process being implemented through several projects.
The Ministry of Economy (MoE) has launched projects to help domestic businesses to adopt and implement ISO standards (e.g., 9001 and 14000) by co-financing the process of certification. This is a good example of know-how transfer to industry. The MoE co-finances up to 30% of the research projects and public scientific institutions work with the business sector on the development of new products, processes, materials, etc. A key issue is that upon completion of the projects, the grant holders have an obligation to disseminate the results of the project to the public and to business participants.

Another example is training and support in the area of ICT. MASIT, the association for information technologies, has a proactive approach to fostering ICT issues in the public and SME sectors through an aggressive awareness raising campaign on these issues.

The most recent initiative is the establishment of an Innovation Relay Center (IRC) by SINTEF, Norway in 2006. The IRC seeks to increase Macedonian business competitiveness by strengthening the technological and innovation base of SMEs. USAID and EAR have helped to establish both the National Council for Entrepreneurship and Competitiveness and the SME Forum, both examples of public-private dialogue in relation to competitiveness and small enterprise development.

With the support of the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), four Centres for Technology Transfer were established in Skopje at the Faculties of Mechanical Engineering, Electrical Engineering and Agriculture and Food and Bitola at the Technical Faculty. More than 50 companies have already benefited directly from this project which focuses on introduction of new technologies; modernisation of current technologies; new product development; and training and specialisation of human resources.

A number of examples can also be found of collaboration among researchers and SMEs, such as the CIRKO MES Centre for Excellence that is developing the Mavnet Network of Macedonian Tool Shops. Nevertheless, the current level of science-business interaction is far from satisfactory in the Republic of Macedonia.

**RECOMMENDATIONS**

The Republic of Macedonia is experiencing constraints in relation to STI policies, which are similar to those of other SEE countries, since gaining independence. The country has a very high rate of unemployment (36%), experiences a massive level of emigration, is undergoing a process of industry restructuring, runs major trade deficits and attracts very low level of investments, both foreign and domestic in nature. To illustrate the situation, the Republic of Macedonia has yet to attain the same level of GDP that existed prior to gaining independence. In 2003, the level of GDP was a mere 78% of 1989 level (EBRD, 2004).

Better performance in relation to science, technology and innovation would assist the process of transition and attainment of higher levels of economic growth. However, the Republic of Macedonia lacks a well defined NIS with clear and well articulated relationships between science, technology and innovation, and their link to economic development. Since economic growth and competitiveness are partly founded on a well-functioning NIS in which all actors, market-oriented and non-market institutions need to perform efficiently, an extensive evaluation of NIS is needed in order to highlight the interactions and interfaces between various actors and the workings of the system as a whole, as well as how it could be improved.
SMEs are at the core of a well articulated NIS and they should be utilising the benefits of a well-developed system. This is currently not the case in the Republic of Macedonia. The lack of clear responsibilities of NIS actors means that their relationship with SMEs is the weakest point in the system. Much more needs to be done to increase the SMEs’ role in relation to the NIS. A key issue would be promotional activities designed to raise the awareness level among SMEs of STI issues, combined with the direct benefits to the company arising from R&D activities. Reinforcing SMEs capacities in relation to STI issues should translate into enhanced NIS performance. In order to strengthen the SME sector in relation to STI issues, a number of policy recommendations can be identified, as discussed below:

**Increase investment in R&D**
- Facilitate discussions to encourage the Government to adopt a target of 1% of GDP to be invested in R&D by 2010.
- Initiate a dialogue with SMEs on the importance of increasing investment in R&D and adopt a target of 40% participation by the private sector in R&D by 2010.
- Encourage the development of Business Angels investor networks and other private sources of capital to supplement shortfalls in funding for new technological ventures.

**Introduce technological and industrial development zones**
- Undertake a feasibility study to select possible Industrial and Development Zones (TIDZs).
- Prepare a programme of support for TIDZs, since as export processing zones they can be an important mechanism for acquiring technology and diffusing it throughout the local economy.
- Negotiate the incentives package with the Ministry of Finance relating to infrastructure; lease land at low or zero cost for 99 years; finance for factory space; co-financing of salaries; tax exemptions (0% CIT for ten years; 0% PIT for five years; 0% public utilities, etc.) for companies investing a minimum of Euros 2 million and employing at least 30 workers.
- Work with the Investment Promotion Agency (Invest Macedonia) to promote the investment opportunity to international companies.
- Identify opportunities to increase participation in international trade since this is an important source of impetus for rapid technological innovation.
- Strengthen already established industry clusters, or initiate new clusters relevant to SMEs.

**Establish technology/science parks**
- Collaborate with the MoES to streamline the relevant legislation (Law on Science and Research Activity, Law on Technological Culture and Law on Technological Development), enabling the creation of technology parks.
- Collaborate with the Ministry of Finance to secure state support (infrastructure, tax incentives, etc.) to stimulate investment in technology parks.
- Establish technology/science parks. There is potential to create at least three viable technological parks in Stip, Bitola and Skopje, however, this is constrained by a lack of funds.
- Network existing technology transfer centres.
**Promote R&D benefits to SMEs**

- Ensure that the Ministries of Economy and Education and Science collaborate to develop an awareness raising campaign (media campaign, best practice fairs, brochures and practical guidelines for SMEs, information on web portals, etc.) highlighting the role of investment in R&D in relation to enterprise competitiveness and profitability.

- Collaborate with Business Associations to organise roundtables by successful companies to highlight best practices in commercialisation of innovations.

- Raise awareness of the importance of R&D at regular meetings, conferences, etc. of the network of Business Associations.

- Develop award schemes which reward innovative solutions to business problems.

- Assist universities to use occasions like ‘Science Day’ to organise fairs and stalls promoting R&D activities with the active participation of SMEs.

**Introduce a National Innovation System/STI scoreboard**

- Create an independent public-private body to oversee the introduction of a system of innovation indicators and its measurement, based on the EC Innovation Scoreboard methodology.

- Adopt indicators from the new EU Charter action plan for Research and Innovation.

- Raise awareness of existence of these indicators among SMEs, as well as the relevant public institutions that will provide data for the Innovation Scoreboard.

- Prepare and publish an annual Innovation Scoreboard for the Republic of Macedonia, benchmarked against EU countries.

- Introduce an independent public-private partnership as an integral part of the newly created IRC, Start-up Centres, Technology Transfer Centres etc.

**Strengthen the science-business interface**

- Publicise to SMEs the services, know-how, software and equipment available via the Technology Transfer Centres and university research institutes that have the capacity to be used as R&D providers.

- Stimulate R&D faculty staff to promote their ideas and knowledge to SMEs through direct contacts, internship programmes, practical work in relation to graduate research, etc.

- Establish regular networking among the Technology Transfer Centres, CIRKO, IRC, CIPOZ, etc. in order to diffuse best practice, develop a common SME database, organise regular events to promote new developments, etc.

- Undertake feasibility studies to establish science parks, hi-tech business incubators, spin-off firms, etc. exploiting links between universities and SMEs.

- Introduce entrepreneurial education among university students, especially science, technology and engineering students, building on the experience of the Ss. Cyril and Methodius University Business Start up Centre.

- Encourage universities to utilise their knowledge of project application and management procedures to assist SMEs to apply for international funds.

- Reform the higher education system, such as adjusting curricula to generate new links between universities, industry and government, thus strengthening the NIS.
• Upgrade the library system through the development of an e-library system open to wider public, including firms.
• Develop ‘open access’ to scientific information for SMEs and other interested parties.

**Develop R&D human capital and reduce brain drain**
• Create a network of Macedonian scientists abroad to stimulate joint projects with Macedonian universities, research institutions and SMEs.
• Increase salaries, enhance quality of R&D equipment and raise the status of R&D staff in research institutions.
• Provide financial support to scientist to participate in international conferences and events.
• Provide financial scholarships funded by government and SMEs to stimulate students to study technology and engineering subjects, especially at the Master of Science and PhD levels.
• Establish a Fund (MoES and MoE) to stimulate young scientist to commercialise their ideas, knowledge, innovations, etc.
• Provide facilities for young innovators (e.g., space, equipment, trainers, internet, etc).
• Encourage SMEs to provide practical work experience for young innovators.
• Stimulate R&D staff transfer to SMEs on R&D positions.
• Strengthen the capacities of professional associations.
• Provide free or low cost on-line access to scientific journals and data bases
• Develop a tracking system to assess careers paths of R&D staff.

**Intensify international cooperation**
• Increase information and awareness of the wide range of possible exchange/knowledge transfer programmes available (e.g., by MoES through regular information provision to universities and SMEs).
• Provide training on project application preparation and project cycle management to enable universities and SMEs to obtain and manage exchange programmes.
• Promote R&D through international technological alliances to take advantage of the growing globalisation of research.
• Raise awareness of the many possibilities of EU funded projects (see www.europa.eu.int), including a greater focus on Structural Funds, 7th Framework Programme (FP7), Competitiveness and Innovation Framework Programme (CIP), European Investment Bank (EIB), Risk Capital Action Plan (RCAP), EUREKA, INNOVA, etc.
• Form international linkages allowing local firms and institutions to partner and sub-contract with similar organisations in more advanced economies, such as through Diaspora channels, public-private partnerships, etc.
• Stimulate SMEs to utilise existing international networks (through MoE and business associations).

**Increase technology dissemination**
• Encourage knowledge creators (universities, public institutes, etc.) to organise fairs and forums to showcase new products and services to SMEs (e.g., Skopje fair exhibitions, Makinova, Entrepreneurship Fair/Europe Day, promotion of international projects at Faculty of Mechanical Engineering, etc.) and attract SMEs to
these events through closer collaboration with business associations.

- Introduce university courses on issues such as new product development, innovation management, commercialisation of innovations, etc.
- Organise courses/seminars for SMEs in the area of new product development, innovation management, etc. with the support of the MoE and MoES.
- Join global value chains such as R&D, design, logistics, marketing, etc.

**Strengthen Intellectual Property (IP) rights**

- Increase awareness among scientists and SMEs of IP issues, such as procedures for obtaining patents, registering trademarks, registering industrial designs, etc.
- Simplify procedures and reduce costs of the above IP procedures, in line with international best practice.
- Stimulate scientists to protect their IP by establishing an award scheme reward and recognise successfully protected innovations.
- Increase awareness of the penalties and costs associated with non-compliance with IP rules and regulations among SMEs and scientists.

**Introduce R&D tax incentives**

- Stimulate innovation in the SME sector by offering tax incentives, such as tax credits for R&D. Any R&D tax incentives need to aligned with EU guidelines.
- Introduce lower levels of VAT (e.g., 5%) and abolish customs duties for investment in innovation-related technology by SMEs, universities and health research institutes.
- Introduce a volume based R&D tax credit enabling all SMEs carrying out R&D exceeding a minimum threshold (e.g., Euro 5000) to claim a tax credit as a part of the company’s annual tax return.
- Introduce tax exemptions for research and investment in renewable energy sources by SMEs.
- Reduce the tax liability for companies in proportion to their expenditure on R&D and innovation.
- Providing an extra tax incentives for companies exhibiting high growth rates of R&D expenditure (e.g., an average increase of +15% over three years).

**CONCLUSION**

The paper has analysed the current situation at STI and the NIS and their relationship to the SME sector in the Republic of Macedonia. Once the weaknesses are clear, a series of recommendations for improvement of the current status is proposed. The analysis presented in this paper is only a starting point. A more in-depth and systematic approach of the STI and NIS issues is needed to take all the issues into consideration. Nevertheless, in the absence of such an analysis, the recommendations highlighted above will enable the Government of the Republic of Macedonia to formulate more relevant policy responses and incorporate them into the SME Development Programme (2007–2010).

**BIOGRAPHY**

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Ricardo Pinto received his PhD from the London School of Economics (LSE) and also worked at the Centre for Economic Performance. He has 15 years of International Consultancy experience based on assignments in Central and South Eastern Europe, as well as Africa and Central Asia. His works with governmental institutions and business support organisations involved in private sector development (economic development, SME development, informal economy, regional development, competitiveness, innovation, etc.). He is a Certified Management Consultant and a member of OECD LEED Trento Centre “Scientific Advisory Group on Entrepreneurship”; OECD Enterprise Forum; Local Economy editorial board, etc.

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