Chapter Three;

ICT & SMEs: A Conceptual Analysis
**Part I: Concepts of SMEs & ICT**

1. **Introduction**

Small and Medium Enterprises (SMEs) are increasingly aware of the positive impact that Information and Communication Technology (ICT) can have as these technologies spread through their organisations. Among the different tools for SME development and competitiveness, ICT have become widespread in every activity sector over the last several decades. Behind this very general acronym hides a multitude of technologies- for example, computers, Internet, groupware, Electronic Data Interchange (EDI) and Enterprise Resource Planning (ERP)-that are supposed to improve the performance of organisations.

One explanation for the pervasiveness of ICT is that these technologies theoretically permit gains in productivity, particularly in terms of transactions and coordination. The strategies implemented by companies to encourage ICT and electronic commerce are theoretically supposed to improve company performance through cost reductions and differentiation strategies. However, ICT provide only a partial explanation for performance improvement in most studies. As Solow's Paradox1 indicates, measuring this performance gain has proven quite difficult and subject to debate.

Historically, large companies were the first to set up ICT (Antonelli, C., Teubal, M. 2008), both for organisational reasons (e.g., to maintain links with subsidiaries, to coordinate distant sites) and economic reasons (e.g., to better integrate processes, to automate data exchanges with key suppliers). In order to accomplish these goals, these pioneering companies had to restructure their operational processes, modify their organisational structures and redefine their core activities and their positions in the value chains. Thus, digitalizing a company's internal and external processes necessitates changes in organisation and management. These changes often generate costs and risks that are proportionately greater for SMEs, which may also lack expertise and knowledge, leading to longer ICT implementation and appropriation phases.

The structural transformations in the various sectors have led to a greater organisational interdependence between firms, especially between large companies and SMEs, which are often sub-contractors providing goods and/or services. This is particularly true of transformations that, applying the concepts of vertical disintegration or networks, have pushed companies to re-centre on their core activities and to modularise their production systems. The external pressure of large companies and clients has led numerous SMEs to set up ICT, especially in industrial sectors.
The arrival of ICT may play a role in restoring competitiveness, since these technologies are also a factor in relaxing the constraints specific to SMEs. ICT makes a number of services possible in a large range of processes and transactions within and between companies. Internally, ICT applications can improve knowledge and information management practices; they can also allow more rapid and more reliable transactions between businesses to business (B2B) and between businesses and consumers (B2C). They are equally quite effective in improving external business communications and service quality for both new and existing clients. They also appear to be a source of competitive advantage for SMEs under certain conditions.

2. The Definition of ICT

Information and Communication Technology (ICT) covers technologies like the simple telephone, point-of-sale systems, stand-alone PCs, networked environments, Internet, and credit card facilities. Ritchie and Brindley (2005) define ICT as “the array of primarily digital technologies designed to collect, organise, store, process and communicate information within and external to an organisation and, in our case, SMEs” (Ritchie & Brindley 2005:206).

ICT is a broad concept that covers Information Systems (IS), Information Technology (IT) and digitalisation. Many authors (Ritchie & Brindley 2005, Martin and Matlay (2001), Fulantelli & Allegra 2003) on this topic concur that ICT brings changes in the global information flow, behaviour, patterns and options of customers, and SMEs stand to benefit from ICT in reduced transaction costs, inventory controls, quality controls, access to a wider market space and leveraging economies of scale. According to Moodley (2002), ICT is an enabler for global “networking” economy.

“ICT offer enterprises a wide range of possibilities for improving their competitiveness: they provide mechanisms for getting access to new market opportunities and specialised information services such as distance consulting, continuous training, new advisory modes, etc.” (Fulantelli & Allegra 2003:45).
Figure 3-1 provides an overview of the terms with mention of the management concepts, applications, and involved parties which formed the basis at the conception of the questionnaire. It is a general framework to describe the systematic of business software and corresponding management concepts. Within the figure is a view of a real/specific company in the centre (sketched through the dotted line). The company has an ERP system at its disposal with which the activities in various departments can be integrated.

At the same time, the ERP system is almost always the connection point for the integration of external applications. The specialist terms contained in the figure were not
used explicitly in the questionnaire but were put in place for the evaluation of the results (Wolfle and Schubert 2005).

3. Definition of SMEs

Small to medium enterprises (SMEs) are businesses that employ 150 people or fewer and are not a subsidiary of a public limited company, according to Southern and Tilley (2000). SMEs play a very significant role in the growth and development of an economy. Empirical studies have shown that a large percentage of the growth in GDPs and of the reduction in unemployment is as a result of activities of SMEs. Mahemba and Bruijn (2003:162) cited the fact that SMEs make up more than 90% of all business establishments worldwide. Authors such as Southern and Tilley (2000), Taylor and Murphy (2004), and Martin and Matlay (2001) agree and acknowledge that SMEs are different and should be treated as such. There are many factors that make SMEs different, such as turnover, industry, number of employees, and format of the business. These factors need to be studied in more detail to establish how they influence the adoption process. In India SMEs will be as defined in RPCD Circular No. RPCD.PLFNS.BC. 31/ 06.02.31/ 2005-06 dated August 19, 2005, which is reproduced below:

“At present, a small scale industrial unit is an undertaking in which investment in plant and machinery, does not exceed Rs.1 crore, except in respect of certain specified items under hosiery, hand tools, drugs and pharmaceuticals, stationery items and sports goods, where this investment limit has been enhanced to Rs. 5 crore. A comprehensive legislation which would enable the paradigm shift from small scale industry to small and medium enterprises is under consideration of Parliament. Pending enactment of the above legislation, current SSI/ tiny industries definition may continue. Units with investment in plant and machinery in excess of SSI limit and up to Rs. 10 crore may be treated as Medium Enterprises (ME).”

4. Features of SMEs

SMEs’ primary competitive advantage is its flexibility; they are often better able to quickly meet customer requests and needs (Temperley, Galloway et al, 2004; Antony, Kumar et al, 2005; Edwards and Delbridge et al, 2005; Murphy and Ledwith 2007).

- Innovation through a research and development program is vital to the existence of a typical SME. However, SMEs tend to focus more on incremental innovation, as
opposed to radical innovation (Temperley, Galloway et al, 2004; Oke, Burke et al, 2007).

- Rapid decision-execution in order to mitigate external threats and capitalise on opportunities (Antony, Kumar et al, 2005; Murphy and Ledwith 2007).

- SMEs are less vertically-integrated than their counterparts, as there are fewer layers of management and bureaucracy. This helps SMEs simplify their management, but also brings the disadvantages that most SMEs focus on operational matters, rather than planning (Antony, Kumar et al, 2005; Deros, Yusof et al, 2006; McAdam, Keogh et al, 2007).

- The personality of an SME’s chief executive officer or managing director is often a key element in the direction, growth, and success of the company; in this way, SMEs are often people-oriented (Temperley, Galloway et al, 2004).

- In SMEs, the working relationship is often loose and informal; the process is often absent of standardisation (Antony, Kumar et al, 2005).

- Policy-making procedures and resource utilisation that are appropriate for large companies are not necessarily appropriate for SMEs (Welsh and White 1981; Deros, Yusof et al, 2006).

5. Characteristics of the SMEs

A) Origin of enterprise. According to Smallbone, Leig, and North (1995), in small firms, where ownership and management were typically combined in one or more individuals, future goals for the business might be determined as much by personal lifestyle and family factors as by commercial considerations. Further, they concluded that one characteristic which did distinguish the best performing firms from other firms in the study was their commitment to growth. Also, they found another characteristic that did distinguish high growth firms from others was their propensity to acquire other businesses.

B) Length time in operation. Length time in operation may be associated learning curve. Old players most probably have learned much from their experiences than have done by new comers. Kristiansen et al, (2003) found that length time in operation was significantly linked to business success.

C) Size of enterprise. Size of enterprise reflects how large an enterprise in employment terms. McMahon (2001) found that enterprise size significantly linked to better
business performance. Larger enterprises were found to have a higher level of success.

D) *Capital source.* In a study in Australia, McMahon (2001) discovered that greater dependence upon external finance associated with better business growth. In a more recent study, in Indonesia, Kristiansen *et al,* (2003) found that financial flexibility was significantly correlated to business success. The SMEs that took advantage of family and third-party investment experienced higher level of success.

6. **Differentiating Factors of SMEs**

Buckley and Montes (2002) explain that compared with big business, SMEs are generally found to spend less per employee on ICT and also spend less on computers and communication. Moreover, SMEs generally do not have R&D (Research and Development) or innovation departments, but in order for them to survive in the digital or knowledge economy, it is very important that they develop these.

One characteristic that almost all small businesses have in common is that they are owner managed. The owner is the centre of the business, making all or most of the decisions, and thus the owner’s personality and attitude towards technology have an impact on the adoption of ICT by the small business. Martin (2005:191) agrees that the owner-manager has limitations, such as:

- “Owner-manager capability gaps or knowledge gaps prevent effective new technology use and selection.
- Intuitive and organic styles of management and operation impact significantly on technology evaluation and implementation because they make it difficult for the owner-manager to make confident decisions.
- Owner-manager motivations, value, attitudes and abilities dominate organisation knowledge. This means that if the owner-manager does not build a technology acceptance culture in the small business it will be difficult for the staff to adapt.” (Martin 2005:191) But this does not make all SMEs the same; there are a number of factors that make them different and unique. This means that the adoption process of ICT should be treated differently for each SME. Factors such as:

- The e-commerce or e-business model used by the SME
- The location of the SME
• The take-up model adopted by the SME
• Whether it is a service or a product development business
• The unique characteristics of the SME will all affect the business and how it adopts ICT. Differentiating factors need to be explored more deeply to uncover the exact factors that make them different. In an attempt to better understand SMEs, this paper looks at the user groups and their characteristics (soft and hard).

7. Categorisation of ICT for SMEs

Lucchetti and Sterlacchini (2004) categorise ICT into the following groupings: general-user, production-integration and market-oriented groups. These categorisations relate to the roles of ICT or the strategic position that ICT can play within a particular SME. The SME’s owner or owner-manager needs to understand the value that ICT can add to the business and then place it within one or more of the following groups:

A) General-user ICT group

This is the basic ICT implementation, which includes e-mail and Internet. The rates of adoption at this level are generally high and do not depend on the size of the business. At this level technology is being introduced into the business in small doses and is not coordinated. This also includes standalone ICT, meaning “PCs used for the purpose that does not require communication technology” (Galloway & Mochrie, 2005:34). They emphasise that adopting standalone ICT applications can meet specific needs of the business like financial planning, customer record-keeping and developing marketing material. Many authors on this topic, including Galloway and Mochrie (2005), point out that the use of standalone ICT, or in this case general ICT, is not prolific. But the use of standalone ICT can be viewed as an entry point into the new economy, meaning it does not necessarily give competitive advantage but it gives access to being competitive.

B) Production-integrating ICT group

These are more advanced than the general-user ICTs as these ICTs are either linked to the production processes carried out within the firm or based on inter-firm relationships. They are expensive and require relevant technological skills to carry them out. According to the levels defined by Ritchie and Brindley (2005), they would form part of the strategic plans of a business for achieving business goals and enhancing or changing business processes. The use of ICT infrastructures such as networks; product data management; virtual prototyping; computer-aided design; Electronic Funds Transfer (EFT); EDI; having LAN (Local Area
Network) or WAN (Wide Area Network) connections within your business; and e-business and e-commerce, are expected to change the process of knowledge creation, embodiment and reuse.

The benefit of this is Product Innovation (PI) and faster service delivery. According to Corso et al (2001:36), “SMEs should heavily leverage these opportunities to support cross-boundary communication and knowledge sharing”. Examples of applications and tools at this level are ERP, CRM, billing systems, and computer-aided design. Generally, applications under this group rely on networked technologies and, according to Galloway and Mochrie (2005:34), this “has transformed the capacity of SMEs to share and transfer information”.

C) Market-oriented ICT group

These represent the firm’s web presence, displaying the goods and the company information on the World Wide Web. Some web sites might have e-commerce functionality, such as offering the ability to place orders. This relates to the marketing aspect of the business. The World Wide Web can be a powerful platform for expanding and reaching new markets. It gives the SME access to 24 hours of trading, borderless market space, and leverage to compete against big companies on the same platform. So by positioning the SME within an appropriate grouping, the owner or owner-manager can change the SME’s business process.

8. Adoption Perspectives of ICT

Authors on the topic of adoption of ICT hold three viewpoints, which are: the technology perspective; management and organisation of technology perspective; and small firm and ICT perspective. According to Southern and Tilley (2000), the first three have dominated the field of enquiry.

- Technology perspective. This perspective examines ICT adoption from the technology point of view. The focus is mainly on technology aspects like the Internet or e-mail technology, without looking at how the business can use this technology to be successful. The focus is thus only on the success of the technology driving the business. Consideration of the SME is not made; success is measured from a technology point of view and not on the success of the business. This perspective holds dangers for both SMEs and large business.
There have been reports of failures of ERP and CRM projects within organisations; one of the biggest problems is not the technology but the readiness of the organisation to embrace the technology. There are a number of things that the organisation needs to take into consideration when implementing technology, for instance, the organisational culture should be technology oriented; business processes need to be flexible in order to consider technology; one need to check the availability of IT skills needed for implementing the technology, and so on. Lack of consideration of these factors might cause failures in the adoption process.

- Management and organisation of technology perspective. This view is similar to the one above, but with greater emphasis on the management or organisational aspects. This view lays emphasis on the strategic approach to ICT by SMEs and on the capabilities and structures of the SMEs.

- Small firm and ICT from the small firm perspective. This view focuses on the SMEs and how they use technology as a tool to improve their competitiveness. This perspective takes into consideration the vision of the SME. Many authors on this topic are now starting to place emphasis on this viewpoint.

The approach of this paper will be based on this last perspective, looking at the owner-managers and how they factor technology into the strategy of the business in order to help the business to become more competitive. It is also important to understand the characteristics and differentiating factors of SMEs.

9. **ICT-User Types of SME**

In an attempt to understand SMEs, it is vital to take a close look at the relationship between SMEs and the usage of ICT and how this impacts on the adoption process. According to Southern and Tilley (2000:145-146), there are three types of user groups, which are:

- Low users. These are the small businesses that have little or no ICT in their business. They do not understand the difference between IT and ICT and are not willing to invest a lot of money in ICT.

- Medium users. This group includes the small businesses that have started using some ICT in their organisation. They have stand-alone PCs and have some form of a network established.
• High users. This group exhibits signs of more sophisticated understanding of ICT and how the technology can be applied.

Southern and Tilley (2000) examine the above user groups in relation to the hard or soft ICT characteristics and show how each user group reacts. The hard issues are visible aspects of ICT that can be observed and the soft issues are qualitative aspects of running a small business. Table 3-1 shows the hard and soft characteristics of the three user groups:

<table>
<thead>
<tr>
<th></th>
<th>Low users of ICTs</th>
<th>Medium user of ICTs</th>
<th>High users of ICTs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hard characteristics</strong></td>
<td>They would use analogue communication systems.</td>
<td>They would use analogue communication systems.</td>
<td>They would use or be on the move toward digital communication technology.</td>
</tr>
<tr>
<td></td>
<td>Have low number of telephone lines</td>
<td>Have a number of computers in a networked environment</td>
<td>Plans in hand to integrate IT and communication technology.</td>
</tr>
<tr>
<td></td>
<td>Low IT skills</td>
<td>Evidence of management information system</td>
<td>Requires specialised skills in IT &amp; ICT.</td>
</tr>
<tr>
<td><strong>Soft characteristics</strong></td>
<td>Very limited speculative IT investments.</td>
<td>Still some speculative investment in IT/ICT but with growing confidence in decision making</td>
<td>Less speculative IT investment and more calculated investment with clear return on investments (ROL).</td>
</tr>
<tr>
<td></td>
<td>Not very sure when making technical-business decisions.</td>
<td>More sophisticated business rationale to employing technology</td>
<td>Business rationale is well articulated for ICT use.</td>
</tr>
<tr>
<td></td>
<td>Generally do not know much about IT/ICT</td>
<td>Know the potential power of IT/ICT</td>
<td>IT/ICT forms part of the business process in producing goods and services.</td>
</tr>
</tbody>
</table>

Table 3-1: The user characteristic model (Southern & Tilley, 2000:148)

10. A Conceptual Positioning Framework

What are ICT? The question is not as innocent as it looks. What constitutes an ICT is the object of much confusion in the scientific business management literature (Diane Poulin and Sébastien Tran, 2010). The Organisation for Economic Cooperation and Development (OECD) provides an indirect answer in its Information Technology Outlook 2010, page 30, by looking at ICT activities rather than ICTs themselves¹: “ICT activities are those that “process, deliver, and display information electronically”. Hence, the ICT industries are those that produce the equipment, software and services that enable those activities.

¹ See Information Technology Outlook, 2010, Organisation for Economic Cooperation and Development. Last visited December, 2010: http://www.oecd.org/document/20/0,3343,en_2649_33757_41892820_1_1_1_1,00.html
Each of the top 250 firms is classified by ICT industry sector:

- Communication equipment and systems;
- Electronics;
- Specialist semiconductors;
- IT equipment and systems;
- IT services; software;
- Internet; and
- Telecommunication services.

Broadcast and cable media and content are excluded.” It should be noted that this OECD survey was conducted in 2006. The ICT activities that were used to identify ICT industries were based on a 1998 definition from OECD’s Working Party on Indicators for the Information Society (WPIIS), later complemented by an ICT goods definition in 2003 and an ICT services definition in 2006\(^2\). This definition was revised in 2007 by the WPIIS for the International Standard Industrial Classification (ISIC) Revision 43: “The following general principle (definition) is used to identify ICT economic activities (industries): The production (goods and services) of a candidate industry must primarily be intended to fulfil or enable the function of information processing and communication by electronic means, including transmission and display.”

Following this OECD WPIIS document, the ICT sector comprises ICT manufacturing industries, ICT repair industries, ICT trade industries and ICT services industries, but excludes the content and media sector, although both ICT and the content and media sectors belong to the broader concept of “information economy”. This definition is evolving and remains problematic for some activities. For example, the case can be made that the publishing of productivity software belongs to the ICT services sector while the publishing of multimedia software is part of the content and media sector. However, both are part of the ICT services industries, notably because ISIC recognises only one software publishing industry that produces both types of software.

In a less structured and coherent manner, ICT producers have also devised their own ICT classification schemes. They group and advertise the ICTs they sell under

---

labels such as ERP or SCM, which reflect the intended fulfilment or enabling function of the ICTs they offer. Such labels and groupings can vary from one source to the next. Moreover, some ICT producers purposefully craft new labels and acronyms for their ICTs in a bid for market differentiation. Finally, some classification schemes originate from other ICT sector stakeholders. Some are industry specific, such as furniture manufacturing ICTs (Diane Poulin and Sébastien Tran, 2010). Others are more inclusive, such as the five ICT families proposed by Reed Business Information’s Manufacturing Business Technology magazine’s Global 100 ICTs for small and medium manufacturers:

- Product innovation (ICT meant to sustain innovation, such as computer assisted design, engineering or manufacturing software);
- Computing infrastructure (ICT meant to enable other ICT families such as servers, computers, security software, and so forth);
- Plant operations (ICT meant to digitise plants and equipment, such as robots and control software);
- Enterprise/supply chain (ICT meant to enact the virtual value chain, such as Radio Frequency Identification (RFID) tags and software);
- Business performance (ICT meant to yield business intelligence and value added knowledge).

A new way to conceptually position Enterprise Information and Communication Technologies (ICTE’s) is offered here. This classification scheme is presented as a complement to other approaches to ICT classification, and is based on making explicit certain assumptions commonly found in business management discourse. On the one hand, an enterprise is composed of ICT-using individuals. On the other hand, it is embedded in an environment providing an enabling infrastructure. As a result, it is assumed that ICTE’s exclude those ICTs which deal first and foremost with such individuals or are provided through the business’s environment. If it were not so, the ICTE landscape would in fact be the global ICT landscape in its ever-changing entirety.

A first conceptual boundary can thus be found between ICTs intended for individuals and ICTE’s. This boundary is useful to determine which ICT is meaningful to the discourse at hand. For example, knowing how to use a telephone refers to an ICT which is common to firms of every size and trade, and which permeates the whole of modern society. This ICT is conceptually outside the boundaries of ICTE’s.
A second boundary refers to the environment, involving the notion of scale. Many ICTs essential or useful to enterprises are found upstream from those intended specifically for enterprises. These include computer operating systems, satellite networks, credit card systems, and the Internet-ICTs of general interest which enable ICTs of more specific intent. To describe them all in the context of enterprises would be an exercise in futility. But at what point does the exercise cease to be futile and start to add meaning to the contextualised discourse? That is where the second boundary can be found, between ICTs presumed to be present in the business environment and useful to commerce in general, versus ICTs intended specifically for enterprises so that they may better interact with such an environment.

These two boundaries find their echo in the scientific business literature. In a contribution to knowledge-based theories of the firm, Diane Poulin and Sébastien Tran (2010) proposed a tripartite view of a firm’s knowledge transfers and conversions. Figure 3-2 adapts this view to represent an enterprise as an internal structure which encompasses conceptual spaces of knowledge transfer and conversion within itself, among competent individuals, with an external structure, and with both of these at once. The enterprise’s internal structure interacts with an external structure such as a market, an industry or an environment. It also interacts through, and among, competent individuals such as employees, investors and end users. Knowledge is transferred and transformed between and through these three poles. Prosperity lies in mastering the interactions of all three poles.

The definition of Enterprise Information and Communication Technology (ICTE) adopted here is inspired by Figure 3-2 and the OEDC’s definition: “A technology enabling knowledge transformation and transfer within the enterprise’s internal structure and with its external structure and competent individual stakeholders.”

By fixing the boundary of an enterprise along the dotted black line encircling the organisation’s internal structure in Figure 2, ICTEs that are mainly relevant to individuals or external structures can find their place outside the SME discourse. ICTEs relevant to both the external and internal structures, or for both competent individuals and internal structure, or for all three, can also find their own conceptual space. Telephones, fax machines, cell phones, email, instant messaging, desktop operating systems and word processors are ICTs which can thus be excluded from the enterprise discourse in modern society, as they are assumed to be mastered by competent individuals. In this contextualised discourse, these ICTs are positioned outside the enterprise’s boundary and
into the competent individual conceptual space. This subjective view is linked to which ICTs are assumed to be mastered by individuals based on regular education and common experience, and which competencies cannot be assumed to exist before the enterprise gets involved.

ICTs that are too costly, too vast or simply impossible to access or create by individual enterprises can also be positioned outside the enterprise’s boundary. Examples include the Internet’s infrastructure (comprising fibre optic cables, satellites, routers and so forth), communication and information exchange standards (such as XML, PapiNet, RosettaNet), credit card networks, social networks, as well as other vast material or symbolic infrastructures. For this contextualised discourse, these are ICTs which are part of the enterprise’s environment—they are part of its accessible resource toolkit and enterprises do not have to put them in place, though they may have to pay to access them.

Figure 3-2 does not imply that internal structures can be disconnected from the external world or from individuals. The enterprise’s internal structure cannot exist without interacting with its external structure or the competent individuals which bring it to life. Likewise, the

*Analysis of Impact of ICT on Performance of SMEs in Karnataka*
external structure cannot exist without firms with internal structures or without competent individuals. Competent individuals need an external structure to interact in, just as they need firms with internal structures to interact with. Figure 3-3 presents broad ICT\(E\) types for manufacturing enterprises and positions them in four conceptual spaces along their most commonly found intent:

- Internal Structure (IS) ICT\(E\)'s concern knowledge transfer and transformation within an enterprise’s internal structure, such as ICT that deal with improving internal product design processes;
- External Structure- Internal Structure (ESIS) ICT\(E\)'s concern knowledge transfer and transformation between the enterprise’s internal structure and its external structure, such as ICTs that deal with value chain logistics or customer relationships;
- Competent Individuals-Internal Structure (CIIS) ICT\(E\)'s concern knowledge transfer and transformation between the enterprise’s internal structure and its competent individuals, such as ICTs that deal with virtual team communication or employee portals;
- Competent Individuals- External Structure -Internal Structure (CIESIS) ICT\(E\)'s concern holistic solutions which try to deal with knowledge transfer and transformation between an enterprise’s internal structure, its external structure and its competent individuals, such as All-In-One (AIO) ICTs which digitise enterprises and elevate them up to best industry practices with internal, external and people processes.
Knowing which $\text{ICT}^E$ belongs to which conceptual space in Figure 3 (IS, ESIS, CIIS or CEISIS) is a matter of judgment. $\text{ICT}^E$ types evolve over time. Many $\text{ICT}^E$ s offered on the market can belong to more than one type or share an acronym for marketing purposes without sharing key characteristics once put in actual use. Note that the acronyms of common $\text{ICT}^E$ types are positioned in Figure 3 to illustrate the use of conceptual spaces and do not constitute an exhaustive categorisation effort for these spaces. One could argue that all $\text{ICT}^E$s have an impact on external and internal structures, as well as competent individuals. For example, Computer Assisted Design (CAD) software is part of the enterprise’s internal structure as far as product creation and innovation are concerned, but is also part of the CIIS space when seen as a work interface between co-creating employees. Moreover, it is also part of the ESIS space when considered under the light of digital CAD files moving across the value web between various stakeholders. This type of reasoning discourages all classification attempts because it does not focus on the intended systemic effect sought by a give $\text{ICT}^E$. It is through such intent that classification may intelligibly take place. In this example, CAD software is primarily intended to assist in product design, and indirectly shapes work and value chain exchanges as more competent individuals start to use it. The acronym itself carries meaning which anchors CAD in the IS space of Figure 3-4.

How intended use is expressed varies, notably because $\text{ICT}^E$ usage varies amongst manufacturing enterprises. In addition, ever more complex $\text{ICT}^E$s are grouped into solutions which can be segmented into specialised modules. For example, ERP solutions often have
invoicing or inventory management modules, but are also part of larger AIO solutions and may feature modules of other AIO components that have little to do with what an ERP system commonly does. Nevertheless, strong hints of an ICT’s intended use can be found in the label attached to it, such as Product Lifecycle Management (PLM) or SCM. However, the definitions of these labels are evolving and sometimes contradictory between ICT makers.

**Conceptual map of Global 100 MSME ICT**

![Conceptual map of Global 100 MSME ICT](image)

**Figure 3-4: Conceptual map of Global 100 MSME ICT**

MRP (Materials Requirement Planning), OS (Operating System), BPM (Business Performance Management), BI (Business Intelligence)
MOS (Manufacturing Operations Suite), BCP (Business Computing Product), CAM (Computer Assisted Manufacturing)
FMS (Financial Management System), AIO (All-On-Solutions), MOS (Manufacturing Operations Suite), CAD (Computer Assisted Design)
PDM (Product Data Management), CCM (Collaboration and Content Management), PDM (Product Data Management),
ERP (Enterprise Resource Planning), IPM (Interactive Process Management), PPM (Project Portfolio Management)
CRM (Customer Relationship Management), EAM (Enterprise Asset Management), PLM (Product Lifecycle Management)
SCM (Supply Chain Management), EAS (Enterprise Applications Solution), BCP (Business Computing Products),
EDM (Enterprise Data Management), SDP (Software Development Platform), EDA (Electronic Design Automation)
SCADA (Supervisory Control & Data Acquisition), CAE (Computer Assisted Engineering), HCM (Human Capital Management)
MP (Manufacturing Products),

**Analysis of Impact of ICT on Performance of SMEs in Karnataka**
11. Positioning of ICT\textsuperscript{E}s for manufacturing SMEs

An exhaustive catalog of ICT\textsuperscript{E}s aimed at Manufacturing SMEs (MSMEs) would be obsolete upon release. Aside from the huge amount of resources such a compilation would entail, one has to take into account that ICT\textsuperscript{E}s are created constantly and evolve over time. A critical catalog would likewise be impractical. The pros and cons of ICT\textsuperscript{E}s depend on each SME’s business context. Choosing relevance over exhaustiveness is the only realistic option for a book discussion. ICT\textsuperscript{E}s were most often grouped along industry, size, or problem solving website navigation options. ICT\textsuperscript{E}s in industry specific navigation were often contextualised aggregates of wider solutions, with many industries getting their own dedicated bundles. Where firm size navigation was an option, different ICT\textsuperscript{E} scopes were offered. SME solutions often turned out to be truncated versions of large firm solutions. Where industry or firm size navigation was not available, only ICT\textsuperscript{E}s with a substantial link to MSMEs were positioned. It should be understood that such substantial character was based on experience and context when dealing with all Global 100 entries. It should also be noted that some developers showcased a multitude of different products or services where others would aggregate them in comprehensive AIO solutions. Offers too numerous and granular compared to similar Global 100 ICT\textsuperscript{E}s were positioned along their product or solution family line. Others were omitted in favour of more aggregate solutions originating from the same developer.

This conceptual map is much more nuanced and heterogeneous than what Figure 3-4 suggested. The five most frequent ICT\textsuperscript{E} types were Enterprise Data Management (EDM), Enterprise Applications Solution (EAS), SCM, CAD and ERP, though one should not forget that many solutions are modular and may thus be included under more encompassing acronyms. For example, CRM is sometimes presented as a stand-alone ICT\textsuperscript{E} type, but is frequently included in AIO, EDM, SCM, EAS and ERP. This complicates any attempt to draw conclusions about the frequency of Global 100 ICT\textsuperscript{E} type. It may be similarly tempting to conclude that there are fewer CIIS ICT\textsuperscript{E}s on the market, though it is far more likely the result of a web navigation bias in favour of SMEs and manufacturing as keywords and selected options.

Figure 3-4 showcases a wide variety of MSME ICT\textsuperscript{E}s that mesh into one another, many being modules of more aggregate ICT\textsuperscript{E}s or featuring modules of other ICT\textsuperscript{E} types. This makes any clear-cut categorisation effort suspect. The fact that new labels are
constantly being created and that established ones keep evolving- as new modules are added and older ones disappear- complicates things further.

12. Emerging trends for MSME ICTs

Navigating the Global 100 revealed two major trends. First is consolidation: numerous websites featured news of fusions, acquisitions or partnerships. The result is widespread aggregation of ICTs around AIO solutions with industry-specific bundling of relevant modules. Few developers advertise a single AIO. Most propose multiple industry verticals such as aerospace, healthcare, finance and so forth, with manufacturing being one of the more commonly found options. Such bundles can be sold as a whole or in parts, as required by MSMEs. Second is web-based online ICT access where current bandwidth limitations make such an option viable. For example, most ERPs are operable through the web, while few CADs are. CAD interfaces need robust 3D manipulation, something which current bandwidth limitations make unavailable to most. Note that such limitations recede ceaselessly, so this trend is likely to continue until all ICTs are available and operable online. Such “anytime-anywhere” access also feeds mobile solutions, though more acutely limited by bandwidth, memory and processing power. Business Intelligence ICTs are the most frequent examples of mobile MSME ICTs.

These two trends are also found at the non-Global 100, local ICT developing SME scale solutions, although they find a different expression; where consolidation goes hand-in-hand with large scale AIO aggregation, local developers instead focus on compatibility and interoperability. This is likely a reflection of who owns industry standards; larger firms have the resources to fight a format war, while smaller firms hedge their bets by advertising compatibility with a major standard solution. Choosing which global format holder to align themselves with is likely a major strategic decision for developers, since other stakeholders in the format are likely to become their main growth enablers and clients. The trend toward web deployed ICT is also present for local developers, which enables competition at a global scale. Interestingly, the computing infrastructure which allows ubiquitous ICT access worldwide is itself partly crafted from locally developed ICTs sold throughout the world.
These two trends feed upon a common source: the ubiquitous availability of intelligible information. Intelligibility should be understood here as a quality which enables ICT modularity and aggregation, while ubiquity refers to real-time, anytime, anywhere access to relevant technologies. The challenge posed to manufacturing SMEs is thus to design ubiquitous and intelligible information in a manner as, if not more, robust than the way in which they design products. This means information designed for the manufactured product, the manufacturer, as well as its entire value web, from supplier to end user. From a high conceptual standpoint, each ICT developer implicitly proposes information designs through its offers, with the most holistic ones found in AIO solutions. A manufacturing SME must choose between three options: (1) to adopt a developer’s information design as offered through third party ICT; (2) to create its own information design; or (3) to adapt a developer’s design by taking what fits and by creating what it can do better than a third party. For all three options, the goal is to find what works best to enact a prosperous business design in a new economy context. In this sense, the challenge posed above can only be met if a manufacturing SME can leverage its mastery of information design to innovate not only in operational terms, but also in terms of business design. Business design seeks to holistically represent a firm and the sum of its actions. Table 3-2, Figure 3-5 and Figure 3-6 present three conceptual frameworks meant to better enable business design and business modelling. It can be affirmed that ICT’s should be conceptualised around such representations rather than around commercial acronyms, so that their impact on the design of a business be adequately grasped. Each of the frameworks is based on four interlaced key elements.

Simply stated, according to Table 3-2, an ICT can have a potential impact on the enterprise’s products, its customer interface, its management infrastructure and its finances. According to Figure 3-5, an ICT can potentially impact on a business’s customer interface, its core strategy, its strategic resources and its value network. Alternatively, according to Figure 3-6, an ICT can potentially impact on an enterprise’s character, its creation system, its offer of products and services, and its stakeholders.
<table>
<thead>
<tr>
<th>Pillar</th>
<th>Business Model Building Block</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product</strong></td>
<td>Value Proposition</td>
<td>Gives an overall view of a company's bundle of products and services.</td>
</tr>
<tr>
<td><strong>Customer Interface</strong></td>
<td>Target Customer</td>
<td>Describes the segments of customers a company wants to offer value to.</td>
</tr>
<tr>
<td></td>
<td>Distribution Channel</td>
<td>Describes the various means the company uses to get in touch with its customers.</td>
</tr>
<tr>
<td></td>
<td>Relationship</td>
<td>Explains the kinds of links a company establishes between itself and its different customer segments.</td>
</tr>
<tr>
<td><strong>Infrastructure Management</strong></td>
<td>Value Configuration</td>
<td>Describes the arrangement of activities and resources.</td>
</tr>
<tr>
<td></td>
<td>Core Competency</td>
<td>Outlines the competencies necessary to execute the company's business model.</td>
</tr>
<tr>
<td></td>
<td>Partner Network</td>
<td>Portrays the network of cooperative agreements with other companies necessary to efficiency offer and commercialise value.</td>
</tr>
<tr>
<td><strong>Financial Aspects</strong></td>
<td>Cost Structure</td>
<td>Sums up the monetary consequences of the means employed in the business model.</td>
</tr>
<tr>
<td></td>
<td>Revenue Model</td>
<td>Describes the way a company makes money through a variety of revenue flows.</td>
</tr>
</tbody>
</table>

*Table 3-2: Osterwalder’s business model framework*

*Figure 3-5: Hamel's business model framework*

Relationships between each of these three frameworks and ICT\textsuperscript{E}s are rich in nuances that are much more profound and subtle than is possible to highlight here. Careful study of these relationships can be most revealing for SME managers as well as for ICT\textsuperscript{E} developers, vendors and integrators. Considering the impact of ICT\textsuperscript{E}s as implicit embodiments of information designs on overall business design, it appears opportune to question what it means to be a manufacturing SME. The megatrends identified above foreshadow a future where numerous SMEs would mostly be nervous systems capable of doing business with subcontractors and partners around the globe. In other words, even if the value creation web as a whole maintains the manufacturing character which is central to the manufacturing SME, it is far from obvious that the SME which evolves into a manufacturing web orchestrator will maintain such a manufacturing character itself. It is more likely that it could be conceptualised as a piloting or orchestrating SME, with or
without internal manufacturing capacity. This questioning is already pertinent at a time when numerous enterprises increasingly source their products from foreign countries.
Part II: ICT & Business Performance of SMEs

1. Introduction

SMEs use ICTs both as input in the production process, and in the transaction process selling their products or acquiring inputs. ICTs can enhance enterprise performance through indirect cost saving such as labour costs and increased labour productivity, and direct cost reduction of firm's input such as information costs. On top of these short-run impacts of ICT adoption in the production process, the use of ICTs in the transaction process can foster input and output market expansion. However, in the long run, ICT may have an even bigger impact as it can completely restructure the production process and transaction methods, increase flexibility and improve outputs. Though ICTs can influence the performance of an enterprise in multifaceted ways, we limit ourselves only to ICT effects on enterprise return, labour productivity and market expansion.

Despite the potential benefits of ICT and e-commerce, there is debate about whether and how their adoption improves firm performance. Use of and investment in ICT requires complementary investments in skills, organisation and innovation and investment and change entails risks and costs as well as bringing potential benefits. While many studies point to the possibility of market expansion as a major benefit for SMEs, larger businesses can also expand into areas in which SMEs dominated. Moreover, it is not easy for SMEs to implement and operate an on-line business, as this involves complementary costs for training and organisational changes as well as direct costs of investing in hardware and software solutions. The emergence of ICT is not only reshaping the business models but also intensely interlining enterprises across its internal as well as external value chain. In other words business enterprises are in the process of major transformation in order to meet the challenges of network economy. The role of ICT is redefined as a fundamental enabler in creating and maintaining a flexible business network of inter-organisational arrangements – joint ventures, alliances and partnerships, long term contracts, technology licensing, and marketing agreement. Traditionally in house developed customised MIS have been used to enhance business networking and now ERP systems, SCM systems, CRM systems and e-Business portals are being used to establish business networking systems. Most of the SME in India are in early stage of business networking as they have recently started adopting integrated information systems such as ERP and supply chain systems.
2. ICT adoption and firm performance

Recent Organisation for Economic Co-operation and Development (OECD) analysis shows the impacts of ICTs and e-business strategies on firm performance are positive overall, but that ICTs are not a panacea in themselves. The OECD’s Electronic Commerce Business Impacts Project (EBIP) studied a set of 220 early successful adopters of e-business strategies in a range of established sectors in eleven different countries. This study showed the positive impacts of e-commerce on their turnover and profitability and to a lesser extent on employment, most notably when e-commerce is part of larger business strategies of firms (OECD, 2002). Further work by researchers in 13 OECD countries based on large scale statistical surveys provides evidence that the use of ICT can contribute to improved firm performance, in terms of increased market share, expanded product range, customised products and better response to client demand. Moreover, it indicates that ICT may help reduce inefficiency in the use of capital and labour, e.g. by reducing inventories, and that the more customers or firms are connected to the network, the greater the benefits (spill over effects). However, the analysis shows that complementary investments in skills, organisational change and innovation are keys to making ICT work, and that the use of ICT affects firm performance primarily when accompanied by other changes and investments and that without these, the economic impact of ICT may be limited.

3. ICT and Return on Investment

An important characteristic of ICTs is that they are mostly scale neutral and available to small firms and poor countries as well, although access is restricted by poor infrastructure and high cost. The increased use of ICTs in enterprises leads to a substitution of ICT equipment for other forms of capital and labour and may generate substantial returns for the enterprises that invest in ICTs and restructure their organisation. However, though ICTs have high return potentials, they may erode a firm's profitability by integrating markets and exposing SMEs to competition. Particularly, SMEs in rural areas serve the local market niche and are protected against competition from bigger enterprises because of high information and communication costs, they are expected to face more competition and hence a reduction in monopoly rents.
4. **ICT and Market Expansion**

ICTs can cause the costs of input and output market interactions for an enterprise to drop. As a result, the costs for inputs can decrease as ICTs reduce information and search costs, and the price of output can raise as ICTs increase the effective price of output by reducing the search and information costs of trade.

Both the input and output markets in developing countries are characterised by imperfect and asymmetric information. As seller looking for a buyer is unlikely to be fully informed about all the potential buyers. Negotiation costs are also large. ICTs have the potential to improve seller-buyer communications. As a result, ICTs-particularly Internet-can change the way that seller-buyer matches are made, and SMEs can integrate themselves with the global market. In other words, the demand for a particular product produced by a SME may become less dependent on local market conditions.

5. **How Do SMEs Use ICT?**

SME usage of ICT ranges from basic technology such as radio and fixed lines to more advanced technology such as email, e-commerce, and information processing systems (See Figure 3-7).

![Figure 3-7: Progression of ICT Adoption](image)

Using advanced ICT to improve business processes falls into the category of e-business Cassidy (2002). However, not all SMEs need to use ICT to the same degree of complexity. The first ICT tool that most SMEs adopt is having basic communications with a
fixed line or mobile phone, whichever is more economical or most convenient for their business. This allows the SME to communicate

6. **What Types of Advanced ICT Products is SMEs Starting to Use?**

Like any firm, an SME decides which type of ICT products to adopt based on the concrete benefits they can bring to its core business, the ICT capacity of its employees, and the financial resources available. Most people are familiar with basic ICT such as fixed phone lines, mobile phones, fax, computers, and basic document processing software—like Microsoft Office. Advanced communication technology, however, is more complex.

Advanced communication technology relies primarily on the Internet and the intranet, which allow people within the firm to share files with each other over the same network. Having Internet connectivity enables firms to do faster research, set up websites, conduct e-commerce, and set up video conferences. One of the most revolutionizing developments in advanced communication technology is Voice-over-Internet Protocol (VoIP). VoIP includes all types of voice communication transmitted through the Internet, whether it is between computer and computer or in hybrid form between computer and regular phone. It competes directly with traditional fixed line and mobile phone operators. Users only pay for their dial-up, broadband, or wireless Internet connection. iSuppli, a market-research firm, estimates the number of VoIP residential users worldwide will reach 197 million by 2010 (The Economist, 2005). Most complex of all is advanced IT. It is often very expensive, sophisticated and takes more time to implement by a firm. SMEs can sign up for one or all available services. In order to reduce costs, some firms opt to outsource this component or use an Application Service Provider (ASP) that provides functional software capabilities over the Internet. Table 3-3 lists the major types of products.
Analysis of Impact of ICT on Performance of SMEs in Karnataka

Enterprise Resource Planning (ERP)
ERP offers a single repository for information on all business functions—human resources, manufacturing, inventory, marketing, sales, accounting, and tax. It allows all levels of a business to obtain real-time management information for their area of responsibility.

Customer Relationship Management (CRM)
CRM software integrates people and technology to maximise external relationships. Functionality includes: sales contact management, activity history, order entry, customer service and support, field service, lead generation, data mining, etc.

Supply Chain Management (SCM)
SCM software helps streamline the procurement of raw materials and delivering of finished products. It helps to decrease error rates, delays, and to increase efficiency. E-Procurement is often a part of SCM.

Enterprise Application Integration (EAI)
EAI integrates different types of ERP and other software systems through a common problem in order to synchronise the processing, storing, and transmitting of information.

Rapid Prototyping and Manufacturing (RPM)
Over the next 20 years, RPM will have a profound effect upon the global manufacturing technology. RPM can reduce the new product design phase from 90 days to just three days. It is still an infant industry based upon newly invented technologies, but it is apparent that RPM will dramatically reduce the cost and time required to convert a new product design to a practical manufacturing process.

Knowledge Management (KM)
KM systems help a firm to better organise and share the knowledge of its employees. They help the firm take better advantage of its human resources.

Table 3-3: Major Productions of Advanced Information Technology

<table>
<thead>
<tr>
<th>7. Why Should SMEs Adopt ICT?</th>
</tr>
</thead>
</table>

SMEs are often the main driver for a country’s economic growth. However, as the number of SMEs increases, competition increases, which then results in a decrease in prices, customer base, or both. This in turn will erode existing profits, creating less incentive for people to start SMEs. This dynamic is captured by balancing feedback loops where the greater the number of SMEs, the greater the competition, resulting in a slower rate of growth for SMEs (Figure3-8, left). To counter the increasing competition, firms can lower prices, increase promotion of their product, improve their product, add new distribution channels, and/or improve their internal processes (Figure3-8, right). The challenge is to counter competition when the firm still has the financial resources to do so. Otherwise, once the pressure of competition sufficiently erodes the SME’s profits, it will no longer have resources to counter the competition and will have to exit the market.
Foreign firms in both the import and export markets further add to competitive pressures, especially if they react faster to improve their product, process, promotion, or distribution channels. This is the problem of the Digital Divide. When firms in developed countries adopt ICT, firms in developing countries will lose out on the competition. This in turn can slow the growth rate of SMEs and hurt the economy as a whole. ICT can thus play a very important role because it can help SMEs both create business opportunities and combat pressures from competition. Appropriate ICT can help SMEs cut costs by improving their internal processes, improving their product through faster communication with their customers, and better promoting and distributing their products through online presence. In fact, ICT has the potential to improve the core business of SMEs in every step of the business process. Figure 3-9 uses Porter’s value chain to summarise various ways that ICT can benefit a firm.
Figure 3-9: Benefits of ICT Tools Categorised under Porter’s Value Chain

In countries where SMEs are only starting to adopt basic ICT, obtaining a fixed or mobile phone line can help their business. It can replace the time and costs necessary for face-to-face communication. In countries where SMEs already have basic ICT, adopting more advanced ICT still brings enormous benefits. Advanced communication technologies such as email can help firms communicate faster and cheaper with both its suppliers and clients.

8. Why Have So Few SMEs Adopted ICT?

Given the benefits that ICT can bring to SMEs, SMEs in most developing countries in the Asia-Pacific region still have been slow to adopt it. For example, 90 per cent of Thai SMEs still use basic communication technology such as fixed phone line and fax, and only 1 per cent use CRM software. Meanwhile, their counterparts in developed countries are using advanced ITs.

One cause of limited adoption is the lack of dynamism between ICT firms and SMEs outside of the ICT sector. ICT firms have not provided goods and services tailored to SMEs in the past because demand from SMEs has been low. However, their demand is low in part because ICT products available in the market are too complex and expensive. The result is a vicious cycle of limited supply and limited demand that ultimately excludes SMEs from the benefits of ICT.

Other factors also contribute to the limited supply and demand of ICT for SMEs:

A) Supply Side

- Poor communications infrastructure results in limited access and higher costs.
Many developing countries still have poor communications infrastructure. Out-dated equipment and state-owned monopolies often result in expensive charges and limited coverage, especially in rural areas. This discourages SMEs from adopting even the basic ICT of fixed lines or mobile phones.

- **Most advanced ICT products are designed for larger firms and not SMEs.**

ICT firms used to target large enterprises because they had a larger budget and were willing to pay for more complex ICT services. Their products are often too expensive and too complex for SME users. However, competition in this market is making firms—both large and small—turn their attention towards the untapped SME market (Lian and Lee Wei, 2005).

**B) Demand Side**

- **Limited ICT literacy of SME owners hinders their ability to choose the appropriate technology and understand the concrete benefits it can bring to their business.**

Many SME owners are unfamiliar with operating a computer, are skeptical of the concrete benefits to its core business, and have the stereotype that ICT is only for larger companies. Even if they have the will and financial resources to integrate ICT into their core business, SME owners are often at a loss when needing to choose the most appropriate and cost-efficient product.

- **Limited ICT literacy of employees in SMEs hinders ICT adoption.**

Even if SME owners have a strategic understanding of why they should adopt ICT, their staffs are often untrained. Training costs both time and money—resources that SMEs usually lack.

- **Adopting ICT is an adaptive challenge, not a technical challenge.**

Adopting ICT is a difficult task for companies of all sizes, whether they are in developed or developing countries. In fact, a lot of management literature focuses on the organisational changes that firms must go through in order to effectively adopt ICT because they change the way firms do business. While the changes may be beneficial in the long run, they often hurt one department and strengthen another. For example, Zhang Hongwei, senior consultant with D’Long International Strategic Investment, comments that “in order to make ERP’s cost-saving and efficiency-building features work, managers must be willing to take measures that can be anathema in the state-owned sector, such as selling businesses, laying off workers, and changing longstanding vendor relationships. All of this can be tough to
do” (Yinyu, He, 2004). Thus, SME owners are often reluctant to bring their firm through a learning curve that may be difficult and costly.

- **Lack of financing options limits SME ability to purchase ICT.**
  Lack of financing and appropriate technology is clearly a major handicap to developing country producers and exporters, and it inhibits developing countries from deriving full benefits from their trade rights.

  Rubens Ricupero, Secretary General of UNCTAD, 18 February 2002, Geneva SMEs usually have limited ability to make larger investments in their firm due to the lack of financing options. Given the financial squeeze, IT budgets are usually small or non-existent. In addition, adopting ICT is not a one-time cost because there are on-going costs of maintenance, upgrading, and human capacity building.

- **Lack of financial and legal infrastructure.**
  SMEs may still be hesitant to engage in e-commerce due to undeveloped legal policy for electronic payment and security issues. Many Asian banks, a key link in the e-commerce chain, have not even adopted online banking in their own systems.

  In the end, the definite costs of identifying the right goods and/or service, finding staff to manage it, taking the company up the learning curve, and obtaining financial resources are not perceived to justify benefits.

9. **Why Have Past Government Interventions Been Met with Limited Success?**

Many governments have not explicitly focused on ICT adoption by SMEs in the non-ICT sector. They have either focused on growing the ICT sector or supporting the growth of SMEs, but they have not focused on integrating the two areas to implement broad-based policies (see Figure 3-10). Since most SMEs who can benefit from the use of ICT are not in the ICT sector, they have not been able to receive the benefits.
In addition, workshops and training seminars, the most common way for governments to encourage ICT adoption by SMEs, often did not tailor the content to the type of audience (Srivastava and Teo (2004) and did not focus enough on the concrete benefits. To encourage SMEs to adopt ICT, efforts first need to concentrate on convincing top management that implementing ICT can improve their business, whether through cost savings or enabling expansion to new markets. This is because these managers determine the overall strategy of the firm, and they make the decision whether or not to adopt ICT. Middle management are usually the ones to implement the ICT project and thus need to have a deeper knowledge of how to implement it, so their training should include a mix of strategy and implementation skills. Frontline employees are the ones who will use ICT on a daily basis. It is therefore more important to concentrate their training on the actual skills required than on the strategic benefits of ICT. The difference in training based on the roles of people in the firm is characterised in Figure 3-11.
This framework is supported by ICT consultants in the field. Zhang Hongwei comments that, “top management and the quality assurance function in its broad sense are best positioned to be directly involved in pushing for ERP implementation, and the number two of a company should be the project leader” (Yinyu, He., 2004).

10. What is an Effective Strategy for Designing Policies and Programmes?
   A) Target entire industries that are most likely to benefit immediately from ICT.

   Targeting entire supply chains will allow the efforts to be more focused, specific and concrete. In terms of ICT adoption by SMEs, most countries are still at the beginning stages of the S-shaped technology diffusion curve. In order to induce mass adoption of ICT and be on the steeper slope of the S-curve, government efforts should target SMEs characterised as innovators and early adopters (see Figure 3-12). Beyond being risk takers, these SMEs should be firms that have the most contact with foreign suppliers and clients, which usually are the tourism/hospitality and export industries. Effective usage of ICT requires both parties to have compatible technology, and since their suppliers/clients most likely have already adopted ICT, SMEs can reap the benefits of ICT very quickly. Targeting supply chains and specific industries quickly increases the rate of adoption, which increases the total number of SMEs that use ICT. This will increase the overall awareness of the benefits of ICT and encourage adoption by other industries.

Analysis of Impact of ICT on Performance of SMEs in Karnataka
ICT adoption in tourism industries usually involves using advanced communication technologies such as email and the Internet. Having an online presence creates an important new marketing channel for the SMEs. In 2004, over 30 per cent of US adults used the Internet for travel research or bookings. The tourism board can play the role of creating a portal that leads to individual websites in order to help increase site traffic. It can also establish an e-commerce platform that SMEs can sign up for without having to adopt it themselves. ICT adoption in export industries often involves encouraging ICT adoption over an entire supply chain. Firms are more likely to adopt ICT if their peers, suppliers, and clients are adopting ICT as well. This can help increase the competitiveness of the industry as a whole.

B) Efforts to increase awareness should focus on concrete benefits, be industry specific, and target the right audience.

Governments need to understand where SMEs are in their decision-making process in order to conduct more focused workshops. Since adopting ICT requires investment in both time and financial resources, SMEs generally go through distinct stages of careful analysis (see Figure 3-13).
Initially, the SMEs become aware of the benefits that ICT can bring to their core business through channels such as word of mouth, media, and workshops. If they believe that ICT indeed has the potential to improve their business, they proceed to the next stage, where they consider whether or not to adopt ICT. In this stage, SMEs try to find out the exact costs and benefits of implementing ICT by obtaining price quotes and seeking advice from supporting agencies or other SMEs. The best way to describe the benefits of ICT is to use terms that the owners are familiar with, such as rate of sales growth, market share, and return on investments, cost reduction, and development of new products or markets. This way, SME owners can connect abstract ICT benefits with how ICT can concretely affect their core business. They need to internalise the benefits before they are willing to make an investment. When SMEs become convinced that the benefits do in fact outweigh the costs, they will begin to adopt ICT into their business practice. If the experience proves to be positive, SMEs may either increase their investment or move towards the final stage of using ICT to innovate in their business practices. SMEs generally prefer products and services that are easy to use, easy to implement, and low cost (Lian, Lee Wei, 2005).

C) Decrease the barriers to ICT adoption.

Even if SMEs are aware of the benefits of ICT, they will only adopt ICT if they can overcome the barriers to its adoption. The lack of affordable and accessible ICT infrastructure is the first obstacle that SMEs need to overcome, whether they are adopting basic ICT such as phones or more advanced ICT such as e-commerce (see Figure 3-14). The next obstacle is human capacity. Users must understand how to use ICT and how it will change the way they do business.

This obstacle is more prominent for advanced ICT such as e-commerce and ERP software than for basic ICT such as phone lines and fax. The third obstacle to overcome is financing. This is a problem for both basic and advanced ICT. Having the appropriate legal framework is the last obstacle to overcome because it mainly applies to online transactions.
SMEs can still adopt phone lines, email, and many e-applications without a well-defined legal structure.

*Figure 3-14: Barriers to ICT Adoption*

**Infrastructure**

Governments can help SMEs reduce ICT connection costs and increase coverage by further expanding its infrastructure, offering subsidies, encouraging ICT providers to have special discounts for SMEs, equipping incubators with ICT at a reduced cost, or allowing alternative methods of communication such as VoIP.

**Human capacity**

Ways that governments can help increase ICT adoption among SMEs include hosting training workshops that are flexible and tailored to specific industries, employees’ position and role, or software/hardware applications; providing subsidies for ICT training; and creating opportunities for firms to try the technologies hands on.

**Financing options**

Governments can increase the affordability of ICT through grants, credits, leasing options, and tax incentives. Government can also encourage the private sector to lend to SMEs in innovate on-payment options.

**Legal framework**

The government needs to take the initiative to establish the legal framework. This provided a foundation for key public and private sector leaders, including the Monetary
Authority, Cisco Systems, and Visa International, to develop more secure e-payment services over a public key infrastructure.

**D) Create locally relevant resources online.**

In a study commissioned by the Asia Foundation on ICT use among SMEs in Indonesia, Philippines and Thailand, results showed that SMEs use the Internet primarily for email and research, but only browse websites for promotions rather than for e-commerce due to security concerns.

**E) Partner with other organisations.**

Governments should partner with international organisations, industry associations, chambers of commerce, and local NGO/SME support agencies in order to obtain technical expertise, financial support, and local knowledge.

*International organisations*

International organisations can offer regional knowledge-sharing and training workshops, provide funding support, help build local capacity, and organise technical cooperation arrangements between countries within the region. For example, UNESCAP created the Asian and Pacific Centre for the Transfer of Technology (APCTT) to promote the transfer of technology to and from SMEs in the Asia-Pacific region. The Association of Southeast Asian Nations (ASEAN) has hosted the e-ASEAN Public Key Infrastructure Forum, the Cyberlaws seminar, and e-commerce programmes to create business environments that support e-commerce development in the region and SMEs in international trade. It has also published a framework to assist countries with the development of e-commerce legislation. The International Network for SMEs (INSME) is an international association with a mission to stimulate trans-national cooperation, and public and private partnership in the field of innovation and technology transfer to SMEs.

*Local industry associations*

Local industry associations can leverage their existing membership base to diffuse information and create programmes. Their specific know-how of the industry can help create workshops that are more relevant to the needs of SMEs and can highlight industry-specific benefits. They are a key local partner in encouraging ICT adoption by industry.

*Chambers of commerce*

Similar to industry associations, governments can use their network and membership base to diffuse information and implement programmes.
**Local NGO/SME support agencies**

Local NGOs and other SME support agencies can also help implement various programmes. For example, they can create portals, provide training programmes, help organise entrepreneurs at the grass-roots level, and provide low-cost or free ICT consulting services for SMEs.

In conclusion, the overall strategy targets entire industries that are most likely to benefit immediately from ICT, increases awareness on industry-specific and concrete benefits, decreases barriers to ICT adoption, creates locally relevant resources online, and partners with other organisations.
Part III: ICT & Competitive Business Advantage

1. Introduction

There are two forms of competitive advantage: cost advantage and differentiation advantage (Porter 2004). Cost advantage exists when a company provides the same products or services as competitors, but at a lower cost. A differentiation advantage exists when a company can provide greater value at the same cost or lower than competitors. Competitive advantages can be created through innovation, efficiency, quality, and customer responsiveness. In ICT SMEs, the competitive advantage often comes from differentiation advantage. According to Smith (2005), that innovation is “essential to the long-term survival of an enterprise and to the maintenance of its market share and competitive advantage.”

2. Definition of Competitive Advantage

A competitive advantage is an advantage over competitors gained by offering consumers greater value, either by means of lower prices or by providing greater benefits and service that justifies higher prices.

3. Competitive Strategies

Following on from his work analysing the competitive forces in an industry, Michael Porter suggested four “generic” business strategies that could be adopted in order to gain competitive advantage. The four strategies relate to the extent to which the scope of businesses' activities are narrow versus broad and the extent to which a business seeks to differentiate its products. The four strategies are summarised in the figure 3-15 below:
The differentiation and cost leadership strategies seek competitive advantage in a broad range of market or industry segments. By contrast, the differentiation focus and cost focus strategies are adopted in a narrow market or industry.

A) **Strategy - Differentiation**

This strategy involves selecting one or more criteria used by buyers in a market and then positioning the business uniquely to meet those criteria. This strategy is usually associated with charging a premium price for the product—often to reflect the higher production costs and extra value-added features provided for the consumer. Differentiation is about charging a premium price that more than covers the additional production costs, and about giving customers clear reasons to prefer the product over other, less differentiated products.

Examples of Differentiation Strategy: Mercedes cars; Bang & Olufsen

B) **Strategy - Cost Leadership**

With this strategy, the objective is to become the lowest-cost producer in the industry. Many (perhaps all) market segments in the industry are supplied with the emphasis placed on minimizing costs. If the achieved selling price can at least equal (or near) the average for the market, then the lowest-cost producer will (in theory) enjoy the best profits. This strategy is usually associated with large-scale businesses offering "standard" products with relatively little differentiation that are perfectly acceptable to the majority of customers. Occasionally, a
low-cost leader will also discount its product to maximise sales, particularly if it has a significant cost advantage over the competition and, in doing so, it can further increase its market share. Examples of Cost Leadership: Nissan; Tesco; Dell Computers

C) Strategy - Differentiation Focus

In the differentiation focus strategy, a business aims to differentiate within just one or a small number of target market segments. The special customer needs of the segment mean that there are opportunities to provide products that are clearly different from competitors who may be targeting a broader group of customers. The important issue for any business adopting this strategy is to ensure that customers really do have different needs and wants—in other words that there is a valid basis for differentiation—and that existing competitor products are not meeting those needs and wants. Examples of Differentiation Focus: any successful niche retailers; (e.g. The Perfume Shop); or specialist holiday operator (e.g. Carrier)

D) Strategy - Cost Focus

Here a business seeks a lower-cost advantage in just on or a small number of market segments. The product will be basic—perhaps a similar product to the higher-priced and featured market leader, but acceptable to sufficient consumers. Such products are often called "me-too's". Examples of Cost Focus: Many smaller retailers featuring own-label or discounted label products.

4. E-commerce and competitive strategy

ICTs can be employed to aid all three of the main strategies listed above. Applying e-commerce technologies to the supply chain, for instance can reduce costs, allowing a company to gain advantage through the ability to sell their product cheaper. In addition, ICT can be employed to differentiate product by providing superior services and allowing the company to respond better to customer requests and requirements. ICTs can also help focus by allowing the company to more easily reach the niche market, obtain better customer requirements, and more simply customise their products and services to the needs of the customer.

Analysis of Impact of ICT on Performance of SMEs in Karnataka
5. What are the Stumbling Blocks for SMEs in Using ICT as a Competitive Tool?

There are a number of stumbling blocks or barriers that make it difficult for SMEs to adopt ICT. Ngwenyama and Morawczynski (2007) argue that everyone assumes that ICT will successfully bring about benefits, but not all environments are the same. The issues affecting successful implementation or adoption of ICT are both socio-economic and technological.

MacGregor and Vrazalic (2006) agree with the findings of Ngwenyama and Morawczynski (2007) that the barriers to adopting ICT by SMEs are both socio-economic and technological, by pointing out that the barriers can be caused by factors external and/or internal to the organisation, which in this case is the SME.

Ritchie and Brindley (2005) mainly look at the barriers or diffusion agents that prevent the SME from adopting ICT. They group them into the following areas:

- Strategic. This level addresses issues that impact on the direction of the business (business strategy), capital investments and networks in relation to ICT. SMEs should formulate their own IT/ICT strategic objectives.

- Technological. This level deals with issues relating to the complexity of technology and professional support for the technology in relation to the production of goods and services. This level should underpin the above level of strategy, by implementing IT/ICT strategic plan in order to build a good IT/ICT architecture.

- Organisational and behavioural. This level deals with issues that relate to the personality, such as capacity and risk perceptions. These also underpin the strategic level but the focus is on supporting the business process.

The focus of this section is on the above three areas, which reflect some socio-economic issues. Yes, ICT is an enabler and it has a number of benefits, as highlighted by Tregurtha and Vink (2002), such as reduction of cost, network scale and improved service levels, but it is very important to look at the ability of the SMEs to leverage ICT and get the best benefit for their particular model of business.

The lack of knowledge about the strategic use of ICT and lack of the necessary IT skills are the two key issues. Other stumbling blocks are the perceived cost of ICT and the ever-changing ICT environment, together with geographical factors such as rural versus urban areas, as discussed below.
A) Lack of knowledge about the strategic use of ICT

There is a lack of knowledge about the potential benefits of ICT and strategies to support SMEs in achieving their business objectives. As mentioned before, SMEs face the challenge that generally they are owner managed and the owner makes all or most of the decisions about the business (strategic direction). Unfortunately the owner-manager’s limitations become limitations of the business. This barrier can be classified as a strategic level problem. ICT needs to be considered a key player in the SME reaching its goals.

B) Lack of necessary IT skills-base

As already expressed, the owner is the centre of the business, making all or most of the decisions in the small business, so the adoption of ICT by the small business depends on the owner’s ICT skills, personality and attitude towards technology. The IT-skills problem forms part of the bigger problem of a shortage of specialists in IT/ICT. However, the owner-managers’ attitudes towards ICT and its value needs to change, and each SME needs expertise to work with. Pervasive use of ICT in the economy depends on well-trained human resources for developing relevant applications, supporting and maintaining systems (Mutula and Van Brakel, 2007).

If they have a well-trained ICT staff, SMEs are likely to adopt and use ICT as a competitive tool successfully. Martin (2005) highlights his findings that successful Internet adoption depends on different roles of employees and uses combat names to describe them, such as warriors, interpreters, clerks and priests. The main aim for using such names was to make them easy to relate to and to give them the kind of responsibility and respect associated with those roles.

The separate roles are described in the following way (Martin, 2005):

- Warriors (leading the way to adoption). This role is the driver of the adoption process, and the person in this role should be passionate and support the adoption. This person does not necessarily need to be a technical person but needs to have a high purpose for the adoption (business reasons). Normally this person is the owner-manager.
- Interpreters (translating the technology to the ordinary employee). This role is that of the person who understands the technology and can sell this to the rest of the employees of the small business, enabling them to understand it.
• Clerk (the administrator of the adoption process and documentation keeper). This role is that of “bringing order to chaos” (Martin 2005:196). What this means is that this person should be an administrator and should organise the information of the adoption process and make sure that the staff know where to get what information in order to make it easy.

• Priest (technology specialist). This role is that of the specialist, the person who gives direction with regard to technology best practices, which application to go with, turnarounds, and the like.

The important thing here is that different roles are essential in achieving a good implementation and separation of duties. The roles can be named in any way that staff can relate to and understand.

This stumbling block to the adoption of ICT can be classified under both the strategic and the organisational and behavioural levels of barriers. Getting the right skills is part of the strategic function of the organisation, since understanding that ICT plays a critical role in the business will help in planning the right budget, creating the right job description and knowing how to interview for ICT skills. The role creation covers behavioural aspects, making staff excited about ICT.

C) Perceived high setup cost

ICT is perceived to be expensive by SMEs so they often do not have a budget for it. ICT solutions are generally associated with millions of rands and stories of ICT solutions are synonymous with running over budget.

The other problem with regard to the cost of ICT is that SMEs may invest in unnecessarily big solutions due to sale pitches, hype of specific products or market patterns without considering their real need. Often they could have purchased a less complicated, smaller package or programme to meet their needs, and thus paid less. This would be like a farmer buying a 10 ton truck to deliver 200 kg of vegetables – it will work, but be inefficient and a waste of money. These are the kind of things that give SMEs the impression that the adoption of ICT is very expensive.

There are different types of costs associated with ICT: product/solution, development, connectivity, hardware, software, maintaining workforce and hidden costs such as annual license fees, upgrade fees, tanning fees etc. These costs can be overcome by having the right knowledge and know-how. For example, there are lots of Open Source Software (OSS)
programmes available—these are free or low cost ICT tools and solutions written by open source communities. These solutions can be used to support business. In terms of connectivity to the World Wide Web (Internet) is driving the cost of communication down through bodies such as ICASA. Such bodies are constantly forcing telecommunication companies like Telkom to reduce their rates and make communication affordable to everyone. Mobile operators also offer broadband technologies such as 3G or HSDPA (High Speed Downlink Packet Access) at a cheaper rate—these are accessible anywhere.

An SME with the right knowledge can use OSS solutions in order to run the business: solutions such as Skype (for free calls), Turbo cash (accounting software) and others can be combined to offer a total solution for all the business processes. The perceived high cost of ICT can be classified as a strategic and/or technological barrier. Technology can be expensive or cheap, depending on which technology platforms are chosen. Once more, understanding the role of ICT will make it easier for the business to achieve its goal. But the key thing here is understanding technology.

D) Ever-changing ICT environment

The ICT environment is ever changing, so constant learning and updating of technologies is needed. Technology is constantly evolving, getting faster, smaller, more powerful, or digital, for example. There are two issues here: on the one hand the SMEs need to monitor the kind of technologies that their clients are using and try to make sure that they are on a par in order to serve them. On the other hand the SMEs don’t need to change every time there is a change in technology; this depends on the focus area of the SMEs.

This latter situation is described in the focus-dominance model of Levy et al, (2001). The focus-dominance model is based on the dimensions of strategic focus (cost reduction versus value added) and customer dominance (few versus many customers). The model has four domains: coordination, efficiency, collaboration and innovation, which create competitive scenarios. Which domain the business falls into will determine the rate at which the business needs to change its technology. If an SME is doing business in the innovation and collaboration domain, it might require constant change of technology, while an SME that functions in the coordination and efficiency space is only required to change after a long time.
This stumbling block touches on all three categories of barriers and diffusion agents. The ICT strategy of the SME needs to take into consideration that technology changes at a rapid rate, the different technologies need to be monitored as they evolve into the future, and the staff need to be excited enough to have an interest in the changes as they happen.

E) Geographical factors

ICT makes it easier to reach remote or rural areas. However, there are other factors to be considered, such as the “FedEx effect” which affects deliveries: for instance, rural areas might not have proper address systems, or there might be no roads. South Africa faces the problem of underdeveloped rural areas and well-developed urban areas. Most rural areas lack resources and infrastructure and have no proper address systems. Fixed-line connectivity in rural areas is still a huge problem, though the use of cell phones is high. Another major problem is the high rate of illiteracy in the rural areas.

This barrier falls under strategic levels of diffusion agents. Issues such as the “FedEx effect” should be addressed at a strategic level. Taking the time to plan to overcome problems such as lack of roads and addresses will make implementation easier.

6. Possible benefits of ICT to SMEs

The drive to adopt ICT is based on the perception that ICT will bring about specific benefits. These benefits differ from business to business. The possible benefits of ICT within the SME include the ability to:

- Reduce cost and operational efficiency
- Work remotely
- Reduce the price by increasing turn-around period or using OSS
- Grow the market share by exposure to a wider client base.

According to Alexander (2008), some of the technologies or tools that SMEs can benefit from and that will help realise the above benefits are:

- Video conferencing. This enables “real time, face-to-face communication with partners, clients, contractors and employees over a broadband network” (Alexander, 2008:3). Video conferencing can benefit the SME in a number of ways by, for example, reducing costs because of fewer expensive trips and hotel stays, reducing
time spent travelling and away from work, still providing the rich content that you would receive from a normal phone call, and allowing meetings to be held more regularly than trips can be planned. Alexander (2008) points out that video conferencing promotes greater communication in the following ways: you can see non-verbal signals that you do not get through a normal phone; you can present more information, for instance with slide shows; demos and training can be done through video conferencing; and staff in different geographical areas can benefit. The magnificent thing about video conferencing is that you can use technologies such as VoIP and OSS, so you will pay next to nothing for your communication. Thus the SME does not need to invest in expensive equipment – it can use platforms such as Skype and Gtalk. Using these technologies can save the small business travelling expenses.

- **Extension mobility.** “Wireless and mobile technologies increase efficiency and productivity by extending the footprint of your office, delivering information and applications to your employees when and where they need it” (Alexander, 2008:3). This enables one to work remotely with a “virtual office”. The benefit to the SME is a saving on rental space, and, if a job requires staff to be on site at the client’s premises, the faster deployment of work to staff while they are on the road. This can be done through the use of IP networks, VoIP tools, the cell phone as a tool, and web-based solutions. Once again the cost of these solutions is cheap compared with normal telephone or travelling costs.

- **CRM.** According to Alexander (2008), CRM technologies are designed to help the business, in this case the SME, have a better understanding of its clients. CRM is often described as having a 360 degree view of the customers, meaning knowledge of all the touch points (communication) that the customer makes with the business and the ability to analyse them to gain a better understanding of the customer’s future needs. For example, knowing that a client has done a certain kind of business with the company, allows the company to follow up on the last service and offer more related solutions. Alexander (2008) explains that you can link your CRM solution with your IP phone, so when a client calls, it pops up the client’s history window. Thus before you answer you already know a lot about the person phoning, and you can address them by name, thus improving the customer’s experience.
• **Unified messaging.** This “is a solution that streamlines business communication, enabling employees to send and retrieve their voice mail, e-mail and fax messages from one device—either their computer or IP phone” (Alexander, 2008:5). The main benefit of unified messaging is saving time and money by viewing all messages on one device. There are free or very cheap solutions that can be downloaded from the World Wide Web.

7. **Ways in which SMEs could use ICT to become competitive**

Schubert and Leimstoll (2007) touch on an important question, that of ICT value. According to Schubert and Leimstoll (2007), there are two schools of thought with regard to the issue of ICT value. The one, known as Porter’s theories, says that ICT adds value to SMEs and the other, known as Millar’s theories, believes that ICT does not really add any value since it is a commodity, just like electricity, available to everyone. In conclusion they agree that competitiveness of an SME depends on the ways in which ICT is used to support business processes. So having ICT implemented in a business does not necessarily give the business any competitive advantage, but having it linked to the business processes and strategy will most likely give a competitive advantage.

In general it appears that SMEs that employ ICT according to the critical success factors below have a better chance of becoming commercially successful, according to Taylor and Murphy (2004). The critical success factors are as follows:

- Owner motivation, experience and management skills
- Expertise in managing growth
- Access to resources (money, technology and people)
- Innovation, competitive advantage and flexibility
- Close contact with customers
- Focus on profit rather than sales
- Strong demand and operating in a growth market.

In order to achieve the above critical success factors, the SMEs need to embark on the following:

- They need to have a clear ICT strategy that will govern the adoption process within that particular SME.
• They need to make sure the ICT strategy is aligned with the business strategy, which means that the ICT strategy should support and achieve business goal.

• The SME should make sure that it employs the right skills (permanent or contracted) and identifies the roles that these skills will play in making sure that the SME is successful in leveraging ICT.

These three steps will be discussed in detail below.

A) Set up of the ICT strategy

SMEs need to define an ICT strategy for the business; this will help the business understand the potential of ICT and outline the processes and methods to be followed during adoption. SMEs need to recognise the impact of ICT on their business and should invest in efforts to take advantage of it.

The owner-manager needs to understand that he cannot be everything in the business and needs to employ or outsource the ICT function. Software is becoming a service: a good example is ABSA bank, which is providing a payroll solution to its SME clients. For the SME, this leads to a reduction in the costs of developing or acquiring payroll solutions, and means that maintenance and upgrading of the solutions is taken care of. SMEs need to spend money and time on getting the relevant advice from ICT experts and consultants in order to set up the ICT strategy, based on the SME business strategy.

By defining the strategic objective of the SME, the SME can decide which strategic investment to make. Levy et al, (2001) have found that investment in ICT is successful when it takes one of the following two forms: providing efficiency and savings, or enabling added value. The former form is taken by SMEs in the Low and Medium user of ICT groups where ICT is used for transaction processing and does not play a huge role, while the latter is adopted by the High user of ICT group; here ICT is used for technical and operational integration and inter-organisational integration.

The focus-dominance model in Figure 3-16 shows the different possible ICT solutions. As mentioned in this section, it is based on the following dimensions of the SME: strategic focus (cost reduction versus value adding) and customer dominance (few versus many customers) (Levy et al, 2001:135). Customer dominance refers to the power of the customers, as “SMEs are driven primarily by customer needs” (Levy et al, 2001:135).
The model’s four domains: coordination, efficiency, collaboration, and innovation, create competitive scenarios.

<table>
<thead>
<tr>
<th>Coordination</th>
<th>Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word processing</td>
<td>Word processing</td>
</tr>
<tr>
<td>Accounting</td>
<td>Accounting</td>
</tr>
<tr>
<td>Customer databases</td>
<td>Electronic business</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Efficiency</th>
<th>Collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word processing</td>
<td>Word processing</td>
</tr>
<tr>
<td>Accounting</td>
<td>Accounting</td>
</tr>
<tr>
<td></td>
<td>MRP</td>
</tr>
<tr>
<td></td>
<td>EDI</td>
</tr>
</tbody>
</table>

**Figure 3-16: The focus-dominance model (Levy, Powell & Yetton, 2001: 136)**

The small business would need to identify the quadrant into which it falls in the above focus-dominance model, by determining whether it’s strategic focus is cost saving or value-adding, and then determining whether the customer dominance is high or low. For example, if the majority of the clients of the SME (high customer dominance) use a specific technology, then it will influence the ICT adoption. Once the strategic positioning is done then the focus will be on getting the right tools and technology to achieve the strategy.

**B) Alignment of business strategy with ICT strategy**

Aligning the ICT strategy with the business strategy will ensure that ICT is used to deliver on the SME’s objectives. The ICT strategy design should be based upon the business strategy, as the SME should not be driven by technology needs but by business needs. Earlier research on this topic was focused more on the technology perspective and the management and organisation of technology perspectives, overlooking the small firm’s perspective, but now the focus is moving towards the relationship between SMEs and ICT from the small firm’s point of view. Authors have begun to take the latter perspective more seriously because they have seen the importance of ICT supporting the business process.

**C) Identification of adoption roles**

Identification of the roles needed for adoption will help the SME understand the skills and knowledge needed to adopt ICT. The four roles discussed above are not only important in the adoption of Internet use but can be used in the adoption of technology in general. The group of high users of ICT would have all four roles implemented, while the medium user of ICT group would have some of those roles but not all of them.
Part IV: ICT Usage and Profitability of SMEs

1. Introduction

Informal businesses have a higher profitability in terms of fixed assets employed than semiformal ones, and semiformal ones a higher profitability than formal businesses. The Kruskal Wallis test shows that the result obtained is significant. This supports the intuition that informal businesses usually operate at a higher gross profit than formal ones. Informal businesses are not bound to minimum wages, can hire casual labour whenever needed, pay mostly no taxes, and operate on fewer infrastructures than formal businesses.

Chowdhury and Wolf (2003) used modified Cobb-Douglas production functions to investigate labour productivity and returns for an SME survey conducted in Tanzania and Kenya. Their main finding is that ICT investments have no significant impact on the return on investment of SMEs.

Failure to distinguish informal from formal businesses will hence lead to incorrect conclusions. Also, using production functions might not be an appropriate approach for dealing with SMEs. Production functions assume a certain relationship between inputs and outputs (Fandel, 2005). Most SMEs are not producing one product or service but more or less anything that makes money. An Internet cafe might offer tailoring and hair salon services at the same time. A locksmith might also fix cars on the side or do spray painting. It is often difficult to judge whether an SME is a manufacturing, a service or a retail/wholesale business because borders lines are fuzzy.

Wolf (2001) mentions that the focus on production processes might be too narrow and that ICTs might exert their influence through product-quality improvements and improved services. ICTs might additionally help SMEs in the administration of their businesses and enhance procurement and marketing processes.

Turnover functions are used to measure the impact of ICTs on the profitability of SMEs. All analysis is carried out separately for SMEs of different formality classifications. A turnover function can be specified as follows:

\[
\frac{F_1}{F_2} = \beta_1 + \beta_2 \left( \frac{F_2}{F_A} \right) + \beta_3 \left( \frac{F_3}{F_A} \right) + \beta_4 \left( \frac{F_4}{F_A} \right) + \beta_5 \left( \frac{F_5}{F_A} \right) + \beta_6 \left( \frac{F_6}{F_A} \right) + \epsilon
\]

where \( F_1 \) turnover; \( F_2 \) average water, electricity cost; \( F_3 \) average cost for one’s premises in terms of rent, land, taxes, and mortgage payments; \( F_4 \) average business expenditure on
telephone calls, fax, postage, and Internet; $F_5$ average wage bill; $F_6$ average direct cost (raw materials and other intermediary inputs or goods bought for resale); and $F_A$ total value of fixed assets.

2. ICT Impact on Labour Productivity

ICT usage also affects labour productivity positively (Stork, 2006). Labour productivity is usually measured by dividing value added of a business by its number of employees (World Bank, 2006). For SMEs a more meaningful definition would be to use value added per individual working full time in the business (i.e., full-time employees, owners, and family members who also manage the business).

Value added is defined as turnover minus direct costs, water, electricity, and any expenditure for premises. The equation below expresses labour productivity as a function of average salary (wage bill/full-time employees plus owners plus family members who run the business) and the ICT usage index. A positive significant coefficient for the ICT usage index would mean that higher ICT usage can be associated with higher labour productivity:

$$V/E_A = \beta_0 + \beta_1 \frac{W}{E_A} + \beta_2 ICTU + \epsilon$$

Where $V$ value added; $W$ average wage bill; $ICTU=ICT$ usage index; and $E_A=full-time employees and owners who manage the business$.

$W/E_A$ is hence the average wage and $V/E_A$ is labour productivity. The difference between informal and formal SMEs has been accounted for by using average wage as part of the independent variables.

Both the ICT usage index and average salary contribute significantly to explaining the variation in labour productivity among sampled SMEs.

Specifying a similar equation for the ICT possession index shows that ICT possession index equally variations in labour productivity:

$$V/E_A = \beta_0 + \beta_1 \left( \frac{W}{E_A} \right) + \beta_2 (ICTP) + \epsilon$$

Where $V= value added (turnover minus direct costs, water, electricity, premises, rent)$; $W= average wage bill; ICTP= ICT possession index; and $E_A= full-time employees and owners who manage the business$. 
Impact of ICT on profitability of SMEs and labour productivity including as:

- Informal businesses have a higher profitability in terms of fixed assets employed than semiformal ones, which in turn have a higher profitability than formal businesses. This is understandable, given that increasing formality encumbers a business, ensuring that it must follow certain laws in its operation, with the associated costs.
- ICTs are significant input factors for both formal and informal SMEs and contribute positively to revenue generation.
- ICT use increases labour productivity.
- Mobile phones have overtaken computers as tools in supporting the running of SMEs, given their prevalence and accessibility.
- The traditional focus on formal businesses particularly in terms of financial support under-mines the role that the informal sector plays in the economy. The fact that it is more difficult to measure does not diminish its impact. The fact that informal businesses are more profitable than formal ones raises the issue that some businesses might prefer to be out of the formal environment.

Mobile phones are used right across the formality index. This situation has arisen by default rather than through regulatory intervention. At an infrastructural level, the opportunity now arises, through liberalisation, to provide users with a wide range of competitive services that can drive increased access and lowered ICT costs.

The focus upon mobile technology is both an advantage and a disadvantage. It is an advantage because it provides an SME with a low cost base and at the same time the flexibility to communicate with suppliers and customers easily. It is a disadvantage because of its limited functionality in terms of its ability to develop as an SME develops and its high usage charges. At present, mobile phones cannot be used to track inventory, provide cash flow and income statements, or even more basically, produce formal letters, marketing campaigns, or brochures.

The impact of these findings from a policy point of view requires further study that is outside of the scope of this report. Suffice to say that there are several key recommendations. A policy focus should be to either encourage the development of SME-specific tools on the mobile phone or to encourage lower ICT (specifically computer) costs:
Well-designed phone- or SMS-based business applications may have an impact on the profitability of SMEs. One of the key factors in providing the informal sector access to credit is the lack of co-operation between mobile operators and banks, often as a result of poor regulation. For example, in many countries, mobile operators are not allowed to be banks, but since mobile operators have access to the informal sector they could effectively service this sector. Encouraging innovation and cooperation between mobile phone operators and banks on the mobile platform could deliver SMS based business applications.

ICT costs can be reduced by establishing a regulatory environment that facilitates competition in the ICT sector. Lower ICT costs could be achieved through regulatory interventions such as

- Introducing number portability between mobile phone operators;
- International gateways for mobile operators and Internet Service Providers;
- Introducing innovative approaches to fixed-line telephony such as prepaid mechanisms and fixed wireless access.

3. **Impact of ICT on Economic Growth**

The United Nations (UN) under its Millennium Development Goal (MDG) set a target of halving the number of people living in extreme poverty by the year 2015. In his Foreword in the UNCTAD (2002) report, the incumbent UN Secretary General, Kofi Anan warns that for the world to achieve the Millennium Development Goal in 2015, ICTs must figure prominently in the effort.

The Asian and the Pacific regions seemed to have heeded Kofi Anan’s warning and embraced ICT in their business practices. It is no surprise therefore, that they fare a lot better in their ICT acquisition and utilisation. This has also given rise to a very sharp rise in the number and volume of ‘off-shore’ businesses that endlessly service the IT needs of the developed countries of Europe and North America. They are also leading players in the deployment of crucial broadband technologies. The governments in these regions make conscious efforts to promote computer and Internet awareness among the populace.

In India for example, apart from the famous “hole-in-the-wall” project hailed by experts as ground breaking, there is also the SARI (Sustainable Access in Rural India) project that has led to improvements in health, empowerment, learning, and economic developments.

*Analysis of Impact of ICT on Performance of SMEs in Karnataka*
amongst the poorest and most disadvantaged communities in India (Warschauer, 2002; Mitra, 2002; Pentland et al, 2004). SMEs, entrepreneurs and individuals in those villages now use the technology in providing e-services like email, voice mail, telemedicine clinics and some forms of e-government like tax returns and enquiries. There are also similar projects e.g. the Grameen Village Pay Phones and the Gyandoot Rural Intranet (Bhatnagar, 2003). Research has shown that the better the quality of goods and services being offered by an organisation, the higher their growth potentials (Oniki, 2003; Ojukwu, 2003). There is also considerable evidence to suggest that the introduction of new technology into organisations of all kinds and sizes has a major impact on the structure and functioning of those organisations (Twist, 2000). The adoption of what Varian et al (2002) called the “Internet Business Solution” in the United Kingdom, France and Germany for instance, has resulted in a current, cumulative cost savings of E9 billion (9 billion Euro) to the organisations deploying them” (Varian et al, 2002).

Furthermore, there is the SARI project in India which has demonstrated that the creation, deployment, and delivery of information and communication services and technologies in poor rural areas leads to improvements in health, empowerment, learning, and economic development amongst the poorest and most disadvantaged communities- and that such services can be realised in an economically sustainable fashion. Villagers in the areas where this project is operational now get affordable Internet services that they are also using (Pentland et al, 2004).

Khalil (2003) established that there is a direct link between information access and poverty reduction.

According to Madon (2000), electronic communication can assist in the management of crises and poverty alleviation amongst international organisations.

Earl (1988) advances four reasons why every organisation that wants to survive must commit itself to a great deal of investment in these technologies: a) To gain competitive edge; b) To improve productivity and performance; c) To facilitate new ways of managing and organising; and d) To develop new businesses.

In cross country studies of growth that mostly include developed and developing countries the availability of telecommunications infrastructure is often found to contribute significantly to GDP growth besides other knowledge related indicators such as education.
This implies that if investment is made in communications infrastructure and complementary factors at the same time considerably higher growth rates can be achieved (World Bank 2006).

However, another study using an inter country Cobb-Douglas production function finds that returns on IT capital are positive and statistically significant only for industrial countries and not for developing countries. The authors conclude that a minimum requirement of infrastructure and other complementary factors is needed for ICT investment to be productive (Dewan and Kraemer 1998). As the study is based on 1985-93 data especially in the poorer countries the new generation of ICT was only very thinly spread and therefore it is not surprising that no overall effect on the economies could be found. These results are largely confirmed by Pohjola (1999) using an augmented Solow model where neither human capital nor information technology seems to have a significant impact on GDP growth. As the relation between GDP per capita and ICT runs in both directions because ICT is not only a production input but also a consumption good it is difficult to separate the impact from the determinants of ICT investment.

This is one possible explanation for the productivity paradox that firms especially in industrial countries but lately also in developing countries have invested heavily in ICT leading to the high growth rates in the ICT sector but overall productivity growth has slowed down at the same time compared to the 1970s where no Internet, mobile phones etc. existed. Other explanations are the time lag between purchasing and effectiveness of ICT due to learning and adjustment requirements. Furthermore the effects will be different for different sectors and enterprises in the economy. Maybe a more important explanation given by Avgerou (1998) is that ICT can only have a positive impact on performance when institutions are adapted through changing incentives and relative costs. This applies to market institutions in general with defined property rights etc. that have to be in place for ICTs to lower transaction cost. But also in the ICT sector itself the institutional background is crucial for the provision of adequate technologies.

4. ICT and SME Competitiveness

Flexibility is considered to be a major source of competitiveness for SMEs compared to larger enterprises. The use of ICT could now on the one hand increase the competitiveness of
SMEs as they enable the creation of more flexible links with trading partners because of faster and more reliable communication channels. On the other hand ICTs could help bigger enterprises to increase their flexibility through a restructuring of the organisation which will enable them to adapt quicker to changing conditions. Therefore the competitive advantage of SMEs could also decline.

In general SMEs rely much more on informal information systems than larger enterprises. To get the relevant information that is needed for a rational decision is not costless especially as in SMEs usually there is only one decision maker - the owner/manager - whose personal resources (time, knowledge, and capabilities) are restricted. However SMEs have the advantage of smaller internal coordination costs, as all decisions are made by one or few people (Muller-Falke 2001).

External transaction costs are associated with the initiation, negotiation and enforcement of contracts. Especially the Internet helps to screen the enterprises’ environment for relevant information and thereby get information about sellers and customers that were previously out of reach. However for the actual delivery of goods and the transmission of payments also other infrastructure like transport and a reliable banking system has to be in place. With the use of ICT transaction costs could be lowered and therefore the economies of scale in exporting can be reduced. This will enable SMEs not only to stick to local markets but to expand regionally and internationally. On the other hand many SMEs that are located in rural areas serve the local niche market and are protected against competition from bigger enterprises because of high transport and communication costs. Therefore ICT might also increase competition for these enterprises, so they either have to become more productive or to close down.

There are hardly any studies that analyse the effect of ICTs on small enterprises in developing countries, partly due to data problems. Muller-Falke (2001) finds for Indian manufacturing SMEs that enterprises that use more advanced forms of ICT have on average a higher labour productivity and a higher growth rate. In a survey of 59 electric and electronic manufacturing Indian SMEs mainly employing less than 50 people, Lal (1996) observed higher profit margins, skill intensity and export and import intensities for firms using IT. There is also some evidence that export performance of SMEs is related to ICT adoption (Lal 1999, Nassimbeni 2001). However it is not the investment in the technology alone but the combination with other technologies and especially relevant skills that make ICT work.
A more qualitative study by Duncombe et al, (2001) stresses the different information and ICT needs for different types of SMEs. They conclude that smaller SMEs with little working capital rely mainly on informal information from known sources where personal relations and trust plays a major role. For these enterprises ICTs are of minor relevance and only telephone can help to increase access to this kind of information. As phones can help to extend social and business networks and in some cases substitute for journeys and business intermediaries access to telephone services should be given priority.

However, for bigger SMEs that are growth oriented, belong to the formal sector, are export oriented etc. information becomes more important and therefore more advanced ICTs can be helpful for building business linkages. The survey SMEs in Botswana revealed the biggest information gap in market information pertaining to new customers and the need to expand into export markets. Information is also lacking about external finance and sources of skills and training. This lack of information was found to raise costs and reduce income. “ICTs can reduce time and money costs of business processes and can improve the certainty and quality of those processes.” These benefits occur mainly in enterprises with bigger size and specific sector of operation such as manufacturing exporters and the tourist industry, where the Internet can be used as a marketing tool.

5. Definition of Performance

Performance is a widely used concept in many areas. Usually, performance is a measure of how well a mechanism/process achieves its purpose. In enterprise management, Moullin (2003) defines an organisation’s performance as “how well the organisation is managed” and “the value the organisation delivers for customers and other stakeholders.” For the purposes of this research, ‘performance’ is related to achieving stockholder/investor interests.

Measuring performance is a multi-dimensional concept. Effectiveness and efficiency are the two fundamental dimensions of performance; this is emphasised by Neely, Adams et al, (2002): “Effectiveness refers to the extent to which stakeholder requirements are met, while efficiency is a measure of how economically the firm’s resources are utilised when providing a given level of stakeholder satisfaction”. To attain superior relative-performance, an organisation must achieve its expected objective with greater efficiency and effectiveness than its competitors (Neely 1998). To illustrate...
efficiency, effectiveness, and the value delivered, multi-measures should be used. Though their forms vary widely, financial indicators are traditionally used; Neely (1998) further expounded upon manufacturing performance measures, suggesting that five key-dimensions should be assessed: quality, delivery speed, delivery reliability, price (cost), and flexibility. By measuring all of these factors, performance is thus balanced and multi-dimensional, better reflecting stockholder interest.

6. Definition of Performance Measurement

Although much research has been conducted on the issues of Performance Measurement (PM) the definition of performance measurement is still debated. Neely (1998) defines Performance Measurement as “the process of quantifying the efficiency and effectiveness of past actions through acquisition, collation, sorting, analysis, interpretation and dissemination of appropriate data.” Moullin (2003) thought that while Neely’s definition describes the process, “it does not give much guidance to organisations about what it is essentially all about.” He suggests that another definition may be more apt: “performance measurement is evaluating how well organisations are managed and the value they deliver for customers and other stakeholders” (Moullin 2003). Moullin (2003) argued that his definition clearly shows the purpose of performance measurement and emphasises the assessment both of the value an organisation gives to its various stakeholders and the way the organisation is managed. Nanni et al, (1990) defined performance measurement as “a means of monitoring and maintaining organisational control which is the process of ensuring that an organisation pursues strategies that lead to the achievement of overall goals and objectives.” Amaratunga and Baldry (2002) provided a more specific definition of PM: “Measurement provides the basis for an organisation to assess how well it is progressing towards its predetermined objectives, helps to identify areas of strengths and weakness, and decides on future initiatives, with the goal of improving organisational performance.” This definition illustrates the role and the process of PM clearly from different aspects.

As identified from the above definitions, performance measurement is a structured system and a process of gathering, monitoring, and assessing the information about an organisation’s activities, in order to achieve the proposed goals and objectives. In this
study, the goals and objectives concern an organisation’s strategic objectives, a business unit’s business goals and objectives, and personal business commission.

7. Functions of performance measurement

Generally, the function of PM can be categorised into the following four aspects (Neely 1998):

- Checking position. Establishment of current status and monitoring of progress over time and against benchmarks.
- Communicating position. Communicate with shareholders, customers, or employees by releasing annual reports, etc.
- Confirm priorities. Performance data provide insights into what is important to a business, thus exposing shortfalls that allow organisations to identify priorities.
- Compel progress. The measures can help organisations focus on specific issues and encourage people to search for ways to improve performance. The measures communicate the priorities and can form the basis for reward.

The above summary actually suggests a clear flow map for PM. Indeed, many SMEs apply PM for quality management. It is observed that the above four points cover the roles of PM from the perspective of quality management (Oakland 2004):

- Tracking progress against organisational goals (represented in the above point (1));
- Identifying opportunities for improvement (represented in the above points (3), (4));
- Comparing performance against internal standards (represented in the above points (1), (2));
- Comparing performance against external standards (represented in the above points (1), (2)).

Therefore, the role of performance measures is to control processes and to enforce continuous performance improvement by quality improvement teams. That is, measures should supply information about how well processes and people perform, the goal of which is to motivate better future performance.

An in-depth illustration of the above functions (3) and (4) of performance measurement is made in (Godener & Soderquist 2004), which summarised the use of
performance into four groups, based on Kerssens-Van & Bilderbeek’s (1999) study of 19 uses of performance on four different organisational levels.:

- Use of performance measurement results for personnel evaluation, promotion and incentives (promotion prospects, salary, project participation, bonuses)
- Use of performance measurement results for resource allocation (project participation, forming/dissolving teams, assignment of new projects and of resources)
- Use of performance measurement results for control/correction (control, correction, reorganisation)
- Use of PM results for learning/continuous improvement

Note the usage of performance measurement results for resource allocation is highlighted in Godener & Soderquist (2004)’s summary. This is important for SMEs, whose development is usually limited by resource.

8. Overview of performance measurement Frameworks

To overcome the shortcomings of traditional measurement systems, various holistic performance measurement frameworks were developed after the late 1980s. The common, changed approach in each of the theories echoes a multi-dimensional approach, which seeks to balance financial and non-financial measures. Kennerley & Neely (2000) had summarised the characteristics of PM frameworks:

- The measures used by an organisation have to provide a ‘balanced’ picture of the business.
- The framework of measures should provide a succinct overview of an organisation’s performance.
- The performance measures should be multi-dimensional.
- The Performance Measurement Matrix (PMM) provides comprehensive mapping. It is possible to map all possible measures of an organisation’s performance onto the framework and identify where there is omission or a need for greater focus.
- The performance measures should be integrated across the organisation’s functions and through its hierarchy.
The performance measurement system can provide data for monitoring past performance and planning future performance. It implies the measures should measure both results and the drivers of them.

Although quality management models—such as the European Foundation for Quality management (EFQM) excellence model, the Malcolm Baldrige National Quality Award (MBNQA) and Australian Business Excellence (ABE) framework—are not designed for PM, they act as tools of managing performance and are often used to help an organisation to improve performance practice. These quality management models are also self-assessment frameworks. In PM aspect, they provide:

- Measuring both performance results and drivers of them. For example, the EFQM Excellence model divides the excellence criteria into two groups: the enablers and results.
- Focusing measures on strategy and process
- Involve all employees in the continuous improvement process to achieve better performance.
- Comprehensive measures including society indicators
- Improved performance, based on innovation, learning, and information analysis.

Besides these models, many other PM theories and methods are applied in practice, such as Key Performance Indicators-system (KPIs), benchmarking, and so on. These theories and models discuss the issue of PM from different perspectives, the relative strengths and weaknesses of which are presented in the following paragraphs.

9. Performance Measurement for SMEs in ICT Industries

During the past two decades, SME performance has been studied by a number of scholars. Most research focuses on the analysis of performance determinants, in which critical success-factors were identified by researching relationships between input-factors and performance. This section builds on previous research about SME performance measurement, in which the features and requirements for PM in SMEs are generalised and discussed. Further, a conceptual PM framework for SMEs is developed.
10. The Requirements of PM in SMEs in the ICT Industries

Many scholars (Storey 1994; Garengo, Biazzo et al, 2005) believe that there are three fundamental differences between small and large firms: environmental uncertainty, innovation in products and service, and sustained evolution. Hence, PM is often used in SMEs to manage uncertainty, to innovate products and services, improve their processes, and benchmark against competitors (Garengo, Biazzo et al, 2005).

For SMEs in the ICT industries, one critical success factor is related to tracking technological trends in order to formulate informed strategies. In this way, PM in SMEs not only helps to deploy and execute strategies, but also to correct current strategies. Many scholars (Bititci, Carrie et al, 1997; Mike Bourne, Wilcox et al, 2000) agree with the opinion that a PM system should also support the definition, development, and evolution of strategy. This is a minority view, however, that contrasts with the widely accepted opinion that a PM system should derive from the company strategy; in their counter, these scholars argue that a PM system and strategy should be separated but interrelated. In SMEs in the ICT industries, developing a right business strategy is more difficult than deploying a proposed strategy. Hence, it is critical for PM to help SMEs develop its strategies.

SMEs are not typically well-endowed with resources and, as such, often cannot conduct institutional PM. In any formulation of SME PM, its engineers should align the PM’s resource-demand with a business’ existing, daily work-processes. It should also be balanced, tailored, flexible and dynamic; all stakeholders should be considered. Of course, this recommendation should be tempered against over-analysis and its associated costs.

In summary, the requirements of ICT-related PM in SMEs include the following key elements:

- Managing uncertainty (by measuring internal and external environmental factors)
- Help the innovation of products and services
- Sustain evolution and change processes
- Competitive measures
- Developing strategy
- Balanced measures
Tailored PM system
Flexible adaptability
Dynamic adaptability

In fact, the above requirements on PM target the properties of ICT companies listed in this section. We have the following observation:

- ICT industries’ rapid-growth plays an important role in many countries’ economics. Actually, the establishing and expansion of a large amount of small and medium sized ICT companies contribute to this growth, which also means a very competitive environment for ICT SMEs. This requires the PM to manage uncertainty in the operation of a company. The PM system should involve competitive measures for the company to assess its position in the market and show the direction to put the resource in for development of the company, i.e. helping to develop suitable strategy.

- Innovation is a typical feature of ICT companies. Research and Development is the core department for many ICT SMEs that stand in market because of new products. For those SMEs supplying IT service, innovation often means improving service based on new technology. It is necessary to notice that innovation is always accompanied by adventure. Accordingly, PM system should assess the innovation property, e.g. the quality of innovation, which is very important to predict the success or not of a new product or service.

- To overcome problems of resource and information limitations, it is common for ICT SMEs to collaborate with large ICT companies, education providers, government and non-ICT companies. The PM system could attributed these actions as external environmental factors and assess all the influence in a dynamic way. Actually, the limited resource also determines that the PM in ICT SMEs should be tailored and flexible, aligning with ordinary process.

- Many entrepreneurs in the ICT industries are technological specialists without business training or experience. This actually could be a barrier for ICT SMEs to establish a PM system to support the operation of the company, since the owners might not reali ze the function of the PM. On the other hand, once a company had such a system built up (which should always be the case if the company wants to survive in the highly competitive market), the managerial competencies of owner-managers should be counted for performance assessment.

---

*Analysis of Impact of ICT on Performance of SMEs in Karnataka*
Part V: ICT and Employment Creation

1. Introduction

In the context of socio-economic development process, globalisation and the shift towards a more integrated and interdependent world economy, poverty and unemployment have become of global concern. The urge to remedy and contain poverty as well as to adapt to flexible labour markets with varying technical skill requirements are priority issues for increasing human welfare and for avoiding the transformation of the human development divide into national, regional, and global conflicts.

The progress of human development is becoming more and more uneven throughout the world\(^3\). The North-South divide was accentuated during the fifth World Trade Organisation (WTO) conference in Cancun. The collapse of the communist regime in Russia has triggered an East-West divide in Continental Europe that is currently infringing the enlargement of the European Union. Growing concentration of poverty and joblessness within developing countries are triggering a national divide with a chronic damaging effect on socio-economic growth.

In Asia, poverty remains a problem that requires immediate actions in order to secure future socio-economic stability and development in the region. Even though, the percentage of India States population in 1999 living below $1 a day is estimated less that 10% and is forecasted to remain below 10% till 2015, the percentage of population that is malnourished during the same period is around 10% and is estimated to increase in 2015\(^4\). In addition, two macro factors have stimulated more poverty and hunger since 1999, the first is the worldwide economic recession that followed the collapse of the Internet bubble and the second is the increasing political instability in the region.

Unemployment rates for India for 2010 are estimated 10.70\(^5\). The risks associated with unemployment, especially among youth, are damaging to the social cohesion of countries as jobless people are easily discouraged and lured into crime, drug abuse, religious fanaticism, and migration. Unemployment and underemployment pose a need for fundamental

---


\(^4\) Number of India people living with less than a $1 a day is estimated at 6 million in 1999 and the number of malnourished India people is estimated at 32.2 million between 1998 and 2000. “Human development report 2003”, UNDP, ISBN 0-19-521915-5, page 53 and 54.

\(^5\) http://www.indexmundi.com/india/unemployment_rate.html
changes in order to develop new appropriate skills that meet the needs of the 21st century labour market demands.

During the last decade, international organisations focused on increased global development. In its Millennium Development Goals (MDG), the UN has adopted eight goals, the first of which is to eradicate poverty with the aim of achieving two targets between 1990 and 2015:

- Reducing by half the proportion of people living on less than a dollar a day;
- Decreasing by half the proportion of people who suffer from hunger.

Within this context, this part investigates the possibilities of harnessing ICT to reduce poverty and create employment. The above targets pose a challenge of how to stimulate sustainable economic growth while reducing the gap between the rich and poor communities in order to secure peace and prosperity in the region.

2. Impact of ICT on Employment dynamic

Other highly relevant and much debated issues are the employment effects of innovation and technical change in general, and the impacts of ICT on employment dynamics in particular. The central question is if technological change and an increasing use of ICT creates or destroys jobs. There is no unambiguous answer to it, and recent research has emphasised that employment effects vary with the level of analysis (firm, sector, national economy) and the type of innovation (product vs. process).

A common simplified argument is the following: Because innovation and an increasing use of ICT are related to growth, it is believed that innovation and intense usage of ICT will solve the unemployment problem in Karnataka. However, innovations and ICT investments might lead to productivity growth without leading to GDP growth. The employment effects can be very different for productivity and GDP growth (Edquist et. al. 2001). In addition, growth effects vary for miscellaneous types of innovation (Kuznets 1972). A common conceptual framework is to differentiate between product and process innovations. This conceptual framework can also be applied to study the impacts of ICT because ICT investments can result in product or process innovations at the firm level.

---

6 www.developmentgoals.org/poverty.htm
Product innovations can occur in goods or in services, while process innovations can be either technological or organisational, with varying implications for employment effects. A product innovation corresponds to the creation of a new production function. Given a sufficient demand for the new product, it will usually create additional demand for both capital and labour production factors by the innovating firm. This is often called the compensation effect (Pasinetti 1981). However, if the new product does not satisfy a completely new kind of demand or does not serve an entirely new function, i.e. if it only functionally replaces an old one, there will also be a substitution effect. The net employment effect of such an innovation could be either negative or positive, depending on (1) whether the new demand for satisfying the function changes when the new product replaces the old one and (2) the labour intensity of the production technology of the new product compared to the old one. However, in most cases product innovations are employment creating even if substitution effects are taken into account (Katsoulacos 1986, Kuznets 1972, Edquist et. al. 2001).

Process innovations usually also have both a compensation and a substitution effect, however, their net effect is less clear than for product innovations. Process innovations usually reduce the costs of production for a given unit of output; hence, they increase productivity per unit of input. In micro-economic models, this corresponds to an outward shift of an existing supply function. Depending on the price elasticity of demand, this outward shift of the supply function will lead to growth and lower equilibrium prices. This compensation effect is stronger for competitive industries and high price elasticity’s of demand. However, an increase in productivity implies that a given level of output can be produced by less amount of input. Thus, if demand and output remain constant, a process innovation will lead to a reduction of labour, ceteris paribus. While the compensation effect can mitigate job losses, they can only promote net employment gains when growth in production and demand outstrips productivity growth. This only happens when the price elasticity of demand is greater than zero, which is only rarely the case (Edquist et. al. 2001).

Also, the effects depend on the specific kind of process innovation. Technological process innovations that replace labour by capital will have a stronger employment reducing effect than process innovations that lead to organisational changes. In fact, organisational process innovations might be either labour saving or capital saving, while technological process innovations are primarily labour-saving (Edquist et. al. 2001, p. 35-37).
Organisational innovations are also special in the sense that they can be viewed as investments into human capital by the provision of new knowledge through education, training and learning-by-doing (Becker, et al, 1996). This constitutes a special kind of investment because it is durable, generates continuing returns and is embodied in “knowledge carriers” (Machlup 1980). Thus, if an employment reducing effect of organisational process innovations exists at all, it is likely to be much smaller than the employment reducing effect of technological process innovations.

In addition to this static firm-level view on different kinds of innovation, a dynamic macro-level view emphasises that there are likely to be secondary effects of innovation because whether something is a process or a product innovation is essentially a matter of perspective. Some product innovations in one sector can turn out to be process innovations in another sector leading to secondary employment effects. Edquist et al, (2001, p.100) differentiate the net-employment effect of product innovations according to three product categories consumer products, investment products and intermediate products. Only investment products can play the double role of employment generation in one sector and labour displacement in another. The net-employment effect of an investment product innovation hence depends both on the effect in the technology producing sector and the effects in the using sectors. ICT are an example of such an investment product, which makes the net employment effects of ICT more ambiguous. For consumer and intermediate goods innovation, there is usually only the primary (typically employment increasing) effect.

A double role of product innovation can also occur in the service sector if the new product is an organisational innovation that is commoditised and sold as a consulting service. The net employment effect of such an organisational innovation depends also on the size of the compensation and the substitution effect in the sectors adopting the innovation and in the sector that supplies the consulting service. An example of such an innovation is ICT outsourcing services. Again, the net employment effect is hard to determine and it cannot be simply assumed that it will be necessarily positive.

Thus, it is clear that the employment effects of innovations depend on the specific type of innovation. They can also vary significantly between aggregation levels (firm, industry, national economy). An employment increase in one (successfully innovating) firm might lead to employment losses at the industry level or at the national level, depending on whether output growth offsets productivity growth. Thus, the net impact of an innovation on
employment remains essentially an empirical issue that cannot be unambiguously predicted ex ante.

From a more aggregate perspective, empirical studies on the industry level show that the employment impact is positive in industries characterised by high demand growth and orientation towards product (or service) innovations, while process innovation tends to lead to job losses. Recent sectorial evidence for Europe suggests a prevalence of labour-saving process innovations. Slow growth on the demand side and increasing international competition has pushed many firms towards restructuring and process innovations. This leads to the well-known phenomenon of jobless productivity growth, which is currently being witnessed in many European countries. However, product innovation has confirmed its positive effects on output and jobs (Pianta, 2001, Antonucci and Pianta 2002, Evangelista and Savona, 2003).

The overall effect depends on the country and period being studied. The higher economic growth (total output and demand), the higher is the positive impact of innovation, while technical change in stagnating or closed economies tends to be associated with serious employment losses. According to Pianta (2004), the empirical evidence suggests that institutional factors and macroeconomic conditions play an important role for the nature and the effect of technical change on employment at the macro level. The employment impact is generally more positive the higher is the ability to generate new products and to invest in new economic activities, and the stronger is the effect of price reduction, leading to increased demand. Aggregate studies generally point out the possibility of technological unemployment, which emerges when industries or countries see the prevalence of process innovations in contexts of weak demand. Firms innovating in both products and processes may be successful in expanding output and jobs regardless of economic context, but often at the expense of non-innovating firms. Yet, the long run trend has been towards simultaneous growth in per capita income, productivity and employment growth (Van Ark et al, 2004).

In addition to the quantity impact of innovation on employment, there also exists a quality aspect. The question is “what kind of jobs are created or destroyed by innovation?” A large literature on skill-based technical change finds that technical change is biased towards skilled workers as it replaces unskilled labour and increases wage inequality and polarisation. Un-skilled jobs have long been declining in absolute terms in Europe and growing only slowly in the US, while skilled jobs for educated workers are created at a faster pace in most countries (Pianta 2004).
Existing empirical studies emphasised that ICT tends to be a skill-biased technology (Berman et al, 1994, Autor et al, 1998). ICT is implemented and facilitated largely by a substantial supply of skilled labour (e.g. IT specialists and consultants) and it substitutes certain types of low skill functions because the computer takes over tasks that were previously executed manually (e.g. aggregating orders for office material from various employees in an online procurement system). Hence, the application of ICT may increase the relative wage gap between skilled and unskilled labour because it decreases the demand for unskilled workers and simultaneously increase the demand for skilled employees. Yet, ICT can also be used to facilitate new products and services in markets that use abundant and cheap unskilled and semi-skilled labour, so the net-effect of ICT on different types of labour can vary among industries.

Nevertheless, the implementation and productive usage of ICT usually requires the presence of educated and skilled personnel. Due to this complementary between skilled labour and ICT usage, firms that have a higher share of well-educated employees should have advantages in adopting ICT and hence higher levels of ICT usage than otherwise comparable firms.

3. **ICT Links to Poverty Reduction and Employment Creation**

ICT constitutes one of the new tools for reducing poverty, empowering impoverished communities, and providing access to vital resources and information. By creating new jobs, reducing unemployment, establishing new distribution channels, and providing new competitive advantages, ICT applications geared towards alleviating poverty will eventually contribute to reducing the gap between rich and poor in India. More specifically, and with the convergence of ICT, the Internet is evolving to become the vehicle for empowerment and socio-economic development. It is only a matter of time when the Internet will be integrated in almost every aspect of the daily lives of the people of the world. The combination of the technology convergence and its speed of diffusion will make the Internet a critical tool contributing to the development of the human being and to the growth of the knowledge economy. There is a correlation between the diffusion of ICT and countries with high Human Development Index (HDI)^7. Countries with high HDI have the highest ICT indicator values suggesting that there is a link between ICT and human welfare. The main challenge is to

---

^7 HDI is a composite index measuring average achievement in three basic dimensions of human development, namely a long and healthy life, knowledge, and a decent standard of living. Source ICT and MDGs, A World Bank Group Perspective, Dec 2003

*Analysis of Impact of ICT on Performance of SMEs in Karnataka*
assimilate the advantages that ICT could bring to poor communities and then to transform these advantages into positive economic, social and political tools aimed at empowering the poor and increasing his/her livelihood.

The following presents macro-level and micro-level factors that leverage from the variety of ICT applications with the objective to extend the life opportunities of the least fortunate and bring about benefits to both wealthy and poor. Equally important is to strengthen the interaction that exists between these two levels.

A. Macro-Level Interventions

The effects of macro-level interventions on poverty and unemployment have critical policy implications. A number of issues that are impacting the use of ICT from a macro-level perspective are discussed below:

- The surfacing of global cities\(^8\) as a command point for increasingly complex production processes: The way that the global economy is expanding has placed an important role on global cities, such as London, New York and Tokyo. ICT plays a crucial role in allowing these cities to fulfil their global functions. The networking matrix of global cities and the link to global and regional circuits of capital are just two examples of the potential of ICT.

- ICT can exponentially increase the benefits of sound transportation infrastructure and trade protocol though the implementation of a regional broadband telecommunication infrastructure and the development of bilateral and multilateral agreements to promote ICT regional integration projects;

- The move from government to governance: This move is increasingly pushing Governments to assume a more strategic role by ceasing to be a provider of services and rather become an enabler of these services. This shift requires more logistical, administrative, and management supports whose efficiency and effectiveness can be facilitated by ICT.

---

\(^8\) Sassen loosely defines global cities as “centres for the servicing and financing of international trade, investment, and headquarter operations.” Globalisation and Its Discontents: Essays on the New Mobility of People and Money. Saskia Sassen. 1999.
B. Micro-Level Interventions

Micro-level interventions will examine the internal dynamics through which ICT applications and expertise are transferred to institutions and citizens as well as the capabilities offered by ICT to mediate such transfer in order to reduce poverty and create employment. The following is a list of important micro-level interventions:

- *The rise of productivity*: ICT increase the level and quality of output, given the same amount of labour, capital and material;

- *The increase in labour capacity*: As people obtain new ICT skills and capabilities their efficiency will increase. This is also reflected in the shift of career to adapt and cope with new changes and building indigenous ICT skills;

- *The increase of competitiveness*: As firms optimise their processes and reduce their costs by using ICT applications such as supply chain management and ERP software, they become more competitive;

- *The increase in access to information*: The empowerment through access to information can create earnings opportunities through their catalytic and leveraging effects.

4. Implementation Modalities

The point of departure for using ICT for poverty reduction and employment creation is to identify key development challenges pertaining to each country or impoverished community and then investigate and analyse how ICT, as a tool for socio-economic development, could make a positive and sustainable impact to combat poverty and create employment. Similarly, regional ICT projects must be designed in such a way to complement each other in order to pave the way for a regional integration. Recognising that ICT is not an end by itself, initiatives have to exploit the ICT potentials as a powerful tool that can produce effective results when applied comprehensively in an overall development strategy. There is no “one-size-fit-all” approach that has proven effective for using ICT for poverty reduction.

The following provides some recommendations for harnessing ICT for employment creation and poverty reduction:
• ICT will benefit the poor more significantly when information is exchanged both ways to and from impoverished communities; i.e. the poor will not just receive information but will also share local knowledge with other communities;

• Statistics related to ICT diffusion are usually national average. More detailed and accurate surveys need to be conducted for targeted areas where employment is to be created and poverty to be reduced;

• The need to keep intermediaries might be a necessary mechanism in some cases at least for the near future. ICT enables bypassing middleman and intermediaries organisation; although, in some cases, the latter are needed to organise local supply of goods and services and to act as clearing houses to assure quality and to generate needed volume to serve external markets;

• ICT is an agent of change, i.e. does not create change but more likely acts as a catalyst for triggering change through the emergence of new coalitions. A typical example is the spill over effect that ICT generates, such as attracting Foreign Direct Investment (FDI).

• National poverty line, human poverty index (HPI-1)⁹ and Gini coefficient¹⁰ constitute useful indicators for monitoring progress of work and for providing a preliminary snapshot of current issues;

• SMEs are the main source for employment creation in rural areas and especially for countries with low to medium HDI;

• Establishment of effective linkages throughout the value chain that is generated from any ICT-based projects. These linkages are mandatory for any ICT-based projects, they supplement the technical output with the needed business alliances and networking for sustaining an economic viable structure and forging effective sales and distribution channels;

• Awareness creation of decision makers is important to capture political will, access new funds, and increase visibility to expand popularity of initiative/projects.

---


¹⁰ The Gini coefficient is a measure of the income inequality in a society. It is a number between 0 and 1, where 0 means perfect equality (everyone has the same income) and 1 means perfect inequality (one person has all the income, everyone else earns nothing). http://en.wikipedia.org/wiki/Gini_coefficient.
A. **Bottom up Approach: Role of Grassroots Organisations**

This approach, recommended for countries with low and medium HDI, capitalises on initiatives launched by civil society institutions/private sector to improve the status of impoverished communities. The main advantages behind this approach are the short-term positive impacts on poor communities and the ability to supplement the lack of resources of local Government authorities to serve their communities\(^{11}\).

Moreover, this approach leverages on the strong relationship between civil society institutions, the private sector and community leaders to initiate, maintain and reinforce structures that serve impoverished communities. Typical observed relationships in the region are based on personnel acquaintance between a community leader and civil society/private sector representative, or in the form of a donation from philanthropists to help develop a particular area or community.

The following is a recommended methodology for proper implementation through bottom up initiatives/projects:

- Identification of priority projects for poverty reduction and employment creation to be implemented in a selected community or area, in consultation with member countries, regional and national NGOs;
- Provision of feasibility studies and detailed business plans;
- Establishment of partnership with local and regional stakeholders;
- Allocation of necessary funds;
- Selection of pilot projects;
- Delivery of technical assistance and training;
- Fine-tuning the whole process through lessons learned during the implementation of pilot projects;
- Dissemination of these projects in other communities or areas.

The mushrooming effect induced from the bottom up approach of using ICT for employment creation and poverty reduction will pave the way for launching national and regional initiatives. It is worth noting that the bottom up approach does not have to be restricted to a single country, it could also be adopted by international/regional organisations.

---

\(^{11}\) "The most striking about modern industry is that it requires so much and accomplishes so little. Modern industry seems to be inefficient to a degree that surpasses one's ordinary powers of imagination. Its inefficiency therefore remains unnoticed." Quoted from *Small is Beautiful*, by E. F. Schumcher. [http://www.serve.com/ecobooks/smbeaut.htm](http://www.serve.com/ecobooks/smbeaut.htm).
to trigger a number of pilot projects aimed at building capabilities of local Governments representative and NGOs as well as creating a successful prototype to get the necessary political will to use ICT for employment creation and poverty reduction.

B. Top Down Approach: Role of Policy-Makers

This approach pursues the implementation of policies originating from the need to resolve the weaknesses of economic and social structures. Governments have to encourage grassroots organisations to bring substantive change in the lives of poor people and in creating jobs. At the same time, policy makers, recognising that the bottom up approach alone will seldom be able to solve economic and social problems on a national level, have to provide an enabling environment for promoting ICT-based initiatives geared towards employment creation and poverty reduction.

The effect induced from the top down approach of using ICT for employment creation and poverty reduction will support the existing initiatives implemented by civil societies. An example of a typical project is the development of ICT infrastructure connecting impoverished and isolated segments of the population to main cities, industrial areas, and education sector.

The following is a list of initiatives to harness ICT for employment creation and poverty reduction:

- Investigating national income poverty line\(^{12}\) and unemployment rate for each country in order to set a well-defined baseline for monitoring progress of work and supporting the decision making process of policy makers.
- Investment in ICT infrastructure through the deployment of national broadband backbone in order to cover a wide area and link isolated segments of the population. This initiative is not sufficient if it is not accompanied by Government support to offer competitive pricing for telecommunications services;
- Development policies to boost the ICT sector and industry with an objective to provide legal security, maintain information privacy, allow e-payment, enforce intellectual property rights, support electronic signature, and fight cybercrime while increasing the traffic of electronic transactions over the Internet;

---

\(^{12}\) This activity could also include the calculation of human poverty index 1 and 2 as well as GINI coefficient for measuring income distribution.
• Partnership with private sector to inject technical and financial resources into government based ICT initiatives. More specifically SMEs are a major source for capacity building and employment creation;

• R&D to increase national research management skills and build leading ICT capabilities, as well as produce commercial opportunities. Typical initiatives would be in the form of ICT incubators, techno poles, technology parks, and centres of excellence in the field of software development and ICT legislative studies;

• The education sector being the ideal place for nurturing the human capacity building of nations in the transfer and disseminations of ICT skills, education curricula should be reviewed to include up-to-date ICT courses and teachers have to be trained to use new learning methodology. These changes should be implemented in parallel in schools, universities and vocational training institutions;

C. Hybrid Approach: Solving The Problem From Both Ends

The proposed hybrid approach establishes a balance between the bottom up and top down approaches by delivering an attainable solution for solving short-term and long-term problems associated with employment creation and poverty reduction. The main objective is to mitigate the risks associated with organisations working in isolation, be they governmental or non-governmental, which allow relations of patronage and is prone to corruption. This approach includes a self-controlling mechanism that questions the underlying apolitical agenda behind many existent initiatives.

D. Role Of Different Stakeholders

All stakeholders, through the proper channels and media, should be involved one way or another in planning, designing, implementing, and evaluating ICT initiatives for poverty reduction. Responsibilities should be divided among stakeholders based on their added values; thus nourishing the idea of ownership and instigating a national dialogue on the use of ICT for employment creation and poverty reduction.

The following is a list of major stakeholders along with a brief description of their role.

• Governments: To define an enabling policy and legislative framework as well as allocate public resources;
• International and regional organisations: To act as a catalyst and to provide the framework within which initiatives on poverty reduction and employment creation will be developed;
• Private sector: To provide technical expertise, business sustainability and to develop new and existing markets, especially the small and micro enterprises;
• Civil society and NGOs: To connect with local and regional communities and to participate in the implementation process. Involving the civil society contributes to the creation of more pluralistic and democratic political systems.
• Education sector: to share knowledge and research results.

E. Indicators Of Achievement

Whether quantitative or qualitative methods of evaluation are used to monitor progress of work or to assess results, it is important to cross check one set of data with another. Defining the right indicators of achievements is one of the crucial tasks while designing an evaluation method. This section lists a number of performance indicators that could be used to judge achievement and that would supplement the two targets set for eradicating poverty in the Millennium Development Goals (MDG). The indicators are:

• Number of pilot projects launched, number of successes, number of failures, and number of pilot projects with sustained operations;
• Number of new jobs created and of increased income by gender and age;
• Threshold values for poverty and unemployment, for example HDI, HPI, Gini, national poverty line, and unemployment rate;
• Real GDP: Percentages increase/decrease of real GDP because it is measured in constant prices, the prices for a specific base year, and it adjusts gross domestic product for inflation.
Part VI: Barriers of ICTs in SMEs

1. Introduction

Measuring SME performance is complex and challenging work (Brush and Vanderwerf 1992; Murphy, Trailer et al, 1996; Sapienza and Grimm 1997; Amason, Shrader et al, 2006). The challenges are usually distinct from those of large organisations and, because most existing performance measurement systems were designed for the latter, few tools are available for SMEs. The main challenges to measuring performance in SMEs are as follows:

First, collecting performance information from privately held SMEs is often difficult due to a lack of historical information and accessibility. The information is often imperfect and the accuracy is hard to be checked even if the information can be obtained. For example, traditional financial measures of performance are often unavailable (Brush and Vanderwerf 1992, Chandler and Hanks 1993; Wang and Ang 2004)

Second, financial data is difficult to interpret (Barnes, Coulton et al, 1998). This is because SMEs usually have small starting base, enormous and erratic growth rate and uneven record-keeping (Sapienza and Grimm 1997)

Third, many measures, such as future profits and survival, require a longitudinal sample-design. It is inappropriate to use such measures on an SME, however, due to the group’s typically short operation-history (Brush and Vanderwerf 1992, Chandler and Hanks 1993; Wang and Ang 2004).

Fourth, financial data is often influenced by industry-related factors (Wang and Ang 2004). The performance measures for ICT SMEs present a different connotation from that for traditional industries.

Fifth, there exists possible source bias, e.g. owner/founder might manipulate the related information in propaganda (Brush and Vanderwerf 1992).

Sixth, SMEs’ future and potential performance is more important than lagged performance. This requires that PM systems not only measure lagged performance, but also capture future performance (Kaplan and Norton 1992).

Seventh, Most SMEs focus on day-to-day operations. There may not be enough resources to execute comprehensive PM measurement (Stephens 2000).

Finally, the decision-making processes in SMEs are always not formalised and their strategies are often poorly planned, which influences the standard PM system employed in SMEs (Garengo, Biazzo et al, 2005).
2. **Barriers to ICT and E-commerce Adoption in SMEs**

This section outlines recent literature on the barriers/inhibitors for adopting ICT and e-commerce by SMEs. Research works investigating the barriers that affect SMEs adoption of ICT and e-commerce have identified a variety of factors which can be grouped into several categories. A number of authors for example Chau & Turner, (2001), OECD, (1998) identify factors relating to three major categories: owner/manager characteristics, firm characteristics, and costs and return on investment (Akkeren & Cavaye, 1999).

The owner/managers play an important role in decision making in SMEs. Hence it can be concluded that a number of factors that affect the adoption of e-commerce relate to owner/manager characteristics. Iacovou et al, (2005) found that the owner’s lack of awareness of the technology and perceived benefits is a major barrier to a take up of e-commerce. The lack of knowledge on how to use the technology and the low computer literacy are other contributory factors for not adopting e-commerce (Knol et al, 2001). Mistrust of the IT industry and lack of time are two other factors that affect the decision to adopt e-commerce (Akkeren & Cavaye, 1999). SME owners are concerned about a return on their investments, reluctant to make substantial investments particularly when short-term returns are not guaranteed (Akkeren & Cavaye, 1999).

There are some other factors related to the characteristics of the organisation, which affect adoption of e-commerce. Iacovou et al, (2005) found that the current level of technology usage within the organisation affects the process of adoption. In another study by the OECD (Panagariya, A., 2000) it was identified that: lack of awareness; uncertainty about the benefits of electronic commerce; concerns about lack of human resources and skills; set-up costs and pricing issues; and, concerns about security as the most significant barriers to e-commerce for SMEs in OECD countries. Low use of e-commerce by customers and suppliers, concerns about security, concerns about legal and liability aspects, high costs of development and computer and networking technologies for e-commerce, limited knowledge of e-commerce models and methodologies, and unconvincing benefits to the company are among some factors found in another study (Cloete et al, 2002). SMEs definitely have limited resources (financial, time, personnel). This “resource poverty” has an effect on the adoption of e-commerce, as they cannot afford to experiment with technologies and make expensive mistakes (EBPG, 2002).
3. Barriers to E-commerce adoption in Developing Countries

It is revealed that less attention with SME e-commerce research has been paid to developing countries with different economic, political, and cultural circumstances. Identifying the differences is an initial step to understanding the process of technology adoption. This is particularly important if governments believe that electronic commerce can foster economic development (Mehrtens et al, 2001).

SME studies of electronic commerce issues in developed countries (Huff & P. Yoong, 2000), (OECD, 1998) indicate that issues faced by SMEs in developed countries can be totally different from those experienced by SMEs in developing countries. Organisations adopting ICT and e-commerce in developing countries face a number of challenges that are specific to them and are more pronounced than would be the case in developed countries. Some of these are the lack of telecommunications infrastructure, lack of qualified staff to develop and support e-commerce sites, lack of skills among consumers needed in order to use the Internet, lack of timely and reliable systems for the delivery of physical goods, low bank account and credit card penetration, low income, and low computer and Internet penetration (Anigan, 1999), (Bingi and J. Khamalah, 2000), (Marshall et al, 2000). Lack of telecommunications infrastructure includes poor Internet connectivity, lack of fixed telephone lines for end user dial-up access, and the underdeveloped state of Internet Service Providers. Cultural barriers in some countries may also exist to deter the acceptance of e-commerce as a way of doing business (Bingi and J. Khamalah, 2000).

In India, shopping is a social activity and personal face-to-face contacts with sellers are an important part of the shopping experience. Distrust of what businesses do with personal and credit card information is an e-commerce issue in any country, but in countries where there may be good justification for such distrust, it could become a serious obstacle to e-commerce growth (Anigan, 1999), (Elkin, 2001). Lack of developed legal and regulatory systems also would inhibit the development of e-commerce in developing countries. Cloete, Courtney, and Fintz (Cloete et al, 2002) in their study of SME adoption of e-commerce in South Africa found that adoption is heavily influenced by factors within the organisation. Lack of access to computers, software, other hardware, and telecommunications at a reasonable cost; low e-commerce use by competitors and supply chain partners; concerns with security and legal issues; low knowledge level of management and employees; and unclear benefits from e-commerce were found to be the major factors that inhibit adoption.
Another study of e-commerce in China found that there are many significant barriers to e-commerce adoption. Limited diffusion of computers, high cost of Internet access, and a lack of online payment processes were found to directly inhibit e-commerce. Inadequate transportation and delivery networks, limited availability of banking services, and uncertain taxation rules indirectly inhibit e-commerce (Cooray, M.N.R., 2003). El-Nawawy and Ismail (1999) found that the main factors contributing to the non-adoption of electronic commerce in Egypt are awareness and education, market size, e-commerce infrastructure, telecommunications infrastructure, financial infrastructure, the legal system, the government’s role, pricing structures, and social and psychological factors. Thong & Yap, (1995) suggest that the main e-commerce issues facing SMEs in Argentina are awareness, access to hardware, infrastructure, organisational culture, financial issues. A comparison of the two studies in Argentina and Egypt, (both developing countries) suggests that the key factors of electronic commerce adoption in developing countries are: awareness, telecommunication infrastructure, and cost. It also suggests that SMEs in developing countries share similar issues. The Internet and e-commerce issues of SMEs in Samoa are consistent with the studies conducted in other developing countries (Thong & Yap, 1995), (Elkin, 2001). There are many significant factors, which affect the adoption of e-commerce technologies. These factors can be grouped to develop a framework for investigations. The barriers for SMEs in adopting ICT and e-commerce can be broadly categorised into Internal and External Barriers as follows.

A) Internal Barriers:

A SME has control over and the ability to change the internal factors within the organisation. For example, lack of time or resources, and lack of awareness on the part of the owner/manager. Internal Barriers could be further categorised into Individual (owner/manager), Organisational barriers and cost and return on investment (Akkeren & Cavaye, 1999).

B) External Barriers

Barriers that cannot be resolved by the SME, They have no control over these, and are compelled work within the constraints, for example inadequate telecommunication infrastructure. Some of the barriers could be addressed by the SMEs working together, and can get together irrespective of the industry sector to form clusters to share expenses, resources and facilities. Alternatively, SMEs from the same industry
sector can work together to address certain other external barriers where governmental intervention may be required.

![Figure 3-17: Model-barriers to adoption](image)
Part VII: ICT & Organisational Productivity of SMEs

1. Introduction

During the last few decades, organisations have made immense investments in ICT. The implications of these investments for productivity have been widely discussed in business and academic communities. Besides, according to the role of ICT in Business is essential for companies to increase potential impact of ICT to overall performance of a company.

2. Productivity

Productivity growth is identified as the foundation for economic prosperity, a prerequisite for national development and also an important indicator of organisational competitiveness (Dedrick et al, 2003). Measured productivity therefore shapes the political decisions of national governments and management decisions within organisations.

The word “productivity” has become such a buzz word these days. It is almost mentioned in different fields such as commercial magazine, newspapers, political speeches, TV news, business news, social magazine and etc…

In a formal sense, probably, the first time the word “productivity” was mentioned in an article by Quensay in the year 1766. In 1833 Littre defined productivity as the “faculty to produce”, that is, the desire to produce. In 1950, the Organisational European Economic cooperation (OEEC, 1950) offered the more precise definition of productivity: “Productivity is the quotient obtained by dividing output by one of the factors of production. In this way it is possible to speak of the productivity of capital, investment, or raw materials according to whether output is being considered in relation to capital, investment or raw materials” After this times many economic specialists offered other definition from productivity. Sumanth offered that total productivity is the ratio of tangible output to tangible input (Sumanth, 1984) and Siegel said productivity is a family of ratios of output to input(Tabatabae, 2000).

Finally, productivity can be defined as the below formula:

\[
\frac{\text{Output obtained}}{\text{Input expended}} \quad \text{or} \quad \frac{\text{Performance achieved}}{\text{Resources consumed}}
\]

Traditional economic studies of productivity focused on labour and capital such as plants and equipment. In order to measure capital, all component categories are considered.
This issue is also considering about measuring labour. In some cases the number of the labours is used and in some other cases the person-hour for special period of time is regarded.

- Increasing the productivity growth causes that:
- The life level in the investigated countries goes up.
- Inflation is decreased.
- The buying power of the people is increased.
- The life quality is improved and etc…

Some authors distinguish between productivity and efficiency. While productivity applies to the transformation of input to output in a process, efficiency expresses the relation between input and output in monetary terms. Thus measured, the results not only indicate the improvement in output per man-hour or the change in the quantity of inputs, but also the importance of changes in costs of inputs such as human resources.

3. Basic Types of Productivity

At this part two basic types of productivity will be introduced.

A) Partial Productivity

Partial productivity is the ratio of output to one of the consumed resources. For example capital productivity is the ratio of output to capital input or Materials productivity is the ratio of output to materials input and labour productivity is the ratio of obtained output to labour input. Also Labour productivity can be defined as the traditional, generally used indicator-measuring output produced per a certain unit of labour time, usually per man-hour (Cororaton, 2002).

Advantages:

- Easy to attain the data
- Easy to compute the productivity indices
- Easy to understand
- Good diagnostic tools for productivity improvement. If used along with total productivity indicators.
- Easy to sale management because of the above first third advantages.
Limitations:

- If used alone, can be very misleading and may lead to costly mistakes.
- Tend to shift blame to the wrong areas of management control.
- Profit control through partial productivity measures can be a hit and miss approach.
- Do not have the ability to explain overall cost increases.

B) Total Factor Productivity (TFP)

Total-factor productivity is the ratio of the net output (pure output) to the sum of associated labour and capital input. “Net output” means total output minus intermediate goods and services purchased. Theoretically, TFP is a relevant measure for technological change by measuring the real growth in production value, which cannot be explained by changes in the input of labour, capital and intermediate input (Zhi et al, 2001).

A series of articles that appeared in the recent World Bank Economic Review highlights the important role of TFP in the process of economic growth of countries (Cororaton, 2002). Total Factor Productivity measures the synergy and efficiency of the utilisation of both capital and human resources. It is also regarded as a measure of the degree of technological advancement associated with economic growth. Higher TFP growth indicates efficient utilisation and management of resources, materials and inputs necessary for the production of goods and services (NPC report, 2003). TFP also refers to the additional output generated through enhancements in efficiency arising from advancements in worker education, skills and expertise, acquisition of efficient management techniques and know-how, improvements in an organisation, gains from specialisation, introduction of new technology and innovation or upgrading of existing technology and enhancement in IT as well as the shift towards higher added value processes and industries (Cororaton, 2002).

Generally, higher productivity growth is associated with growth in Capital Intensity (CI) and the growth in TFP. Capital Intensity measures the physical capital expansion (Fixed Assets) allocated to each employee. This measure indicates whether an enterprise adopts a capital-intensive or labour intensive policy. Higher CI provides the advantage of technology, quality, volumes and speed to increase productivity and hence generate greater output.
There are five major determinants of TFP growth. (a) Demand Intensity which indicates the extent of productive capacity of the economy. A slow-down in demand intensity would result in unused capacity, lowering the utilisation of existing machinery and equipment. Demand intensity is reflected in sales performance. (b) Education and training of the worker which aims to upgrade skills, and knowledge. With higher level of skills, workers will be more efficient and produce better quality products and services. (c) Economic restructuring which refers to the movement of resources from less productive to the more productive sectors of the economy. Experience of the developed countries indicates that resources in the more productive sectors of the economy were utilised at the more efficient level than resources in the less productive sectors. (d) Capital structure which relates to the proportion of investments in productive capital inputs. Investment in machinery and equipment which are productive capital inputs yields immediate output as compared to infrastructure, plant and buildings which have longer lag time. (e) Technical progress which relates to the effective and efficient utilisation of technology, innovation, work attitudes and management and organisational effectiveness. With high technological capabilities, a motivated workforce and as effective management, higher value-added products and services will be produced at competitive costs (NPC report, 2003).

**Advantages:**

- The data from company records are relatively easy to obtain.
- This factor investigates the efficiency of resources convert and studying the value added that made in the companies.
- Planning and managing the resources will be facilitated by measuring TFP.
- Measuring TFP causes that the company knows how to compete and recognise and increase its ability for competing in target market.

**Limitations:**

- The value added approach is not very appropriate in a company setting because it is difficult for middle managers to relate the value added output to production efficiency.
4. **Benefits of Productivity Measurement in the Organisations**

Productivity measurement should be considered in order to organisations know in which productivity level they are working now and in which corresponding level should be operating productivity measurement also shows the direction for companies within their industries. Productivity measurements in the organisations have the following benefits:

The organisations access to the conversion efficiency of their resources. Hence, more goods and services are produced for a given amount of expended resources. Also resource planning can be facilitated. The economic and none economic objectives of the companies can be re organised by the priority in the light of the productivity measurement efforts.

Measuring and investigating the productivity create the competition action among companies. Strategies to improve productivity would be determined based on the extended distance (gap) between the planned level and measured level of productivity (Sumanth, 1984).

5. **Benefits of the Higher Productivity in the Organisations**

Higher productivity in a company with the respect to physical and human resources will mean higher profit because, Profit= revenue – cost of goods and services produced by the utilisation of the material and labour resources. Also higher productivity can be translated in to higher real earnings for its employees. Moreover, it causes the cost of manufacturing to be reduced and the customers to pay relatively low price. This role increases the market share (Tabatabae, 2000).

6. **Economic Performance**

Economic performance can be interpreted in a variety of ways at each level of analysis. At the country level it usually refers to economic growth, labour productivity growth, and consumer welfare. Economic growth is the rate of change in real output, or GDP, and is measured at the country level. Labour productivity growth, is a measure of the efficient use of (human) resources to create value. It “allows the economy to provide lower-cost goods and services relative to the income of domestic consumers and to compete for customers in international markets” (Dedrick, 2003). Corresponding measures focusing on the output of an
industry sector and companies are utilised at the industry level and company level (kraemer, 2003).

Clearly, labour productivity growth is also an indicator of the economic performance of firms. A firm that is more productive than its competitors will generally enjoy higher profitability, which is of course, also an important measure of economic performance for firms. A more productive firm will either produce the same output with fewer inputs and thus experience a cost advantage, or produce higher quality output with the same inputs, enabling a price premium. Sustaining higher profits through productivity gains requires a firm to maintain productivity levels higher than its competitors. Therefore, over time, profits might be competed away with result that consumers benefit (Gurbaxani et al, 2003).

7. ICT and Productivity

Some recent studies have highlighted both the opportunities and the challenges that ICT has imposed on the world economy. For instance, Brynjolfsson and Hitt (1996) have analysed the implications of ICT on productivity while studies by Stiroh (2001), Pohjola (2001) have looked at growth and development (Satti and Nour, 2002). Proving the business value of ICT on organisational productivity has been a major concern of information system (IS) research. It has been a matter of much debate whether or not investment in ICT provides improvements in productivity and business efficiency. In 2002, Morgan Stanley reported that US companies wasted $130 billion in the previous 2 years on technology. While organisations have increased investments in ICT in order to improve organisational performance, findings from earlier ICT productivity studies have been inconclusive despite the fact that several recent firm-level empirical studies have found a positive relationship between ICT investments and organisational performance. For several years, scholars and policy makers lacked conclusive evidence that the high levels of spending on ICT by businesses improved their productivity, leading to the coining of the term “ICT Productivity Paradox”.

Morrison and Berndt (1990) concluded that additional ICT investments contributed negatively to productivity, arguing that “estimated marginal benefits of investment in ICT are less than the estimated marginal costs.” Others, such as Loveman (1994) and Barua et al, (2000), said that there is no conclusive evidence to refute the hypothesis that ICT investment in inconsequential to productivity. Of late, researchers working with firm-level data have
found significant contributions from ICT toward productivity (Brynjolfsson and Hitt 1996). Most of these firm-level studies have been restricted to the manufacturing sector, in large part owing to lack of firm-level data from the service sector.

**Wong et al,** (2004) Declared that appropriate use of ICT in the companies increase the productivity by three ways: (a) Increasing the volume of capital used per worker (capital deepening), when firms invest in ICT (b) A speedup of growth of Total Factor Productivity in industries producing information technologies, thanks to technological progress (c) A speedup of growth of TFP in industries using information technologies.

8. **The Productivity Paradox**

   During the last few decades, organisations have made immense investments in ICT. The implications of these investments for productivity have been widely discussed in business and academic communities since the American economist Solow questioned their benefits (Horzella, 2005). In a now famous quote from 1987, he claims, “You can see the computer age everywhere but in the productivity statistics” (Solow, 1987).

   Growth in productivity is a central measure of national and organisational success and is often considered in economic decision-making. This is because the amount that a nation can consume is closely linked to what the nation produces. In a similar way, the performance of a company is dependent on its ability to deliver more value for consumers based on the same resources. The inability to demonstrate a positive correlation between ICT investments and improved productivity and increase the ICT investments in the companies was later defined as the productivity paradox and formed a baseline for many studies and discussions in subsequent years. The results were conflicting (Harker, 2000).

   Many studies in the 1980s showed no correlation between ICT investments and productivity growth, whereas research based on subsequent data and new assumptions mainly showed a positive and significant effect on productivity and economic growth (Dedrick *et al,* 2003).

   As various questions of measurement made it difficult to present distinct conclusions based on aggregate national or industry-level data, researchers turned to aggregate firm-level data when seeking explanations for the productivity paradox. This research indicates that
organisations that have made ICT investments of equal scale show substantial differences in the development of their productivity (Brynjolfsson, 2003).

Explanation for this phenomenon is that the benefits gained from investments in ICT are dependent on firm-specific conditions. Idiosyncratic conditions (market position, cost structures and etc.) and complementary investments in management practices, organisational development and strategy are decisive for achieving planned effects. As an example is Asa Horzella (2005) concluded that there is a correlation between the level of employee education and the productivity gains from investments in ICT.

Another part of the explanation for the productivity paradox is the view of ICT as a General Purpose Technology (GPT) that makes extensive further development possible and offers a wide range of potential applications. The implementation of other GPT’s, such as the electrical dynamo and the steam engine, has shown that it takes time before full advantage of the technology can be taken and productivity improvements achieved. Information structures and operating modes need to be developed and organisations adjusted for the effects of a new technology to be realised. Another explanation for productivity paradox includes:

- Miss measurement of outputs and inputs.
- Time lags due to learning and adjustment.
- Redistribution of profits, and Mismanagement of ICT.
- Inappropriateness of traditional productivity measures (Brynjolfsson, 1993; Loveman, 1994).

Some experts claimed that inconsistent findings from ICT productivity research were due to interchanging terms between productivity and financial performance and also lack of adequate data. However, recent studies have claimed that ICT productivity paradox no longer exists (Horzella, Asa, 2005) and there is a positive correlation between appropriate use of ICT and economic growth.

9. **Role of ICT in the Production Process**

Production process is defined as the process of producing the products or presenting the services. Many studies addressed and evaluated the role of ICT on the production process and its affection on productivity both in industry level and country level. Yet, the decision makers who choose to invest in ICT are managers who deploy ICT for use in their organisations and
who use investment criteria that are related to the outcomes at the level of the firm. Labour productivity and total factor productivity is certainly one often-used criterion, managers also use measures such as profitability, market share, margins, and product variety and quality as justifications for investment in ICT systems.

In order to understand the overall impact of ICT at the firm level, it is useful to begin by thinking about the qualitative impacts of introducing ICT into a firm’s production processes. Past research has distinguished among using ICT to automate processes, to provide better information, and to transform entire processes. For example, a cashier at a retail chain store using a computer-based information system such as a scanner can process a transaction in less time.

Impact of improved information allows workers and managers to make decisions more effectively. For instance, information provided by the store-based system allows the managers to better manage inventory. Transformation impacts occur when a firm redesigns a process to achieve significantly higher levels of productivity. One key difference between ICT capital and other forms of capital is the dual roles that ICT can play in a firm. First, like other types of capital, ICT can be used directly as a production technology to improve labour productivity, as in the case of a bank’s transaction processing system. However, research suggests ICT has its greatest impact in its second role as a technology for coordination also it has important role on effective integration of business process of the company for increasing the productivity of the firms (Gurbaxani et al, 2003).

10. The Production Function Model

In order to better understand ICT and productivity debate, it is useful to begin with a discussion of the production process by which inputs are transformed into outputs in firms and economies, and the specific role of ICT as a factor of production. Economists use two related approaches to modelling the production process by which inputs are transformed into outputs. One approach to understanding the output of an economic system is production economics, which uses specific functional forms, called production functions, to model the production process (Brynjolfsson and Hitt 2000).

This approach uses econometric techniques to relate the output of a firm, industry, or economy to the inputs based on estimation models derived from the production function.
Inputs typically accounted for in this approach include labour and capital, including both ICT and non-ICT capital. Most of the studies at the firm level use this approach. The primary approach used to model the production process inherent in an economy (or industry) is growth accounting (Oliner and Sichel 2000; Jorgenson and Stiroh, 2000). This method also assumes specific properties of the production process and, based on these assumptions, allocates shares of output to the various inputs to production. Output growth in firms, industries, and the economy may arise from increases in input levels, improvement in the quality of inputs, and growth in the productivity of inputs (Gurbaxani et al, 2003).

The production function framework has been the most widely used methodology in the study of returns to ICT investment (Loveman 1994; Lichtenberg 1995; Brynjolfsson 1996). In the absence of measures of actual benefits associated with ICT, it is not possible to perform cost-benefit analyses of ICT investment and thus, production functions which relate ICT spending to overall productivity or output measures are seen as the best alternative (Parsons et al, 1993).

Production function techniques have been shown to be valid and quite successful through hundreds of empirical studies. The choice of the form of the production function is constrained by economic theory which requires that conditions such as monotonicity and quasi-concavity be satisfied. One of the simplest production functions that satisfies such conditions and has been used for about a hundred years is the Cobb-Douglas function (Berndt 1991). Most of the studies on ICT-based productivity have used this model (Lichtenberg 1995, Brynjolfsson and Hitt1996).

A) Cobb Douglas Function

The Cobb-Douglas function has had a long and successful life and is still a popular production function. The parameters estimated from this function have provided results which seem to be meaningful from the point of view of economic theory. In a majority of the cases the function fitted has been of the unrestricted type, in the sense that the parameters were allowed to take any value whatsoever, positive or negative, high or low. The Cobb Douglas Function is:

\[ Q = A \cdot K^\alpha \cdot L^\beta \]

Where:

\( Q \) = Total production (the monetary value of all goods produced in a year)
Analysis of Impact of ICT on Performance of SMEs in Karnataka

\[ L = \text{labour input} \]

\[ K = \text{capital input} \]

\[ A, \alpha \text{ and } \beta \text{ are constants determined by technology.} \]

If \( \alpha + \beta = 1 \), the production function has constant returns to scale. That is, if \( L \) and \( K \) are each increased by 20\%, \( Q \) increases by 20\%.

If \( \alpha + \beta < 1 \), returns to scale are decreasing, if \( \alpha + \beta > 1 \) returns to scale are increasing. Assuming perfect competition, \( \alpha \) and \( \beta \) can be labour and capital's share of output.

B) Translog Function Model

This production function was introduced by Christenson & Jorgenson and Lau in 1973. The general equation of Translog is:

\[
\ln C = \ln \alpha_0 + \sum \alpha_i \ln P_i + \frac{1}{2} \sum\sum \gamma_{ij} \ln P_i \ln P_j \quad i,j=1,...,n. \tag{1}
\]

\( C \) is the minimum amount for producing a given amount of output (\( Q \)) from \( n \) number of inputs—production worker (\( L \)), non-production worker (\( N \)), capital-investment (\( K \)), material (\( M \)), and energy (\( E \)), and \( P_i \) and \( P_j \) are the prices of the inputs. With the assumption of symmetry condition, an application of Shepherd Lemma in the translog cost function gives rise to the following linear demand equations that can be estimated.

\[
S_i = \alpha + \sum \gamma_{ij} \ln P_i + \mu_i \quad i,j=1,...,n. \tag{2}
\]

\( S_i \) is the respective cost share of the inputs and \( \mu_i \) is the random error term in the cost minimisation condition. Furthermore, the assumption of homogeneity of degree one in input prices implies that:

\[
\sum \alpha = 1 \tag{3}
\]

and

\[
\sum \gamma_{ij} = 0 \quad i=1,...,n \tag{4}
\]

Given symmetry condition,

\[
\gamma_{ij} = \gamma_{ji} \quad i,j=1,...,n \tag{5}
\]

The imposed conditions explain that:
\[ \sum_{i} y_{ij} = 0 \quad j=1,...,n \] (6)

This implies that constant return to scale is specifying the translog. Given this assumption, testing for linear homogeneity is the same as testing for symmetry (Turnovsky & Donnelly, 1984).

As pointed out by Berndt (1991, p. 472), estimation of equation (1) by OLS results in a singular and non-diagonal error covariance matrix. To avoid this, the factors prices of production workers, non-production workers, capital, and material are stated relative to the price of energy and the equation is re-estimated. With the estimates from equation (2) given the relative prices, and from the symmetry and homogeneity of degree one in input price conditions, the estimates of the share of energy are retrieved.