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(STIPRO)

Impact of ICTs Adoption and Application on Innovation in Selected Manufacturing Firms in Tanzania

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1.0 Introduction

1.1Background of the Study

Over the years manufacturing has been part and parcel of the Tanzanian development efforts and has been recognized as an important ingredient for rapid and sustainable growth of the economy (Nathan, 2006). Manufacturing in Tanzania is pursued with a wide range of objectives. Vision 2025 says Tanzania will be semi industrialized by then. Among the national goals which manufacturing is geared to include economic transformations for achieving sustainable economic growth (Nathan, 2006).The sector's current contribution to country's GDP is only marginal. For instance it contributes about 9.8 per cent in 2010. Apart from the large manufacturing firms, the SMEs are also accountable for the 50% of the above manufacturing contribution to gross domestic product.

In 2007 the government continued to promote the establishment of various programmes for the purpose of increasing the contribution of small enterprises to economic growth, including the sensitization, development of creativity and dissemination of appropriate technology such as construction and agro processing equipment. However, despite these efforts, manufacturing sector is not growing as fast and contributing to GDP as it should be. For instance the growth in manufacturing activities (at 2001 price) declined by 1.9% from 9.9% in 2008 to 8.0% in 2009. Some of the mentioned general weaknesses of this sector are their weak productive capacity which manifests in low domestic and international market coverage, low level and poor access to technology, and market and management problems (Molony, 2005). Others are poor and expensive energy sources (electricity), water scarcity, lack of market incentives for innovation and inputs market information (Diyamett, 2010). Because innovation has a great role to play in productivity growth, it should form part of the solution to these general problems. Innovation is basically an interactive venture, requiring reliable information and communication technologies (ICT) facilities. Through the rapid spread of ICTs and ever decreasing prices for communication, markets and production become more integrated in different sectors, making innovation much easier. Tanzania has taken major steps forward in creating policy and legislative structures to anchor growth and development of ICT. The government's national ICT Policy, launched in 2003, articulates a range of focus areas that will aid optimal use of ICT in the country. Moreover, Tanzania's economic development blueprint, 'Vision 2025,' recognizes the ICT sector as a key accelerator for all national development efforts. According to the strategic plan, broad-based application of ICT in both the public and private sectors is crucial for fostering economic growth, peace and stability and improving the quality of life. The Tanzania Development Vision 2025 calls upon Tanzania to transform from a low productivity agricultural economy to semi-industrialized. The vision stipulates that "the new opportunities which the ICT are opening can be harnessed to meet the goals of the vision" (URT, 2001). In the late 1990s, many firms in Tanzania, albeit on a limited scale, have embraced ICT.

The value of ICT grows as firms adopt more competitive strategies and vertically integrate into value-added offerings. As a result, ICT needs can vary significantly across firms and industries, often driven by an organization's place in the value chain. Today, after substantial advances in information processing technologies, the computing power is embedded directly into new Computer Numerically Controlled (CNC) machine. This computer coordinates

machining tasks across these different CNC machines and directly reduces setup-time. Another example, Computer-Aided Design (CAD), also known as Computer-Aided Design and Drafting (CADD), is the use of computer technology for the process of design and design-documentation. Computer Aided Drafting describes the process of drafting with a computer. CADD software, or environments, provides the user with input-tools for the purpose of streamlining design processes; drafting, documentation, and manufacturing processes. CADD output is often in the form of electronic files for print or machining operations. The development of CADD-based software is in direct correlation with the processes it seeks to economize; industry-based software (construction, manufacturing, and engineering) typically uses vector-based (linear) environments whereas graphic-based software utilizes raster-based (pixelated) environments. CAD may be used to design curves and figures in two-dimensional (2D) space; or curves, surfaces, and solids in three-dimensional (3D) objects. Example, architectural engineer use CAD to design the tools and machinery and in the drafting and design of all types of buildings, from small residential types (houses) to the largest commercial and industrial structures (hospitals and factories).

However, while firms worldwide are increasingly investing in new ICT applications such as three-dimensional Computer Aided Design (3-D CAD), internal and external computer communication networks and Product Data Management (PDM) systems (Corso & Policy, 2001), the value of ICT, especially for poor developing countries has been found to be in the use of ICT in communication and management. The early adopters in Tanzania and the experience of successfully developing economies show a path where ICT broadly defined can become ubiquitous economic tool, customized to the needs and sophistication of a particular user.

1.2 Statement of the Problem

The value of ICT grows as firms adopt more competitive strategies and vertically integrate into value-added offerings. As a result, ICT needs can vary significantly across firms, industries and countries, often driven by an organization's place in the value chain. Tanzania like other developing countries has embraced ICTs in firms as the catalyst for development (Kijo, 2004). However, so far little is known on how the adoption and application of ICTs can be a catalyst for competitiveness and growth in different sectors of the economy in developing countries. For Tanzania, scanty empirical evidence do exist, including Killango (2004) who assesses the role of ICT in enhancing CRDB bank performance within the framework of service delivery effectiveness and productivity. Others are Kijo (2004) who examines the impact of investment in, and utilization of ICTs on market extension of SMEs; Elly (2002) who investigated access to and use of ICT in agricultural research institutes of the Ministry of Agriculture and Food Security in Tanzania; Nathan (2006) who analysed the contribution of ICT in the performance of Mbeya Cement Company, and Mcharo (2005) who looked at the attitude towards ICT use and challenges facing small and medium enterprises, in printing and publishing industry in Dar es Salaam. From this empirical work we gather that, there is little if not completely lack of systematic study of links between adoption and application of ICTs by firms and its contribution to innovativeness of these firms. There is also no study that dis-aggregates ICT adoption and application by size of firms: we assume that firms of different sizes have different capabilities and challenges in the adoption of ICT. This study attempts to

bridge this knowledge gap. Specifically the study examines the impact of ICT adoption and application on innovation in micro, small, medium and large firms in Tanzania.

1.4 Objectives

1.4.1General objective

To determine the types and role of ICTs in innovativeness of manufacturing firms (in micro, small, medium and large) in Tanzania

1.4.2 Specific Objectives

- To identify sources of information for innovation in the selected Tanzanian manufacturing firms
- To assess the extent to which manufacturing firms in Tanzania have adopted ICT
- To identify the ICT resources available in selected Tanzanian manufacturing firms and their application in enhancing innovation activities
- To assess the impact of ICT on the innovation activities in Tanzanian manufacturing firms
- To examine the factors that seem to influence the adoption and application of ICTs in the Tanzanian manufacturing firms (size, knowledge base)
- To identify constraints to access and use of relevant ICTs in the Tanzanian manufacturing firms by size.

1.5 Research Questions

- What are the sources of information for innovation in selected Tanzanian manufacturing firms?
- To what extent manufacturing firms in Tanzania have adopted ICT?
- What ICT resources do the Tanzanian manufacturing firms have and apply in enhancing innovation in the selected industries?
- To what extent the adoption and application of ICT has contributed to enhance innovation in the selected Tanzanian manufacturing firms?
- What are the factors that influence the adoption and application of ICTs in the Tanzanian manufacturing firms?
- What are the constraints to access and use of relevant ICTs in the Tanzanian Manufacturing firms?

1.6 Significance of the Study

This study is important to the government in terms of public policy on industrial development, for it gives deeper insights into the challenges facing Tanzanian Manufacturing sector as far as access to, and use of ICTs is concerned. The findings will also benefit the studied firms by availing knowledge on the power of ICT on the innovativeness of their firms: the mere act of filling the questionnaire informs firms the type of ICT that they should be having. Furthermore, the study will contribute toward the body of knowledge about ICT for innovation in least developed countries.

1.7 Scope and Delimitation

The study will examine the impact of ICT adoption and application on innovation in micro, small, medium and large manufacturing firms in Tanzania, and its scope will be limited on the impact on innovations rather than extending on the implications of ICT adoption to the general performance of the firms. This study embraces the assumption that; innovation is beneficial to individual firms and society in general. The limitation in data collection could occur due to low level of education and knowledge of respondents on the subject for some technical terminologies used in ICT. To solve this problem, data was collected through face to face interviews.

2 Literature Review

2.1 Introduction

The literature review provides an overview of ICTs and innovation practices in manufacturing sector. Different aspects of ICTs and innovation such as theoretical foundation, conceptual framework and empirical studies are reviewed. Also, the rationale for this study is provided by examining the gaps in the literature, as related to this investigation.

2.2 The Concept of Innovation

The word innovation derives from the Latin word "innovare", meaning to renew or alter. The senses of both the "introduction of novelties" and of "something new introduced" go back the sixteen century (Oxford English Dictionary, 1989). The Renaissance philosophers who contributed to spread Renaissance economic thinking throughout Europe gave birth to the term "innovation" as used in economic theories even today (Reinert, 2007 in Szogs, 2010). Around 1605, Francis Bacon wrote "An essay on innovations", and as the "scientific leader of the new industrialists" he advocated to apply science in the production of manufactured goods (Crowther, 1960).

The OED also offers a meaning for innovation, but in commercial use, namely the action of introducing a new product into the market. According to many scholars of innovation, innovation does not only refer to change based on advances in scientific and technological knowledge; nor is it confined to changes in products and processes. Innovations in services are also important and often lucrative, and so are innovations in organizational forms and in marketing. Thus innovation is generally defined as a positive change in, or emergence of, new processes, products, organizations, markets and behaviors. The novelties brought about by innovation may be in services or in a system of management and marketing by which products and services are brought into being and distributed. A useful classification is the differentiation between incremental and radical innovations. Incremental innovations are consecutive changes and improvements in already existing processes and products. In contrast to this, a radical innovation is when an entirely new process or product is introduced. Product and process differentiations are another crucial part of the definition of technological innovation. In broad sense innovation is not confined to the manufacturers or distributors of products and services in the commercial sector. Organizations in government and all branches of the not for profit sector also need to innovate to meet changing conditions and even to anticipate them.

Kline & Rosenberg (2000) argue that, there is no single, simple dimensionality to innovation. There are rather, many sorts of dimensions covering a variety of activities. We might think of innovation as a new product, but it may also be a new process of production - the substitution of cheaper material newly developed for a given task in an essentially unaltered product; the reorganization of production, internal functions or distribution arrangements leading to increased efficiency, better support for a given product, or lower costs; or an improvement in instruments or methods of doing innovation. The Oslo Manual has five elements of innovation (OECD, 1997): 1. Introduction of a new product or a qualitative change to an existing product; 2.Introduction of a process new to an industry; 3.Opening of a new market;

4.Development of new sources of supply for raw materials or other inputs; and 5.Changes in industrial organization. The 1997 version of the Manual, however, only considers the first two elements of the definition. Generally speaking, the 1997 version of OSLO manual treats innovation as the introduction of a new product or process within a given period. Innovation is also heavily dependent on science and technology (S&T) and therefore technological research and development (R&D). However, subsequent revisions of the manual include the rest of the types of innovations as defined in the 1997 manual.

2.2.1 The Concept of Innovation, Invention and Creativity

Innovation, in most cases has wrongly been used interchangeably with the word "invention" (Diyamett, 2010). The concepts of creativity, invention or innovation are often used indistinctively in policy documents, but conceptually they are rather different. The question is, where is the point of departure? Invention refers to creation of something new; innovation is actual putting of the new thing into the market place. Invention is the first step in the long process of bringing a good idea to widespread and effective use; and invention cannot be termed as innovation unless it has been put in the market or any other effective use (Mutlu&Er, 2003; Diyamett, 2010). Again, the word creativity has synonymously been used as innovation, but these again are two different things. Creativity can be defined as problem identification and idea generation, whilst innovation can be defined as idea selection, development and commercialization. While it is true that innovation involves creativity, and all innovations begin with knowledge and creative ideas, creativity is not identical to innovation (Amabile et al, 1996).

2.2.2 Types of Innovation

Innovation may be present in various forms in organizations, such as product or process innovation, radical or incremental innovation, administrative or technological innovation. For the purpose of this study, some of the main four areas that determine the firm's overall innovativeness were identified from extensive literature review.

2.2.2.1 Organizational innovation

This is defined as an organization's overall innovative capability of introducing new products to the market, or opening up new markets, through combining strategic orientation with innovative behaviour and process (Deselnicu, 2008). "Organizational innovation" is a broad concept that includes strategies, structural, and behavioural dimensions. It includes competitive strategy (i.e. role of innovation, costs, people etc.); structural characteristics of the organization such as hierarchy, functional lines, and organizational boundaries; work processes including the use of different production inputs, the flow of work, job design, work allocation, and use of suppliers and subcontractors. Organizational innovation consists of three main types: production and efficiency practices; human resource management practices; and product/service quality- related practices. In turn, each of these organizational innovations consists of various single practices (Surendra&Gu, 2004). Also, for organizational innovation there is a view that technical change in many instances requires an adaptation of the organizational configuration of firms and industries, and therefore influenced by technological process innovation (Diyamett, 2010).

2.2.2.2 Process innovation

This captures the introduction of new production methods, new management approaches, and new technology that can be used to improve production and management processes. Process innovativeness is imperative in overall innovative capability in that an organization's ability to exploit its resources and capabilities, and the ability to recombine and reconfigure its resources and capabilities to meet the market requirements is critical for organizational success (Deselnicu et al, 2008). This type of innovation focuses on improving profit margins by extracting waste not from the offer itself but from the enabling processes that produce it. The goal is to remove nonvalue-adding steps from the work flow.

2.2.2.3 Product innovation

It is considered as the novelty and meaningfulness of new products introduced to the market at a timely fashion. Thus product innovativeness can be regarded as a salient dimension. The product innovativeness maintains a central focus of product newness (Deselnicu et al, 2008).Product innovation focuses on existing markets for existing products, differentiating through features and functions that current offers do not have. This form of innovation is normally highly dependent on fast time to market, although patents can sometimes keep competitors at bay for prolonged periods. Example include the hybrid engines in automobiles, cameras in cell phones, wireless connectivity in laptop computers, and flat-screen plasma displays for entertainment centers.

2.2.2.4 Market Innovation

Refers to a newness of approaches that companies of firms adopt to enter and exploit the targeted market. Market innovativeness emphasizes the novelty of market-oriented approaches. Product and market innovativeness are treated as salient factors, they are inevitably inter-twined (Deselnicu et al, 2008). In the same vein,OECD (2004) cited in Diyamett (2010) argues that, market innovation concerns marketing of new products, and covers activities in connection with the launching of the new product. Thus market innovation is primarily a result of product innovation, and to a large extent can be captured by product innovation. Market innovation can also happen with old products, basically focusing on differentiating the interaction with a prospective customer during the purchase process. The goal here is to outsell the competitors rather than out product them. For example, using viral marketing on the web to create buzz about new movie, product placements in TV shows, peer to peer of marketing of social networks, and single-vendor showcase stories.

The above four types of innovation are inter-linked. In particular, product and market innovativeness are externally focused and market based, whereas, organization and process innovativeness are internally focused, and underline the need for product and market innovativeness. Product and market innovativeness embodies the process, and organizational innovativeness. This study includes all the four types of innovation (organizational, process, product and market innovation).

2.3 The Concept of ICT

The term "Information and Communication Technologies (ICTs)" and "Information Technology (IT)" tend to be used interchangeably. The former recognizes the multiple technologies involved as well as the ubiquitous convergence of communications with information technologies. However, the term IT has come to include the idea of many technologies as well as the communication element. In general, IT tends to be used more in the United States of America, while ICTs is the preferred usage outside the USA and among multilateral organizations (Kijo, 2004). In this study we use the term ICT to imply both IT and ICT.

ICTs has been defined as office, computing, accounting and information processing (IP) machinery and equipment which include computers, communication equipment, scientific and engineering instruments, photocopiers and related equipment and software and related services (Brynjolfsson and Young, 1996). ICTs encompass all those technologies that enable the handling of information and facilitate different forms of communications among human actors, between human beings and electronic systems. These technologies can be subdivided into capturing, storage, processing, communications and display technologies (Hamelink, 1997). For the purpose of this study, ICTs will cover mobile (cellular) phones, e-mail, fax, fixed lines telephones, computers and others similar technologies related to this category of ICTs, and knowledge thereof

Modern society is moving through a period of rapid transformation. Information and Communication Technology (ICT) are playing a significant role in this transformation and development of modern society. It has become a vital resource for any socio-economic development in the 21st century (Mostafa, 2009). ICTs offer new ways for communicating and exchanging information and knowledge in various sectors (Emmanuel and Lwoga, 2007; Tumsifu, 2002) including industrial sector. The deployment and use of ICTs provide a variety of strategic opportunities for economic growth and development. ICTs can change the structure of economic and physical relationships and provide economic players with new ways of interacting and doing business. Hence causing a ripple effect that leads the way to general economic growth. That is why ICTs are considered as an efficiency enabler and thus an integral part of many development strategies. The collective legacy of ICTs is built on empowering people with the ability to innovate and facilitate the development process by increasing: Efficiency:- the ratio of output to cost; Effectiveness:- which determines the quality of output and services; Equity; i.e. - the distribution of development benefits throughout the society (Yonah, 2002). ICT is considered to have both a direct and an indirect impact on productivity. The direct impact may be measured by ICT capital investment over time, a capital deepening effect; however, indirect impacts are the more subtle changes that result as ICT capital changes the nature of production processes (Atrostic and Nguyen, 2004). For example, Computer-Aided Design (CAD), also known as Computer-Aided Drafting, is used to design and create 2D and 3D virtual models of goods and products for the purposes of testing. It is also sometimes referred to as Computer Assisted Drafting or Computer-Aided Designs and Drafting (CADD). Other computer aided includes Computer-Aided Manufacturing (CAM), Computer-Aided Engineering (CAE), and Computer-Aided Processing (CAP).Many firms are thus investing in new Information and Communication Technology (ICT) applications like three-dimensional Computer Aided Design (3-D CAD), internal and external computer communication networks and Product Data Management (PDM) systems (Corso & Paolucci, 2001).

2.3.1 ICT and Innovation:

ICTs and Organizational Innovation

OECD (2002) argues that ICT improves productivity by enabling "organisational innovation". The greatest benefits from ICT appear to be realised when ICT investment is combined with other organisational assets, such as new strategies, new business processes, new organisational structures and better worker skills. Empirical evidence suggests that organizational changes may improve economic performance of firms through their mutually-reinforcing relationship with ICT. OECD (2002) argues that ICT is a key to facilitating new organisational approaches, from lean production to teamwork to customer relations. ICT enable firms to introduce significant organisational changes in the areas of re-engineering, decentralisation, flexible work arrangements and outsourcing. It allows firms to produce with greater flexibility and shortened product cycles to satisfy shifting consumer preferences. In fact, organizational innovation and ICT may be regarded as complementary factors. To be successful, firms typically need to adopt ICT as part of a "system" or "cluster" of mutually reinforcing organizational approaches (Milgrom and Roberts, 1990).

ICT and Process Innovation

Process innovation is often introduced in conjunction with new technologies (ICT and non-ICT) such as robots, advanced manufacturing cells, automated process control and many similar state- of-the-art technologies, all of which are integral to new processes. ICT as a general purpose technology facilitate the introduction of process innovations (Surendra & Gu, 2004).Today, after substantial advances in information processing technologies, the computing power is embedded directly into new Computer Numerically Controller (CNC) machine. This computer coordinates machining tasks across these different CNC machines and directly reduces setup-time. Another technology that is becoming more common in valve making plants is three Dimensional Computer-Aided Design (3D-CAD) and Drafting (CADD), Computer-Aided Manufacturing (CAM), Computer-Aided Engineering (CAE) and Computer-Aided Processing (CAP). These are constantly advancing IT method for turning customers' specifications into a specific design, thereby reducing the time that elapses from order placement to design presentation to the customer. For many years, employees did time-consuming inspections with manual measuring devices. Over the last several years, automated inspection sensor machines have been introduced which use a computerized touch-probe technology (Bartel et al, 2005).

ICT on Product Innovation

Product innovation and customization is a second critical area of competition in the industry. The ICT advances described in this section play a critical role in the move toward product innovation and customization. As more sophisticated controllers make changeovers between product runs faster and therefore less costly, plants will be able to start producing a greater number of different products in smaller manufacturing lots. For example, first, adopting new IT-enhanced equipment alters business strategies of valve makers, moving them away from commodity production based on long production runs to customized production in smaller batches. Second, new IT investments improve the efficiency of all stages of the production process by reducing setup times, run times and inspection times. The reductions in setup times are theoretically important because they make it less costly to switch production from one product to another, and support the change in business strategy to more customized production in smaller batches. The Computer Numerically Controlled (CNC) machines produce more accurately and with a greater number of features that allow plants to produce more product varieties at a reduced cost. New CNC machines raise the quality of the machines in use (Bartel et al, 2005). Also, CAD is mainly used for detailed engineering of 3D models and/or 2D drawings of physical components, but it is also used throughout the engineering process from conceptual design and layout of products, through strength and dynamic analysis of assemblies to definition of manufacturing methods of components.

ICT and market innovation

ICTs can cause the costs of input and output market innovation and interactions for an enterprise. 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 characterized by imperfect and asymmetric information. A seller looking for a buyer is unlikely to be fully informed about all the potential buyers. As a result, ICTs particularly internet can change the way that seller-buyer matches are made, and enterprises can integrate themselves with the global market. The use of Internet in the transaction process known as electronic commerce can reduce the costs of the export process before, during and after the export. Clayton and Criscuolo (2002) argue that e-commerce has had a significant positive impact on the way business to business transactions are conducted, improving information flows between suppliers and consumers, and speeding up market access. For example, the ICT enables firms to restructure their organizations, to re-engineer business process (like e-commerce) and develop completely new products (software and consultancies). On top of these short-run impacts of ICT adoption and application in the production process, the use of ICTs in the transaction process can foster input and output market innovation. Through designing new products using CAD it becomes possible to begin the process of market testing much earlier than in the past.

2.3.2 ICT Resources Used By the Tanzanian Firms

The types of ICTs mostly used by enterprises to process, disseminate, receive information and innovate include: telephone, mobile phones, typewriter, photocopier, fax and computer. For example, Kijo (2004) found that, most of enterprises in Tanzania use mobile phones because it is the most cheap and important. Matambalya and Wolf (2001) observe an increase in the percentage of firms that use mobile phones and that it has already outgrown the usage of fax machines despite the fact that it started late only in 1994. The findings showed that, in Tanzania, mobile phones were considered to contribute significantly to regional market expansion by most of enterprises followed by fixed phones and faxes. This notwithstanding however, use of other ICTs have not been systematically explored in the Tanzanian business firms, especially their contribution to innovativeness of firms and hence one major reasons for this study.

2.3.3 Indicators for the Study

System of appropriate indicators is paramount for any study. The section below is devoted to the identification of indicators that are adopted by this study.

ICT Indicators

Some of ICT indicators on use which were identified from business, innovation, economic and social studies are indicated in the Table 2 below. These indicators will be used to measure adoption and application of ICTs in the study firms

Table 1: ICT Indicators

	Indicator	Definition	Derivative Measures	Interpretation
1	**ICT Investment (Equipment &Software)**	ICT investment indicators typically cover acquisition of equipment and computer software that is used in production. ICT has three components: information technology equipment (computers and related hardware), communication equipment and software. Software includes acquisition of pre-packaged software, customized software and software developed in house	Total ICT investment, ICT expenditure (%) and ICT per capital and employee	ICT has been the most dynamic component of overall investment activity and is considered by economists as a key driver of national economic growth and productivity.

2	**Participation in Life Long Learning (LLL) and training (ICT Literacy)**	This is an indicator of no. of persons involved in LLL and investment being made in continuing education and on-going competencies. Productivity service quality and the rate of innovation are all improved by training; continuous learning by workers enhances a firm to cope with fast paced technological change. Activities that qualify as LLL include course of relevance to the employment and general interest courses.	Participation in LLL of employee and employer, Kind of training and numbers of persons participated	An innovation economy is characterized frequently as knowledge economy is in which individuals are continually learning new ideas and skills and participating in LLL activities. The ability to learn creates a more flexible and adaptable workforce and faster adjustments to economic and technological disruption. It includes initial education, further education, continuing or further training, and training within a company, apprenticeship on-the job training, seminars, distance learning and evening class
3	**Computers and Broadband Deployment**	Measures of business access to computer, internet and high speed broadband networks. Broadband corresponds to fast internet, and includes several technologies (DSL, cable, wireless, cable modems, satellite power line, dedicated lines and optical fiber or Long Reach Ethernet)	No. of broadband connected businesses; broadband penetration rate; No. of computers per capital; internet costs; internet use by business; broadband costs and no. of internet domain names.	Developed and developing countries give high priority to expanding access to high speed internet connections as critical to deployment of advanced internet applications, digital services, networking and collaborative innovation. It is a key measure of innovation capacity of the economy and is a driver of productivity. However, broadband definitions vary widely. "Broadband" is commonly understood as high speed, always-on communication links that can move large files much more quickly than regular phone lines
5	**Workforce Education**	The education level of a labor force is an important indicator of economic innovation and general economic health, as lower unemployment rates typically correlate with higher levels of education.	Level of education in relation to no. of employees	In order to "adapt and innovate to contend with global—not just national—competitors", the state must ensure that its residents are highly educated by global standards. However, while studies tend to focus on the education level of the population, an indicator focusing on the education level of the *workforce* is arguably more important in determining potential innovation and ingenuity in the state, since this indicator would represent people that are actively taking measures to work or potentially innovate.

Source: ASTRA (2007); Reffitt et al (2007); Thoma & Torrisi (2007); Hughes & Holbrook (1998)

Innovation Indicators

Table 2 below provides a number of common indicators used for measuring innovation. The same indicators will also be used for this study.

Table 2: Innovation Indicators

	Indicators	Definition	Derivative measure	Interpretation
1	Product	A technologically new or modified product is a product whose technological characteristics or intended use differs significantly from those of previously produced products. A simple product may be improved in terms of better performance or lower costs through the use of higher performance components or materials	Involves incremental or radical changes of new technologies based on combining existing technologies in new use or can be derived from the use of new knowledge. It is measured in terms of number of new or improved products introduced in the market in a given time period.	In this indicator, technological products has significantly been enhanced or upgraded
2	Process	This is the adoption of technologically new or significantly improved production methods, including method of product delivery	The methods involve changes in equipment or production organization and new knowledge. Infrastructure measures of significance to innovation performance. For example Computer Aided Design and Drafting. It is measure in terms of number of new or improved processes introduced in the production process in a given time period	Product innovation is normally accompanied by process innovation
3	Organization	This is a broad concept that includes strategies, structural, and behavioural dimensions. It includes competitive strategy, structural characteristics of the organization such as hierarchy, functional lines, and organizational boundaries. Organizational innovation consists of three main types:	This is the use of different production inputs, the flow of work, job design, work allocation, and use of suppliers and subcontractors. Measure in terms of existence of Cross-functional teams, quality circles,	For organizational innovation there is a view that technical change in many instances requires an adaptation of the organizational configuration of firms and

		production and efficiency practices; human resource management practices; and product/service quality-related practices.	decentralization of planning, operating and, controlling functions, preventive maintenance, quality audits/certification (ISO)	industries, and therefore influenced by technological process innovation
4	Market	Refers to a newness of approaches that companies of firms adopt to enter and exploit the targeted market. Market innovativeness emphasizes the novelty of market-oriented approaches.	This involves the interaction with a prospective customer during the purchase process. This involves the way of marketing the products for example e-commerce is the one way used by competitive firms. Can be measured by number of new marketing strategies introduced in given time period; new markets entered	This indicator is a proxy for the degree of diffusion of state-of-the art technologies. Product and market innovativeness are treated as salient factors, they are inevitably inter-twined

Source: Deselnicu et al, (2008); Diyamett, (2010)

2.3.4 Impact of ICTs Adoption and Application on Innovation in Manufacturing Sector: An Empirical literature Review

Macro analysis of the ICTs impact, at industry level, has been the focus of more recent work in the US, and the EU. Brynjolfsson and colleagues, in 'Scale without Mass' (Brynjolfsson et al, 2006) looked at the relationships between industry ICT intensity, and the characteristics of competition across US industries and concluded that: greater ICT use in industries speeds up diffusion of new, successful, business models by 'winning' firms, and so is leads to greater market share change within these industries; the effect of this process is to encourage increasing supply concentration, as successful firms supported by ICT grow, and others lose market share or exit the market.

UK analysis linking ICT use surveys to questions in the Community Innovation Survey on sources of innovation shows a strong link between the use of high speed internet connections by employees within firms (in the ICT use survey) and the ability to innovate using ideas from outside the firm, and outside the customer / supplier chain. This suggests a link between fast internet network use and the ability of firms to acquire and manage knowledge in the innovation process, to develop higher sales of new goods or services, or more use of new processes. Evidence from Sweden and Netherlands suggests that ICT use – reflected in the

proportion of fast internet linked employees and levels of e-commerce – is related to the intensity with which firms produce and sell new products / services. This also is likely to reflect network effects on knowledge management, on the effectiveness with which firms are able to convert knowledge into new products and services, and on the speed with which they are able to commercialize them out into the market.

Analysis across all participating countries using DMD shows that in industries which have relatively high levels of ICT use on the core metrics, there also tend to be higher absolute amounts of market share change (or 'churn'). This is consistent with the view that ICT intensive industries in Europe show the same tendency seen in the US by Brynjolfsson et al, for successful firms to be better able, and quicker, to replicate new market share winning innovations across production and distribution networks. From Sweden and Netherlands there is initial evidence, using datasets restricted by the limits of overlap between production, ICT and innovation surveys, in regressions in which both effects are considered simultaneously, that productivity effects of ICT use are associated more strongly through the 'indirect innovation' effect (percentage of new products / services) than through ICT use measures directly. The Swedish analysis tests the relative strength of direct and indirect productivity effects and concludes that the ICT => innovation => productivity channel is significantly stronger than the direct ICT => productivity channel for the individual firm. The Swedish evidence is concentrated on larger firms due to sampling effects. Evidence from Netherlands suggests that ICT use can substitute in productivity equations for the CIS process innovation indicator, indicating that ICT use may be a good proxy for process innovation in certain types of firms. This provides statistical evidence for a position that has been argued by researchers, that in service industries particularly, ICT introduction is often the embodiment of process change.

The most significant set of results from firm level analysis may be the relationships emerging from the three countries which have linked innovation and ICT use surveys. Taken together these suggest that a significant part of the productivity impact associated with ICT investment and use is channelled through innovation, broadly defined to include non-technical and business process innovation, by a range of mechanisms:

- by enabling knowledge exchange and management, through networks,;
- by supporting 'roll out' of new goods, services and processes, through ICT enabled business systems which enable rapid scaling up and replication;
- by enabling better marketing of new products / services to new markets via e-commerce;
- by 'being the innovation' in business process improvement and redesign.

This evidence should be considered alongside the growing literature on 'innovation accounting', developing at both firm and national accounts level. This recognizes a range of intangible inputs to innovation, including software, technology based R&D, non-technical expenditure on new products and services, skills, organizational and reputation capital. This

framework is still under development with major measurement problems especially in the areas of non-technical service innovation (not least financial services) and organizational and business process change. But the central role of information and organization in the 'intangibles' framework suggests that ICT hardware and software provide an important part of its infrastructure. Looking ahead to a 'next generation' of ICT impact indicators, the changing patterns of innovation should perhaps be an organizing framework for thinking about how measures should develop. The interaction between ICT as a knowledge management infrastructure and the skills (ICT and general) of workers is worth further exploration. So is the relationship between ICT and organizational / business process change or're-engineering'.

2.4 Research Gap

The empirical literature review above and other recent enterprise-level studies in developing countries have reported a mix of positive and non-positive effects of ICTs on firm's performance. For instance the study by Chowdhury and Wolf (2003) that assess the use of ICTs and their impact on the economic performance of SMEs of three East African countries: Kenya, Tanzania and Uganda suggest that investment in ICT has a negative impact on labour productivity and a positive impact on general market expansion. The study further indicates that such investment does not have any significant impact on enterprises' return, nor does it determine enterprises exporter (non-exporter) status. This means that the role of ICT in Africa's SMEs is still not clear, and therefore warrants further research. This is especially rooted at the fact that benefits of use of ICT are greatest for firms higher in the value chain: most of the African SMEs are lower in the value chain. Furthermore – as earlier alluded to - the relationship between firms' productivity growth and ICT is still very much debatable - is it a direct one or indirect, e.g through enhancement of innovation. While for more developed countries, research indicates that what is actually important is ICT enhancement of innovation, for less developed countries this is yet an answered empirical question. The current is an attempt towards bridging this knowledge gap. It is an attempt to gauge the role of ICT adoption and application in enhancing innovation in micro, small, medium and large firms in the Tanzanian manufacturing sector.

2.5 Conceptual Framework for ICT and Innovation

Firms usually face a comparatively uncertain environment and investors often have a short-term time horizon. The decision to implement and apply ICT depends on the intuition of the firms which invest in training and ICT adoption and application, as well as to optimism or pessimism with respect to policy changes and economic conditions in the future. The ICT adoption and application on innovation decision is therefore determined not only by firm characteristics but also by characteristics of the environment the firm operates in. This explains why not all potential users introduce the different ICT technologies at the same time despite its advantages (Tahir& Sam, 2010). The diffusion of an innovation starts slowly with a few early adopters. As other potential users, including early and late majority witnesses the

benefits of ICT to the early adopters, the diffusion and the speed of penetration increases. When most potential adopters have the new technology the speed of diffusion decreases again until the saturation level is reached, where investor might not see a benefit of the new technology but fear to have a disadvantage if they don't use it (Müller-Falcke, 2001).

Strategically, well blend ICT adoption and application, with creativity and innovation will promote the development of economies without the intensification of the labour and capital. At the tip of this strategy and activity, the involvement of the industrial sector is crucial. As an initiator for the development, the involvement in ICT application and innovation should be cultured in the firm. From those scenarios, a problem statement is whether the firm can capture knowledge from use of ICT at work place that later transform to innovative product. The issues of slow technology development that is caused by inadequate sharing of knowledge, networking and failure to internalize the spillover effect of knowledge and skill creation can be studied by looking at the variable of ICT usage at work place, the innovation created and the knowledge captured from the ICT usage. The relationship between the creations of innovation promoted by the present knowledge that had been captured from usage of ICT at work place in the firm can be explored by using the Two Ordered Multiple Regression Model as shown in Figure 2.

Figure 2: Framework of ICTs Adoption & Application on Innovation in Firm

Source: Modified from Tahir & Sam (2010)

Figure 2 above shows that innovation activities will be created with certain amount of knowledge captured by the firm workers through the use of ICT. On the other hand, the capability of the firm workers to capture the knowledge from ICT usage depends strongly on the strategic internal and external environment of the organization, namely the human capital, decision-making and customer capital. The subject of virtual innovation systems is questioned because the tacit knowledge (basic to promote innovation) and confidence cannot be substituted by the ICTs. To study the relationship between ICT and innovation, a number of variables (indicators) at the firm level has to be studied: Frequency of using ICT tools, level of ICT literacy, ICT investment in equipment and software, LLL, venture capital, computers, and broadband, and how finally the use of all these have improved innovativeness of the firm. In all these, what is important is to measure how the knowledge captured from using

ICT has promoted innovation. Indicators that should be explored include; the extent at which they gained knowledge from using ICT at work place rather than training, and the significance of such knowledge in improving their performance at work place. These indicators will show the effect of knowledge that has been captured from ICT use at work place (Tahir & Sam, 2010).

3.0 The Context: The Situation of the Manufacturing Sector in Tanzania

Attempts for industrial development after independence from the British colonial power in 1961 were geared towards processing agricultural products such as cotton, sugarcane, tobacco and products of the natural resources including fertilizers. This led to the establishment of industrial firms such as Kilombero Sugar and Mtibwa Sugar in 1962. Textile industry was also established and targeted to consume 85% of the locally produced cotton. These establishments were implemented under the 1961-1964 and the 1964-1969 five years national development plans, and mainly through private external investments or National Development Corporation (NDC). The role of the state was provision of investment incentives such as accelerated depreciation, tariff protection and guarantee of profit under the Foreign Investment Protection Act of 1963. During the period, the industrial sector in average contributed for 6% of the GDP annually (Masuha, 1996a cited in Diyamett, 2010).

Before the end of the period for the 1964-1969 national development plans, the Arusha Declaration was proclaimed in February 1967 with the view of socialism and self-reliance. All major industries were nationalized through state ownership and other new large industries were established under state ownership. These industrial firms were capital intensive, and technology choice and transfer were not accorded due importance; and this to a large extent contributed to the declining of the industrial share of the GDP (Wangwe, 1993). This decline triggered the introduction of the Basic Industry Strategy (BIS) that targeted the import reduction, Africanized public parastatal management and industrial growth of 8.8% per annum between1975 and1995. BIS industrial thrust on the manufacturing sector aimed at raising its GDP contribution from 7% in 1995 to 18.8% in 1995 by putting emphasis on the producer goods. During the last two decades, Tanzania like many other African countries had its assets privatised. In general, privatization, as one of the reform measures supported by the World Bank and IMF, has involved the transfer of all or any of three kinds of property rights from the state to the private sector: ownership rights, operating rights and development rights. Between 1995 and 2004, a total of 219 parastatals were privatized out of 400 enterprises earmarked for divestiture, and 499 non-core assets were sold (Masuha, 1996a cited in Diyamett, 2010). The government basically retained its ownership on public service, but in some instances it acquired private management. However, under the private investments the role of the government reduces to that of building friendly environment for private investors and country can benefit or loose from privatization depending on how it manages the

privatization process through policies. Although privatization had some negative impacts on delivery of some social services, it has been noted to have some positive impacts, including; enhancing efficiency, increasing investment opportunities, enhancing government revenue and creating employment.

4. Research Methodology

4.1 Research Design

A research design is very important in any research because, it provides the overall structure or plan of a study (Singleton & Straits, 2005). Given the nature of the research problem and objectives, the study was designed to be quantitative in general using of survey methods, but including qualitative follow up questions. Before the actual field work, research instruments were tested in some of manufacturing firms in order to establish their validity and credibility.

4.2 Research Area

Dar es Salaam which is the major commercial centre in Tanzania was is selected due to the fact that, it holds a large proportion of manufacturing firms in the country and accommodates all kinds of manufacturing firms (i.e. micro, small, medium and large industries). The study included firms of all sizes, randomly selected (stratified). The definition of different sizes is as follows: employees including 1-9 as micro, 10-49 small, 50-99 medium and 100 above as large firms.

4.3 Sample size

A population of about 400 firms was used to provide a random sample of 120 Tanzanian manufacturing firms. The surveyed firms were categorized into three groups where 40 firms were of large scale, 40 medium and 40 small and micro manufacturing firms. This aimed at making a fair representation of all categories of manufacturing firms from micro to large firms and to accord comparison. There was no sub sector categorization during the sampling process given the nature of the database from which the sample was drawn. However most of the key manufacturing sub sectors were surveyed as indicated on chapter 5 below.

4.4 Sampling Procedures

Random sampling was used to generate a sample of manufacturing firms to ensure fair representation. Tanzania Manufacturing Sector Database was used as sampling frames to

randomly select the firms which were considered as basic sampling unit in this research. Additionally the survey was complimented by in depth interviews on firms with desirable outcome, e.g. those who adopted ICT and innovative, and those who adopted ICT and not innovative.

4.5 Data Collection Methods

The data collection involved administration of a questionnaire. Primary data collection steps include setting the boundary for the study, collecting information through questionnaires (survey), interviews and observation. The structured questionnaire was administered by researchers to collect a wide array of information from a representative sample.

4.6 Secondary Data

Secondary information was sought from existing; both published and unpublished related materials.

4.7 Data Analysis

The analysis and presentation of the quantitative information, applied the descriptive statistics tools such as percentages, frequencies, and graphical representation. In testing association between innovativeness and ICT adoption, cross-tabulation was used as the main tool. For qualitative data, pattern matching technique. In this technique the information collected was arranged in groups with similar meanings. In drawing conclusions, emerging patterns was matched and analysed.

4.8 Ethical Issues

Ethical issues such ensuring confidentiality of information and respecting respondents' consent in response to questionnaire were observed throughout the research.

5. Research Results and Discussion

5.1 Introduction

This chapter highlights the key research findings drawn from the field survey data and at some points complimented by findings from related studies. Initially the main features of the surveyed firms are described, followed by analytical overview of their innovativeness and ICT usage and later the two parameters are mapped in the discussion section. Attempts are made to enrich the discussion by drawing some comparative evidence from other similar studies.

5.1.1 Structure of the Sample firms

This study was conducted on120 manufacturing firms in Dar es Salaam, Tanzania. As stated on chapter 3 the distribution covered 40 firms which are categorized as micro and small in terms of size, 40 medium firms and 40 and large enterprises with a diversity of sub-sectors within the manufacturing sector. Micro and small firms are at higher proportion whereas the large firms contribute more in terms of value addition. However the study chose to take an equal distribution of the three categories so as to have balanced results. Geographically the firms are located in the capital city, Dar es Salaam. In terms of age, the sample firms used in this survey ranged from the 20 years old firms to some newly established firms as close as six months from the time of survey execution. As it appears on figure 5.1 below that there are a relatively higher number of firms which indicated to be established on 2008 compared to other years. Such a high concentration in 2008 is not uncommon, a study by the MITM (2010) indicated the existence of 683 new industrial establishments in 2008 out of which 93% consisted of the manufacturing sector. Similarly the analysis of 20 years trends from 1999 to 2009 indicated that; the contribution of the manufacturing sector to the GDP peaked at 9.9% in 2008 (Kahyarara, 2010). Generally the establishment surveyed firms range between mid-1980s to recent years. While the expansion of industrial establishments and growth in recent years coincides with the policies on promotion of private sector driven economy, the 2009 decline suggests the impacts of global economic crisis.

Figure 5.1 the distribution of establishment year among the surveyed firms

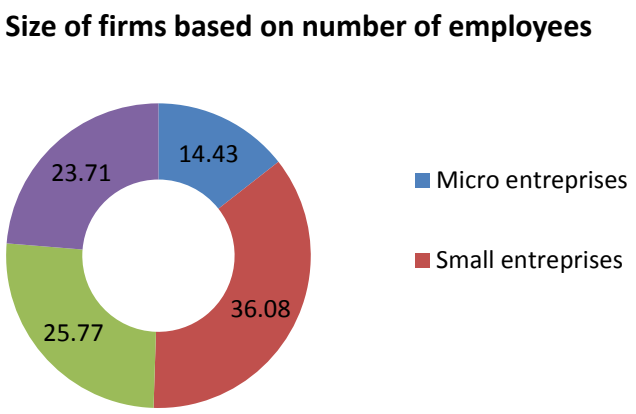
Source: Field data, 2011

5.1.2 Size, Ownership and Employees education level.

Size of Firms

The survey was designed to have an equal distribution of the three groups; small and micro firms, medium and large firms. The team approached 120 firms sampled from the database of industries by the Ministry of Industry Trade and Marketing. According to this list; 40 firms were classified as small firms including micro, 40 medium and 40 large enterprises. Generally the response rate reached 85% covering the total of 102 respondents out of the planned 120 firms. During the analysis the researchers decided to use the number of employees of the firms as a criterion for classification. This classification used in the analysis was derived from the Tanzanian SME policy of 2002 (URT, 2002). According to this classification the micro enterprises are those with up to 5 employees; small enterprises have 5 to 49 employees; whereas the medium ones have 50 to 100 employees and firms with more than 100 employees are categorized as large enterprises. From the empirical data the distribution of the firms was found to be spread across all the four categories. Based on the number of employees' classification, the distribution was slightly skewed with more small firms occupying about 36% of the distribution. On the other hand the micro enterprises occupied about 14.4% leaving the large and medium enterprises at 23.7% and 25.7% respectively. Based on these results the combination of micro and small firms formed about 50.5% instead of the originally planned 40%. The result of firms' distribution based on their size is also indicated on figure 5.2 below;

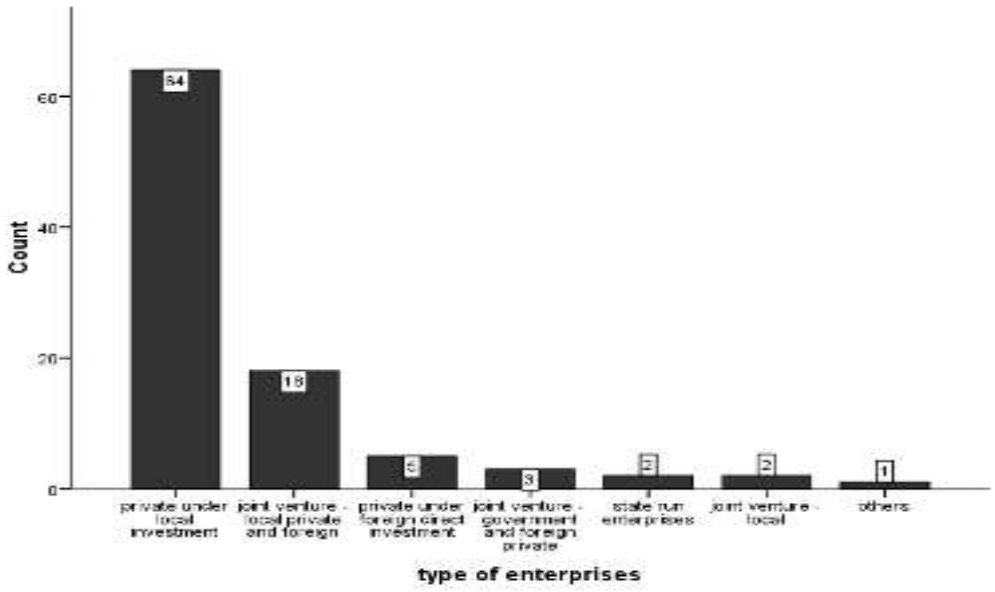
Figure 5.2: Distributions of the firms' size based on number of employees



Source: Field data, 2011

Another important feature of the firms used by the study to describe firms is their ownership status. It was found that; 64 out of all 102 surveyed firms were private firms under local investiment, covering 67.4%. This category is followed by a joint venture local private and foreign firms occupying 18.9 % and leaving the rest of the categories including state run and local joint venture with less than 10 % each as indicated on figure 5.3 below.

Figure 5.3:Ownership of the surveyed entreprises



Source: Field data, 2011

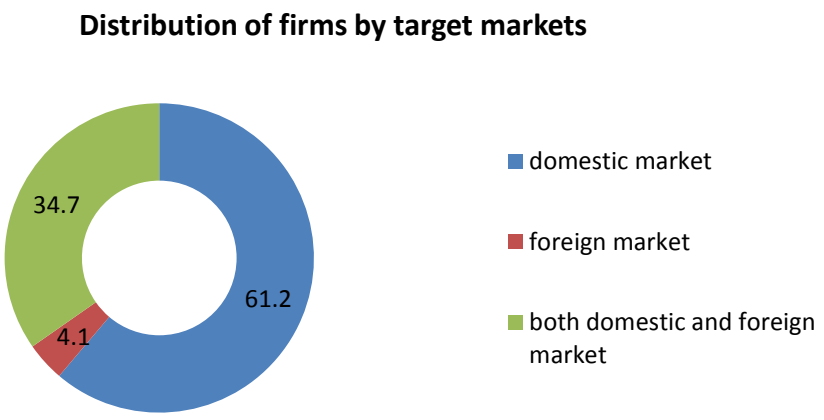
On average, 32.3% of the firms' employees aggregated were recorded to attain primary education as their highest level of qualification while about 67.7% of attained education higher than primary level. Additionally there is a comparatively lower proportion only at 6.9% of the total employees with undergraduate degree or above qualification, the rest of the employees were found to have attained other qualifications including; post-primary certificate, vocational training, secondary o-level, secondary- a level diploma qualifications. Such results denote a spread of expertise from low to medium levels of skills among the staff of the firms. It was found that; the main products manufactured by the surveyed firms include; foods and beverages, textiles, jeweller, pharmaceuticals, chemicals, metals, plastics and cigarettes. Industries in pharmaceuticals, chemical and cigarette are technology intensive and

needs skilled labour compared to sectors like metals and textiles and timber which absorbs a large proportion of unskilled labour. While the large proportion of low skilled laborers caters the demands of the labor intensive industrial activities, the limited proportion of experts with higher academic qualifications signals a skills gap for hi tech industries. The observed skills gap also suggests a low level of technological capability with limitation on application of complex knowledge driven technologies including ICTs. This proposition is also supported by findings from other variables as it will be seen later on this chapter.

5.1.3 Source of Raw Materials, Capital Goods and Markets

It was found that; 60 out of 98 firms that responded to the question on geographical distribution of their market mentioned that they targeted the domestic market. On the other hand 4 firms stated that they focus exclusively on the foreign markets. Although there were also about 34 firms which declared selling their products to both local and foreign customers, the sample was evidently dominated by the locally selling firms. Such results are not uncommon provided the country's export portfolio with a large proportion of raw agricultural and mineral resources and a comparatively lower proportion of processed products such as manufactures.

Figure 5.4: Distribution of firms by target markets



Source: Field data, 2011

Looking at the sources of raw material for the enterprises, there are more diverse sources again lead by local sources, followed by imports. The main regions where the firms import from are led by Asia, Europe, USA and neighbouring African countries. This study could not

undertake an extended analysis looking into the type of material obtained from each location. The analysis on the linkages between distances of suitable raw materials in relation to their actual industrial usage would help revealing the level of information gaps. The scope of this study is to capture the role played by ICTs on informing the firms about availability of inputs they require. Further studies are suggested on the extent and implication of gaps on knowledge and information related to markets, technologies and raw materials for innovation. Firms tend to select the source of raw material based on costs and quality, table 5.1 below shows the multiple responses on different locations where the firms obtain their raw materials.

Table 5.1: A multiple response distribution of firms' sources of raw materials

Where are you getting your raw materials? [a]	Responses	
	N	Percent
raw materials from Tanzania	71	44.7%
raw materials from Africa	22	13.8%
raw materials from Asia	34	21.4%
raw materials from Europe and USA	32	20.1%
Total	159	100.0%

Source: Field data

5.2 Degrees of Innovations

The degree of innovation by a firm depends on its originality; while those innovations from within a firm are of higher degree compared to those adopted from elsewhere; similarly innovations introduced for the first time in the world are of higher level than those new to the firms' market area or operational experiences. Findings from the analysis of field data indicate that; innovations created through firms' introduction of new products are still at low level, recorded at 36.5%. It is also shown that there has been only about 11% of new techniques which are claimed to be developed from within the firms.

Table 5.1 Firms degree of innovations

Parameter	Yes (N)	%	No (N)	%
Have you introduced any product that is new to the Tanzanian market in the past 3 years?	35	36.5	61	63.5
Have you adopted any new products?	63	64.3	35	35.7
Have you modified any product during the three years?	65	66.3	33	33.7
Have you developed any new techniques (processes) in the past three years?	11	11.2	87	88.8
Have you adopted any new techniques in the past 3 years?	66	67.3	32	32.7
Have you modified your production techniques in the past 3 years?	56	56.6	43	43.4
Has your firm been through organizational change in the past 3 years?	63	68.5	29	31.5

Source: Field data, 2011

Although the introduction of new products and techniques by firms is reported at low level, further analysis of the data portrays a slightly different picture when it comes to the adoption of the product and process innovations developed elsewhere. In this case the analysis found that; about 64% of the firms acknowledged to have adopted new products whereas 67.3 % of the firms adopted new techniques within the past three years prior to the survey. The situation on which there are higher proportions of firms that have adopted technologies has some policy implications for the transfer and adoption of technologies. Such information conforms to (WBI, 2010) indicating that developing countries are more consumers and adopters than developers of knowledge.

Similarly, there has been several success stories on incremental innovations related to modifications of existing products. Analysis of time taken by firms to undertake innovation related activities revealed that; less time devoted by the firms on projects that would come up with new products and processes compared to that project aimed at improving and adapting the existing products or processes. About half the respondents (52%) reported to take the average duration of one week to undertake innovation activities, only a few cases of declared to spend longer duration of month and above. In fact only 11% of the firms mentioned that they spent two years and above on their innovations projects.

The level of innovativeness by firms is constructed from combination of seven key indicators of innovation; development and marketing of new products, adoption of new products, modification of products, development of new techniques, adoption of techniques, modification of production techniques and whether the firm has undergone through

organizational changes in the past three years. The seven parameters were equally weighed and added up to form a variable named 'innovation index'. The visual binning[4] of the variable as implemented to group the firms into four categories as indicated on table 5.2 below. By running a frequency distribution analysis of the newly formed variable from a visual binning process, there was an observed skewed cumulative distribution of firms with an accumulation of the firms in the two lower groups forming (62.7%) compared to the two upper groups. This is to say that; by average there are more firms with low to mid low levels of innovativeness compared to the mid high to high innovativeness level.

Table 5.2: Distribution of firms in four categories by their level of innovativeness

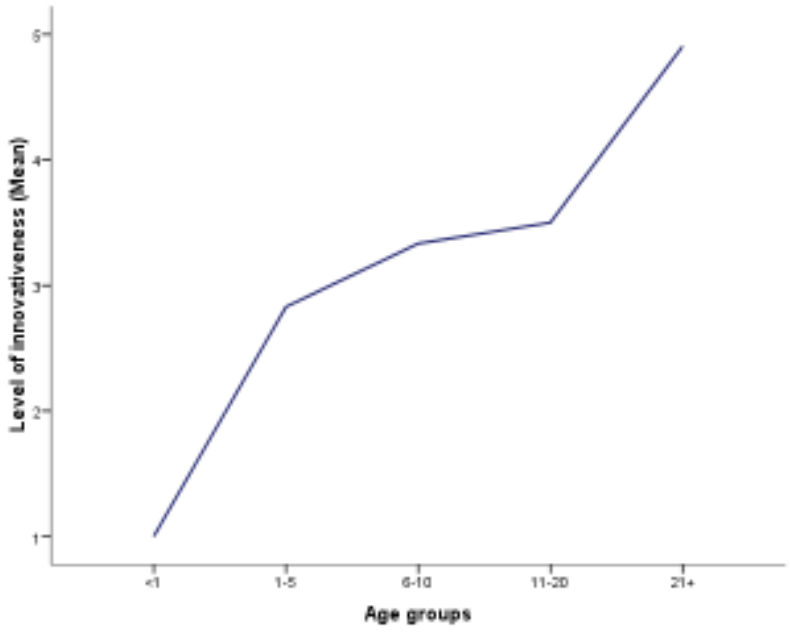
Category	N	%
Low	30	29.4
Mid Low	34	33.3
Mid High	17	16.7
High	21	20.6
Total	102	100.0

Source: Field data, 2011

Figure 5.5 below suggests that; the older firms are more innovative than the infant ones. Based on the year of establishment the age of the firms is determined and grouped into five categories. As the line graph indicates, the mean level of innovativeness increases across the age groups as the firms gets older. . Older firms are more experienced on the market, stronger established in terms of investment and they appear to be having less fear of investing on new technologies than their infant counterparts.

Figure 5.5: The trend of innovativeness level by firms' age

[4] This process creates a new variables by grouping contiguous values of existing variables into a limited number of distinct categories



Source: Field Data, 2011

5.3 Sources of information for Innovation

The field data shows that; although firms acquire information from multiple sources, the three main sources of information for innovation include; local sources within the firm, suggestions from the customers and imitation/adoption of innovations from local competitors. Table 5.3 below also indicates a relatively lower utilization of ICT driven information sources in this case patents databases and technology information centers.

Table 5.3: Firms' sources of information for innovations

Where did the idea to carry out the innovations mentioned originate?			
	Responses		Percent of Cases
	N	Percent	
within the firm	66	17.4%	66.7%
follow other local producers	39	10.3%	39.4%
suggestion from customers	62	16.4%	62.6%
suggestion from suppliers	29	7.7%	29.3%
working with research and development institutions	16	4.2%	16.2%
patent publication and database	7	1.8%	7.1%
overseas trained personnel	23	6.1%	23.2%
technology information centres	8	2.1%	8.1%
seminars and conferences	18	4.7%	18.2%

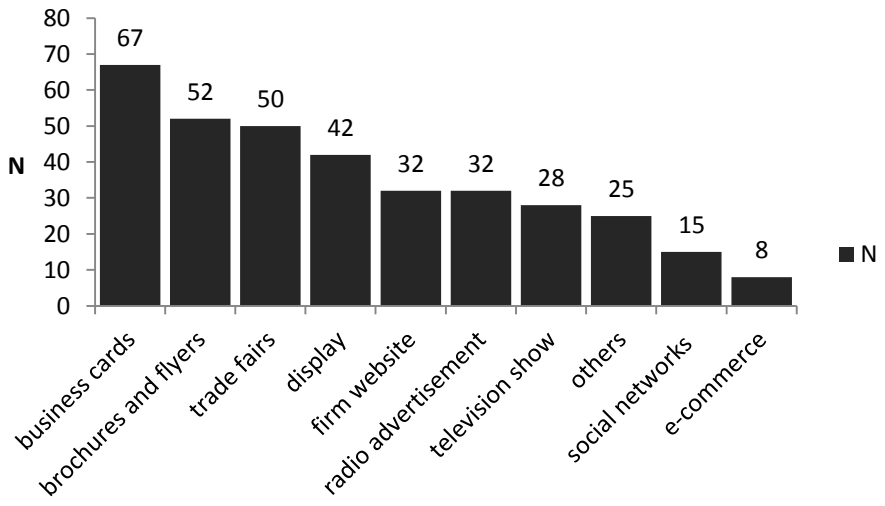
specialised journals	18	4.7%	18.2%
exhibitions and trade fair	26	6.9%	26.3%
newsletters	4	1.1%	4.0%
technology organizations	9	2.4%	9.1%
professional society meeting	4	1.1%	4.0%
laboratories	11	2.9%	11.1%
advisory boards	20	5.3%	20.2%
site visits	15	4.0%	15.2%
others	4	1.1%	4.0%
Total	**379**	**100.0%**	

Source: Field Data, 2011

Both table 4.3 above and figure 5.6 below demonstrates the two-way role played by trade fair and exhibitions in supporting industrial innovation efforts. Firms use the exhibitions as sources of information for innovation as well tools for promoting and marketing their innovations. As indicated on the data, many firms uses the trade fairs to update themselves with innovations from competitors, signals the market demands and also use such platforms to market their own innovations. In additional to that, the analysis entails a high utilization of print media in networking, marketing and other related print-outs which promotes innovation. For instance business cards, brochures, fliers and displays appear among the top ranked marketing tools used by the firms.

Figure 5.7: Tools used by firms for marketing

Which marketing system and strategies are used in obtaining new markets?



Source: Field Data, 2011

5.4 Adoption and applications of ICT resources

Recent trends from TCRA indicate a boom of ICTs in Tanzania, as by 2011 mobile telephony penetration was approaching 50% of the population with a fast expansion rate. The empirical data from field work also indicates a high level of ICT usage by firms led by mobile phones as shown on table 5.4 below;

Table 5.4 ICT facilities used by the firms

	Responses	
	N	Percent
computers	75	14.3%
mobile phones	101	19.2%
land line	59	11.2%
printers	59	11.2%
videos conference	7	1.3%
IP phones (telephone over computer)	8	1.5%
fax	51	9.7%
radio call	12	2.3%
teller machine	5	1.0%
television	33	6.3%
radio	55	10.5%
photocopy machine	58	11.0%
others	3	.6%
Total	**526**	**100.0%**

Source: Field Data, 2011

The responding individuals were asked to indicate whether their firm uses different ICT tools during their daily operations. It was found that the entire respondent group (100%) on this study indicated that they use mobile phone. The usage of computers is also high, covering 75% of the responses. Only the usage IP phones, teller machines, fax, TV and radio calls appeared have coverage of less than 50% of the respondents. Apart from radio and TV, on average the usage of ICTs by surveyed industries is relatively higher than the population averages. Table 5.5 below summarizes the comparison of proportions of responses from field data in relation to population level study on usage and access levels (Intermedia, 2010)

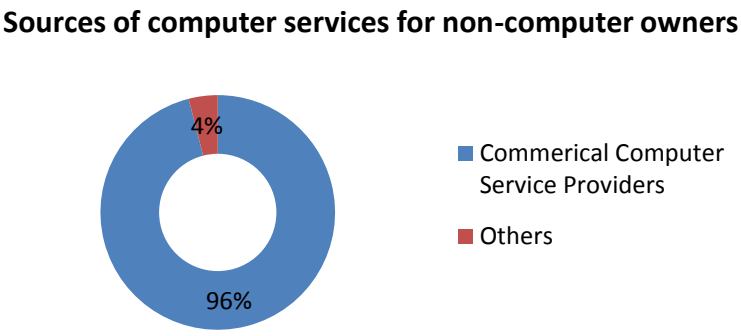
Table 5.5: Comparison of ICT usage by firms with population average

Item	Firms %	Population %
Radio	54.5	85
Mobile phones	100	62
Computers	74.3	3
TV	32.7	27
Fixed telephone	58.4	-
Internet	-	4

Source: Field Data, Intermedia,(2010)

The computer based services for those industries which do not possess computers are obtained mainly from the commercial computer service providers. Among those service providers include the wide spread internet cafés and small shops offering secretarial and consultancy services on office automation, desktop publishing, printing and related services together with sales of office stationeries. Figure 5.8 shows the sources of computer based services by firms lacking computers.

Figure 5.8: Sources of computer services for non-computer owners



Source: Field Data, 2011

The usage of computer based communication services is spread around various purposes as indicated on Table 5.6. The most popular usage of computer based services is on email communication occupying 27.5% of the multiple responses also equivalent to 92% of all the firms responded. This is followed closely by internet surfing at 25.5%. Interestingly, there are about 23 firms which indicated that they also use electronic-business services which include online shopping. Although the specific nature and purposes internet usage varies broadly, the proportion of firms which uses computer communications for acquisition of specialized information services useful for innovation remains low.

Table 5.6: Types of computer based communication services in use

	Responses	
	N	%
using electronic mail	70	27.50%
using internet	65	25.50%
using file transfer protocol (FTP)	17	6.70%
using usernet/newsgroups/social network	17	6.70%
using electronic data interchange (EDI)	14	5.50%
advertisement/marketing (e-business)	23	9.00%
subscription to specialized information services	5	2.00%
sending and receiving faxes	23	9.00%
using instant messaging	12	4.70%
using IP telephone	9	3.50%
Total	255	100.00%

Source: Field Data, 2011

An indicator named ICT usage index was created from an aggregation of the 13 related variables on usage; these variables are also shown on table 5.4 above. The ICT usage aggregate variable is then visually binned to form the major 4 categories ranging from low to high usage. The categories were formed based on number of scores out of total 13 items; each type of ICT usage was given an equal weight. As it is shown on the cumulative distribution of the grouped data there is a slight skewness where the first two lower groups occupies 64.7%. This distribution depicts a higher proportion of firms using half or less ICT services.

Table 5.7: Distribution of ICT services usage

		N	%	Cumulative%
Valid	Low	38	37.3	37.3
	Mid Low	28	27.5	64.7
	Mid High	11	10.8	75.5
	High	25	24.5	100.0
	Total	102	100.0	

Source: Field Data, 2011

5.5 Linkages between innovativeness and ICT applications

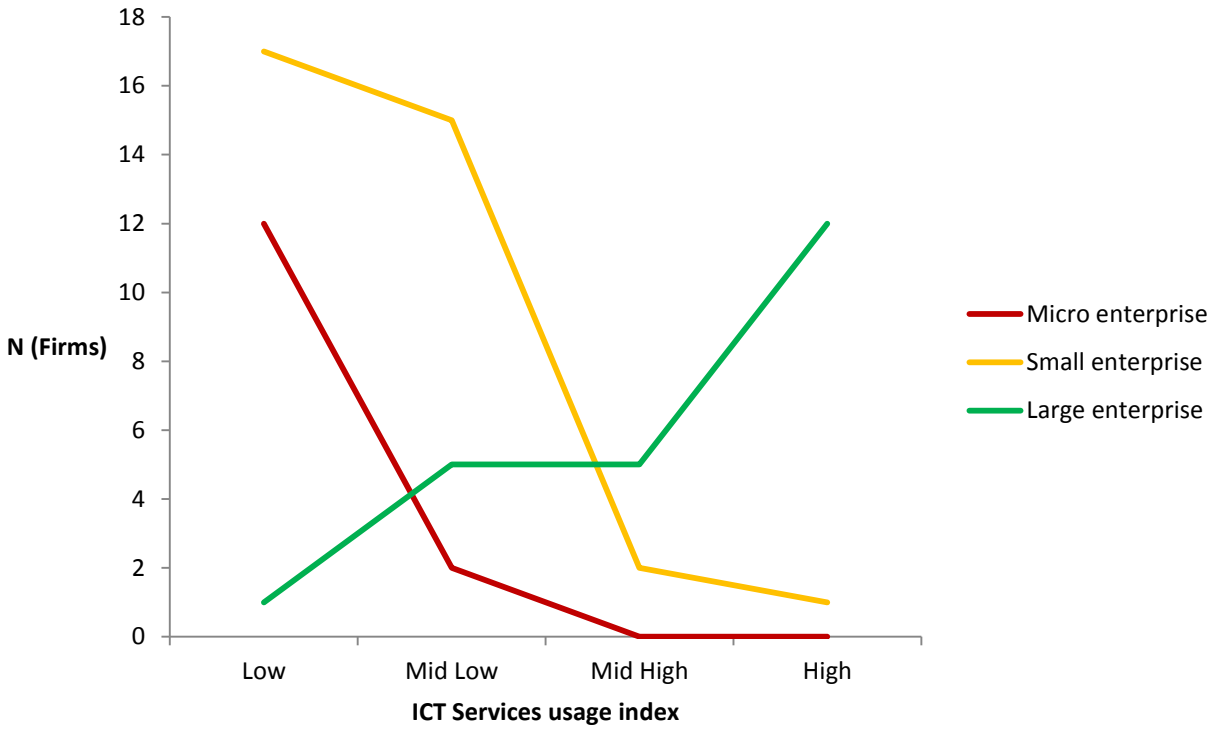
This part covers the major linkages between the previously described ICT usage and innovativeness characteristics of the firm. Cross tabulations, pivot charts and linear plots are used to show the relationships between two parameters.

5.5.1 ICT application by different Firms' characteristics

ICT application by firms' size and ownership

The cross tabulation of the field data was carried to explore the relationship between ICT usage and size of the firms. According to the results represented on figure 4.9; the micro firms indicated by a blue line of fitness, are highly concentrated at the low and mid-low levels of ICT usage index and tends to decline towards the higher usage groups. Similarly the results show a rise in distribution of the large enterprises (green line) across the ICT usage index. The large manufacturing firms therefore tend to use ICTs more widely than the micro and small counterparts. Such results are not uncommon; the trend can be linked to the Schumpeter mark II concept of creative accumulation Soete and Weel, (1999, p.11) which supports the dominance of large firms on innovations due to the availability of resources and less fear of risks of investments in costly innovation projects complimented by their accumulated technological capabilities.

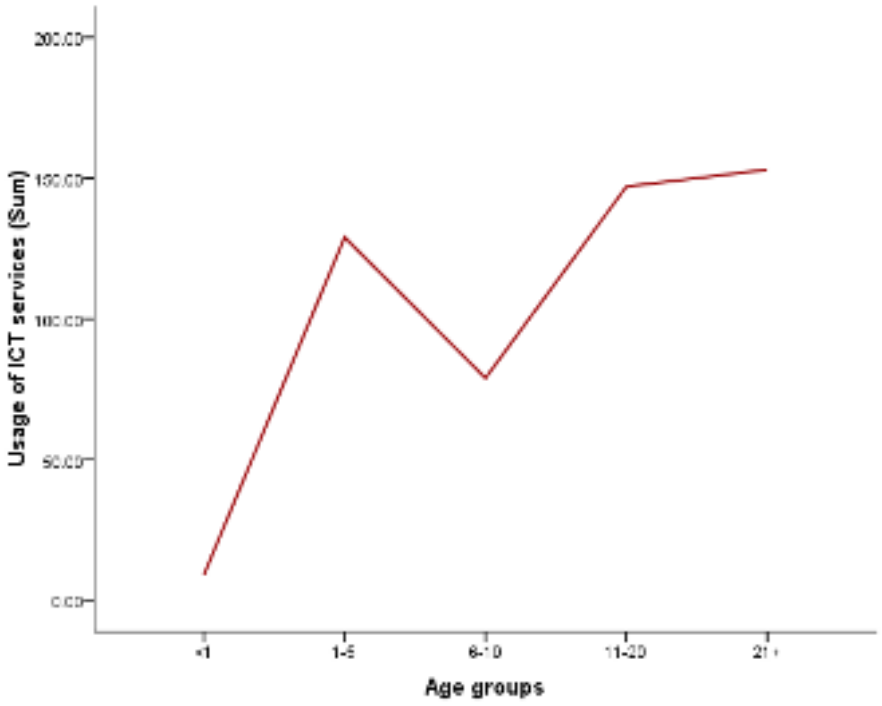
Figure 5.9: ICTs usage by firms' Size



Source: Field Data, 2011

It is also evident from the data that older firms tend to use more ICT services than the newly established ones. This result reinforces the fact that experience matters when it comes to application of technologies and performance in innovation. Figure 5.10 below summarizes the level of ICT usage by firms' age groups on which the line of fit (sum of usage index) as the age group of the firms gets higher.

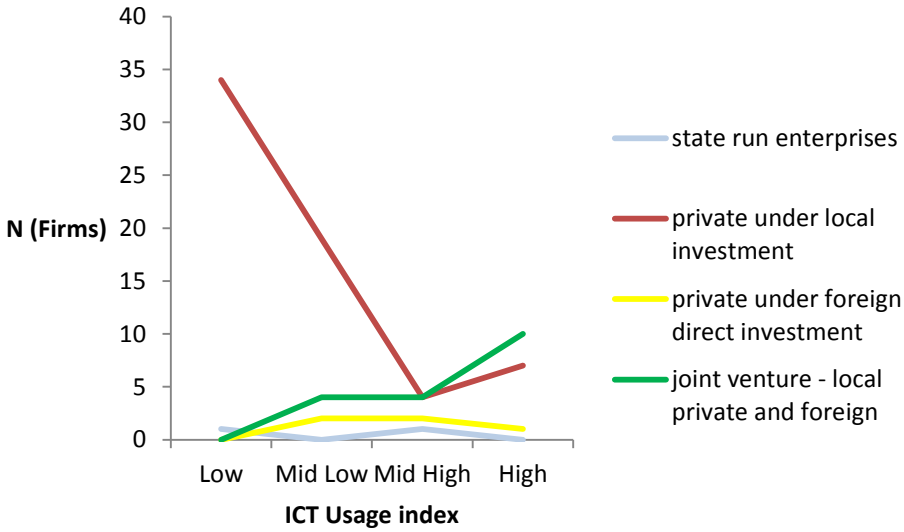
Figure 5.10: ICTs usage by firms' Age groups



Source: Field Data, 2011

Although the amount data collected offers a limited presentation when disaggregated by ownership type, the attempt to run such analysis on figure 5.11 below indicates some interesting trends on which; local firms appears to be concentrated at the lower categories of ICT usage and the representative green line decline across. On other hand the local-foreign joint venture firms appears as better users of ICTs with a rising red fit-line. Such a trend indicates the role played by FDIs in provision and transfer of modern technologies such as ICT. Promotion of joint ventures between local and foreign investors can be translated into technological capability building and transfer of modern technologies including ICT to the participating local manufacturing firms.

Figure 5.11: ICT usage by Ownership of the enterprise



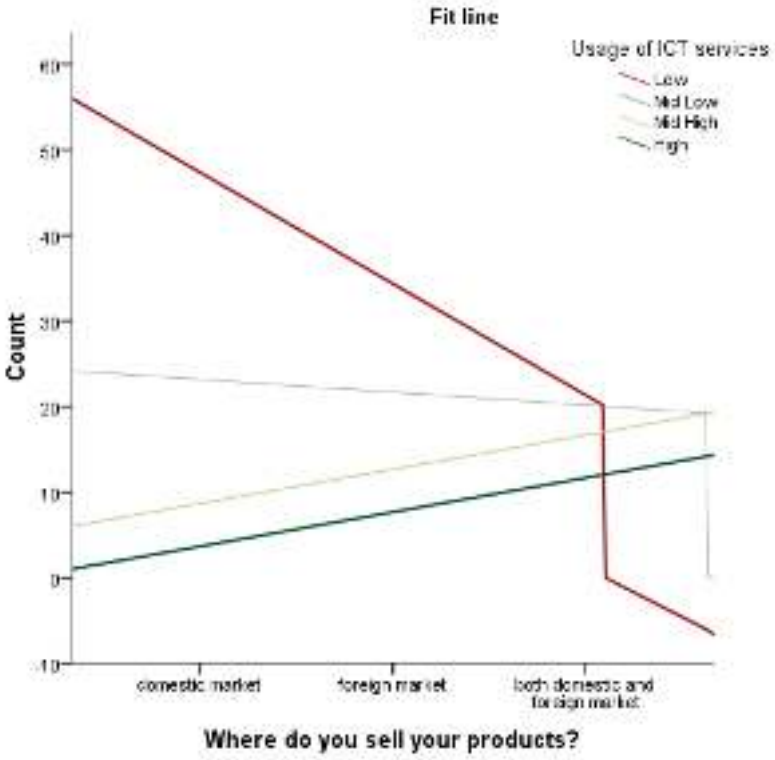
Source: Field Data, 2011

ICT application by target market

Evidence from field data reveals that; firms that sell at domestic markets tend to use less ICT compared to those supplying the foreign markets. Although there are a limited number of firms that target the foreign market exclusively, such firms are shown to be more concentrated at the higher ICT usage categories

. A key argument derived from such results (see figure 5.12 below) is that; the foreign market orientation compels the firms to utilize more ICTs. Among the suggested reasons for this situation include the distance between the firms and their market which requires intensive and cheaper communication approaches, and also the influence of the foreign customers who are already advanced in ICTs. The higher level competition on the international markets is another factor that compels the firms interacting with foreign markets to advance their ICT capabilities.

Figure 5.12: ICT usage by market target

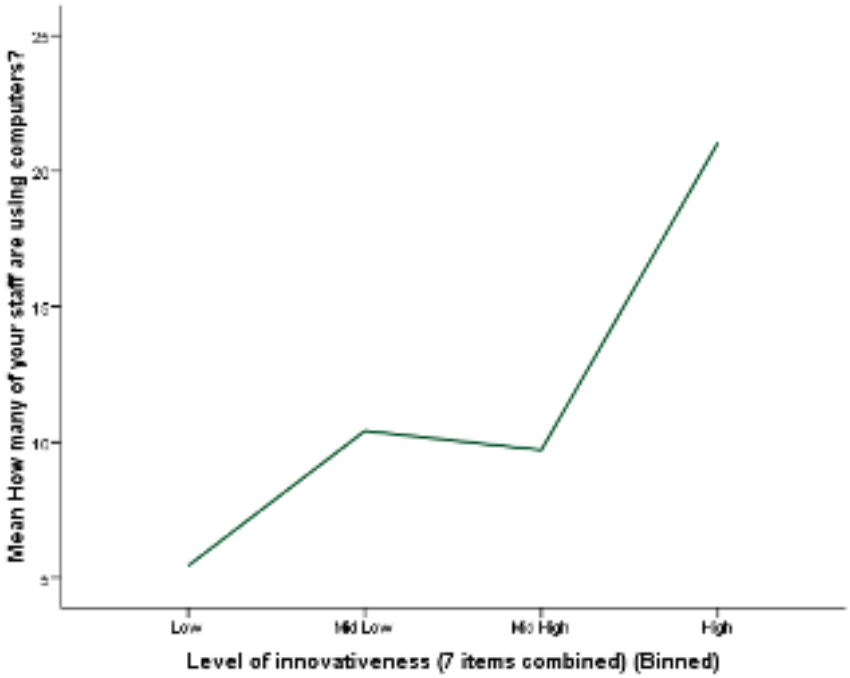


Source: Field Data, 2011

5.5.2 Innovativeness by level of ICT application

Usage of ICTs enhances the firm's level of innovativeness. The argument is supported by the line graph (figure 5.13) below. The graph shows a rising number of computer using staffs as the innovative index gets higher. Such results suggest a positive correlation between market share and level of innovativeness with usage of computers and other ICTs. Similar results are found on other studies including; a study in the United States by Brynjolfsson *et al* showing that; in industries which have relatively high levels of ICT use on the core metrics, there also tend to be higher absolute amounts of market share change (or 'churn').

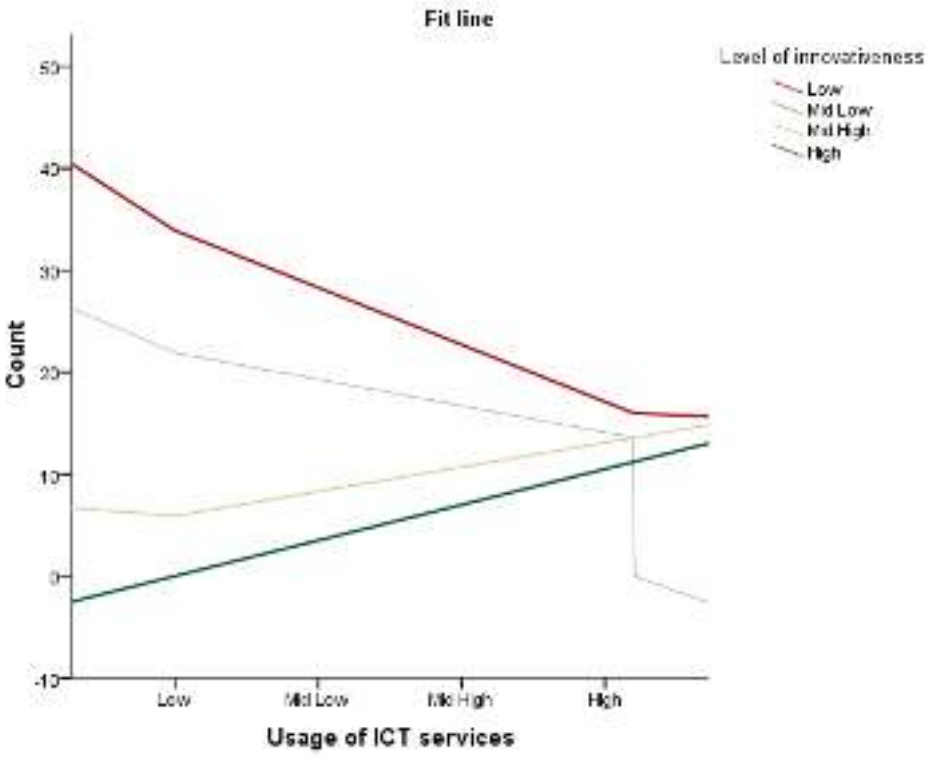
Figure 5.13: Level of innovativeness by number of employees using computer



Source: Field Data, 2011

The results represented on figure 5.13 above are also similar to those on figure 5.14 which indicates an existence of a positive linear relation between ICT usage and innovativeness. A cross tabulation graph indicates the increase in level of innovativeness among the firms with more ICT usage. The interpretation of the graph shows declining lower innovativeness bars (green and blue) towards the higher ICT usage quintiles. On the other hand the purple coloured bars which represent higher level of innovativeness tend to raise along the ICT index quintiles.

Figure 5.14: ICT usage by level of innovativeness



Source: Field Data, 2011

5.5.3 Key contributions of ICT on innovations

The respondents were asked to give their opinion as to what extent they agree that ICT plays various roles in relation to their innovative activities. The two type of responses; agree and strongly agree were combined to form a multiple response variable tabulated below. On this table the general overview of all the responses indicated sufficient acknowledgement of the entire list of ICT item to be to be supportive in innovation. Only one item which that asses 'the role played by ICTs in supporting roll out of new goods and services' scored less than 50% of the 122 responses. The respondents recognize the role of ICT in eliminating hierarchy and geographical boundaries, improving decision making in the firms and also facilitate operational efficiencies among the major contributions.

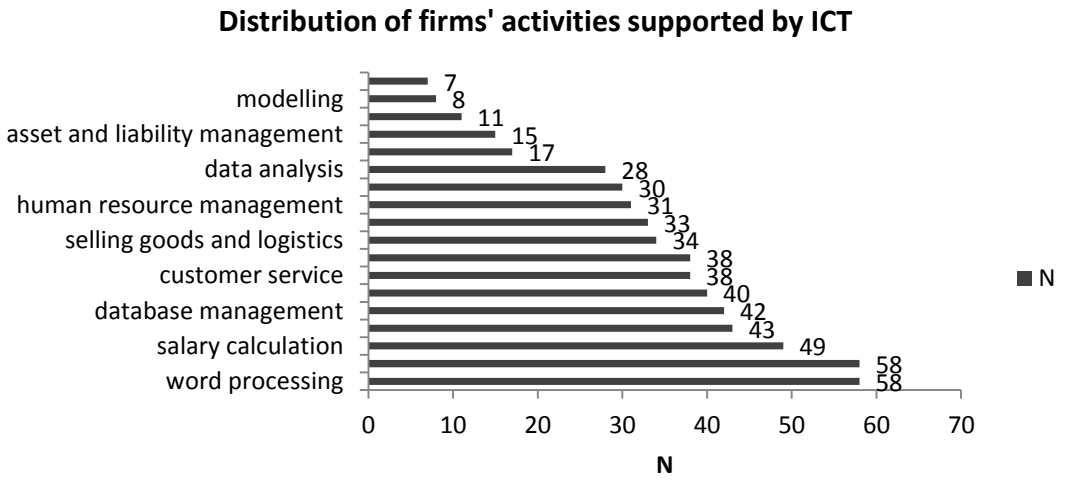
Table 5.10: ICT usage by type of enterprise.

	Responses	
	N	%
making the firm introduce the new products to markets	50	8.0%
making possible to conduct e-commerce and business	52	8.3%
important for decision making	63	10.0%
resulting in the efficiency and effectiveness of operations	63	10.0%
making the firm more competitive	49	7.8%
making easier to follow new technical development	60	9.6%
access enhancement to better and cheaper supply sources	56	8.9%
making designing activities more simple	51	8.1%
shortening distance and eliminate hierarchy and geographical boundaries	82	13.1%
enabling knowledge exchange and management through networks	62	9.9%
supporting roll out of new goods, services and process through ICT	39	6.2%
Total	**627**	**100.0%**

Source: Field Data, 2011

The type of services which are supported by ICTS are spread broadly ranging from production/operational enhancement, financial management, information management to security as indicated on figure 5.15 below.

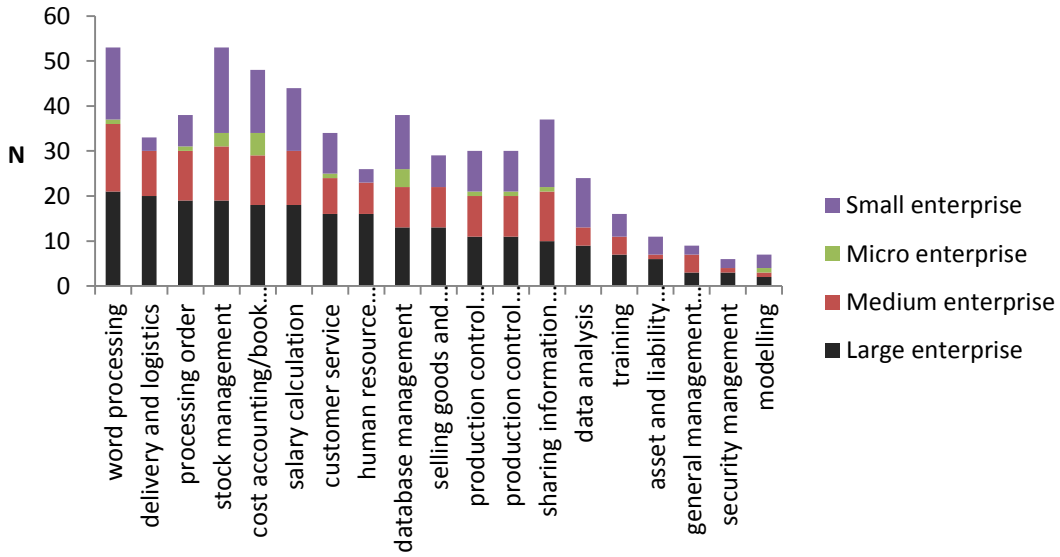
Figure 5.15: Firms activities supported by ICTS



Source: Field Data, 2011

Furthermore; while the large firms uses ICTs to enhance most of the asked services, micro and small firms are rather limited to fewer services. For instance micro firms did not indicate using ICTS in human resources management, security management, delivery logistics management and data analysis. While the micro and small firms uses more ICTs in general activities such as accounts, word processing and information sharing, the medium and large enterprises utilizes the technology more broadly extending from general to complex applications.

Figure 5.16: Activities supported by ICT by Firms' Size

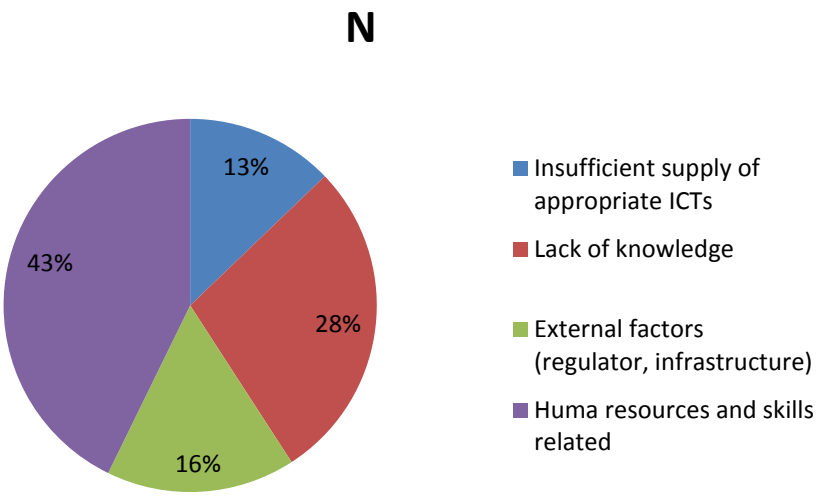


Source: Field Data, 2011

5.5.4 Barriers to the applications of ICTs in promoting innovations

The study also attempted to seek for the opinion of respondents in relation to the typical barriers that hampers their efforts to mainstream ICT applications into their industrial activities. The responses ranged from non-significant to most significant barriers. The multiple response chart presented on figure 5.17 below summarize the distribution of the responses clustered into four categories. ICT human resource related barriers seem to be a common problem to many firms covering 43% of all the barriers. Challenges such as lack of skilled ICT staff, limited availability of training services that suits the needs of the firms are among the issues under this category. Many firms (28%) also mentioned lacking sufficient awareness and knowledge on how ICT can assist enhancing their efficiency. Some managers acknowledged using ICT at personal level but could not figure out how such technologies relates to their business.

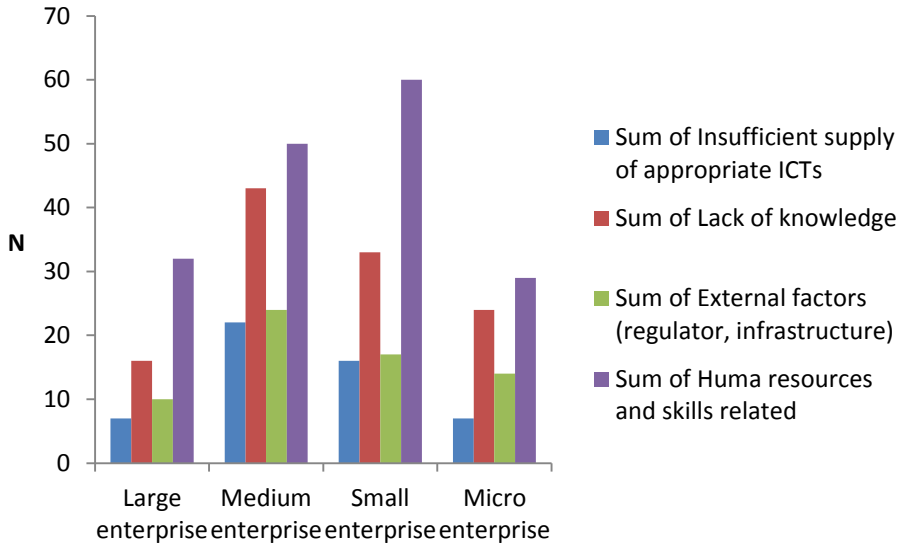
Figure 5.17: Major barriers on firms' ICT usage



Disaggregating the results above by size of the firms shows that the challenges of ICT usage are more or less shared by all the categories. Distribution wise the number of responses from micro and large enterprises is lower and thus making difficult to draw a conclusion from figure 5.18 below.

Source: Field Data, 2011

Figure 5.18: Barriers to ICT usage by firms' size



Source: Field Data, 2011

6. 0 Policy implications, recommendations and conclusion

6.1 Policy implications

A number of key areas of improvements were observed when respondents were asked to provide their views on necessary interventions by firms and government to enhance ICT usage for facilitating innovations. For the firm level interventions, the most frequent recommendations include;

- Firms are urged to train their staff on ICT and seek for specialized skills tailored to their requirements
- The firm level improvement of computer security measures including information protection and purchase of antivirus software is a necessary measure to be taken
- Firms should invest more on usage of automated/computerized machinery equipment

Similarly the respondents recommended that the government should enhance the ICT interventions especially through;

- Facilitating the training of qualified professionals on ICT sector including provision of subsidy to private training service providers
- Incentivize the growth of ICT cadres especially software developers
- Provide a tax relief on ICT based equipment to make them more affordable
- Improve accessibility and affordability to networks and other ICT infrastructure facilities especially to SMEs

6.2 Conclusion and Recommendations

This study has revealed the role played by adoption and application of ICTs in improving the level of innovativeness among 102 manufacturing SMEs in Dar es Salaam. Evidence on linkages between ICT usage with growth and efficiency has been laid down by this study; it was shown clearly that firms using more ICT tend to be more innovative. The study laid down strong evidence that older firms are more innovative than the newly established ones. Those firms which are more innovative also use more ICT services. The usage is defined from

complexity of services on which ICTs are applied to the number of ICT tools in use. Also the large and medium firms are more innovative and make more use of ICTs that micro and small firms. Thus ICT usage is directly linked to the innovativeness of the firm, and it is dependent on the size and age of the firms. Moreover the study has indicated the main barriers facing the SMEs on their effort to utilize ICT including high costs, and low level of skills. Finally it was suggested that the government and firms should join hands in investing in ICT so as to at firm and National levels.

Being a small study covering about 102 firms, this study might have not a good representative of Tanzania's manufacturing sector. The sample size also limited the disaggregation such as by sub-sector. Methodologically the study utilized a combination of both quantitative and qualitative data collecting tools, interviews were only used to a few firms which showed desirable findings from the quantitative analysis. Care was taken in design of the tool and data analysis so as to maximize the quality and relevance of the findings.

Further studies covering a wider sample size surveys with broader variables are suggested on the similar topic. Further investigations to extend the findings of this study such as measurement of value addition and other benefits acquired from ICT usage are encouraged when sufficient resources are available. Also a comparative study with other East African country given the varying levels of ICT penetration and industrialization would be insightful.

Additional to the known efforts on the ground by the Government of Tanzania, civil society organizations and private sector, a few policy below areas are given a special emphasis by this study;

6.2.1 ICT skills Development

This study has revealed that training in ICT is necessary for growth and innovativeness of the SMEs in Tanzania. The majority of the respondents for this study indicated that; poor skills on ICT among their staff members are one of the major bottlenecks for the efficient utilization of the technology. Some literature sources revealed a number of efforts aimed at promoting the ICT training at both vocational and academic levels. The National ICT Policy of 2003 recognizes the role of ICT in education as well as ICT education. The government interventions has enabled; the establishment of ICT policy for basic education in (2007), increasing in number of ICT trainees. It was found that the university enrolments in science and ICT increased from 1949 in 2001 to 4807 in 2005 (Materu and Diyamett, 2009). At the top of these initiatives, more efforts are needed to improve training at all levels to keep up with an increasing demand. Appropriate implementation framework for the prepared strategy onintegratingof ICT in basic education at primary and secondary levels is needed; this should also be complimented by promotion of training services tailored to the needs of SMEs.

6.2.2 ICT Infrastructural development

The SME's access and affordability of ICT services depends on penetration and infrastructural advancement. For many years the internet services has been dependent on expensive satellite technologies. On the other hand the telephone networks have been poorly distributed especially in rural areas. As a result the SMEs became weakly connected to their markets as well as raw material supplies. The situation became worse for the enterprises located in rural areas. Poor infrastructural development also triggered a high cost of ICT services. However in recent years both private and public sectors have played a major role in the expansion of ICT infrastructure. The government through the MCST initiated developing the NICTB which is now on the second phase. As in 2011, 19 regions were covered by the terrestrial fiber network countrywide. Such the efforts coincide with the private projects on marine cables and expansion of the telecom data services. The SEACOM cable which landed Dar es Salaam in 2010 is now serving a number of public institutions and private resellers. While the NICTB initiative covers the regional level connectivity, the last mile connectivity becomes the next important step to be taken to ensure that the SMEs tap into the expanding

ICT infrastructure. Price regulation on broadband and other ICT related services is also crucial for translation of the infrastructure enhancements efforts into accessibility and affordability of ICT services.

6.2.3 SMEs investment on ICTs

This study has shown a strong linkage between usage and application of ICTs and improvement of its innovative capabilities. Such evidence is useful in eliciting the SME managers on the importance of strategically investing into ICT usage While Large and medium firms seems to be more active on ICT usage, majority micro and small firms needs to be sensitized on importance of ICTs for their business performance. Promoting the relevance of ICTS and telling the success stories would fuel the usage especially by newly established and small firms.

6.2.4 Local contents creation

There is a need for more creative development of relevant local contents and services that improves the SMEs operations. The demand for mobile financial applications that facilitates payments, access to price information and cash transfer is becoming increasingly important. The usage of social media, web technologies and multimedia tools also expands the creation of relevant local content that in turn enhance both the market for innovations and interaction between SMEs and their existing markets. It should be noted that the creation of relevant content is a responsibilityof both private and public actors. The emerging PPP initiatives including SAGCOT creates a good avenue for interactive and inclusive content creation and sharing mechanisms such as agricultural information portal.

6.2.5 Development of the ICT industry

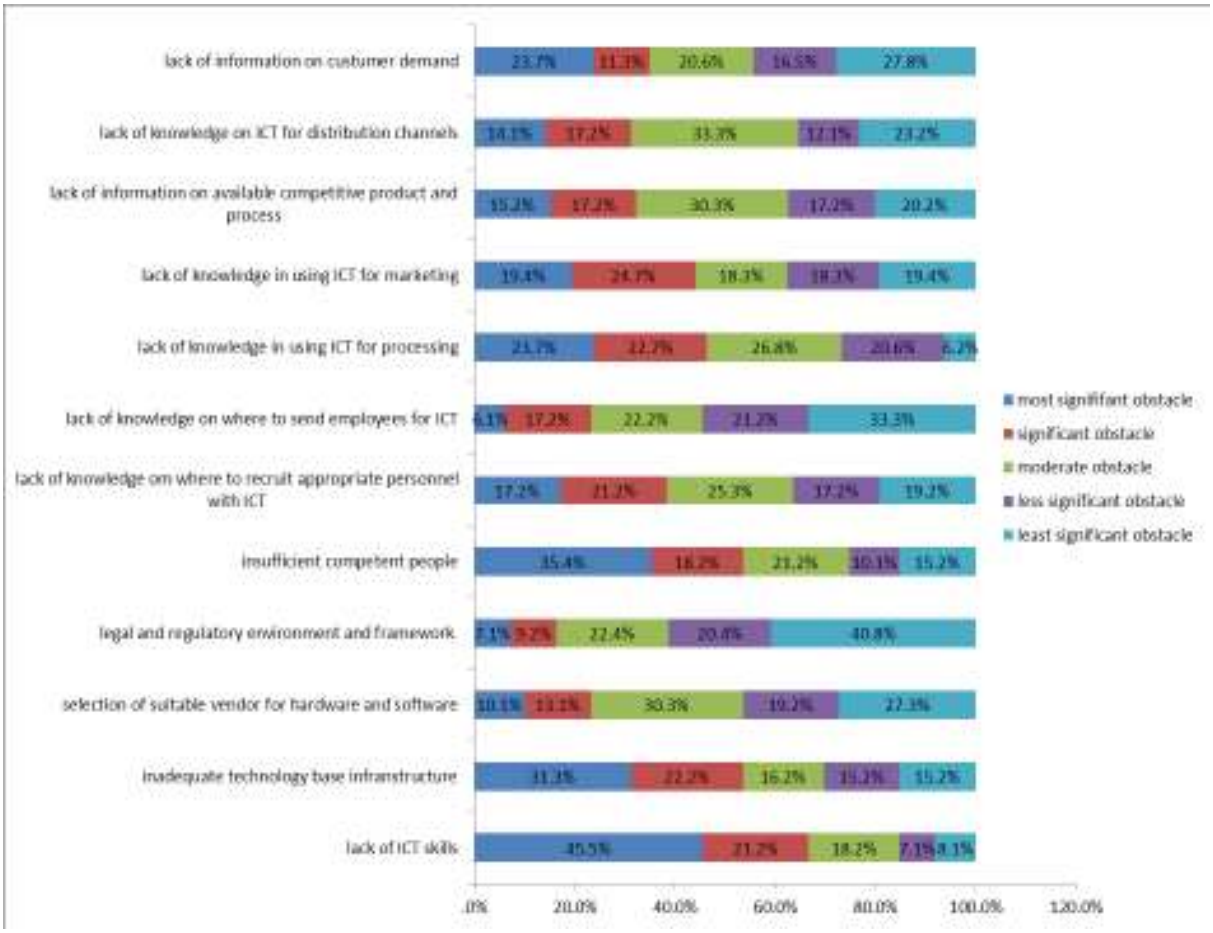
In 2011, the Tanzania Investments Centre (Tanzinvest, 2011) reported that ICT investments in Tanzania had reached USD 4.527 and resulted in the employment of approximately 32,600 people. Although Tanzania may not be ready for hi-tec activities such as hardware assembly and electronics in a near future, the growth of network infrastructure acts as a base for expansion of ICT industry in Tanzania. Services such as IT outsourcing and business process outsourcing (BPO) can serve other technology intensive sectors including manufacturing, financial and mining and hence facilitate the adoption of ICT by other industries. Through

promotion of incubators, clusters and special economic Zones, the government will be able to facilitate the growth of emerging and infant local firms in the ICT industry.

7. Annexures

Annex 1: The survey questionnaire

Annex 2: Main barrier on ICT usage by firms



8. References

ASTRA. (2007). *Innovation Indicators for Tomorrow: Innovation Vital Signs Project "Candidates"-by Framework Category, A Better Taxonomy &Nomencluture for the Innovation Process?* Department of Commerce's Technology Administration, USA

Bartel, Ann P. Casey Ichniowski and Kathryn L. Shaw (2005). How Does Information Technology Really Affect Productivity? Plant-Level Comparisons of Product Innovation, Process Improvement and Worker Skills, *Working Paper 11773,* Cambridge, National Bureau of Economic Research.

Brynjolfsson E. McAfee A. Zhu F. and Sorell M. (2006) Scale without Mass: Business Process Replication and Industry Dynamics. Harvard Business School Technology & Operations Mgt. Unit Research Paper No. 07-016.

ChowdhuryS.K and Susanne Wolf (2003).Use of ICTs and the Economic Performance of SMEs in East Africa,*Discussion Paper No. 2003/06*, Washington DC, World Institute for Development Economics Research

Clayton T and Criscuolo C (2002) e-Commerce and business change. Economic Trends 583.

Closing Speech Delivered By Honourable Prof. M.J. Mwandosya (Mp), Minister For Communications And Transport At The National Stakeholders' Workshop On National Information And Communications Technologies (ICTs) Policy Held At The Royal Palm Hotel, Dar Es Salaam, 25 May 2002:

Corso, M and Emilio Paolucci. (2001). Fostering Innovation and Knowledge Transfer in Product Development through Information Technology, *International Journal of Technology Management, Vol.22, No.1-3, p126-148*

Deselnicu, D.C, CostacheRusu and Luliana, Martin.(2008). Innovation Process and Competitiveness in Romanian SMEs. The 5th International Conference "GLOBELICS-RUSSIA-2007: Regional and National Innovation Systems for Development, Competitiveness and Welfare: the Government-Academia Industry Partnership (theory, problems, practice and prospects)"

Diyamett, B.D.(2010). *Inter-Organizational Linkages and Firms'Innovativeness in Least Developed Countries: The Case of Metal Working and Engineering Sector in Tanzania*. A Thesis Submitted in Fulfilment of the Requirement for the Degree of Doctor of Philosophy (Development Studies) of the University of Dar es Salaam

Doležal, J .(2009).*ICT Industrial Research, Knowledge Transfer and Innovation –Barriers, Trends and Needs,*National Executive Czech Republic, Honeywell spol.sr.o.

Elly T. (2002).*Access to and use of ICT in Selected Agricultural Research Institutes, A case of Ministry of Agriculture and Food Security in Tanzania*, Master of Arts in Information Studies of the University of Dar es Salaam

Emmanuel, G and EddaT.Lwoga. (2007). Information and Communication Technologies (ICTs) and Environmental Conservation: challenges for developing countries, *University of Dar es Salaam Library Journal, Vol.9, No.2,* Dar es salaam, Inter Press of Tanzania Limited.

Hampell, T, et al (n.d).ICT, Innovation and Business Performance in Services: Evidence for Germany and the Netherlands, *The Economic Impact of ICT: measurement, evidence and implications*

Hughes, L. P. & Holbrook, J. A. D. (1998). Measuring Knowledge Management: A New Indicator Of Innovation In Enterprises, *Centre for Policy Research on Science and Technology (CPROST) Report #98-02* , Vancouver, Simon Fraser University at Harbour Centre

Intermedia, (2010), http://www.audiencescapes.org/access-media-television-radio-tanzania-mobile-phones-media-internet-newspapers, accessed: August, 2012

Kahyarara, (2010), Market Competition and Performance of Tanzanian Manufacturing, Economics Department, University of Dar-es-Salaam, Tanzania

Kijo N.D. (2004). *Impact of Investment in and Utilization of ICTs on Market Extension: Overview of Small andMedium Enterprises inTanzania*, Master of Business Administration Dissertation of the University of Dar es Salaam.

Killango, A.A. (2004). *The Role of ICT in Enhancing Firms Performance Evidence from CRDB Bank (T) LTD*, Master of Business Administration Dissertation of the University of Dar es Salaam.

Kline, S.J & Rosenberg, N. (2000). An Overview of Innovation, *The Positive Sum Strategy: Harnessing Technology for Economic Growth,* the National Academy of Sciences

Ludena, M.E &J.J.P.Alcazar. (2008). A Framework for Analyzing Innovation Networks in Nanotechnology-Its Application to Brazilian Case

Matambalya, F. (2003). ICTS, in Emmanuel Nnadozie, Ed., *Afican Economic Development,* Department of Economics, Truman State University: ACADEMIC PRESS

Materu and Diyamett (2009), Tanzania ICT Sector Performance Review 2009, Dar es Salaam Tanzania

Mcharo, J.T. (2005). *The Attitude Towards ICT Use and challenges Faced by SMEs: The Case Study of Printing and Publishing Industry in Dar es Salaam*. Master of Business Administration Dissertation of the University of Dar es Salaam.

Milgrom, P. & Roberts, J. (1990). "Rationalizability, Learning, and Equilibrium in Games with Strategic Complements," Levine's Working Paper Archive 449, David K. Levine.OECD, (2002),

MITM, (2010), Annual Survey of Industrial Production and Performance, 2008, Ministry of Industry Trade and Marketing, Dar es Salaam, Tanzania

MITM, (2011), Integrated Industrial Development Strategy 2025, Ministry of Industry Trade and Marketing, Dar es Salaam, Tanzania

Molony Thomas S.J. (2005). *Food, Carvings and Shelter: The Adoption and Appropriation of ICTs in Tanzanian Micro and Small Enterprises*, PhD Thesis, University of Edinburg

MostafaG .(2009). *Information Technology for Library and Information Centre*, Dhaka, FouziaProkasoni

Mwantimwa, K. (2010). *Information Services and Innovation for Manufacturing Industries' Performance in Tanzania,* Paper presented at The 8th GLOBELICS International Conference:The Global Network for the Economics of Learning, Innovation, and Competence Building Systems. 1-3 November 2010: Kuala Lumpur-Malaysia

Nathan A. (2006). *Analyzing the Contribution of ICT in the Performance of a Tanzanian Manufacturing Industry, A case of Mbeya Cement Company*, Master of Engineering Management (IT) of University of Dar es Salaam

OECD. (1997). "Proposed Guidelines for Collecting and Interpreting Technological Innovation Data (The Oslo Manual), 2nd Edition" . Paris: Organization for Economic Co-operation and Development.

OTF Group. (2005). *Improving Competitiveness and Increasing Economic Growth in Tanzania: The Role ofInformation and Communication Technologies. Washington, DC: infoDev / World Bank. Available at: http://www.infodev.org/en/Publication.81.html*

Reffitt, M et al. (2007). Innovation Indicators, *Report to the Council for Labor and Economic Growth,* Michigan Department of Labor& Economic Growth, Bureau of Labor Market Information and Strategic

Singleton, Royce A & Bruce Straits. (2005). *Approaches to Social Science Research*, Oxford, University Press

Soete, L. and Weel, B. (1999), Schumpeter and the Knowledge-Based Economy: On Technology and Competition Policy, Maastricht, Netherlands

Surendra, Gera &WulongGu. (2004). The Effect of Organizational Innovation and Information Technology on Firm Performance, *InternationalProductivity Monitor*, No. 9.

Tahir, H &M.F.M.Sam. (2010). Innovation Activities in The Malaysian Public Sector: Factors Promoting the Byproduct of ICT Usage, *IJRRAS2 (3)*

Tanzinvest, (2011), www.tanzaniainvest.com/tanzania accessed: June, 2012

Thoma, G &Torrisi, S. (2007). *Creating Powerful Indicators for Innovation Studies with Approximate Matching Algorithms*, A Test Based on PATSTAT & Amadeus Databases, CESPRI

Tiber, A. (2002). Critical Success Factors and Information Needs in Estonian Industry, *Information Research, Vol.7 No.4*

Twaakyondo H.M, E.P. Bhalalusesa and J. L. Ndalichako .(2002) . *Factors Shaping SuccessulPublic Private Partnership inTheICT Sector In DevelopingCountries.The Case Of Tanzania*

URT (2002) The Small and Medium entreprises Policy for Tanzania (2002), Dar es Salaam, Tanzania

URT. (2001). *The Tanzania Development Vision 2025*. Dar es Salaam, Planning Commission

Wangwe, S. M. (1993), " Implications of Changing External and Internal Conditions for Industrial Restructuring in Tanzania" in Bagachwa, M. S. D and Mbelle A. V. Y. (eds.) (1993), *Economic Policy under Multipartism system in Tanzania,* Dar-es-Salaam University Press, Dar-Es-Salaam.

WBI, (2010), World Bank InsitituteInstitute Innovation Policy: A Guidance for Developing Countries

Wolf, S. (2001),Determinants and Impact of ICT use for African SMEs: Implications for Rural South Africa, Center for Development Research (ZEF Bonn)

Wolf, S. (2001). *Determinants and Impact of ICT use for African SMEs: Implications for Rural South Africa*, Center for Development Research (ZEF Bonn)

Yonah, Z.O, (2002). *Building Infrastructure for ICT Development in Tanzania*, Paper Presented at the National Stakeholders' Workshop on National Information and Communcations Technologies (ICT) Policy Held at the Royal Palm Hotel, Dar es Salaam;25th May 2002