The Impact of Adoption and Usage of Information and Communication Technologies (ICTs) in Selected Manufacturing and Business Firms in Zambia.

By

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A dissertation submitted to the University of Zambia in partial fulfilment of the requirements for the award of degree of master of engineering in ICT policy, regulation and management.

THE UNIVERSITY OF ZAMBIA

LUSAKA

2016

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DECLARATION

I, Daka Philemon hereby declare that this dissertation is my own work which has not been submitted for the award of a Masterôs degree at this, or any other university.

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CERTIFICATE OF APPROVAL

This dissertation by Daka Philemon is approved as fulfilling the requirements for the award of the degree of Master of Engineering in ICT Policy, Regulation and Management of the University of Zambia.

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ABSTRACT

This study was aimed at investigating the impact of adoption of Information Communication Technologies (ICTs) on selected manufacturing and business firms in Zambia.This study was exploratory in nature, hence, a cross sectional approach was undertaken in the first half of 2015 to measure firmsô responses regarding adoption of ICT. The diffusion theory of innovation was used as a theoretical framework to understand the phenomenon of ICT adoption.

An online questionnaire was designed to help answer the research questions. Questionnaires were sent to 70 randomly selected organisations from mining, banking and finance, manufacturing and processing, education, professional management; IT related service and advertising sector using stratified random sampling method.

The research findings reveal that common ICTs such as computers and internet have high usage among firms. However, the use of high-technology ICTs as SCADA is still average and there is need for more effort from all stake holders to focus on stimulating accelerated adoption of ICTs. The results also shows that Zambiaôs manufacturing industries could rebrand and increase productivity, improve their profit margins and contribute effectively to the economy if they adopt more ICTs in their businesses. In this regard ICTs serve as a very important cost saving measure and as a means of increasing productivity and efficiency.

The study therefore, recommends that awareness be increased on the importance of ICTs amongst firms. In addition, company owners should be encouraged to train their employees in ICT usage. Innovators should develop systems that benefit firms in their areas of expertise. Firms must be encouraged to adopt and use ICTs in carrying out their businesses.

Key Words: ICTs, Manufacturing and business firms, Adoption, Perceived Benefits

ACKNOWLEDGEMENTS

I thank God almighty for the strength and good health granted to me during this research. I would like to express heartfelt gratitude to my supervisor Dr. D.E. Banda, for the guidance provided since the inception of this research .My gratitude also goes to the coordinator of the Master of Engineering in the Department of Electrical and Electronics Dr.S. Tembo and all the Lecturers for the opportunity to study in School of Engineering and the relentless support rendered to me throughout this research. I would want to thank my wife Elizabeth Kakonde Daka, my son Prince Joseph Daka and our latest addition to the family, my daughter Soteria Zangi Daka for being by my side and for the motivation to pursue further studies. Lastly but not the least, I would like to express my heartfelt gratitude to my friend and brother, Mwila Boniface Chimpampwe for editing and re-editing this work.

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LIST OF ACRONYMS

AMT.....Advanced Manufacturing Technology

CAD.....Computer Aided Design

CAM.....Computer Aided Manufacturing

DVDé é é é é é é Digital Video Disc

VCRé é é é é é é Video Cassette Recorder

ICTsé é é é é é é Information Communication Technologies

HDTVé é é é é é .High Definition Television

ITé é é é é é é é Information Technology

ICT .....Information and Communication Technology

IDCé é é é é é é .International Data Corporation

OECDé é é é é é Organization for Economic Co-Operation and Development

TAMé é é é é é ...Technology Acceptance Model

TPBé é é é é é ....Theory of Planed behavior

UNACTADé é é é .United Nations Conference on Trade and Development

UNESCO .....The United Nations Education, Scientific and culture

SCADA..... Supervisory Control and Data Acquisition

SECé é é é é é é Securities and Exchange Commission

SMEs.....Small and Medium Size Enterprises

ORGANISATION OF THE DISSERTATION

The dissertation is organized as follows: In the section that follows a brief background on the status of ICTs in manufacturing and business firms is provided. The chapter also delves into the definition of ICTs and their application. Chapter two focuses on the drivers of ICT adoption in manufacturing and business firms. It gives a partial background to the development of ICTs and provides an understanding of the factors that either inhibits or encourages ICT adoption by various industries. Chapter three provides details with regard to the research instrument and methodology used in this research. The research findings are presented in chapter four .The findings addresses both the research questions and objectives of the research. Chapter five discusses the results in view of the objectives of the research and the research questions. Chapter six concludes the research and provides recommendations and scope of future works.

CHAPTER 1: INTRODUCTION

1.0 Background to the study

Technology is defined as the collection of tools, machinery inclusive, modifications, arrangements and procedures used by humans (Liddell, 1980). Technology has affected todayôs society and its environment in several ways. In many societies, technology has helped develop more advanced economies and has improved the welfare of many in society. Different implementations of technology influence the values of a society. Examples include the rise of the concept of efficiency in the sense of human productivity, a term originally applied only to machines, and the challenge of traditional customs. Information and communication technology (ICT) encompasses all devices used in creation, storage, processing, retrieval, exchange and transmission of data (Quinn, 2013).These include products such as mobile phones, smartphones, laptops, tablets, integrated circuits, radio, television, computer, network hardware, software and satellite systems (Valacich and Schneider, 2012).

Mostly, the economic growth is continuously triggered by organisational and technical innovations that ensure resource, labour, and capital productivity improvements (plepsy, 2002). The general-purpose technologies, such as steam engines, electricity, or telegraphs always had strong economic and lifestyle impacts.

In this modern era, a similar role is played by information and communication technologies (ICTs). A significant part of economic growth is associated with their innovative applications in manufacturing and service sectors. It is expected that ICTs are capable of dissociating the economic growth from environmental degradation primarily due to their potential to increase productivity and create

value-added in the form of manipulating ideas and information rather than energy and materials (Romm, 2000).

ICT is thought to have a profound effect on all forms of manufacturing and business firms (plepsy, 2002). Consequently, factory automation industry is slowly but steadily experiencing a paradigm shift (Cucinotta et al, 2009). The increasing demand for efficiency in machine retooling and commissioning to reduce time-to-market of new products requires a drastic improvement in efficiency throughout the design chain, from process engineering to field tests. A reasonable way to improve this efficiency is to control the placement of new hardware and software technologies, such as embedded real-time systems, standard networking protocols and Information and Communication Technologies (ICTs). Additionally, the possibility, in the factory automation context, to reuse open standards, protocols, network infrastructures and software components that are broadly used in general-purpose ICT application areas, is becoming increasingly appealing, due to their support for quality-of-service (QoS) and low costs of deployment(Cucinotta et al, 2009). Unfortunately, there are some technological barriers preventing the deployment of such technologies in current industrial practise. For example a critical bottleneck in process efficiency and flexibility of current systems is represented by the networking infrastructure. Today, many communication networks adopted for process automation are still proprietary, designed for collecting input/output data from the field, even though open standardized protocols such as Modbus, Profibus, Ethernet variants are making inroads. The adoption of an open network infrastructure, with the ability to provide Plug & Play services and the capability to hide the devices complexity, provides a simpler and more natural workflow from the mechanic engineer to the control engineer, allowing for the adoption of the same

platform in the identification of the objects and their properties. At the same time, reconfiguration of an industrial plant affected by, among other factors, the lack of a sufficient level of ñintelligenceò embedded directly within the components. These usually exhibit a passive behaviour and are controlled by a centralized Programmable Logic Controller (PLC). Such an approach requires a change in the PLC code at each reconfiguration, which limits modularization and interoperability. On the other hand, increased efficiency, configurability and monitoring capabilities may be obtained by distributing such functionality as self-diagnostic, self-configurable, and local real-time control within the components, or within embedded micro-controllers close to them, a typical industrial application of ICTs.

Automation is one of the broad application of ICTs. It was introduced as a cost-saving measure because it is less expensive for a machine to perform a particular job than a human being. Considering the competitive nature of companies, lower production costs entails lower prices for the consumer. The drop in the price of a product has dual beneficial effects. First, it increases the demand for the product. In order to produce more of the product, workers must be hired. Second, people who were already purchasing the product donôt have to pay as much for it. That gives them more money to spend on other things, increasing the demand for other products. This, too, results in job creation. Finally, another effect, not illustrated in the figure is that some people must be employed designing, creating, and servicing the automated devices themselves. In the past, shares of securities were bought and sold on the floors of stock exchanges by people employed as floor brokers. Today, with automation of stock exchanges, electronic systems handle most of the transactions, and electronic trading has made transactions quicker and less expensive. Despite electronic trading greatly decreasing the number of individuals employed as floor brokers, the number of shares being traded has increased sharply,

and employment in the securities industry has continued to rise (except during recessions) (Strople, 2005 cited in Quinn, 2013). New kinds of jobs have been created. For example, securities firms have hired mathematicians and computer scientists to develop sophisticated automated trading systems. As a result of automation, manufacturing output in America continues to rise. It has doubled since 1970 (The Economist, 2003 cited in Quinn, 2013). In other words, productivity has increased that is to say fewer workers are making more products. For example, in 1977, it took 35 person-hours to manufacture an automobile in the United States. By 2008, the number of person-hours dropped to 15 hours (Lassa 2008 cited in Quinn 2013). The logic of these ñautomation optimistsò is illustrated in the figure 3 below. On the surface, it is obvious that automation eradicates certain jobs. However, itôs also important to look further beneath the surface.

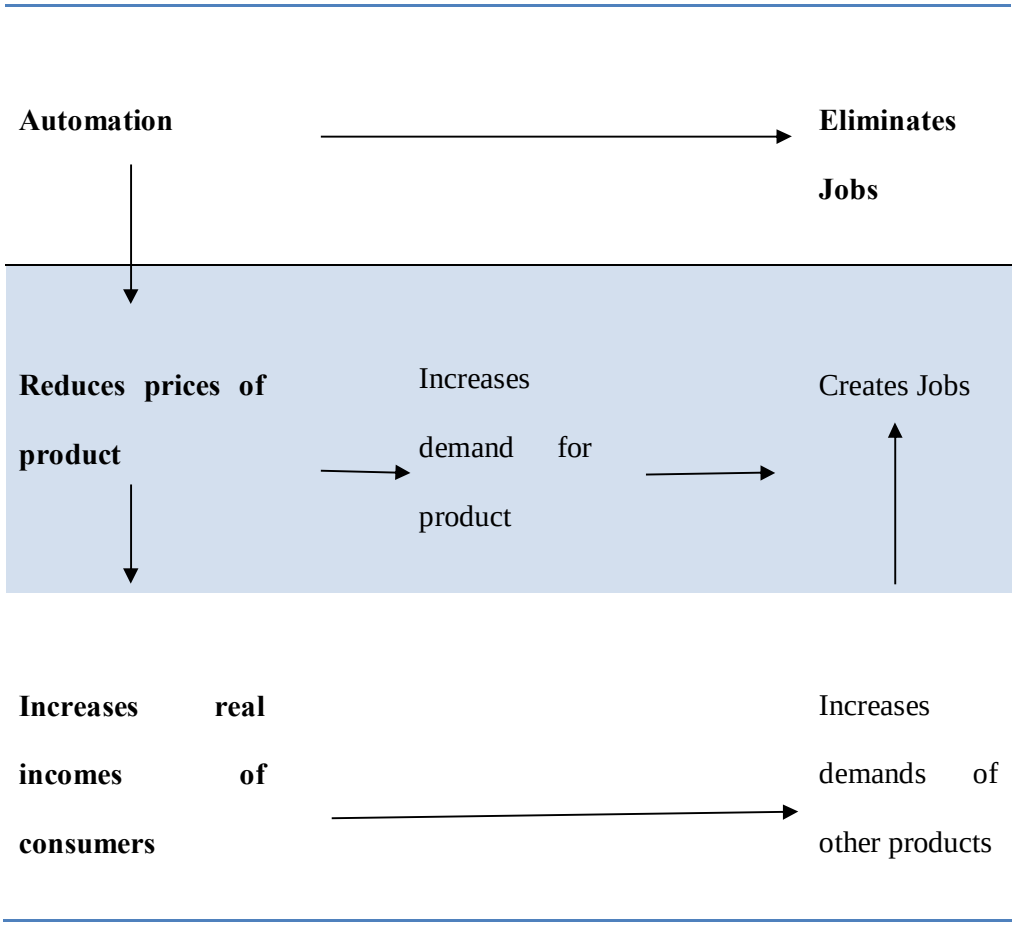

Figure 1: Impact of Automation on Employment (Source: Quinn 2013, p. 478)

In order to successfully automate a production plant there are considerations which must be satisfied. These requirements implicitly require that some more ñintelligenceò be put inside interconnected components of the automated factory. Not only must they be capable of carrying on the main control operations they have been designed for, but they must also embed the software infrastructure needed for dealing with monitoring and reconfiguration capabilities. The additional layers of software needed to provide a uniform interface for accessing the multitude of heterogeneous devices introduces new problems, along with the many advantages they have been conceived for. One important problem concerns the real-time and Quality of Service aspects (QoS). For the system to operate properly, activities must

be provided within pre-specified timeliness and/or QoS constraints. As an example, the operation of setting the value for a property of a component must be completed within a bounded time, otherwise, the system may not work properly. For a system to function properly itôs vital that it adheres to basic principles of integration, heterogeneity, interoperability and accessibility. Integration implies that the hardware/software architecture of the plant control system must facilitate integration of different parts, to reduce costs incurred when assembling the system for commissioning and due to maintenance operations. Heterogeneity on the other hand implies that given the wide range of commercial solutions and standards and the fragmentation of available technical solutions, it is not realistic to mandate specific hardware/software. The provided solution must integrate multi-vendor and multipurpose software and hardware. Various subsystems may in principle use different hardware, programming languages and models, where legacy subsystems with copyrighted protocols must be supported and cannot be ruled out from any realistic solution.

This is another requirement which needs to be satisfied for successful automation of a plant. Despite heterogeneity of devices composing the global automation system, it should be possible to interconnect them through a standardized, clearly defined, possibly open set of interfaces. That is what interoperability entails.For successful automation, it should be possible for operators to have an easy and immediate access to the monitoring and reconfiguration interfaces of each interconnected device.

1.2 Literature Review

It is argued that the diffusion of the information and communication technologies (ICTs) is changing the way companies compete and create value (Oyelaran-

Oyeyinka, 2007). New opportunities are taking place both to create new ventures and to modify the existing businesses.

These changing processes are due to the ICTsô capability to transfer, collect, manage a great amount of information and to reduce the space and time barrier (Oyelaran-Oyeyinka, 2007). Therefore, firms may reduce the transaction costs of information-intensive activities by resorting to ICTs. These opportunities may especially favour industries that in most cases operate in a dense network of inter-firm relationships. The productivity impact has been a subject of much controversy but the visible impact of ICTs is undeniable. At this level of impact some countries particularly in East Asia, China notably the most recent, have used electronics as a basis of significant wealth creation (Carbonara, 2005). ICTs have not only been a significant inclusion in traditional sectors but a basis of new production regimes.

In the 1980s, main-stream firms began to use in-house ICTs such as Computer Aided Design/Computer Aided manufacturing (CAD/CAM), and CAE, but by the 1990s, firms began to adopt new advances in ICTs particularly the use of network technologies for intrafirm co-ordinating of activities (Lal, 2004). Large corporations connect distant production facilities in order to create greater networks and reduce transaction costs. Traditional sectors such as garment adopted industry-specific ICT techniques. By the beginning of the twenty-first century, the adoption of ICTs for inter-firm commercial and non-commercial transactions was fully grown. While many manufacturing technologies have been industry-specific, business organisations and other institutions have applied networking technologies, including the Internet on a general basis. Due to the unprecedented developments in communication and Internet technology, new courses of network technologies have emerged varying from the simplest forms, such as e-mail, to more complex forms

such as portal-based technologies (Lal, 2004). Although these technologies are not activity, firms or industry specific their adoption is influenced by firm- and industry-specific factors. Presently there is relatively widespread use of ICTs by firms in developing, as well as developed, countries in all business activities (Oyelaran-Oyeyinka, 2007).

ICTs have also found wide application in electronic commerce and electronic business. There is a difference between electronic commerce (e-commerce) and electronic business (e-business) technologies. According to an OECD (2002) study, examining the application of ICTs in commercial activities, defines e-commerce as the sale or purchase of goods or services, whether between business, households, individuals, governments, and other public or private organisations, conducted over computer mediated networks. The goods and services are ordered over those networks, but the payment and the ultimate delivery of the good or service may be conducted on or off-lineò. This differs from e-business, a term that encompasses the application of ICTs in all business processes from office automation, production processes, co-ordination with other plants, customer relation management, supply chain management, and to the management of distribution networks (Lal, 2004).

A study of East European and Cyprus SMEs show that firms establish websites to reduce cost, ease the search for new markets, and to augment competitiveness (Damaskopoulos and Evgeniou, 2003). The study concluded that e-business affects first the boundaries of the firm with the market in which it operates. Broadly speaking, there are three modes of e-business transactions. These are off-line, online, and e-business using shared or individual portals. Off-line e-business is enabled by electronic messaging systems, which are comparatively less effective than other forms of e-business tools. Off-line e-business is normally done through e-

mail systems while on-line e-business transactions take place with company web sites although having a web site does not necessarily mean that an enterprise is able to process on-line e-business transactions (Lee & Clark, 1997).

Web sites must be dynamic and should have on-line transaction facilities such as Active Server Pages (ASPs) that allow online transactions. The most effective way of doing e-business is through portals. Portals are the essential additions in network technologies and fulfil an important role of amassing contents, services, and information on the net (Damaskopoulos and Evgeniou, 2003). To a great extent, their function on the internet is to mediate between users e.g. buyers and web contents. This unique position enables portals to leverage marketing and referrals, as they are intermediaries between web users and industries. Industrial application of ICTs lead to reduction in co-ordination costs and promotes efficient electronic markets.

A number of studies have examined the impact of web-enabled technologies on the export market development (Hodgkinson & McPhee, 2002). A study by Teltscher (2002) deals with the fiscal implications of e-business. Following an analysis of the total value of transactions conducted through electronic means and its implication on fiscal policies of developing and developed countries, Teltscher (2002) observed that an increasing number of e-commerce businesses are small entrepreneurs and the fiscal impact of international e-commerce is likely to be felt more strongly in the developing countries. Drew (2003) investigated the causes and consequences of the adoption of e-business by SMEs in East of England. The findings of Drew (2003) suggest that SMEs are placing e-business at the centre of their technology strategy. The majority of the sample firms reported that the driving force behind e-business adoption has been opportunities for growth and the need to remain competitive. The

study further concludes that adoption of the Internet by SMEs is higher, although marginally (68.8%) than large firms (66.7%).

In the context of developing countries, several studies (Moodley, 2002a; 2002b; Goldstein & OôConnor, 2002; Goldstein, 2002) have examined the adoption of e-business by manufacturing firms. Moodley (2002a) did not find sufficient evidence to support the argument that export-oriented apparel firms in South Africa gain more in adopting e- business due to its promise of improved market penetration and its direct link to international competitiveness. Moodleyôs (2002b) findings on the South African automobile industry are similar. Goldstein & OôConnor (2002) noted that as multinational corporations integrate the Internet into their cross-border business operations, firms from developing countries run the risk of exclusion from global value chains if they cannot establish electronic ties with their major business partners. They also argued that, despite these general remarks, an evident need persists for detailed sectoral analysis of the adoption of e-business. A case study of one of the top automobile firms (Fiat) by Goldstein (2002) suggests that while the company has been very successful in optimising supply-chain management in Brazil, it has not been able to replicate the same success in India. The study further reveals that the use of the Internet by the company in India (Fiat India) has been limited to knowledge management, research and development, and marketing. In other words ICT are differentially adopted depending on context that is specificity.

In Africa, studies have been carried out in recent times that focus on industrial and sectoral determinants of ICTs adoption and applications (Oyelaran-Oyeyinka and Lal, 2005) According to these studies; the adoption of ICTs is likely to promote greater productivity within the enterprises. However, the effective use of e-business tools at the enterprise level is strongly conditioned not by a single factor, but the

availability and interaction of a host of external elements such as access, diverse range of skills, telecommunication network, and good physical infrastructure.

1.2.1. Marketing and customer relations

ICTs enable the companies to get access, promote and sell goods and services (e-commerce) in a global market by overcoming geographic constraints. The global spread of the Internet networking and the ever present availability of a web server create time and geographical independence and enable customer service to be decoupled from supplier availability (Timmers, 1999).Dealing with and delivering great amount of information in different ways that is text, graphics, sound and video, ICTs enrich the opportunities for the promotion of goods and services and for the provision of in-depth information. Supporting application-to-application as well as person-to person and person-to-application interactions, ICTs allow the direct interaction and continuous links with customer. Consequently, this provides opportunities for better targeting goods and services at the same time accelerates and redefines the possibilities of remote product or service experimentation (Venkatraman and Henderson, 1998).

New intelligent agent software helps to identify the customer profile and the pattern of purchases. All the information can be easily organised and stored in a database that supports customer service, marketing, and new product development processes. According to Timmers (1999), Internet technology and the related trading models provide supplier assets and customer benefits, namely lower transaction costs, better prices, reduction of time to market, affirmation of brand image, market share and access to markets, customer orientation, customer choice increasing, and customer-driven design.

1.2.2 Innovation development

The ICT tools supporting knowledge management e.g. groupware, videoconferencing, Intranets, Extranet, are aimed at facilitating the inter-connection and integration among individuals through the fast and effective exchange of information and knowledge. These ICTs allow the communication of non-codified knowledge between actors in context. They use the digitisation only to transmit information without modifying the contents. In this case, the codification regards only the transmission of signals across space and time and not the content of information. Then, the knowledge management technologies allow interactive communication even when it regards not codified and contextual knowledge. Besides, thanks to the virtual abolition of the distance, the communication of such kind of knowledge, which has been always limited within a bounded territorial system or a business unit, can now spread in meaningful way (Rullani, 1997).

All these ICT functionalities aid the inter-organisational exchange, and help the processes of collective learning, supporting the innovation developments. Likewise, CAD/CAM, 3CAD, e-mail, and other ICTs can be used in the new product design and development, whether within or between firms, to shorten the development cycle, increase the number of alternative designs considered, reduce development and manufacturing costs, and produce a higher quality product (Malone et al., 1987).

Lastly, it is argued that the customers contribute significantly to the development of new products and services. Similarly, listening to the customers and, engaging them in a dialogue and listening to their remarks on the products are vital means of obtaining input data for sustained innovation. To that effect, companies are now regularly using, e-mail response addresses, discussion forums and online

questionnaires besides traditional means. Information for innovation can also be obtained by monitoring online the customer behaviour by tracking visits and downloads (Timmers, 1999).

1.2.3 ICT and labour productivity

The potential of ICT as a cheap substitute, particularly with respect to labour, is well recognized in the literature (Berndt and Morrison, 1995). As an input in the production process, ICTs can have both substitution and complementary effects; they can be a cheaper substitute for other inputs and they might have positive complementarities with other inputs through which ICTs can increase productivity of other inputs.

1.2.4 ICT and return on investment

An important characteristic of ICTs is that they are mostly scale neutral and available to small firms and poor countries as well, although access is restricted by poor infrastructure and high cost. The increased use of ICTs in enterprises leads to a substitution of ICT equipment for other forms of capital and labour and may generate substantial returns for the enterprises that invest in ICTs and restructure their organization (Chowdhury and Wolf, 2003).However, though ICTs have high return potentials, they may erode a firmôs profitability by integrating markets and exposing SMEs to competition. Particularly, SMEs in rural areas serve the local market niche and are protected against competition from bigger enterprises because of high information and communication costs, they are expected to face more competition and hence a reduction in monopoly rents.

1.2.5 The integration of ICTs in decanters

This is a case of industrial application of ICTs. The case study investigated and explored how Alfa Laval integrated ICTs into decanter centrifuges, allowing clients to run more efficient processes for sludge dewatering in wastewater treatment plants. Wastewater treatment plants treat effluent water and recycle safe water to waterbodies. Alfa Lavalôs business idea relates to the last phase in the wastewater plant. It involves manufacturing decanter centrifuges designed to remove as much water as possible from the sludge. This is the most cost-intensive process in the wastewater plant, representing some 35 per cent of the total operating costs (Beniger, 1986). Sludge dewatering is a constantly changing process involving a high degree of ambiguity, since the quality and density of feed also constantly vary. As the input to the process cannot be predicted it requires a high degree of attention if it is to run efficiently.

Alfa Laval began to work, on a system to automate decanter operations in 1991. After some problems related to ability to measure the quality of the sludge, the project was abandoned only to be revived in 1999 when improvements in the technology enabled sludge measurement. In 2002, Alfa Laval had a pre-launch of a self-optimizing system, Octopus, for sludge dewatering, which would operate at peak performance and optimize the dewatering process based on overall costs, solids recovery or cake dryness, independent of feed conditions. Octopus, in real-time, monitors, analyzes and adjusts the process parameters in the dewatering process in order to enhance the process in the absence of human supervision. Octopus is able to produce savings in the operating costs of the dewatering process of up to 20 per cent, which corresponds to a saving of about 7 per cent in the plantôs total operating

costs (Beniger, 1986).It also speeds up production as it enables plant operators to dewater sludge at a faster rate.

1.2.6 The integration of ICTs in compressors

This case study explored how Beta introduced new technologies to its compressed air installations, leading to reductions in energy costs through improved utilization of installed capacity. Compressed air plays a vital role in most industries in the world. A substantial part, around 30 per cent, of all energy used in industry is consumed by compressors (Beniger, 1986).Compressors are used for a wide range of applications that use compressed air as a source of power or as active air, in industrial processes. With a substantial increase in energy costs as well as pressure to limit carbon dioxide emissions, electricity consumption has become an important issue in many manufacturing industries. For compressed air users, energy costs are by any measure the highest cost center during the compressorôs life-cycle (ASME, 1999).

Energy consumption represents around 70 per cent of the overall compressed air system life cycle cost, whereas the capital investment typically only represents 20 per cent and maintenance 10 per cent. Compressors typically have on board their own control. This control ensures that the compressor operates within a predetermined pressure range to deliver a volume of air that fluctuates with demand (ASME, 1999). When the pressure reaches a predetermined level the compressor unloads decreasing the pressure and when the pressure drops to a lower predetermined level the compressor loads increasing the pressure. The range between these two pressure levels is the compressorôs set-point, which defines when the compressor should load and unload. Local control works well in situations where

a company has a single compressor and steady demand. However, most companies have a multiple compressor installation and add compressors as demand increases. When there is a series of compressors running, the load/unload of pressure of the individual compressors needs to be offset in order to prevent compressors from starting at the same time and to ensure stability in the net pressure. This method of connecting compressors is called cascading, and is the basic way of dealing with increases in air demand, resulting in a waste of a lot of energy. Beta considered that if it could lower the customerôs energy costs this would result in a considerable saving of money over a compressorôs life cycle.

Beta acted upon this business opportunity in 1999 by working on development of a centralized control system operating in real-time. The idea was to optimize the running of compressors so that the customer could match demand with compressor output, as close as possible to what was required. The control system therefore had to be able to select what compressors need to be run, and stabilize and lower the pressure to the lowest possible point.

In 2002 the company had achieved a centralized control system that allowed customers to automatically select the optimum mix of compressors, either by installed power or by technology, allowing a reduction in the required working pressure, through a pressure sensing signal and control at one centralized point rather than at every individual compressor. The control takes over operation from the local compressor controllers and works with one communal set-point in lieu of one set-point for every compressor. In real-time the control selects the most energy efficient and optimal compressor mix, and their operating points. This enables users to save around 10 per cent on their energy costs, which is considerably great value for the customer.

This centralized control was enabled through the incorporation of ICT into the compressed air installation. The control system comprised of hardware and software. The control system hardware consists of an industrial computer, a monitor and a controller area network which links all local compressor controllers to the centralized controller unit, the computer, in the form of a closed box. It is the software inside the computer that is critical to the control system.

The software consists of algorithms of the compressorôs operation, including reaction times, and flow and energy characteristics, and control logic for starting, stopping, unloading and loading the compressors to maintain the user-defined pressure level, which involves decisions about which compressors should be run. These algorithms represent Betaôs core capabilities and are highly specific to the company. While the algorithms were developed in-house, everything related to the coding and manufacture of the hardware was contracted out to external suppliers.

1.2.7 The integration of ICTs in ball bearing housings

This case analyses how SKF tried to provide monitoring of customer application processes around its process point, the bearing, to create new value for users (Björkdahl, 2009). Ball bearing housings, which are an important part of SKFôs product portfolio, are used to protect bearings from break downs. In many applications, it is sufficient just to have a bearing housing for the bearing, which runs until it breaks down; in others bearing housings are not needed. Though, some applications are very critical and it vital for processes to function continuously with no unintentional stops or redundancy in production, which in some industries would prove extremely costly. By measuring various parameters around the bearing SKF was able to extract information about how a given machine was performing, which

brings benefits such as production reliability, increased safety and increased application knowledge. From as far back as the mid-1980s SKF had measured these various parameters using decoupled sensors, through point measurements in large production and process plants. It believed that it could increase functionality for its customers by incorporating an integrated sensor solution into its ball bearing housings. The initial idea was to equip all ball bearing housings with shaft diameters of 50ï 120 mm, annual sales of which were some 500,000, with pre-installed sensors that could measure speed and temperature. SKF considered that to prepare the housings with these sensors would not cost much and could become the reference point in bearing housings. A vibration sensor, on the other hand, was more expensive (Björkdahl, 2009).

The ability to measure temperature and speed would become the new selling point, which it was hoped would increase the chances that customer would want the functionality that the new technology would provide. It was also seen as providing an efficient distribution channel. If customers wanted the monitoring functionality they would be able to purchase a box that could be connected to the housing and that would show the data on a display, or even charge the customer, depending on how much the customer exploited the functionality of the new technology for controlling machines.

In 2003 SKF launched what it called Smart Housing, which was a bearing housing equipped with sensors and electronics for monitoring the customer application process in which it was being used (Björkdahl, 2009). With Smart Housing allowed vibrations (axial and radial), temperature and rotational speed to be measured within the bearing housing, giving a status report on the customerôs application. The sensors and electronics in Smart Housing reside in the base cavities of the bearing

housing. Signals from the sensors are transferred by two connectors on the front of the housing. One connector is connected to an assembly of two directional accelerometers in the sensor holder, which deliver axial and radial vibration. The other connector delivers rotational speed and bearing seat temperature, which are protected and adjusted by a printed circuit board. Temperature is measured by an integrated circuit sensor with linear relation to temperature, while speed is measured by a Hall Effect sensor sensing a magnet mounted on the shaft. Signals are transferred to data collectors or analysis equipment through the output connectors. The user can either employ a portable device for periodic monitoring or a local monitoring unit for continuous monitoring. The connectors and sensors are standard equipment and can be incorporated into any third party systems, but can also be bought from SKF. The signals can also be incorporated into process control and decision support systems.

1.2.8 Industry Structure and Sectoral Differences

Oyelaran-Oyeyinka (2004) presents a state of the art review of the role of Information and Communications Technologies (ICTs) on industrial development, structural transformation and employment generation. Results of different country-level studies across sectors suggest there are industry-specific factors that influence the degree of the adoption of ICTs. The intensity of adoption in the skill- and knowledge-sectors, such as electrical and electronic goods sector, was found to be higher than in labour-intensive sectors such as garment, auto-component manufacturing, and food and beverages. Another factor derived from the skill-intensity of a sector, that is, the knowledge and academic qualifications of managing director or owner is another factor that appears to have played an important role in influencing the intensity of new technologies adoption. According to Oyelaran-

Oyeyinka and Lal, 2004, the intensity of ICT tools adoption was not affected by factors such as profitability, size of operation, age of firm, and per capital investment at the industry level. Though, there are significant variations in the performance of firms that employed the lowest levels of e-business tools from the more advanced users of new technologies within an industry.

1.2.9 ICT Application in Indian Service Sector

Aditi Technologies, one of the companies participating in the high-technology developments in Bangalore (India) has pioneered ICT services in customer relationship management and computer-aided technical support (Steinmueller, 2001). Aditiôs technological leapfrogging was based on the experience gained by its founder, Pradeep Singh, at the time he was working for Microsoft, where the increasing technical complexity of ñdeveloper applicationsò - the languages and support tools used to design new software was placing increasing strain on technical support capacities. Software developers are highly sophisticated and demanding users who often ask complex questions (Steinmueller, 2001). Resolving these clientsô needs requires complicated capabilities for referring queries to suitable experts and following up on the results of a number of enquiries, capabilities that must be backed by detailed and easily accessible electronic records of the history of problem-solving activity. Though Aditi does offer telephone support services, its main advantage in the global market is managing email support, a service that requires its own software for customer care. The Aditi system supports high-priority service to favoured customers and the means to identify and notify particular user communities. It also provides the means for monitoring productivity and customer satisfaction, giving clients (such as Microsoft) accurate information about the quality of the services it provides. Aditiôs success is an indication of the growing

opportunities for relatively technologically sophisticated workers in developing countries to develop a means to trade their services in global markets. Although Aditi has achieved a globally competitive position in this specialized market, the tools that enabled its success are capable of handling support for smaller national markets and in languages other than English (Steinmueller, 2001). A crucial feature of this enterpriseôs success has been the technological leapfrogging it achieved by proceeding directly to ICT-based tools for managing the information flows emanating from email communication.

1.3 The case of Zambia

Export of ICTs picked up globally in 2013 with an annual growth rate of 5 per cent to reach US$1.9 trillion (UNCTAD, 2015). ICT goods grew slightly faster than total merchandise trade, representing 11 per cent of exports and 12 per cent of imports, with communication equipment being the main growth driver. This supports the assertion made by the United Nations Conference on Trade and Development (UNCTAD) that information and communication technology (ICT) is the key factor in achieving economic growth and employment around the world.

However, Africa as a continent declined in the export of ICTs by 12 percent while the decline on the import of ICTs was at 1 percent as depicted by UNCTAD report. This reveals the extent to which developing countries like Zambia are struggling in the adoption of ICTs. Zambia is a country with an economy which mainly thrives on copper exports. There are calls for Zambia to diversify her economy and increase productivity in other sectors, like manufacturing, agriculture and tourism etc. However, many SMEs in Zambia face stiff competition from domestic and foreign competitors due to globalization.

Zambia Information and Communications Technology Authority (ZICTA) report reveals a steady growth in the adoption of Mobile phones among the general populous in Zambia. This growth was attributed to the fact that the use of technology such as mobile phones and mobile Internet services resonates well with people in developing countries due to enhanced prospects for quality of life. The increase in the adoption and use of ICT facilities such as mobile phones has not translated into broad adoption of ICTs among SMEs. Widespread adoption of ICTs among business firms has been particularly slow to evolve in Zambian SMEs. The picture is expected to be better among large corporations and multinational companies because they import technology from their sister companies around the world. In many cases these big conglomerates benefit from research and development taking place in parent companies in Europe and the United States. This is typical in the mining sector of the Zambian industry which is flooded with foreign investors and a handful of local investors. Other big established companies in the food and material processing sector as well as mobile telecommunication sector with huge cash flows can easily afford ICTs related to the production of goods and services. To a certain extent, sectors like communications are technological intensive as such they have little or no option but invest in ICTs because most of their operations are centered on available technology. The problem however faced by multinationals as well as SMEs is the rapid rate at which technology and innovation is evolving (Grant and Meadows, 2012). Among several macro environmental factors affecting domestic companiesô ability to serve their customers better in Zambia is the technological environment. The pace of asset replacement and investment in new technologies is extremely rapid and capital intensive. For example, in the telecommunication industry there has been a rapid shift from 2G to

3G and now 4G (Long term revolution) and the looming 5G networks in which many mobile operators have had investment dilemmas of whether to reinvest in upcoming technology or not (TeleGeographyôs CommsUpdate, 2015). This has created a low penetration rate of new technologies among mobile service providers in Zambia. Those that have moved have complained of not being able to harvest the necessary profits from the preceding technology from which they upgraded. In addition, there is increased research and development where most technological advances focus on minor improvements. Business firms have to be very shrewd in the way they invest their resources to guarantee return on investment. In many cases before businesses have fully recovered capital from sunk costs new technology emerges and company executives are faced with the decision dilemma of whether to move with technological advancement or remain with the existing technology until they get a return on investment. Zambia has successfully implemented the digital migration as at June, 2015 which stages opportunities to broadcasters and operators to offer new services and generate new income while manufacturers benefit from increased receiver sales. The Zambian business sector needs to take advantage of this positive development to create new business trends. Widespread adoption of ICTs has been particularly slow to develop in the business world in the case of small and medium enterprises (SMEs) in Zambia creating a digital divide among business firms. SMEs face a lot of challenges in their operations and as much as ICTs provide the much needed solutions to their operations, these facilities come at a cost. Only a few SMEs can afford ICT facilities in their organisations. Unfortunately, the majority of business firms in Zambia fall under the category of SMEs. The enactment of the Citizens Economic Empowerment Act No. 9 of 2006 which was principally aimed at uplifting the targeted citizens who have been victims of

marginalization has seen substantial increase in the participation of targeted citizens at all levels of the population in the economy, fostering wealth creation and significant decrease in income inequalities (Nchimunya, 2012). Consequently, this has given rise to the formation of many SMEs in the country by citizens in various economic sectors aimed at job creation and economic empowerment. For these SMEs to survive in a competitive business environment they need to be innovative and generally, there is need for Zambiaôs manufacturing industries to rebrand and increase productivity if they are to improve their profit margins and contribute effectively to the economy.

According to (Porter and Millar, 2001) the structure of the industry in any country is characterized by five competitive forces that collectively determine industry profitability: the power of buyers, power of suppliers, threat of new entrants, threat of the substitute products, and the rivalry among existing firms. ICTs have altered each of these competitive forces and eventually the industry attractiveness as well. Porter and Millar (2001) observed that ICTs requiring investment in complex software and hardware have increased the barrier to entry. Banks competing in cash management services require investing in expensive advanced software and hardware to give corporate clients online account information. Besides, flexible computer aided design and manufacturing systems have influenced the threat of substitution of products in many industries by making it quicker, easier and even cheaper to incorporate advanced features into products. The automation of order processing and customer billing has increased rivalry in many distribution industries. These ICTs have raised fixed costs at the same time rendered people redundant. Consequently distribution companies have often struggled for incremental volume. ICTs have impacted the bargaining power of companies and

suppliers, channels and buyers. Systems that connect suppliers and buyers are spreading. For example, Xerox offers manufacturing data to suppliers electronically to enable them supply materials (Porter and Millar, 2001).

The strength of each of the five forces has either improved or eroded the attractiveness of many industries. ICTs have denatured the structure of many industries creating the need and opportunity for change.

ICTs are used to speed up manufacturing processes and achieve flexibility in the product value chain. The increasing flexibility in performing many value activities in the production chain combined with falling costs of designing products has triggered a number of opportunities to customize and serve small market places. Computer aided design capability has not only reduced the cost of designing new products but also the cost of modifying and adding features to existing products. As a result, the cost of tailoring products to market segments is falling and affecting the pattern of industry rivalry. The use of ICT facilities such as supervisory control and data acquisition (SCADA) among the big corporations in Zambia such as Zambia Electricity Supply Corporation (ZESCO), Lafarge Cement, and the mines is also applied in gathering information from hazardous environments. The information gathered is entered into processing units and provide engineers with processed data for decision making. SCADA systems are used to collect field information, communicate it to a computer facility and display the information to the operator graphically or in text form, hence allowing the operator to control an entire system from a central location in real world. SCADA is a form of ICT used for gathering, analyzing and storage of real time data. Managers are using ICTs to enhance their management capabilities. ICT facilities such as email, the intranet & internet, computers, and software are used for efficient communication within and outside

their organization. Organisations can now use ICTs in form of website to communicate with their clients about the latest products on offer. Computers and servers are now used to create customer profile according to customersô needs which help management serve their clients better. ICTs provide faster response to market needs and allow more flexibility in product design, production and equipment delivery. For Instance, automated bills for material and vendor quotations have enabled buyers to easily evaluate sources of material and make-or-buy decisions. Moreover, ICTs open more opportunities for training and retraining of existing staff in the mastery of the new and sophisticated equipment. It has also led to acquisition of additional capabilities by the employees in these organisations. In addition, there are also the sociological and psychological impacts on employees created by these technologies in the workplace. Introduction of ICT applications in a firm has impacts on work-group effectiveness, organizational climate, job satisfaction, personal growth and accomplishment (Mouelhi, 2008). As a result of the positive worker incentives created by new organisational firmôs performance and efficiency increase.

Products have both a physical and an information component. The physical component entails everything that a buyer needs to know to purchase the product and use it to achieve the intended purpose. For example a product includes information about its characteristics as well as how users should use and support it. In that case information on maintenance and service procedures is an important buyer criterion in consumer appliances. ICTs have made it feasible to supply far more information along with the physical product. For instance General Electricôs appliance service data base supports a consumer hotline that helps differentiate GEôs service support from its rivalsô. In the same line, railroad and trucking companies

offer up to the minute information on the location of shippersô freight, which enhances coordination between shippers and the railroad in the U.S.

ICTs also make it possible to offer products with no physical component at all. For example compustatôs customers have access to corporate financial data filed with Securities and Exchange Commission (SEC) in the U.S. As such many SMEs have sprung up in that regard.

Information and Communication Technology (ICT) is changing the rules of competition in many ways in a wide range of industries. First and foremost, advance in ICTs are changing the structure of the industry. Secondly, ICTs are an important tool that companies are using to leverage competitive advantage. A companyôs quest for competitive advantage through ICTs is spreading to affect industry structures as competitors often imitate the leaderôs strategic innovations. Finally, the ICT revolution is generating completely new businesses. These three effects are critical for understanding the impact of ICT on a particular Industry and for formulating effective strategic responses among firms in Zambia.

1.4 Problem Statement

In order to make intelligent and informed investment decision there is need to study the correlation between the rate of ICT adoption and the benefits it brings to the industry. There is no guarantee that any technological advancement will attract corresponding consumer adoption. New product development and marketing is highly dependent on consumerôs acceptance and intention to adopt new technology (Boshoff & Nel 2009, p.4). In many instances, successful diffusion of technology is partially determined by whether potential users adopt the innovation or not (Wang and Fang 2008, p.101).

The increased proliferation of ICTs globally has led many businesses to run more efficiently and effectively. This is not true for all businesses especially in the global south. With the benefits that ICTs could bring to a business, it is no brainer to expect all businesses regardless of size to jump into this technological band wagon. Adoption of ICTs come at a great cost which may lead to cost of production or cost of doing business to skyrocket thus reducing the mark up a business makes. The benefits of ICT adoption, however, seems to be way too more than the cost and hence the need to investigate the impact of ICT adoption on manufacturing industries thus far.

1.5 Objectives

a. To investigate drivers for adoption of ICTs in selected firms in Zambia
b. To establish the types of ICTs used by firms in Zambia
c. To establish the effects of adoption of ICTs on industries productivity and efficiency level.

1.6 Research Questions

a. What are the types of ICTs existing in Zambia?
b. What is the pattern of ICT usage?
c. What are the drivers and barriers of ICT adoption?
d. What are the effects of ICT adoption on firmôs productivity and efficiency?

1.7 Motivation of the study

Africa is a marginalized region in terms of economic production and world trade. The size of internal markets is relatively small in general and in particular for the manufacturing sector (Chowdhury and Wolf, 2003). These countries also share a

relatively low gross domestic fixed investment, a poor export performance, and a relatively less diversified export portfolio. SMEs in African countries contribute significantly to the economy especially in the manufacturing sector both in terms of employment and of value-added. It is estimated that small enterprises in Kenya generate 12 to 14 per cent of the national income (Daniels and Mead, 1998).

Despite their importance, one principal weakness of SMEs in general is their weak productive capacity, which manifests in low domestic and international market coverage. There are specific obstacles in economies of scale for SMEs in both domestic and export market expansion because of high fixed costs of marketing, particularly of export marketing. In fact, one of the important reasons that have led to the dominance of SMEs in developing economies is due to poor physical and communication infrastructure. This result in relatively isolated markets with limited demand that can best be served by small-scale localized production (Tybout, 2000). But weak infrastructure also acts as a major obstacle for SMEs in any outward expansion.

In the 1990s, many Africa, although on a limited scale, have embraced information and communication technology (Jorgenson and Stiroh, 1999). The increased use of ICT in enterprises can lead to a substitution of such equipment for other forms of capital and labour and may generate substantial returns for enterprises that invest in ICT. ICTs are often lauded as the catalyst for development not only for industrialised countries but also for developing countries (Brynjolfsson and Hitt, 2000). The empirical evidence of the impact of ICTs on enterprise performance is at best mixed. In fact in the industrial countries, the growth of total factor productivity that is associated with technical change has even declined in parallel to the increased use of ICTs in the past 10 to 20 years (Jorgenson and Stiroh, 1999). It is only in the

1990s that empirical evidence has shown ICTs to have a substantial effect on firmsô productivity levels (Brynjolfsson and Hitt, 2000). There are hardly any studies that analyse the effect of ICTs on small enterprises in developing countries, thus the motivation to research the impact of ICTs in manufacturing and business firms in Zambia.

1.8 Scope of the study

The scope of this research is to investigate:

1. The kind of ICTs that exists in various manufacturing industries.
2. The factors driving the adoption of ICTs in manufacturing Industries and firms.
3. To determine the existence of ICTs in manufacturing and business firms.
4. To determine productivity and efficiency levels before and after adoption of ICTs in selected Zambian firms.

1.9 Theoretical Background

This study employed the diffusion theory as its theoretical framework. For more than a century, researchers have studied adoption, effects, and other aspects of new technologies, identifying patterns that are common across dissimilar technologies, and proposing theories of technology adoption and effects.

Theoretical approaches are useful in understanding the origins of the information based economy in which we now live and why some technologies take off while others do not. They also help understand the impacts and effects of technologies, and the economics of the communication technology marketplace. A number of theorists have studied the development of the information society, and its origin.

Beniger (1986) argues that there is a control revolution: ñA complex of rapid changes in the technological and economic arrangements by which information is collected, stored, processed, and communicated and through which formal or programmed decisions might affect social controlò. As society progressed, technologies were created to help control information. For example, information was centralized by mass media. In addition, as more and more information is created and distributed, new technologies must be developed to control that information. For example, with the explosion of information available over the Internet, search engines were developed to enable users find it. Another important point is that information is power, and there is power in disseminating it and withholding it. At different times in modern history, governments have blocked access to information or controlled information dissemination to hold on to power (Beniger, 1986).

1.9.1 Diffusion of Innovations

The diffusion of innovations, also referred to as diffusion theory, was developed by Everett Rogers (1962; 2003). This theory tries to explain how an innovation is communicated over time through different channels to target consumers in society. Rogers (2003) undertook extensive research on the subject of diffusion of innovation. The innovation diffusion theory states that there are four factors which influence the adoption of innovation by target consumers.

Firstly, the innovation, secondly, the communication channel employed to communicate information about the innovation, thirdly, time and fourthly nature of the group to which it is introduced. In the case of information and communication technologies (ICTs), the innovation is some technology that is perceived as new.

Interpersonal channels are equally an important means of communication about innovations. These interactions generally involve subjective evaluations of the

innovation. Rogers (2003) outlines a five-step decision-making process a potential user goes through before adopting an innovation. The first step is knowledge. For instance, a target consumer finds a new available mobile phone and finds out about its new features. The next step is persuasion that is the formation of a positive attitude about the innovation. The third step is when the consumer decides to accept or reject the innovation. Implementation is the fourth step that is when the consumer decides to use the innovation. Finally, confirmation occurs when the consumer decides that they made the correct decision.

Another stage noted by Rogers (2003) and others is ñreinvention,ò which is defined as the process by which a person who adopts a technology begins to use it for purposes other than those intended by the original inventor. For example, though mobile phones were initially designed for calling other people regardless of location, users have found ways to use them for a variety of applications ranging from alarm clocks to personal calendars. This illustrates why some people are the first to have the new technology gadget, while others refuse to adopt a proven successful technology.

Adopters can be categorized into different groups according to how soon or late they adopt an innovation or product. The first to adopt are the innovators. Innovators are special because of their willingness to take a risk adopting something new that has potential of failing. Next the early adopters, the early majority, and then the late majority, followed by the last category, the laggards. Innovators make up the first 2.5% percent of adopters, early adopters are the next 13.5%, early majority follows with 34%, late majority are the next 34%, and laggards are the last 16% (Rogers, 2003). Adopters can also be described in terms of ideal types. Innovators are adventurous; they like to take risks and can deal with failure. Early adopters are

respectable; they are valued opinion leaders in the community and role models for others. Early majority adopters are deliberate; they adopt just before the average person and are an important link between the innovators, early adopters, and everyone else. The late majority are sceptical; they are hesitant to adopt innovations and often adopt because they pressured to do so. Laggards are the last to adopt and often are isolated with no opinion leadership. They are suspicious and resistant to change (Grant and Meadows, 2012).

Other factors that affect adoption include education, social status, social mobility, finances, and willingness to use credit (Rogers, 2003). Adoption of an innovation does not usually occur all at once; it happens over time. This is referred to as the rate of adoption. The rate of adoption generally follows an S-shaped ñdiffusion curveò where the X-axis is time and the Y-axis is percent of adopters. The innovators are at the very beginning of the curve, and the laggards are at the end. The steepness of the curve depends on how quickly an innovation diffuses. For instance, Digital Video Discs (DVD) technology has a steeper curve than Video Cassette Recorders (VCR) because DVD players were adopted at a faster rate than VCRs.

Additionally, different types of decision processes lead to faster adoption of technology. Voluntary adoption is slower than collective decisions, which, in turn, are slower than authority decisions. For example, a company may let its workers decide whether to use a new technology, the employees may agree collectively to it, or finally, the management may decide that everyone at the company is going to use the technology (Grant and Meadows, 2012). In most cases, voluntary adoption would take the longest, and a management dictate would result in the swiftest adoption.

Moore (2001) further explored diffusion of innovations and high-tech marketing in bridging the gap. He noted there are gaps between the innovators and the early adopters, the early adopters and the early majority, and the early majority and late majority. For a technologyôs adoption to move from innovators to the early adopters the technology must show a significant new benefit.

Innovators are visionaries that take the risk of adopting something new such as curved televisions. Early adopters then must see the new benefit of curved televisions before adopting. The gap between early adopters and early majority is the greatest of these gaps. Early adopters are still visionary and desire to be change agents. They donôt mind dealing with the troubles and hitches that come along with a new technology. Early adopters are likely to use a beta version of a new service like Google+ (Grant and Meadows, 2012). The early majority, on the other hand, are pragmatists and want to see some tangible improvement in productivity. Mooreôs description of ñcrossing the gapò is as a result of the difficult associated with moving from serving the visionaries to serving the pragmatists.

This phenomenon explains why Google+ hasnôt moved beyond the early adopter stage. Finally, there is a smaller gap between the early majority and the late majority. Unlike the early majority, the late majority reacts to the technical demands on the users. The early majority is more comfortable working with technology than others. So, the early majority would be comfortable using social networking but the late majority is put off by the perceived technical demands. The technology must alleviate this concern before late majority adoption.

This perspective provides a more complete picture of a technology because it focuses attention beyond the initial use of the technology to the time that the technology is in regular use, and ultimately, disappears from market (Grant and

Meadows, 2012). Considering the short lifespan of many communication technologies, it may be just as useful to study the entire lifespan of a technology rather than just the process of adoption. To determine the adoption of ICTs by organisations as an adoption of technological innovation, a research model was constructed using these five perceived characteristics of innovation by Rogers ; relative advantage, compatibility, complexity, trialability, and observability; to explain adoption of information and communication technologies (ICTs). The Diffusion Theory was the major theoretical framework for this research.

1.9.2 Other Theories of Adoption

Other theorists have attempted to explain the process of adoption. Among the most notable perspectives in this regard are the Theory of Planned Behavior (TPB) and the Technology Acceptance Model (TAM). Both of these models emerged from the need to identify factors that can help predict future adoption of a new technology when there is no history of adoption or use of the technology (Grant and Meadows, 2012).The Theory of Planned Behavior (TPB) (Ajzen, 1991; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) presumes that a suitable predictor of future behaviour is ñbehavioural intention,ò a cognitive rather than behavioural variable that represents an individualôs plans for adopting or not adopting an innovation. Behavioural intentions are then predicted by attitudes toward the innovation and the innovators.

The Technology Acceptance Model (Davis, 1986; Davis, Bagozzi & Warshaw, 1989) elaborates on TPB by adding factors that may predict attitudes toward an innovation and behavioural intentions, including perceived usefulness, perceived ease of use, and external variables. A significant body of research has demonstrated

the efficacy of these factors in predicting behavioural intentions (e.g., Mathieson, 1991; Jiang, Hsu & Klein, 2000; Chau & Hu, 2002; Park, Lee & Cheong, 2007).

1.9.3 Critical Mass Theory

Interactive technologies such as telephone and e-mail become more and more useful as more people adopt these technologies this is referred to as network effects. There have to be some innovators and early adopters who are willing to take the risk to try a new interactive technology. These users are the ñcritical mass,ò a small segment of the population that chooses to make big contributions to the public product (Markus, 1987). In general terms, any social process involving actions by individuals that benefit others is known as ñcollective action.ò In this case, the technologies become more useful if everyone in the system is using the technology, a goal known as universal access. Ultimately universal access means that you can reach anyone through some communication technology.

For example, in the United States, the landline phone system reaches almost everywhere, and everyone benefits from this technology, although a small segment of the population initially chose to adopt the telephone to set the ball rolling. There is a stage in the diffusion process that an interactive medium has to reach in order for adoption to take off. This is the ñcritical mass.ò Another conceptualization of critical mass theory is the ñtipping pointò (Gladwell, 2002). For instance, the videophone never took off partly because it never reached critical mass. The videophone was not really any better than a regular phone unless the person you were calling also had a videophone. The worth of adopting videophones was as much as the number of people who possessed videophones. On the contrary, if most of oneôs regular contacts had videophones, then that critical mass of users might drive everyone to adopt the videophone. ICT requires other types of international

systems such as electronic data interchange to reach a critical mass among business partners such as suppliers, customers, banks. The critical mass has improved in the recent past. In some cases, some companies have used ICTs since the beginning but they cannot maximise its use since their clients do not have it (Scupola 2001). Critical mass is an important aspect to consider for the adoption of any interactive technology.

Another good example is facsimile or fax technology. The first method of sending images over wires was invented by Alexander Bain, who proposed using a system of electrical pendulums to send images over wires (Robinson, 1986). Within a few decades, the technology was adapted by the newspaper industry to send photos over wires, but it was limited to a small number of news entities. Lack of critical mass is another major reason.

The development of technical standards in the 1960s brought the fax machine to corporate America, which generally ignored the technology because few businesses knew of another business that had a fax machine. Adoption of the fax took place in phases of two machines at a time, with those two usually being purchased to communicate with each other, but rarely used with additional receivers. By the 1980s, so many businesses had fax machines that could communicate with each other that many businesses started buying fax machines one at a time. Consequently, ñcritical massò point was reached, fax machine adoption increased to the point that it became referred to as the first technology adopted out of fear of embarrassment that someone would ask, ñWhatôs your fax number?ò (Wathne & Leos, 1993). The fax machine became a business necessity in less than two years.

Social information processing theory goes beyond the rational choice models because it states that perceptions of media are ñpartly, subjective and socially

constructed.ò Although people may use objective standards in choosing communication media, use is also determined by subjective factors such as the attitudes of co-workers about the media and sensational learning, or watching othersô experiences. Social influence is strongest in ambiguous situations. For example, the less people know about a medium, the more likely they are to rely on social information in deciding to use it (Fulk, et al., 1987).

CHAPTER 2: DRIVERS OF ICT ADOPTION.

America in the late 1800s provided a favourable environment for the development of new calculating technologies (Quinn, 2013). This period commonly known as the Gilded Age, was characterized by rapid industrialization, economic expansion, and a concentration of corporate power. Corporations merged for the purpose of increasing efficiency and profits, but the new, larger corporate organizations had multiple layers of management and multiple locations, and in order for middle- and upper-level managers to monitor and improve performance, they needed access to up-to-date, comprehensive, reliable, and affordable information (Quinn 2013, P. 34). Bookkeepers and accountants could not meet all these requirements using pen and paper to sum long columns of transactions by hand. Many entrepreneurs began producing adding and calculating machines to meet this demand. William Burroughs, a former bank clerk who had spent long days adding columns of figures devised a practical adding machine. He operated in a cut-throat market; companies competed fiercely to reduce the size of their machines and make them faster and easier to use (Quinn, 2013). To distinguish himself from his competitors, Burroughs put together first-class manufacturing and marketing organizations, and by the 1890s, the Burroughs Adding Machine Company led the industry. Calculating machines were entrenched in the offices of large American corporations by the turn of the century.

2.1.1 Data Processing Technology: Cash register

The first cash register was constructed in 1879 by James Ritty and his brother John .It was essentially an adding machine capable of expressing values in dollars and cents. Improvements followed rapidly, and by the early 1900s, the cash register had

become important information processing device (Quinn, 2013). Cash registers were capable of creating printed, itemized receipts for customers, maintained printed logs of transactions, and performed other accounting functions that provided shop owners with the detailed sales records. Cash registers also made embezzlement by clerks almost impossible (Quinn, 2013).

2.1.2 Data Storage technology: Punched cards

In the late 1800s, as corporations and governmental entities expanded they needed to process greater volumes of information. The U.S. Bureau of the Census, which gathered and analyzed information on tens of millions of residents every decade, was among these agencies (Quinn, 2013). In response to the tedium and errors associated with clerks manually copying and tallying figures, several Census Bureau employees developed mechanical tabulating machines. Herman Hollerith created the most successful device. Unlike a predecessor, who chose to record information on rolls of paper, Hollerith decided to record information on punched cards (Quinn, 2013, P.35). The use of punched cards to store data was a more superior approach, because cards could be sorted into groups, allowing the computation of subtotals by categories. Hollerithôs equipment proved its worth when used in the 1890 census. Contrary to the 1880 census which required eight years to complete, the 1890 census was finished in only two years. Other data-intensive organizations found applications for punched cards. Railroads used them to improve their accounting operations and send bills out more frequently. Retail organizations, such as Marshall Fieldôs, used punched cards to perform more sophisticated analyses of information generated by the cash registers at its many stores. The Pennsylvania Steel Company and other heavy industries began to use punched-card technology to do cost accounting on manufacturing processes (Quinn, 2013, P.37). The invention of

sorters, tabulators, and other devices to manipulate the data on punched cards created a positive feedback loop. As organizations began using tabulating machines, they devised new uses of information-processing equipment, stimulating further technological innovations. International Business Machines (IBM) is the corporate descendant of Hollerithôs company. Over a period of several decades, IBM and its principal competitor, Remington Rand, developed sophisticated machines based around punched cards: card punches, card verifiers, card sorters, and card tabulators (Quinn, 2013). Users used these devices to create data-processing systems that received input data, performed one or more calculations, and produced output data. Within these systems, punched cards stored input data, intermediate results, and output data. In the most complicated systems, punched cards also stored the program. The program showed steps of the computational process to be followed during execution.

2.1.3 Modern data processing facilities: Commercial computers

The first commercial computer, Universal Automatic Computer (UNIVAC) was developed by the Eckert-Mauchly Computer Corporation which signed a preliminary agreement with the National Bureau of Standards (representing the Census Bureau) in 1946 (Quinn, 2013). The project experienced huge cost overruns such that by 1950, the Eckert-Mauchly Computer Corporation was on the verge of bankruptcy. Remington Rand bought them out and delivered the UNIVAC I to the U.S. Bureau of the Census in 1951 (Shurkin 1996 cited in Quinn, 2013). The Remington Rand cooperated with CBS to use a UNIVAC computer to predict the outcome of the 1952 Presidential election in a coup to advance public relations in the U.S. Adlai Stevenson had led Dwight Eisenhower in polls taken before the election, but less than an hour after the polls closed, with just seven percent of the

votes tabulated, the UNIVAC was predicting Dwight Eisenhower would win the election in a landslide. The UNIVAC had predicted Eisenhower would win 438 electoral votes to 93 for Stevenson. The official result was a 442ï 89 victory for Eisenhower Microprocessors (Quinn, 2013). Microprocessors made it possible to integrate computers into everyday devices. Today, there are so many devices containing microprocessors: cell phones, MP3 players, digital cameras, wristwatches, ATM machines, automobiles, microwave ovens, thermostats, traffic lights, among others. The highest-profile use of microprocessors, however, is in personal computers.

2.2 Application of ICTs in Business Firms

The explosion of information and Communication Technologies is having specific ramifications for all business careers and Industries (Valacich and Schneider, 2012). The ICT revolution is creating Interrelationships among industries that were previously disjointed. The convergence of computer and telecommunication technologies has profound effects on the structure of both industries. AT & T is using its position in telecommunication as a platform to penetrate the computer industry. On the other hand IBM which recently acquired Rolm, the telecommunication equipment manufacturer is now entering the telecommunication industry from the other end. ICTs are also at the core of growing convergence in financial services where the banking, insurance and brokerage industries are merging. ICTs are also merging office equipment such as typing, photocopying, data and voice communication (Porter, 2011).

In industry today ICTs have found a wide range of applications as outlined below.

2.2.1 Accounting and Finance

In todayôs digital world, accounting and finance professionals rely heavily on information systems. Information and communication systems are used to support various resource planning and control processes as well as to provide managers with up-to-date information. Accounting and finance professionals use a variety of information and communication systems in form of networks, and databases to effectively carry out their functions (Valacich and Schneider, 2012). In addition to changing the ways internal processes are managed and performed, ICTs have also changed the ways organizations exchange financial information with suppliers, distributors, and customers (Valacich and Schneider, 2012). For instances, in the transportation industry ICTs in form of micro-computers are helping Intermodal Transportation Services, Inc in U.S to link its offices to a centre that calculates all prices. This new system gives the company the capacity to introduce a new pricing policy to offer discounts to national accounts which place their orders from across the U.S. ICTs are enabling Intermodal to tailor its value chain to large national customers in a way that was previously impossible (Porter and Millar, 2001).

2.2.2 Operations Management

ICTs have also greatly changed the operations management profession. In the past, orders for supplies had to be placed over the phone, production processes had to be optimized using tedious calculations, and forecasts were sometimes only educated guesses. Today, enterprise resource planning and supply chain management systems have eliminated much of the ñtedious workò associated with making production forecasts and placing orders. Additionally, with the use of corporate extranets, companies are connecting to their suppliersô and distributorsô networks, helping to

reduce costs in procurement and distribution processes (Valacich and Schneider, 2012). ICTs increases the companyôs ability to coordinate its activities regionally national and globally. It unleashes the power of geographic scope to create competitive advantage. For example, in the newspaper industry, Dow Jones, publisher of the wall street Journal pioneered the page transmission technology that links its 17 U.S. printing plants to produce a truly national newspaper. Dow Jones started the Asian wall street Journal and the Wall Street Journal European Edition and shares much of the editorial content while printing the papers in plants across the globe (Porter and Millar, 2011). The post newspaper Ltd in Zambia uses similar software to coordinate editorial and advertising content as well as electronic transmission of newspaper content to its printing plant.

2.2.3 Human Resources Management

The human resources management profession has experienced widespread use of ICTs for recruiting employees through Internet job sites, distributing information through corporate intranets, or analysing employee data stored in databases. In addition to using information systems within daily work schedules, organizations have to deal with other issues related to ICT use and misuse within the organisation. For example, executives need to find the best methods for motivating employees to use a system they do not want to use, find policies to use regarding monitoring employee productivity or Internet misuse. Human resource management professionals, use ICTs as a valuable tool in recruitment and management of personnel.

2.2.4 Marketing

Information systems have changed the way organizations promote and sell their products. For example, business-to-consumer electronic commerce, enabled by the

Internet, allows companies to directly interact with their customers without the need for intermediaries; likewise, customer relationship management systems facilitate the targeting of narrow market segments with highly personalized promotional campaigns. Marketing professionals must therefore be proficient in the use of various types of information systems in order to attract and retain loyal customers. Currently, observation of ICT is relatively easy for both consumers and industry adopters. ICTs increases company visibility as the Website can be seen as a place where the homepage is a shopping window. Websites allow businesses to remain open 24 hours, 7 days a week to a lot of potential customers and suppliers on the internet (Blackwood, 1997). Customers and suppliers can visit the company Website to search for general information with a quick response anytime and anywhere they can access to the Internet. This creates convenience and flexibility for the organization to create relationships with both buyers and sellers. Adoption and use of ICTs increased productivity by speeding up the process of storing, processing and transmitting information at the same time resulted in effective use of time among those that adopts them. It increases the speed at which knowledge is generated and diffused within firms (Milana and Zeli, 2002).

2.2.5 Information Systems

ICTs have become a ubiquitous part of organizational life, where systems are used by all organizational levels and functions. Because of this, there is a growing need for professionals to develop and support these systems. To most effectively utilize the investment in information systems, professionals must be proficient in both business; management, marketing, finance, and accounting and technology. In other words, IS professionals must understand the business rationale for implementing a particular system as well as how organizations can use various systems to obtain a

competitive advantage. Being able to understand both the business needs of the organization and the way in which ICT-based solutions can meet these needs will provide you with a competitive advantage in the job market.

2.2.6 Production Cost Management

Information and Communication Technology alters companyôs cost in any part of the value chain. Historically the impact on cost was confined to activities in which repetitive information processing played a large part. These limits have diminished; however, even activities like assemble that mainly involve physical processing now have a large information-processing component. Canon for example built a low cost copier assembly process around an automated parts selection and materials-handling system. Assembly workers have bins containing all the parts needed for a particular copier. Canons success with this system derives from the software that controls parts inventory and selection. In insurance brokerage, a number of insurance companies usually participate in underwriting a contract. The costs of documenting each companyôs participation are high. Now a computer Model can optimize and reduce the number of insurers per contract lowering the brokers total cost. In garment production equipment such as automated pattern drawers, fabric cutters, and system for delivering cloth to the final sewing station have reduced the Labor time for manufacturing by up to 50 % (Porter, 2011).In additions to playing a direct role in cost, ICTs alter the cost drivers of activities in ways that can improve or erode a companyôs relative cost position. For instance, Louisiana Oil & Tire has taken all ten of its sales people off the road and made them into telemarketers. As a result sales expenses have fallen by 10% and sales volume has doubled. However the move has made the national scale of operations the key determinant of the cost of selling, rather than scale.

2.3 Factors Driving ICT Adoption

In order to identify the impact that each individual characteristic of a technology has, the factors within each area of the ecosystem may be identified as ñenabling,ò ñlimiting,ò ñmotivating,ò and ñinhibiting,ò depending upon the role they play in the technologyôs diffusion.

2.3.1 Enabling factors

These are factors that make an application possible. For example, the fact that the coaxial cable used to deliver traditional cable television can carry dozens of channels is an enabling factor at the hardware level. Similarly, the decision of policy makers to allocate a portion of the spectrum for cellular telephone is an enabling factor at the system level (political system). One starting point to use in examining any technology is to make a list of the underlying factors from each area of the technology ecosystem that make the technology possible in the first place.

2.3.2 Limiting factors

These are factors that create barriers to the adoption or impact of a technology. For instance, despite coaxial cable increasing the number of television programs that could be delivered to a home in the U.S, most analogue coaxial networks could not transmit more than 100 channels of programming. To the viewer, 100 channels may seem to be more than is needed, but to the programmer of a new cable television channel unable to get space on a filled-up cable system, this hardware factor represents a definite limitation. Similarly, the fact that the policy makers discussed above initially permitted only two companies to offer cellular telephone service in each market was a system-level limitation on that technology. Again, it is useful to

apply the technology ecosystem to create a list of factors that limit the adoption, use, or impacts of any specific communication technology.

Lukasz Arendt (2007) investigated barriers in ICT adoption from selected regions of Spain, Portugal and Poland focused on matters regarding the use of information and communication technologies by small and medium-sized enterprises. It was found that the main barrier and thus the main reason why SMEs face Digital Divide is not lack of access to ICTs but rather exact knowledge, education and skilled owner-managers and workers within the enterprises. Digital divide at business level means the SMEs are lagging behind large corporations in adopting ICTs and e-Business. Arendt (200) argues that efforts aimed at bridging the Digital Divide in SMEs should focus on overcoming the ñskills accessò and ñusage accessò barriers within the enterprise and not material ones. The research reveals that the differences in connectivity between SMEs and big enterprises are losing ground though there is still a noticeable gap when it comes to e-Business solutions implementation and utilization of ICT potential. It was also found that low quality of human capital is the reason why SMEs are lagging behind large corporations in ICT and e-Business application and not lack of funds or access to technology. In view of these findings it is imperative to focus initiatives and programs that promote information society concept from supporting ñmaterial accessò to ñskills accessò and ñusage accessò (Arendt, 2007).

2.3.3 Motivating factors

These are factors that provide a reason for the adoption of a technology. Technologies are not adopted just because they exist. Rather, individuals, organizations, and social systems must have a reason to take advantage of a technology. The desire of local telephone companies for increased profits, combined

with the fact that growth in providing local telephone service is limited, is an organizational factor motivating the telcos to enter the markets for new communication technologies (Porter and Millar, 2001). Individual users desiring information more quickly can be motivated to adopt electronic information technologies. If a technology does not have sufficient motivating factors for its use, it cannot be a success. According to a study by Lymer et al. (1997) ICT implementation in the organization which includes SMEs has the potential to reduce costs and increase productivity level. According to them small firms might find cost-effectiveness a motivating factor to use Internet-commerce for improving communication with trading partners and consumers. Lauder and Westall (1997) have given their experts opinion that ICT impacts include cheaper and faster communications, better customer and supplier relations, more effective and efficient marketing, product and service development and better access to information and training. Barua (1995) found a positive impact on ICT usage in business and it is able to increase business performance.

2.3.4 Inhibiting factors

These are the opposite of motivating factors, providing a disincentive for adoption or use of a communication technology. An example of an inhibiting factor at the content level might be a new electronic information technology that has the capability to update information more quickly than existing technologies, but provides only ñoldò content that consumers have already received from other sources. One of the most important inhibiting factors for most new technologies is the cost to individual users. Each potential user must decide whether the cost is worth the service, considering the available funds and the number of competing technologies. Cost is a serious concern to businesses when it comes to adopting ICT

solutions, which like most services varies depending on the size and needs of the business. According to Premkumar et al. (1997) there is a direct and significant relationship between cost and adoption of technology. Generally, the lower the cost of adopting technology the higher the adoption of technologies such as ICTs by companies. Perceived cost plays a vital role for SMEs in determining adoption of ICTs in their business and they are most likely going to ignore adoption of ICTs in the initial stages of their business if the cost is high (Alam and Noor 2009). A ready-to-use online package from a vendor that can provide the desired features at a specific rate is an alternative for SMEs, unlike investing in complete control of the system and integrating a new system into the existing system, which is very expensive (Mehta and Shah, 2000). Hence, SMEs donôt have to spend a lot of start-up cost for implementing ICTs. They can develop on the scales that equal their resources and capabilities, which should lead to their willingness to adopt ICTs in their organization. Early HDTVs and HD cable and satellite systems were very expensive, which slowed the rate of adoption. The general picture shows that a high cost of adoption of innovation slows down the rate at which innovation expansion takes place (Alam & Noor 2009). In India the Union Ministry of Communications and Information Technology launched the National Cloud under MeghRaj Initiative on 4 February 2014 in a bid to reduce the cost of ICT adoption and usage (Josh, 2014). The National Cloud was implemented by Indiaôs National Information Centre (NIC) to help the procurement departments to purchase ICT services on demand in the OPEX model rather than investing upfront on the CAPEX. The Cloud Services available include; Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) and Storage as a Service (STaaS). The features of the National Cloud include; self-service portal, multiple Cloud solutions, secured VPN

access and multi-location Cloud (Josh, 2014). This strategy has significantly slashed the total cost of ICT adoption in India.

Reynolds (1994) stated that small businesses often have difficulty in obtaining financial resources. Any new technology like ICT may be considered too expensive to many SMEs because of their lack of financial power. Overall, organisations adopt innovation as a cost cutting measure. Determining whether an innovation is expensive or not depends on the benefits the technology brings in the long term. One key benefit is the reduced cost of production of the goods and services. However much technology costs, if the reduction in the production cost in the long term outweighs the current cost of adoption, itôs worth going for.

Competition from other technologies is one of the biggest barriers any new (or existing) technology faces. Any factor that works against the success of a technology can be considered an inhibiting factor. There are usually more inhibiting factors for most technologies than motivating ones. And if the motivating factors outweigh the inhibiting factors, it is an easy bet that a technology adoption will be successful.

Enabling, limiting, motivating, and inhibiting factors can be identified at the system, organizational, content, and individual user levels. However, hardware and software can only be enabling or limiting; by themselves, hardware and software do not provide any motivating factors. The motivating factors must always come from the messages transmitted or one of the other areas of the technology ecosystem (Grant and Meadows, 2012).

The final dimension of the technology ecosystem relates to the environment within which communication technologies are introduced and operate. These factors can be termed ñexternalò factors, while ones relating to the technology itself are ñinternalò

factors. Both internal and external factors must be studied and compared to understand a communication technology or be able to predict the manner in which a technology will diffuse (Grant and Meadows, 2012).

In most cases, organizational and system-level factors are more important in the development and adoption of communication technologies than the hardware itself. For example, political forces have, to date, prevented the establishment of a single world standard for high definition television (HDTV) production and transmission (Grant and Meadows, 2012). As individual standards are selected in countries and regions, the standard selected is as likely to be the product of political and economic factors as of technical attributes of the system. Organizational factors can have similar powerful effects. For example, the entry of a single company, IBM, into the personal computer business in the early 1980s resulted in fundamental changes in the entire industry, dictating standards and endorsing an operating system (MS-DOS) as a market leader. Additionally, the individuals who adopt or choose not to adopt a technology, along with their motivations and the manner in which they use the technology, have profound impacts on the development and success of a technology following its initial introduction (Grant and Meadows, 2012).

2.4 Benefits of Adopting ICTs in Manufacturing Industries

Vigorously selecting and implementing courses of action which are complementary, not only at the level of manufacturing but rather in terms of the entire organization, creates competitive advantages (Baba 1989; Collins et al. 1988; Gerwin, 1988). Nevertheless, utilizing such a widespread system of complementarities requires a multi-disciplinary team to provide significant co-ordination. ICTs such as Computer Aided Design and Computer Aided Manufacturing (CAD-CAM) are examples of the mentioned complementary technology. Schlumberger Well Services, a major

supplier of oil-field equipment, using complementary advanced manufacturing technologies in form of CAD-CAM is able to process 300 engineering change notices compared to only 100 prior to AMT implementation (Cook, 1990). Besides, the change cycle decreased from six weeks to less than one week. As a result, by functionally integrating both product innovation and Advanced Manufacturing Technology (AMT), organizations create powerful competitive advantages. Preventing accidental impacts needs an organizational perspective. Developing technical changes independently of organizational changes increases dramatically the probability of accidental impacts (Robey, 1987). Anticipating changes in organizational structure, job design, communication patterns, and interorganizational relationships reduces the probability of AMT failure. However, no matter how well managed AMT project implementation is, accidental impacts occasionally do arise and surprise both system designers and managers (Robey, 1987). Typical accidental impacts occur when designers view their job technically, as opposed to organizationally. Regulating implementation by a technical perspective, system designers are neither ready for such impacts nor able to explain why they occur, regardless of their favourableness or unfavourableness. Managing social impacts before making irreversible technical choices requires an organizational perspective. Since not all consequences are anticipated, monitoring projects for unintended side effects aids in keeping AMT projects on course.

Technology, by itself, presents a limited competitive advantage, but when leveraged by the power of peopleôs minds, the consequence can be brilliant as well as a process of continuous improvement (Teresko, 1990). AMT should leverage employee knowledge, creativity, and initiative. Increasing productivity is the objective and not replacing employees.

Managementôs job does not end with purchasing and installing automation; rather it just begins. AMT requires continuous management just like any resource (Cook and Cook 1984). However, leaving control of technology strictly to technicians often results in isolated tasks being optimized. AMT projects often positively impact employees, particularly if personnel and machines are utilized in a complementary manner. The implementation of an AMT project should use machines to enhance task consistency and efficiency while utilizing workersô decision-making flexibility to improve productivity.

Flexibility refers to the tactical ability of an entire production and logistics area to switch with reasonably little time and effort to new, although similar, families of components by changing manufacturing processes, material flows and logistical functions.

The technical efficiency in a production unit is defined as the achievement of the maximum potential output given the amounts of factor inputs without ignoring physical production relationships (Mouelhi, 2008). Many organisations want to establish how precisely ICT affect the economic performance and the efficiency of firms before making critical decisions of adopting it. Mouelhi (2008, p.7) argues that there are several reasons why technical efficiency, productivity and growth might change when there is change in the production technology at firm level. In most analysis of ICT use impact, two effects of ICT on productivity and growth are tackled. In the first place, as a capital good, investment in ICT vastly contributes to overall capital deepening which provides productive equipment and software to business and therefore helps raise labour productivity (Mouelhi 2008). Investment in ICT equipment leads to an increase in the amount of available capital for labour thus increasing economy wide labour productivity and is likely to increase economic

growth as well. Secondly, greater use of ICT help firms raise their overall efficiency hence increase Multiple Factor Productivity. Increased use of ICT also contribute to networks effects, such as lower transaction costs and more rapid innovation, which will improve the overall efficiency (Pilat, 2004 cited in Mouelhi, 2008). Network effects: the value of the network to *each* user increases or decreases, respectively, with every addition or subtraction of *other* users to the network.

The benefits of ICT for a firm include savings of inputs, general cost reductions, higher flexibility, improvement in product quality, etc (Arvantis, 2004 cited in Mouelhi 2008). ICTs play also a key role in increasing the speed of generation, diffusion and use of new knowledge within plants (Milana and Zeli, 2002 cited in Mouelhi, 2008). The information stimulates the creation of new knowledge by giving firms and innovators fast access to knowledge. Adoption of ICT has also resulted in more effective use of time. It has contributed significantly to eliminating communication gaps, as users and suppliers can now communicate more easily and faster, through electronic mail (E-mail) and website, when placing orders or sourcing for raw materials (Kajogbola, 2004 cited in Mouelhi, 2008). It has positively influenced time and space in the sending and retrieving of information both within and across different organisations. However, several empirical studies suggest that the impact of ICT depends on a range of complementary investments and factors, such as the availability of skills in the firm, and organisational factors (Dirk, 2004 cited in Mouelhi, 2008).

The greatest benefits from ICT are realised when ICT investment is combined with other organisational changes and human capital upgrading. Computer-based technologies are often used by workers with higher skills. Availability of know-how and qualified personnel is a precondition for the use of ICT; for example training in

problem-solving, statistical process controls and computer skills can increase the benefits of ICT (Arvamtis, 2004 cited in Mouelhi, 2008).The firm-level evidence also suggests that the uptake and impact of ICT differs across firms, varying according to some firmôs characteristics such as the size of the firm, the age of the firm, activity etc (Dirk 2004 cited in Mouelhi 2008).

2.5 Stages in the Adoption Process

Consumers go through five stages in the process of adopting a new product: Awareness stage; the stage when a consumer becomes aware of the new product but lacks information about it followed by Interest stage; the consumer seeks information about the new product and then evaluation stage; the consumer considers whether trying the new product makes sense. The following stage is the trial stage; the consumer tries the new product on a small scale to improve his or her estimate of its value. Adoption stage; the consumer decides to make full and regular use of the new product (Grant and Meadows, 2012).

2.6 Influence of Product Characteristics on Rate of Adoption

The characteristics of the new product affect its rate of adoption (Grant and Meadows, 2012). Some products catch on almost overnight; for example, both the iPod and iPhone flew off retailersô shelves at an astounding rate from the day they were first introduced. Others take a longer time to gain acceptance. For example, the first HDTVs were introduced in the United States in the 1990s, but the percentage of U.S. households owning a high definition set stood at only 28 percent by 2007 and 62 percent by 2010 (Business Wire, 2010)

Rogers also defines characteristics of innovations: relative advantage, compatibility, complexity, trialability, and observability drivers of ICT adoption as elaborated in figure one.

Product Characteristics as drivers of adoption

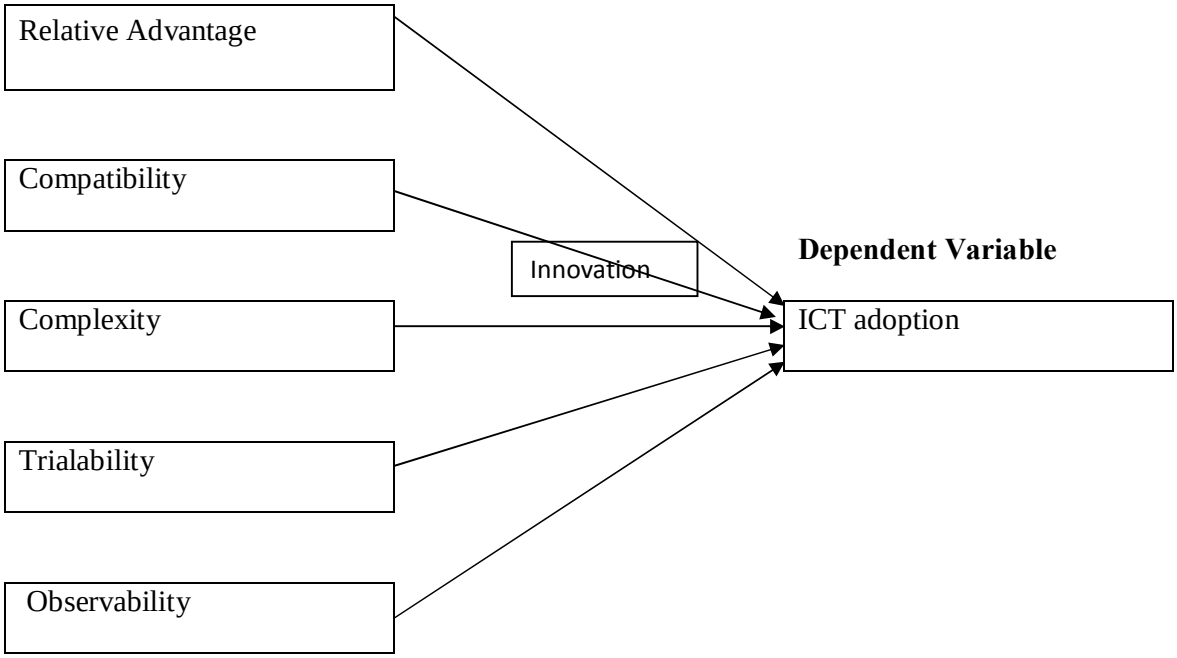

Figure 2: Schematic diagram of the theoretical model

(Source: Rogers, 1962)

Five characteristics are especially important in influencing an innovationôs rate of adoption, these include:

2.6.1 Relative Advantage

The extent to which an innovation is perceived as being better than the idea it overtakes is defined as relative advantage. Relative advantage is regarded as a plus for the organization over previous methods of performing the same task (Agarwal and Prasad, 1997). Relative advantage has been noted as one of the best predictors and is positively related to an innovationôs rate of adoption (Premkumar,

Ramamurthy, and Nilakanta 1994; Rogers 1983, 1995; Tornatzky and Klein 1982). HDTV offers substantially improved picture quality. The potential opportunities and benefits of ICTs include; strengthening customer relationships, reaching new markets, optimizing business processes, reducing costs, improving business knowledge, attracting investment, and creating new products and services. At the same time ICTs represents an opportunity for SMEs to compensate for their traditional weaknesses in areas such as access to new markets and gathering and diffusing information on an international scale, which improve communication and creates greater job flexibility (Limthongchai & Speece 1999). Therefore growing awareness and understanding of the advantages of ICTs among SMEs can positively influence their desire and interest in adopting ICTs in their businesses.

2.6.2 Compatibility

The extent to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters is referred to as compatibility. Tornatzky and Klein (1982) found that an innovation is more likely to be adopted when it is compatible with oneôs job description and value system. The likelihood of adoption is high not only if it is compatible with deeply held cultural values but also if it is compatible with previous ideas. Compatibility of a technology with its predecessor can either accelerate or retard its adoption rate in an organization. HDTV, for example, is highly compatible with the lifestyles of the TV-watching public. However, in the early years, HDTV was not yet compatible with programming and broadcasting systems, which slowed adoption. Now, as more and higher definition programs and channels are becoming more available, the rate of HDTV adoption has increased rapidly. The degree to which innovation solve customer needs is an added aspect of the compatibility of a technology. Firms

should endeavour to determine the needs of their clients, and recommend innovations that tackle them. Every time felt needs are met there is usually a faster rate of adoption (Rogers, 1995).

2.6.3 Complexity

The extent to which technology is perceived as relatively difficult to understand and use is referred to as complexity (Agarwal and Prasad 1997). Fresh ideas that can be easily understood are adopted more rapidly than innovations that require the adopters to develop new knowledge, skills, and understanding (Premkumar et al. 1994). For instance, High Definition Televisions (HDTVs) are not very complex. Therefore, as more programming has become available and prices have fallen, the rate of HDTV adoption is increasing faster than that of more complex innovations. Technology that is seen to be easy to use and less complex have a higher likelihood of being accepted and used by potential users (Agarwal and Prasad 1997). Some literatures reviewed indicate that, some SMEs have little resources to support it. For example, SMEs frequently feel that they have limited knowledge of technology in their organizations. It is difficult to attract employees and experienced in-house ICT staff with the right skills in developing countries. Forty percent of SMEs in UK felt not really sure how to make best use of technology that they currently have (Limthongchai & Speece, 1999). Besides, some SME business owners lack appropriate education, information, and knowledge. They do not have the necessary competencies to understand the full implications of ICTs (Scupola 2001).

2.6.4 Trialability (Divisibility)

This refers to the extent to which technology may be experimented with restriction. It is an important feature of technology because it provides a means for perspective

adopters to reduce the uncertainty they feel toward an unfamiliar technology or product (Weiss and Dale, 1998). Rogers observes that potential adopters who have an opportunity to experiment with an innovation before committing to its usage will feel more comfortable with it and are more likely to adopt it (Agarwal and Prasad 1997; Tan and Teo, 2000).

2.6.5 Observability (Communicability)

This refers to the extent to which the results of an innovation are visible to others is referred to as observability. Most of the innovations studied in past diffusion research are technological ideas (Rogers, 1995). Observability is hard to establish in a market that is already dominated by an established technology. Hence, it is important to establish observability in a niche market or a new application of the technology before attempting to challenge the dominant technology in its native market and application (Weiss and Dale, 1998). For instance, Because HDTV lends itself to demonstration and description; its use spread faster among consumers. Other characteristics influence the rate of adoption, such as initial and ongoing costs, risk and uncertainty, and social approval.

2.7 ICT Adoption and SME Growth in Developed Countries

There has been vast adoption of ICTs by developed countries since their invention. According to Kessler (2011) by the year 2008, 74 million (63%) of American households had high speed broadband access. In 2009, the penetration increased to 70.9%, then to 75.3% in 2010 (More Americans, 2012). International Data Corporation (IDC, 2012) reported that Internet users worldwide reached 1.5 billion in 2008 and forecast that the number would reach 2.3 billion in 2013, an annual growth rate of 9% (Kessler, 2011).

In 2010, the average amount of time per month spent connected to the Internet ranged from 22.3 hours for users of ages 12-17 to 39.3 hours for users of ages 45-54. Age groups in the range of 18-24; 25-34; 35-44; 55-64; and 65+ all averaged between 32.2 and 37.4 monthly hours of Internet activity (Kessler, 2011). The Internet became the primary reason that consumers purchased new computers during the first decade of the 21st century, (Kessler, 2007a). Cable modems and Digital Subscriber Line (DSL) telephone line connections increased among home users as the means for connecting to the Internet, as more than half of American households accessed the internet with high speed broadband connections.

Outside the United States, DSL has an edge over cable Internet access because of the much greater penetration of wired telephone lines relative to cable infrastructure (Bensinger, 2007). Viewers on YouTube, an online video viewing service created in 2005, watched 63 billion videos online (com Score as cited in Kessler, 2011). By 2010, 441 billion videos were seen online, representing an annual growth rate of 38% (Kessler, 2011).

In 2010, 142.4 million American households were viewing videos via the Internet, up by 4.8% from 2009. The average household viewing of this type occurred for 14 hours and 33 minutes monthly, an increase of 34.5% from the previous year (Amobi, 2011a). In July 2011, more than 180 million unique viewers of Internet video consumed an average of 1,107 minutes of online video (Kessler, 2011).

Commerce is among the popular uses of the Internet. In 1994, Internet content was hosted on about 10,000 web servers. By 2006, more than 100 million servers were operating. In 2008, 187 million websites were operating and the number increased to 234 million in 2009 and 255 million in 2010. In 2011 online commercial revenues were 25% higher than in the previous year and the sixth consecutive year in which

growth occurred. ñBy any measure, the internet has been one of the fastest growing commercial phenomena in historyò (Kessler, 2011, p. 17). Online access spurred the development of social networking services, particularly among teenagers and later among adults. Social networking also operates through a variety of online services that allow individuals to use mobile phones to send out reports of daily activities. Users obtain application software for their phones from websites.

This application software allows messages and photographs to be sent to receivers who use phones or computers to access websites for reception (Stone & Richtel, 2007). Facebook emerged as the most popular social networking service (Kessler, 2009). In February 2010, the service reported more than 400 million users, a number equivalent to the third most populous country in the world, larger than the United States. The number of users passed 500 million in July 2010 and 750 million by mid-2011. More than 250 million users accessed the service in 2011 with mobile devices. By late 2010, Facebook had become not only the largest social network in the world, but the third largest Internet Company of any kind (Kessler, 2011). Blogging and micro blogging became popular in the early 21st century. *Twitter,* a micro blogging service that takes advantage of the Internet, was created in 2006 by a group working at Odeo, Inc. (Sagolla, 2009). The group created *Twitter* while attempting to develop a technique of communicating short text messages by mobile phone. The messages, or *tweets*, consist of 140 characters. By March 2011, Twitter registered 175 million users, equivalent with the seventh most populous nation in the world (Kessler, 2011).

Locke (2004) established that there is a vivid relationship between ICT and the growth of small business, the nature of this relationship, and how it is affected when considering other factors found to have significant impact upon the ICT-growth

relationship needs further investigation. It was found that high levels of internet adoption coupled with moderate adoption of cellular phones were encouraged by small scale business in New Zealand in order to promote growth in profit margins (Locke 2004). However, the extent to which small and medium enterprises are taking advantage of ICTs demands further investigation. Zambian SMEs can emulate the strides undertaken by SMEs in New Zealand to establish new trends of ICT adoption in Zambia despite the different economic environments prevailing in the two countries.

2.8 Impact of ICTs on Developing Countries

Research reveal that firms that use ICTs in Tanzania tend to be more innovative, though further investigation is required to ascertain whether the extra time recovered through this innovation is used on productive tasks in the firm or on employeesô personal activities(Diyamett, Makundi and Mwantimwa, 2012). It was also made clear that older firms are more innovative with the use of ICTs than newly established ones. The study also indicated that high cost and low ICT skills are the main encumbrance facing SMEs in utilizing ICTs (Diyamett, Makundi and Mwantimwa, 2012). However, the sample size of 102 firms was not representative enough to give the general overview of the Tanzanian manufacturing firms. Further studies covering wider sample sizes survey is needed on similar theme. Further investigations such as measurement of value addition and other benefits acquired from the use of ICTs are necessary.

In Tunisia, research reveals that there is a corresponding increase in productivity and growth on every investment made in information and communication technology. The research results indicate that there are significant technical inefficiencies which

can be eliminated by adopting existing technology. With full adoption of technology the Tunisian manufacturing firms could increase their production by about 30% through efficient use of their existing resources (Mouelhi, 2008, p.7). The results from this research were in accordance with the foreseen expectations on the impact of ICT use on efficiency. It was found that firms that have greater use of ICTs are on average 5% more efficient than those that do not. The study also showed that a combined use of ICT and human resource yields greater return on firm efficiency unlike adopting ICTs alone. The results also revealed a substantial and positive exporting rate and technical efficiency. Efficiency in firms with high foreign human capital participation is more compared to firms with low human capital participation. Taking part in export markets and developing business partnerships with foreign firms brings a firm into contact with international best practices and enhance learning and efficiency growth (Mouelhi, 2008). Nevertheless, the study suffered from lack of ICT adoption and usage data. At the firm level the available data on ICT use were rough estimates in Tunisiaôs manufacturing sector. New indicators on up-and-coming technologies need to be devised to meet new userôs needs. A survey on the use of ICTs by enterprises needs to be conducted.

In Oman, Middle East research has provided an insight into the barriers for the adoption of ICT (Ashraf and Murtaza 2008, p135). It was noted that ICT usage within SMEs in Oman is moderate in common technologies though limited in more complicated technologies such as wireless, data storage and network security solutions. It was realised that Omani SMEs were taking an all-inclusive approach to ICT investment focusing on both strategic and operational aspects of business. From the results it was seen that ICT investment in Oman is mainly driven by the need to

provide better and faster customer service to remain market leaders and following top management strategy (Ashraf and Murtaza 2008, p.135).

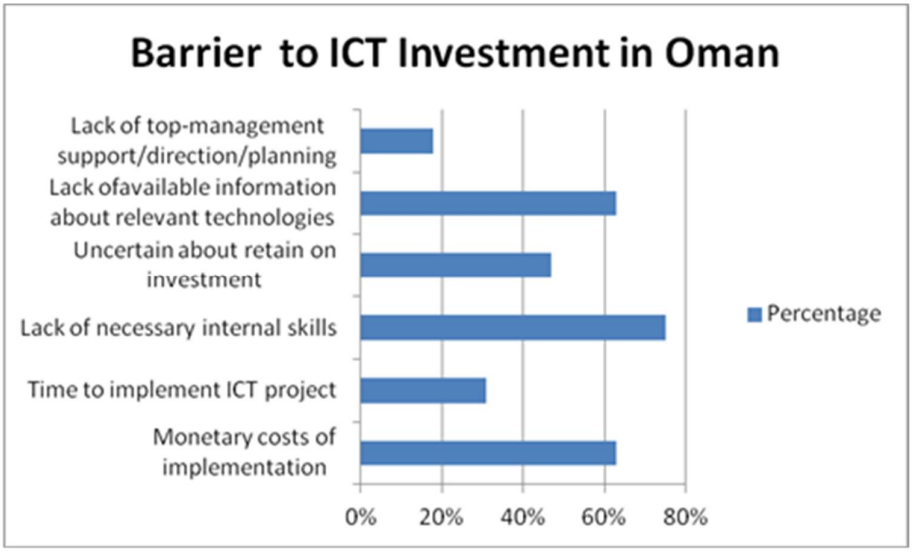

Figure 3: Barrier to ICT Investment in Oman

(Source: AshrafiAndMurtaza, 2008)

The figure above shows that 75% of the firms in Oman feel that a lack of necessary internal skills is a major barrier to ICT investment. About 63 % felt that the monetary cost of ICT solutions and implementation are too high (Ashraf and Murtaza 2008). About 47% are uncertain about retaining their ICT investment. Among the respondents, 31% feel they simply have no time to implement the projects (Ashraf and Murtaza, 2008). Of the respondents, 18% of the managers feel there is not enough support from the top management in the firms. Other factors include: government regulations and requirements (6%), and bad experiences in the past (8%) (Ashraf and Murtaza, 2008). In Malaysia, research reveals relatively low investment of ICT in SMEs. Businesses were reluctant to adopt ICTs due to lack of government support as it was seen to be the most vital factor which could influence the adoption of ICT by an organization (Alam and Ahsan 2007). The level of ICT

skills and knowledge among managers in an organization was another factor most organization considered before adopting ICTs. The research revealed that SMEs should develop strong capabilities by adopting suitable technologies in-terms of ICT services in order to become competitive against multinational companies and become market leaders. To achieve this goal, managers needed to become more receptive to the idea of adopting the internet (Alam and Ahsan 2007).

According to the United Nations Education, Scientific and culture (UNESCO) potential barriers of ICT adoption in Zambia include lack of coordination and insufficient communication; Despite Zambia having the ICT policies, policy implementation plans and supporting regulatory instruments in place, the policies still need finalization and approval in some instances. Lack of coordination and insufficient communication are major hindrances. Even though the Vision 2030, the Fifth National Development Plan (2004), and the National ICT Policy (2007) all provide for the necessary policy guidance on provision of ICTs and establishment of an information society and economy, it seems there is no productive inter-ministerial and inter-agency engagement to facilitate inter-sectoral policies and strategies to guide policy execution by various ministries, government agencies and civil society. Building the capacities of the leadership is necessary to facilitate internal-dialogue as well as monitoring of activities to ensure the agencies are working towards achievement of set goals.

Lack of capacities; the National Technology Business Centre (NTBC) is a Zambia government agency that supports the commercialization and transfer of technology. The NTBC has a documentation centre, whose relevance to science and technology is limited by inadequate research and documentation skills among Zambians. The centre provides an opportunity for information sharing, which is currently

underutilised due to lack of skill. It was noted with dismay that the levels of information literacy in Zambia are extremely low.

Poor ICT infrastructure; according to UNESCO only one in 400 people have a personal computer or laptop; and only one in 100 have access to a telephone. There is high mobile telephone access, on the other hand, the computer and internet access and utilisation is very low. Such statistics indicate that the country faces serious constraints in bridging the digital divide, establishing an information society and developing a knowledge-based economy.

The government envisions a Zambia changed into information and knowledge based society and economy, backed by unswerving development and all-encompassing access to ICT by all citizens by the year 2030 (UNESCO). The Zambia National ICT policy launched in 2007 portrays a vision where information and communication technology will contribute to national objectives for providing innovative and productive education and training that is accessible to all citizens as a significant pre-requisite to knowledge-based development.

ICT in the Zambia National Policy and the implementation plan views ICT as a vital instrument for achieving the United Nationsô Millennium Development Goals in Zambia. As a result of improved Internet connectivity via international submarine cables and national fibre networks, Zambia is experiencing substantial growth in virtual access capacity. According to (UNESCO), ñZambiaôs three public universities have placed proposals before government for the installation of improvements to Internet access and connectivity between local and regional universitiesò. Despite this initiative there is need for more investment in ñlast mileò connections to every home and business in a given area with the national fibre backbone so that as many organisations and individuals as possible can have virtual

access capacity. A huge chunk of Zambiaôs geographical region remains isolated from the national fibre backbone. This is a task which the Zambia Information and Communication and Technology Authority (ZICTA), parastatals and many other private companies should undertake going forward: ensuring that the remotes parts of the country get connected to the national grid. ZICTA has already embarked on a country wide project of installing communication towers in the remote areas of the country where the private companies and other players in the telecommunication sector havenôt seen the economic sense or viability of doing business in such places. The idea is to lease this infrastructure to whosoever intends to provide mobile services to the local communities in these areas.

CHAPTER 3: DATA COLLECTION AND ANALYSIS

3.1 Research Instrument

A survey instrument was formulated to obtain feedback from manufacturing and business firms in Zambia, assessing their awareness and adoption of ICT in their business. As such, a questionnaire was designed to help answer the research questions. This study was exploratory in nature, hence, a cross sectional approach was undertaken to measure firmsô responses regarding adoption of ICT. Cross-sectional-data is the type of observational study that is based on the analysis of data gathered from a sizeable population, or a representative sample, at one specific point in time.

3.2 Population and Sampling

The population of this study comprised selected manufacturing and business firms in five provinces of Zambia. Data was gathered based on email and personal administered questionnaire online powered by Google Forms. A total number of 70 questionnaires were sent to randomly selected organisations from eight strata categorised using stratified random sampling method. The respondents for this study were targeted to be the owner and or manager of the organisations because they always had the chance to deal with ICTs in their working position.

3.3 Data Analysis

Data was analysed so as to enable the researcher detect consistent patterns with the data collected. Quantitative data was analysed using descriptive and inferential methods. The Statistical Package for Social Sciences (SPSS) was used to create tables, graphs and charts as well as conduct regression and factor analysis. Content

analysis involving the interpretation of views and perceptions was used to analyse qualitative data.

3.3.1 Regression analysis

The relationship between independent variables and dependent variables was analysed using multiple linear regression analysis following the guidelines established by Hair et al. (1998) cited in Alam & Noor (2009). The purpose of regression analysis is to relate a dependent variable to a set of independent variables. The causal relationship between factors and organisationôs overall ICT adoption is illustrated by employing the following structural equation modelling technique.

$$\text{ICT Adoption rate} = C + A\,\text{cost} + B\,\text{QoS} + C\,\text{efficiency} + D\,\text{competitive advantage} \quad (1)$$

The predictor variables are cost reduction, quality of service improvement, improved efficiency and increased competitive advantage. The coefficients A, B, C and D were determined together with the constant using the Statistical Package for the Social Sciences (SPSS) Software. Each of the characteristics of innovation was measured on a five-point Likert scale in which 1 indicated ñstrongly disagreeò, 2 indicated ñmoderately disagreeò, 3 indicated ñneutralò, 4 indicated ñmoderately agreeò, and 5 indicated ñstrongly agreeò. Relative advantage as a predictor was measured by asking respondents about their perception towards ICTs whether ICTs will reduce the companyôs overall operating cost; reduce operating procedure (e.g., reduce the time to communicate across international boundaries, reduce the time to access resources information); increase the competitive advantage for the company. The regression coefficient of independent variables on ICT adoption was estimated. The overall model is significant at the 1% level. Regression analysis was also used to test the hypothesis.

3.3.2 Factor Analysis

Factor analysis is a correlational method used to find and describe the underlying factors driving data values for a large set of variables (Alam & Noor 2009). Factor analysis identifies correlation between and among variables to bind them into one underlying values e.g. in a set of variables (Var1, Var2, Var3, Var4, Var5) a correlational relational relationship can be found between Var1, Var3 and Var4. This means that these three variables may in fact be only one factor or value. Accordingly, large numbers of variables may be reduced to only several factors. Factor analysis is often referred to as data reduction. A factor analysis was conducted by Alam and Noor (2009) in order to develop factors that help in explaining the role of experience and reference group in online brand trust. In their study as suggested by Hair et al., (1995), six factors were identified for the factor analysis using the eigen value criteria that suggest extracting factors with an eigen value of greater than 1.0. In conducting the factor analysis in this research, the work of Hair et al (1995) was followed. The rotated factor matrix is displayed. The five factors identified explain the total variance. The extraction method used was principal axis factoring with Varimax rotation.

3.4 Limitations of the study

This research is not without its limitations like any other empirical studies. The sample consisted of manufacturing and business firms mainly from Lusaka and copperbelt provinces of Zambia which may limit the generalisability of the results despite these regions being the industrial hub of the country. The sample size of 70 was representative especially if you consider the central limit theorem or the law of large numbers.

One factor that limits the above analysis is that there may be a substantial time lag between ICT investments and their effects. Especially the learning effect has to be taken into account. Thus it is possible that the lack of an ICT effect may simply reflect the time lag before investments in these technologies begin to payoff. Information and communication technologies may exert their influence through product-quality improvements, improved services and especially through improved networks, which also might have external effects. Further investigations are needed to reveal the complementary factors that impact on the links between ICTs and SME performance and may provide additional impetus for investments.

CHAPTER 4: RESEARCH FINDINGS

In this particular chapter the results are presented with regard to the ICTs existing in manufacturing and business firms in Zambia, the levels of ICT usage in manufacturing and business firms in Zambia, the factors which influence the adoption and use of ICTôs by manufacturing and business firms in Zambia, the Quality of Service and efficiency levels of manufacturing and business firms in Zambia before and after Adopting ICT and establishing the role of stakeholders in the adoption and use of ICTs by manufacturing and business firms in Zambia.

Graphs were used in presenting some data that was collected. Data in graphs was also presented in percentages and frequencies. Questionnaires were used to collect data in this research. A total of 63 completed questionnaires were retrieved representing 90 % response rate.

4.1 Demographic characteristics of respondents

The demographic orientations of the respondents were as shown in figure 4. Respondents whose firms are based in Chingola equalled 3.2%, Chipata was at 1.6%, Choma 4.8%, and those who indicated copperbelt for the sake of anonymity equalled 4.8% .The highest numbers of respondents were from Lusaka at 45.1% followed by Kitwe at 12.9%. Respondent whose firms have outlets in all towns across the country was at 3.2%.

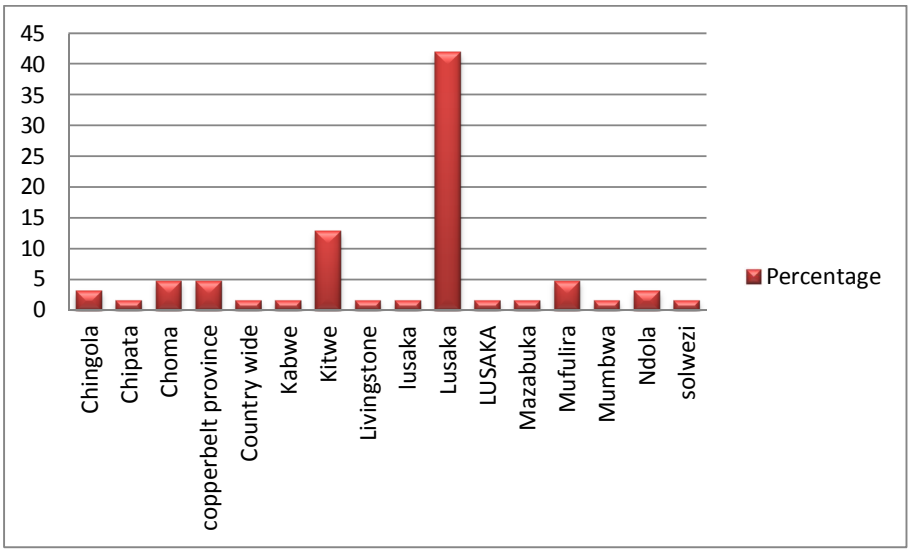

Figure 4: Location of the participating Organisations.

Among the respondents, 43.5% were in middle management, 40.3% were tactical managers while 14.5% were top managers. Their age ranged from 25 to 53 yrs. All the respondents atleast had attained tertiary education with the majority possessing barchelors degrees. The gender orientation of the respondents as depicted by figure 5 shows that 87.10% of the respondents were male while 12.90% were female.

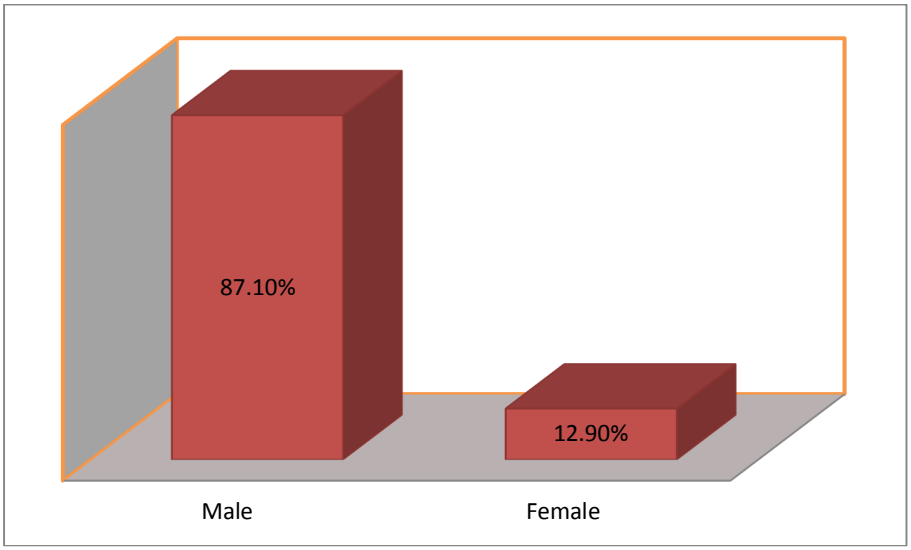

Figure 5: Gender of the Respondents

4.2 Existence of ICTs in Manufacturing and Business Firms

The respondents were asked to indicate whether some ICTs such as computers, SCADA, telephone, CAD-CAM Software, Intranet and internet were present in their organisation. Results in table 1 below reveal that 90.3% of the firms use computers, 91.9% use software, 83.9% using phones, 93.5% use internet while 62.9% use intranet.

Table 1: Availability of ICTs in Manufacturing & Business Firms

ICT facilities present	Responses		Percent of Cases (%)
	Frequency	Percent (%)	
Computer	56	21.4	90.3
Software	57	21.8	91.9
Telephone/Mobile phones	52	19.8	83.9
Internet	58	22.1	93.5
Intranet	39	14.9	62.9
Total	262	100.0	422.6

Table 2 shows the type of application software used in the production of goods and services. The availability of CAD-CAM Software among firms was at 27.1% that of manufacturing support software was at 29.2%, design software was at 60.4%, while the prevalence of SCADA Software was at 47.9% as shown in the table below.

Table 2: Software used in the production of goods & services

Software used under production	Responses		Percent of Cases (%)
	Frequency	Percent (%)	
CAD-CAM Software	13	16.5	27.1
Manufacturing Support Software	14	17.7	29.2
Design Software	29	36.7	60.4
SCADA Software	23	29.1	47.9
Total	79	100.0	164.6

Table 3 shows various software applications used for management purposes in manufacturing and business firms. The results in the table shows that availability of office application for management purposes among firms was at 86.4%, project management applications were at 42.4 %, communication software was at 44.1%, while 61% of firms make use of the Internet for management.

Table 3: Available Software for Management Purposes

Software used for Management	Responses		Percent of Cases (%)
	Frequency	Percent (%)	
Office application	51	37.0	86.4
Project Management	25	18.1	42.4
Communication	26	18.8	44.1
Internet for Management	36	26.1	61.0
Total	138	100.0	233.9

Table 4 shows Software available for growth. The table reveals that 39.3% of the cases possess sales and marketing software, 76.8% possess presentation and multimedia software while 62.5% of the cases possess websites.

Table 4: Software used for Growth

Software used for growth	Responses		Percent of Cases (%)
	Frequency	Percent (%)	
Sales and Marketing	22	22.0	39.3
Presentation and Multimedia	43	43.0	76.8
Web browser	35	35.0	62.5
Total	100	100.0	178.6

4.3 The pattern of ICT usage in manufacturing and business firms in Zambia.

Table 5 shows how ICTs are used among organisations for management purposes. It was found that 77% of the cases use ICTs for financial and administrative activities, 68.9% use ICTs for internal and external communications, 54.1% use ICTs for monitoring company progress, 62.3% use ICTs for providing support to company processes and operations.

Table 5: ICTs Used for Management Purposes

ICT usage under management	Responses		Percent of Cases (%)
	Frequency	Percent (%)	
Financial and administrative activities	47	29.4	77.0
Internal and external communications	42	26.2	68.9
Monitor company progress	33	20.6	54.1
Provide Support to company processes and operations	38	23.8	62.3
Total	160	100.0	262.3

Table 6 reveals how organisations used ICTs in the production of goods and services. It was realised that 77.8% of the cases used ICTs for process operations, 42.6% use ICTs for Feeding Operations, 40.7% use ICTs for providing support to process and feeding operations.

Table 6: ICT usage under production

ICTs usage under production	Responses		Percent of Cases (%)
	Frequency	Percent (%)	
Process operations	42	48.3	77.8
Feeding Operations	23	26.4	42.6
Support to the above process	22	25.3	40.7
Total	87	100.0	161.1

Table 7 below shows how organisations used ICTs under technical support. It was realised that 86.4% used ICTs for providing technical support to personnel; 54.2% of the cases used ICTs for training and preventive maintenance while 23.7% used ICTs for system development.

Table 7: ICT usage under technical support

ICT use under technical support	Responses		Percent of Cases (%)
	Frequency	Percent (%)	
Technical Support to Personnel: use of Computers, Networks, Peripherals & Software	51	52.6	86.4
Training and Preventive maintenance	32	33.0	54.2
Systems development	14	14.4	23.7
Total	97	100.0	164.4

Internet was used in a variety of ways among firms as depicted by table 8. The research reveals that 44.3% of the cases used the Internet to explore machinery and new technology, another 44.3% used internet to communicate to improve manufacturing, 50.8% used the Internet to research manufacturing techniques/methods, 59.0% used the Internet to do transactions with customers and suppliers, 70.5% used the Internet to communicate via email and videoconferencing, 72.1% used the Internet to exchange data electronically, 41.0% used the internet to sell and purchase electronically, 45.9% have a company web site, 32.8% used the internet to promote products and services online. 51.0% of cases used internet to provide customer service over the internet.

Table 8: How organisations use the Internet

How organisations use the internet	Responses		Percent of Cases (%)
	Frequencies	Percent (%)	
To explore machinery and new technology	27	8.8	44.3
To communicate to improve manufacturing	27	8.8	44.3
To research manufacturing techniques/methods	31	10.1	50.8
To do transactions with customers and suppliers	36	11.8	59.0
To communicate via email and videoconferencing	43	14.1	70.5
To exchange data electronically	44	14.4	72.1
To sell and purchase electronically	25	8.2	41.0
We have a webpage and web site	28	9.2	45.9
To promote our products and services over the net	20	6.5	32.8
To provide customer service over the net	25	8.2	41.0
Total	306	100.0	501.6

Figure 6 shows how the respondents described the level of ICT usage in their organisations. 14.7% described it as low, 21.3% described it as average, and 49.2% described it as high while 14.8% described it as very high

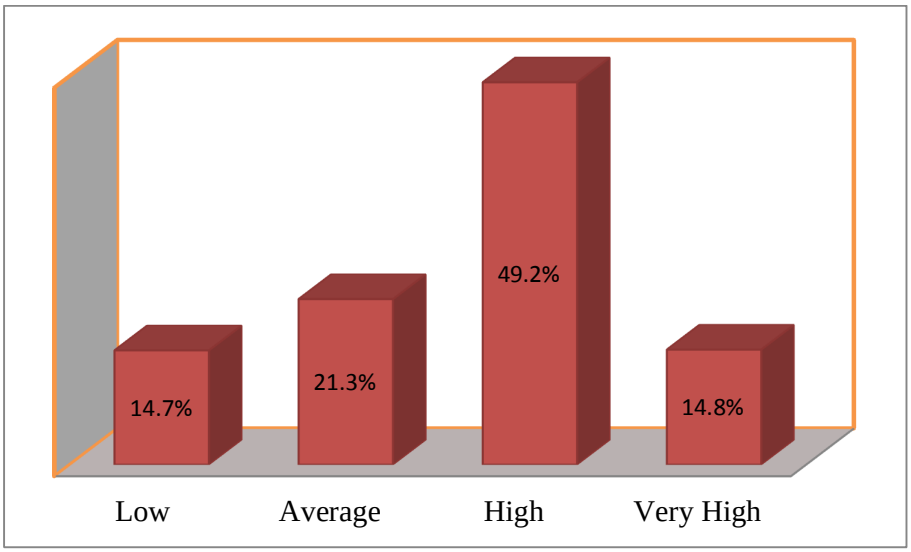

Figure 6: General ICT usage among organisations

4.4 Drivers of ICT adoption in manufacturing and business firms in Zambia.

Organisations were motivated by the following factors to adopt ICTs: 38.7% were motivated by the lure of staying ahead of competitors; 74.2% wanted to increase productivity; 90.3% wanted to increase the efficiency of their organisations; 79% of the cases wanted to improve Quality of Service; 38.7% wanted to reduce cost; 41.9% wanted to achieve flexibility in production; 16.1% wanted to eliminate errors emanating from human labor. Details are as portrayed in table 9.

Table 9: Motivating factors for adopting ICTs

Motivating factors for Adopting ICTs	Responses		Percent of Cases (%)
	Frequency	Percent (%)	
To stay ahead of competitors	24	10.2	38.7
To increase productivity	46	19.6	74.2
To increase efficiency	56	23.8	90.3
To improve Quality of Service	49	20.9	79.0
For cost reduction	24	10.2	38.7
To achieve flexibility in production	26	11.0	41.9
To eliminate human labor	10	4.3	16.1
Total	235	100.0	379.0

The following were cited as potential barriers to the adoption of ICTs among firms. Among the respondents, 75.4% of the cases cited cost of implementation, 37.7% cited lack of time to implement ICTs project, 57.4% cited lack of necessary internal skills, 44.3% uncertainty about retains on investments, 37.7% Lack of relevant technology while 59% lack of top management support/direction/ planning as barrier to ICT adoption. Details are as portrayed in table 10.

Table 10: Barriers to the adoption and use of ICTs

Barrier to ICT adoption	Responses		Percent of Cases (%)
	Frequency	Percent (%)	
Costs of implementation.	46	24.2	75.4
Time to implement ICTs project.	23	12.1	37.7
Lack of necessary internal skills	35	18.4	57.4
Uncertainty about retains on investments	27	14.2	44.3
Lack of relevant technology.	23	12.2	37.7
Lack of Top management support/direction/ planning.	36	18.9	59.0
Total	190	100.0	311.5

4.4 Productivity and Efficiency levels of Manufacturing and Business Firms in Zambia before and after Adopting ICTs.

Figure 7 below reveals how respondents described firm productivity levels before and after adopting ICTs. Before adopting ICTs, 16.1% of the respondents described productivity levels in their organisation as very low, 30.6% as low, 40.3% as average, 6.5% as high and another 6.5% as very high. After adopting ICTs the picture changed as follows: only 2.6% of the firms described productivity in their organisations as very low, 8% described it as low, 25% described it as average, and 37% described it as high while 27.4% described it as very high.

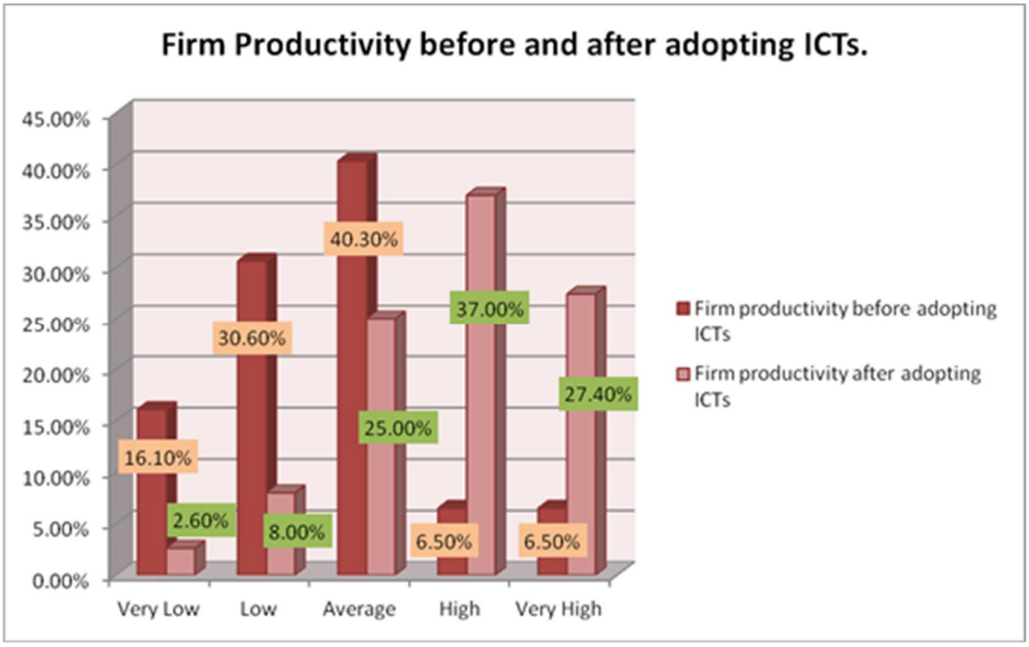

Figure 7: Firm Productivity before and after adopting ICTs

Figure 8 reveals how respondents described firm efficiencies before and after adopting ICTs. Before adopting ICTs, 12.9% of the respondents described productivity levels in their organisation as very low, 32.3% as low, 33.9% as average, 17.7% as high and another 3.2% as very high. After adopting ICTs the picture changed as follows: only 1.6% of the cases described productivity in their organisations as very low, 3.2% described it as low, 14.6% described it as Average, and 38.7% described it as high while 41.9% described it as very high.

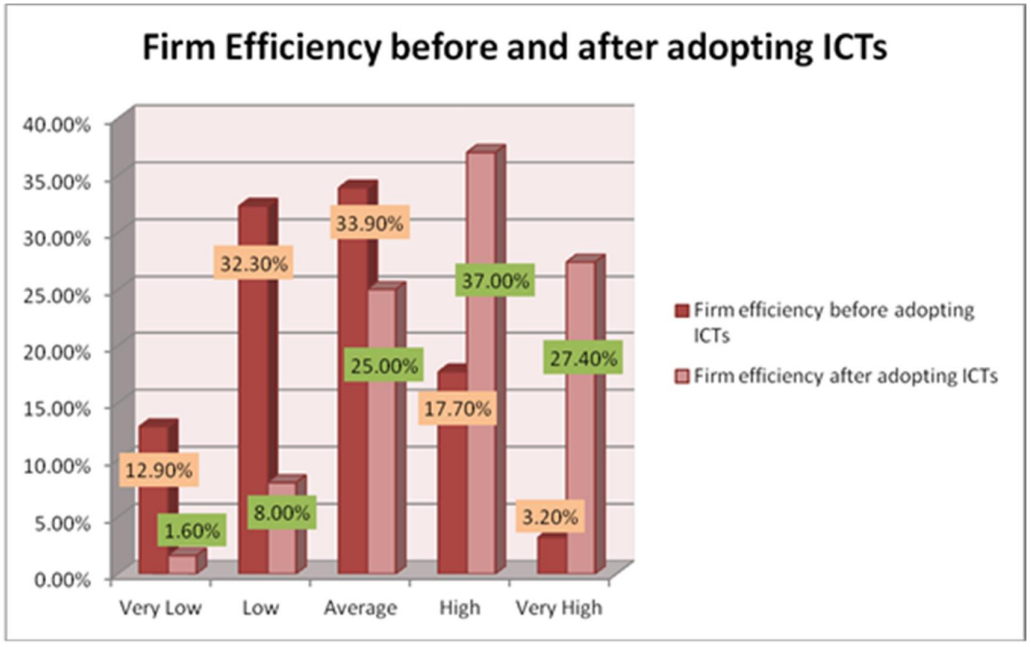

Figure 8: Firm Efficiency before and after adopting ICTs

4.5 Presence of government policy and legal framework

The respondents were also asked to find out the role of stake holders such as government in providing a favourable environment for the adoption of ICTs among firms. The feedback obtained was as follows: 53.2% of the cases indicated that there is enough policy and legal framework for ICT adoption while 46.8% of the respondents indicated otherwise as shown in figure 10 below.

4.6 Factor Analysis of the driving factors of ICT adoption

The driving factors for ICT adoption were reduced to two using SPSS software as shown in the figure 11. The first four factors load on the first component while the last factor loads on the second component. To prove that the two factors are independent of each other, a component transformation matrix was generated as depicted by table 12.The transformation matrix show that component one loads on component one significantly.

Table 11: Component Matrix

FACTORS	Component	
	1	2
Competitive advantage as driving factor of ICT adoption	0.790	0.011
Productivity as driving factor of ICT adoption	0.743	0.193
QoS as driving factor of ICT adoption	0.684	-0.357
Cost Reduction as driving factor of ICT adoption	0.648	-0.060
Increase Efficiency as a driving factor of Adopting ICT	0.141	0.936

Table 12: Component Transformation Matrix

Component	1	2
1	0.995	0.104
2	-0.104	0.995

Table 13 and 14 shows results of regression analysis from which the following linear regression (predictor) equation was derived**.**

ICT adoption =2.857-0.169 Cost + 0.206 QoS + 0.393 Competitive advantage - 2.63 Productivity **(2).**

The predictive ability of the Model is very low with a reliability of 20.4%

Table 13: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.520[a]	0.270	0.204	0.815

Multiple regression results below show that Quality of service, competitive advantage, and efficiency are significant elements of ICT adoption.

Table 14: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t
		B	Std. Error	Beta	
1	(Constant)	2.857	0.731		3.909
	Cost Reduction as driving factor of ICT adoption	- 0.169	0.114	- 0.188	-1.480
	QoS as driving factor of ICT adoption	0.206	0.151	0.178	1.359
	Competitive advantage as driving factor of ICT adoption	0.393	0.106	0.527	3.724
	Prouctivity as driving factor of ICT adoption	- 0.263	0.103	-0.352	-2.562
	Increase Efficiency as a driving factor of Adopting ICT	0.034	0.099	0.041	0.348

CHAPTER FIVE: DISCUSSION

This research can serve as a starting point for further ICT adoption research, while encouraging further exploration and integration addition adoption constructs. Future research needs to focus more and more on a larger cross section and more diversified random samples to verify the findings of the current study. Moreover, to further clarity of the factor influence on ICT adoption in the businesses, Technology Acceptance Model (TAM) and or other model could be used. In addition, future research needs to examine ICT adoption in the context of cross-national differences.

All the research questions have been addressed in this chapter. The results of the study collected were interpreted in reference to the relevant literature and principal data sources such as questionnaires.

5.2 Existence of ICTs in Manufacturing and Business Firms

The presence of ICTs in manufacturing and business firms was investigated by identifying the common ICTs available in the conduct of any business. The survey instrument was designed to capture data in these lines. The results indicate that the use of internet among organisations was as high as 93.5%. Organisations use internet for communication and networking with other partners which is a key ingredient to achieving organisation growth. The presence of other common ICTs such as software was at 91.9%, computers were at 90.3%, use, and phones were at 83.9%, while intranet was at 62.9%. This shows a positive picture as far as adoption of ICTs is concerned. It must be noted that this is a picture depicted by multinational organisations and not SMEs. The picture would be quite different for SMEs as they have difficulties in sourcing finances (Alam & Ahsan 2007). Manufacturing firms have the financial muscle to fund most of the common ICTs as can be seen from the

results of the research. The average usage of software was at 41.15 percent. 90% of the firms import software for use in their organisation. Only 10% of the respondents use self-developed software. There is over dependency on imported innovation and ingenuity among local firms. This is partly due to the fact that organisations which vastly use software and ICTs are multi nationals and they conduct research and development in other branches of their organisation outside the Zambia.

With the advancement of digital processors and communications systems, information technology, distributed computing and telecommunications have converged. And increasingly, become crucial in the operation and maintenance of modern systems (Alves et al. 2011). From Alves (2011) observation, it is expected that more and more industries will adopt and use ICTs as they will become exceedingly at the centre of all communication systems. SCADA systems are widely used in power system and manufacturing industries for process control and remote data acquisition. The results also show that organisations not only use software for the production of goods and services but also for managing as well as attaining growth for their organisations. It was realised that office application was the most common application used under management with a usage level as high as 86.4%.

Marketing departments were leading consumers of presentation and multi-media software with a use level of 76.8%. At the same time as many as 62.5% of the cases had web browsers installed on their computers for accessing the internet.

5.3 The levels of ICT use in manufacturing and business firms in Zambia.

Fabiani (2005) argues that ICTs have stronger productivity impact in information-intensive industries relative traditional low-tech sectors however this research shows that there is a significant usage of ICTs Financial and administrative activities

(77%).The research shows that wherever there is information processing ICT facilities are handy.

It is a goal of every manufacturing organization to avoid redundancy, errors and inefficiency in handling production processes. The results are in line with expectation when a figure as high as 77% of the cases use ICTs for process operations. This helps manufacturing firms to beat deadlines and meet consumer demand with ease. Fabiani (2005) also argues the adoption of ICTs for production of goods and service depends on the firm size, this was affirmed by the research findings. The larger the firm size the greater the adoption of ICTs.

In order to attain growth, firms are encouraged to adopt more of the internet than any other form of ICT (Locke & Zealand 2004). The research shows wide usage of ICTs among firms. Manufacturing firms continuously strive to discover new methods of operation, search for new equipment, and constantly communicate with suppliers and consumers across borders, market products online all these activities can be done on the internet. The Zambian industry has taken advantage of the internet to maximize their visibility to clients over massive geographic areas and as means of information acquisitions and transactions as seen from the research results. Now that the number of ISP providers is increasing, firms and individuals can access the internet on the mobile phones, tablets and on computers. Sadly, the level of ICTs usage for system development was as low as 23.7%. This shows how low the level of innovation and ingenuity among the Zambian firms. System development is cardinal for custom made facilities which befit the local business. Considering, the fact that Zambia is still a developing country the current ICT usage among firms is encouraging with 49.2% of the respondents describing it as high.

5.4 Factors which influence the adoption and use of ICT's by manufacturing and business firms in Zambia.

Just like Henry Ford revolutionalised the automobile industry through automation to achieve high levels of efficiency and productivity, 90.3% of the cases were motivated by the lure of achieving high efficiency followed by lure of achieving high quality of service and productivity levels at 79 and 74.2 percent respectively. Other factors such as cost reduction, production flexibility, competitive advantage and eliminating human errors were all below the 50 percent mark. This is against the notion that the opportunity to gain competitive advantage is a huge driver of ICT adoption by organisations wanting to exert market power (Bayo-Mariones and Lera-Lopez, 2007).

According to Arendt (2007) the common barrier to ICT adoption is the lack of financial resources to implement ICT project. This was found to be the case in this research considering that 75.4% of the cases cited cost of implementation as the barrier to ICT adoption. Unlike, Arendtôs (2007) research which showed lack internal knowledge and skills as second common barrier to ICT, this research revealed that ñlack of top management supportò was the second common barrier to ICT adoption cited by 59% cases of the respondents. Lack of necessary skills and knowledge was at 57.4% which is inconsistent with the findings of Ashrafi & Murtaza (2008) whose study ranked ñlack of necessary skillsò as a top impeding factor to ICT adoption. Forty Four (44.3%) of the cases were worried about retains on investment while 37.7% were deterred by lack of relevant technology in the market.

5.5 Productivity and efficiency levels of manufacturing and business firms in Zambia before and after Adopting ICTs.

It was worth noting that firms realised the anticipated benefits from the adoption and use of ICTs. Respondents with very low productivity reduced by 13.5%,those with low productivity reduced by 22.6% ,those with average productivity reduced by 15.3% while those with high productivity increased by 30.5% and those with very productivity levels increased by 20.9% after adopting ICTs.

In terms of efficiency levels, the benefits were equally evident. There was remarkable reduction of the cases with very low efficiency levels of 11.3%, those with low efficiency levels reduced by 29.1%, those with average efficiency levels reduced by 19.3% after adopting ICTs. The cases of high levels of efficiency increased by 21% while that of very high efficiency increased by 38.7%. The results were consistent with the findings of other studies e.g. (Ashrafi & Murtaza 2008) who found that over 50% of the firms in Oman realised reduced cost, improved revenue and better customer relationship due to the adoption and use of ICTs.

5.6 The role of Stake holders in the adoption and use of ICTs by manufacturing and business firms in Zambia

The respondents were asked to state what roles stake holders are playing and should play to stimulate ICT adoption among firm. As many 56.7% indicated that there was enough ICT policy and legal framework in Zambia. On the contrary, 43.3% indicated otherwise. The literature reviewed show that much work has been done by the government to create an enabling environment for continued adoption and use of ICTs in Zambia. One notable issue raised by the respondents was the need for policy that is centred on reducing the overall cost of ICTs to stimulated maximum adoption among SMEs either by reducing or eliminating import duty of ICT related items. It

was equally noted that there is little sensitisation on the existing policies and the enforcers are, hence, a few firms are taking advantage of the existing policies. There were also calls to review ICT regulations with the involvement of all stakeholders.

The findings of this research may have implications for IT consultants, vendors and government wings responsible for ICT adoption and use. In addition, policy makers will be better positioned to devise policies that facilitate the adoption and effective usage of ICTs based on this information. ICT specialists will better understand the ICT needs of other sectors of the economy and better address these specific needs. Business experts in the manufacturing sector will have a better understanding and appreciation of the benefits of ICT adoption and usage. Managers in various manufacturing industries can be made aware of the requirements and the factors that can promote or hinder the adoption and use of ICTs enabling them to develop proper information systems which are expected to promote productivity and efficiency in the production chain of goods and services. Moreover, the results from this research will add new information to the body knowledge and also motivate people to investigate any knowledge gaps existing in this field of study.

This research is very important because it establishes any positive relationship between ICT and the performance of companies in the manufacturing industry in Zambia. It will equally help establish if ICT only has a greater influence on productivity and efficiency in manufacturing companies.

ICTs are necessary tools in handling information for organisations not only in production of goods and services but also in the management and growth of firms. The picture may look good among multinationals but may not be the case among SMEs. It is therefore imperative for government to take more initiative in making ICTs accessible to all by passing significant duty exemption on all ICT facilities.

ICT regulators should continuously engage stakeholders to help address the challenges innovators and consumers face in the adoption and use of ICTs.

CHAPTER 6: CONCLUSION AND RECOMMENDATION

6.1 Conclusion

This chapter concludes the study and also makes recommendations based on the major findings of the research. The research findings showed that there are significant levels of ICT adoption among manufacturing and business firms in Zambia. The higher the benefits in form of productivity and efficiency levels the more incentive there was for firms to adopt and invest in ICTs. The study revealed there was high level of utilisation of low cost ICTs such as computers, internet, intranet, phones and office applications compared to expensive high-tech software such as SCADA and CAD-CAM software. It was also realised that information processing intensive firms adopted and used more ICTs than others. The convergence of information technology, distributed computing and telecommunications has also contributed to the wide adoption and usage of ICTs among firms in Zambia.

From the research findings, it was established that ICTs have wide application not only in the production of goods and services but also in management and growth of organisations. ICTs found wide application in process operations, feeding operations Financial and administrative activities, internal and external communications, monitoring company progress and providing Support to company processes and operations. Overall ICT usage was deemed to be high in as many as 49.2% of the cases, while 14.8% of the cases had very high usage of ICTs.

It was found that firms were motivated by perceived benefits of adopting ICTs such as competitive advantage, Increased productivity and efficiency, Improved quality of service, cost reduction, achieving production flexibility and elimination human

errors in production chain to adopt and use ICTs. Using factor analysis it was found that these factors can be reduced to two components with the majority loading onto the first component. The research established that there is a significant relationship between perceived benefits and ICT adoption and use as seen from the regression analysis.

However, it was also established that there are a number of factors which hinder the adoption and usage of ICTs. These include: cost of implementation; Lack of time to implement ICTs project; Lack of necessary internal skills; Uncertainty about retains on investments; Lack of relevant technology and Lack of Top management support/direction/ planning as barrier to ICT adoption.

With regard to productivity and efficiency levels, it was found that after adopting ICTs firmôs recorded high productivity and efficiency levels. And the more benefits firms accrued the more motivation they had to adopt and use ICTs.

In terms of sensitization of the public on the availability of ICT policy and Legal framework, it was discovered that there is a lot of work to be done as 43.3% of the respondents were still ignorant of the existence of ICT policy in Zambia. It was also realised that entrepreneurs and innovators are not taking advantage of the business opportunity ICT possess, to create ICT related products. In addition, ICTs help communication gaps between suppliers since users and suppliers can communicate more easily through electronic mail and websites when sourcing raw materials (Kajogbola 2004). As a capital good ICT contributes to overall capital deepening of a firm consequently provides productive equipment and software to businesses which in due course improves labor productivity (Mouelhi 2009).Wide use of ICT increase the overall efficiency of a firm which in turn raises Multiple Factor

Productivity (MFP) which measures the changes in output against every unit of combined inputs. Adoption and usage of ICTs in firms result in *inter alia* savings of inputs, general cost reduction, higher flexibility and improvement in production quality (Arvantis, 2004).

This changes the way society interacts, learn and access medical care through e-health, e-commerce, e-governance and e-education. E-Health is healthcare practice enabled by electronic processes and communication. The same principle applies to Ecommerce, Egovernance and E-education.

6.2 Recommendations

There is need for awareness activities to sensitize the industry on the benefits of using ICTs. As revealed by the research, there is lack of top management support in many organisations with regard to the adoption of ICTs. This picture may change once top executives realise the benefits firms will accrue once they adopt and use ICTs. It was found that Management ICTs were more common than high tech ICTs because many top executives use these facilities for management purpose. It is assumed the adoption of high industrial ICTs will increase with an increase in awareness of the perceived benefits of using ICTs. There should be more investment by firms in ICTs that are relevant to their area of expertise. System development using ICT solutions can be an added stream of revenue if properly explored. Software and other related ICT facilities developed can generate huge sums of revenue once developed for export. This can help fend-off competition from multinational companies from other countries and help diversify their businesses. In addition, there is need for innovators to assure firms on the certainty about retain on investment in ICTs. It is evident from the results that a certain number of firms were discouraged from adopting ICTs due to uncertainty about retains on investment. It is

evident from the research findings that wherever ICTs where used positive benefits were accrued. Innovators should do more to advertise and sell the benefits that come with the adoption and use of ICTs.

The Internet is proving to be a crucial source of information. There is a variety of ways in which firms are using the internet in an attempt to disseminate and receive information. The use of smart phones in accessing internet is one area which can broaden internet access. ICT regulators should allow more players in the mobile telecommunication sector to benefit consumers in terms of cost of accessing mobile internet. Security and integrity of information should safe guarded by the use of restricted access level password on all office computers and mobile phones.

For firms to survive and grow their business in the global market there is need to adopt new ways of producing goods and services. ICTs offer that solution. The versatility of ICTs offer many organization that sort for flexibility in the production chain. Firms must adopt ICTs to achieve and maintain high levels of productivity, efficiency, precision and accuracy in the production of goods and services. The adoption and use of ICTs can further be accelerated by providing adequate pre-training to employees on how to use ICT systems in firms at all levels. Management should ensure this is done so that employees get comfortable using ICT facilities.

6.3 Future Works

This research focussed on the positive impact of ICTs in manufacturing and business firms in Zambia. Future works should focus on the negative impact of ICT adoption with respect to the environment.

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APPENDIX A

Questionnaire No……..

Dear Respondent,

My name is Daka Philemon; I am a student at The University of Zambia pursuing a Master's degree of Engineering in ICT policy, regulation and management. I am conducting this research which is aimed at investigating the impact of ICTs in manufacturing and business firms in Zambia. You have been randomly selected to participate in this research. The responses that you will provide will be kept confidential and will only be used within the confines of this research. To maintain anonymity do not put your name or any information that may identify you. I would be very grateful if you can kindly provide your honest opinion to the questions below. This research is a partial fulfilment for the award of Master of Engineering in Information & Communication Technology at The University of Zambia. Please note that this research is purely for academic purpose. Write or tick appropriate responses in the spaces/box provided at the end of each question. Thanks in anticipation.

BACK GROUND INFORMATION

1. Genderé é é é é é é é é é é é ..

2. Job titleé é é é é é é é é é é é .

3. Academic Qualificationé é é é é é

4. Ageé é é é é é é é é é é é é é

5. Approximate size of company?

Below 100

Between 100-300

Above 300 ☐

6. Location of organisationé é é é é é é é é é é é é .

7. Category of the organization/company.

Manufacturing ☐

Food/Material Processing ☐

Telecommunication ☐

Media ☐

Transport ☐

Other ☐

INFORMATION ON THE EXISTENCE OF ICTs AMONG FIRMS

8. What kind of ICTs do you have in your organisation?

Computers ☐

Software ☐

Telephones/Mobile phones ☐

Internet ☐

Intranet ☐

Other: ☐

MOTIVATING FACTORS FOR ADOPTING ICTs AMONG FIRMS

9. What are the motivation factors for adopting and using ICTs in your organisation?

To stay ahead of competitors ☐

To increase productivity ☐

To increase efficiency ☐

To improve Quality of Service ☐

For cost reduction ☐

To achieve flexibility in production ☐

To eliminate human labour

Other

INFORMATION ON THE EXISTING ICT USAGE AMONG FIRMS

10. How would you rate ICT usage in your organisation?

Very High

High

Average

Low

Very Low

11. What do you use ICTs for under production?

Process operations

Feeding Operations

Support to the above process

Other:

12. What do you use ICTs for under Management?

Financial and administrative activities

Internal and external communications

Monitor company progress

Provide Support to company processes and operations

Other:

13. What are your current ICT uses for growth of your organisation?

Strategic planning

Expand market share and venture into exporting

Other:

14. What are your current ICT uses under technical support?

Technical Support to Personnel: use of Computers, Networks, Peripherals & Software	
Training and Preventive maintenance	
Systems development	
Other:	

CRITERIA FOR ADOPTING ICTs AMONG FIRMS

15. Do you have a strategic plan for using/expanding ICT use or positions?

Yes	
No	

18. If your answer to the previous question is Yes / No please explain why?

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19. How often do you replace existing technology in your organisation?

When new technology emerges	
When the existing technology is obsolete	
When competitors adopt new technology	
Market forces	
Other: specifyé é é é é é ..é é é é é é é é é é é ...	

INFORMATION ON THE USE OF SOFTWARE AMONG FIRMS

20. What kind of software is your organisation using for production of goods and services?

Manufacturing	
CAD-CAM	
Manufacturing Support	
Design	

SCADA

Other: specifyé é é é é é é é é é é é é é é é é .

21. What kind of software is your organisation using for management purposes?

Office application

Project Management

Communication

Internet

Other: specifyé é é é é é é é é é é é é é é é é .

22. What kind of software is your organisation using for growth?

Sales and Marketing

Presentation and Multimedia

Web browser

Other: specifyé é é é é é é é é é é é é é é é é

RATING OF FIRMS' PERFORMANCE BEFORE & AFTER ADOPTING ICTs

23. How do you rate the performance of your organisation before adopting technology in terms of the following?

	Very High	High	Average	Low	Very Low
Cost reduction					
Efficiency					
Product quality					
Competitive advantage					

24. Which of the following do you consider as the barrier to the adoption and usage
. of ICTs in your organisation?

Costs of implementation.

Time to implement ICTs project.

Lack of necessary internal skills	
Uncertainty about retains on investments	
Lack of relevant technology.	
Lack of Top management support/direction/ planning.	
Other: specifyé é é é é é é é é é é é é é é .	

25. How do you rate "lack of necessary internal skills" as a barrier to the adoption and use of ICTs in your organisation?

Very High	
High	
Average	
Low	
Very Low	

26. Does your organisation take interest in offering specialised training to its employees in an effort to foster ICT adoption and usage?

Yes	
No	

FACTORS THAT DRIVE THE ADOPTION & USAGE OF ICTs BY FIRMS

27. How do you rate the following as driving factors of ICT adoption in your company?

	Very High	High	Moderately	Low	Low Very
Cost Reduction					
Quality of Service					
Competitive advantage					
Productivity					

Efficiency					

DISADVANTAGES OF A DOPTING & USING ICTs AMONG FIRMS

28. Are there any disadvantages of using ICTs in your organisation?

Yes	
No	

29. Explain your answer to the preceding question

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INFORMATION ON THE CURRENT USAGE OF INTERNETAMONG FIRMS

30. Indicate how you use, or should use Internet in your Organisation?

To explore machinery and new technology	
To communicate to improve manufacturing	
To research manufacturing techniques/methods	
To do transactions with customers and suppliers	
To do transactions with customers and suppliers	
To communicate via email and videoconferencing	
To exchange data electronically	
To sell and purchase electronically	
We have a webpage and web site	
To promote our products and services over the net	
To provide customer service over the net	
Other:	

31. Is there enough government policy and legal framework to stimulate ICT adoption among firms in Zambia?

Yes

No

32. What do you think the government should do or should have done to stimulate , ICT adoption among firms?

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THANK YOU FOR SPARING YOUR TIME TO ANSWER THIS QUESTIONNAIR