AN ANALYSIS OF MOBILE INFORMATION AND COMMUNICATIONS TECHNOLOGIES IN TELECOM NAMIBIA: AN INTEGRATION ARCHITECTURE

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION IN MANAGEMENT STRATEGY AT THE UNIVERSITY OF NAMIBIA

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. I, Valerie Garises, declare hereby that this study is a true reflection of my own research, and that this work, or part thereof has not been submitted for a degree in any other institution of higher education.

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DEDICATION

I dedicated this study to my parents, Mr. & Mrs. Makupu, and my children, Vaughn, Carmen, Bertha and Mary-Ann, for the sacrifices you made during the many hours in my absence from home while I undertook this research. I love you and thank you.

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I thank God Almighty, my Strength and my Fortress, for having given me the mental strength and belief to complete this research. He deserves all the Glory! I also wish to express my gratitude and regards to a number of people for the support and assistance they have given me during my study.

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My deepest gratitude and a special word of appreciation goes to my friends, family and children for their prayers, love, understanding and moral support before and throughout this study.

ABSTRACT

The purpose of this study is to analyze Mobile Information Communications Technologies (M-ICT) usage and recommend an integration architecture to Telecom Namibia (TN). The major problem of the research was the current usage of mobile technologies and the benefits of integration M-ICT in TN. The specific objectives are to assess the risk posed by the usage of mobile technologies to TN and to recommend suitable integration architecture for M-ICT in TN.

The study is a quantitative research which investigates the current usage levels and possible use cases of M-ICT by TN employees. The positivist research strategy was used for the quantitative non-experimental research survey that includes the gathering and analysis of quantitative data for the study. The data received from respondents was captured in Survey Tracker software, extracted in .SAV file format and imported into SPSS for further analysis. The responses to all items was classified and tabulated in different categories using the IBM SPSS 20 software. The coded data was analyzed by means of One-Way Anova at significance level of .05 in order to determine the relationship of the variables. Significant variables to the study were identified and interpreted accordingly and where possible linked to literature review to gain a full understanding from both primary research data and secondary research.

The finding of the study showed that there is a high risk of sensitive information leaking from the company due to corporate data being accessed from mobile device. It is

recommended that the company integrates M-ICT using the secure Enterprise Mobility Architecture to control data accessed through the mobile devices.

ACRONYMS

AMICT-TN	Analysis of Mobile Information Communication Technology in Telecom Namibia
APPS	Applications
BYOD	Bring Your Own Device
CRM	Customer Relationship Management
EM	Enterprise Mobility
ERP	Enterprise Resource Planning
EAI	Enterprise Application Integration
ICT	Information Communication Technology
IDE	Integrated Development Environment
IKE	Internet Key Exchange
IPsec	Internet Protocol Security
IT	Information Technology
M-ICT	Mobile Information and Communication Technologies
MEAP	Mobile Enterprise Application Platform
MAM	Mobile Application Management
MDM	Mobile Device Management
NPTH	Namibia Post and Telecom Holdings
OS	Operating System
PKI	Public Key Infrastructure
PWC	PricewaterhouseCoopers

SAP	Systems, Applications and Products
SPSS	Statistical Product and Service Solutions
SSL	Secure Sockets Layer
TN	Telecom Namibia
VPN	Virtual Private Network

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CHAPTER ONE

INTRODUCTION

1.1 Orientation of the study

The chapter introduces the research by providing an overview of the study, research problems, research aim, research objectives, limitations and significance of the study. It concludes with an outline of thesis.

With the consumerisation of Information Technology (IT) enterprise, employees are increasingly on the move. They rely on the ability to work anytime, from anywhere and have access to corporate information without apprehensions for potential compliance, security and cost implications. According to Basole (2008), proliferation of mobile devices and applications has led to a new paradigm in the way people work, communicate, collaborate and conduct business. In view of Basole, this wave presented businesses of all shapes and sizes with challenges as well as opportunities. This trend is also experienced in Telecom Namibia's customers, employees, and partner engagement. It compels the enterprise adoption of Mobile Information and Communication Technologies (M-ICT) such as laptops, tablets, smart phones and other handheld devices in Telecom Namibia (TN).

Furthermore, Basole (2008) stated that the integration of M-ICT to access enterprise information is often called as Enterprise Mobility (EM). He added that EM enables mobile

enterprise users access to information anytime from anywhere through the use of M-ICT. On the other hand, he said that mobile enterprise is a general term for the companies which decided to use wireless mobile device in order to support critical business functions and provide access to business applications to employees. He stated that in a mobile enterprise employees use mobile devices for work purposes such as checking email, project status, documents, meeting schedule, accounting and to-do lists, etc. These examples are the most common uses with working purpose that an employee might use any or all of them but there are many other mobile applications that a company might develop and let their employee work with. Similarly, TN can benefit from embracing EM through employee enablement to access business applications from anywhere, at any time and from any device.

Nevertheless, Mason (2013) stated each enterprise might have different key drivers of using enterprise mobile applications that might be unique and depends on the nature of their business. They added that across all industries, organisations are working to utilise mobile applications to drive productivity gains, sales performance, reduce costs, customer and employee satisfaction. Moreover, TN can facilitate the acceleration of business processes using EM and provide more flexibility to workflows, improving response time, communication, collaboration and reducing operational costs. Therefore, Analysis of Mobile Information Communication Technology in Telecom Namibia (AMICT-TN) determines these benefits of integrating M-ICT and provides TN with a vigorous EM integration architecture to enhance their mobile communications.

In addition, Basole (2007) stated that companies realized the great benefits of mobility for their business and look at mobility from a more strategic perspective. Congruently, Albo, Chigullapali, Reddy, and Wallace (2012) added that EM offers a multitude of powerful ways that redefine real-time business process enablement and ever-increasing business value. Similarly, TN can take advantage of EM to bring tangible and intangible benefits by increasing mobility, data management and communications. In addition, the integration of M-ICT into business requires some technical changes in the Information Communication and Technology (ICT) architecture, infrastructure and support processes.

On the contrary, Basole (2008) highlighted that with these new opportunities comes a host of challenges, including device selection, applications, manageability, security and connectivity that IT professionals must address to meet user requirements and align them to the evolution of seamless mobility capabilities. In addition, he stated that there can be organizational related challenges such as organizational silos, lack of or outdated strategic plans, mismatch or lack of internal skills required to support the emerging mobility capabilities and incomplete characterization of the mobile workforce. He said that all of these elements are critical to ensuring the successful adoption and efficient delivery of mobile services. He recommended that with the multiple dynamics at play, combined with rapidly advancing technology that enables even greater efficiency and productivity, a seamless mobility strategy will be an essential part of a strategic IT plan to ensure competitive success. In view of Basole, AMICT-TN aims at creating a transformative

enterprise mobility strategy which purposefully addresses challenges of M-ICT integration in TN.

This research centers on development of EM architecture for TN and in particular the technological aspects related to the enterprise applications integration architecture of M-ICT.

1.2 Background

The TN company profile (2013) stated that the national telecommunications operator was established in August 1992 and is wholly owned by the Government of the Republic of Namibia. It is functioning as a commercialized company and as a subsidiary of its parent company, Namibia Post and Telecom Holdings (NPTH) Limited. TN is serving more than 145,360 customers, with 1,134 employees with annual revenue of more than N$1 Billion TN has presence all over the fourteen regions of Namibia. It runs the largest digital telecommunication network in Namibia and is a leading supplier of voice, text, data and video solutions. TN is a customer driven company that change telecommunication products and services to the demand of its customers Today customers want fast, reliable and advance services which is TN responsibility to deliver these services. In order to meet the customers' demands TN must equip its employees with M-ICT to serve the customer needs better (www.telecom.na). Furthermore, the growing use of mobile technologies and enterprise applications create business value when information is readily available at the fingertips of the relevant people such as sales force.

In the past TN supported and even encouraged employees to work remotely by issuing corporate laptops and mobile phones for corporate email, voice calls and enabling intranet, email and business applications access via Virtual Private Network (VPN). Today, the demand for mobile and wireless technologies in TN is pervasive thus many employees are now using consumer devices such as smartphones, tablets and laptops to support business productivity—a trend called consumerisation. TN employees are acting as a catalyst for change by using their personal devices and third-party applications for work purposes, leading to what has been labelled by experts as the "consumerisation of IT". In short, consumerisation involves the use of the same mobile device for personal and business purposes.

Historically, TN provided multiple mobile devices to employees as employee benefit but due to the high management costs of the company resolute to provide an ICT allowance instead of company funded equipment. Henceforth, the employees can choose the package that suit within their ICT allowances and buy any type of device(s) according to their preference. This phenomenon is often referred to as Bring or Buy Your Own Device (BYOD).

The BYOD programme in TN focuses on reducing costs without proper fore thought of how to manage network resources, devices, employees and how IT Department should integrate these new devices in terms of support like access and security. Furthermore, the BYOD poses challenges as well as the opportunities that were not taken into

consideration. This business problem resulted by BYOD phenomenon is presented in the next section.

1.3 Statement of Problem

The fundamental problem is TN employees own multiple mobile devices such as: laptop computers, smart phones, tablets and demand for mobility on their devices. TN employees bring their privately owned devices to work, access various mobile applications for personal and corporate use. Subsequently, the consumerisation of IT extends the reach of the company's wired and wireless information infrastructure. Therefore, the personal devices operate outside of the company IT architecture by doing so the company information also becomes more vulnerable to security breaches outside the perimeter.

Forrester (2012), reported that the top concerns for BYOD are related to security in particular device, data breach, mobile data an application security. In view of above, employee mobility increases risks of unauthorised exposure to sensitive and critical corporate data. It also creates many challenges for TN's IT Division forcing them to rethink traditional methods of providing computing services, ensuring information security and controlling the use of enterprise technologies. Furthermore, the degree and extent of risks to company is not known and can pose serious threats to corporate data on the mobile devices within TN. This situation has created dilemma for TN IT management who need to main corporate data security, while enabling more devices and functionality.

Consequently, they are under pressure to find the right balance between end-user demands, mobile platform diversity and security requirements.

In response to some of the abovementioned requirements the IT division opted for a Mobile Device Management (MDM) solution to secure, manage and control the BYOD devices and mainly to protect the corporate data on the mobile devices. According to Krishnan (2013), MDM solutions bring features like data encryption, remote data wipe to iOS and Android smartphones thus focuses only at device level. He further stated that Mobile Application Management (MAM)) arose as a popular alternative with features that allow IT to manage selected business applications deployed to mobile devices by providing deployment tools, application-level encryption, and single-sign-on. In view of PricewaterhouseCoopers (PWC), both MDM and MAM solutions focuses only management devices and applications and does not address integration of M-ICT into business. Hence, the need for Enterprise Mobility (EM) which comprised of technology solutions that can manage the increasing array of mobile devices, applications, data, secure access to enterprise infrastructure. Given this situation, the researcher has been motivated to carry out this research. Therefore, an AMICT-TN remain indispensable in this research.

1.4 Research Aim

The purpose of this study is to analyze the M-ICT usage and recommend a device agnostic enterprise application integration architecture to TN. This architecture aims to boost business and employee performance by expanding office functionality beyond the walls of TN to reap the benefits of M-ICT. Furthermore, it also aims to reduce risks of network security, intellectual property and corporate data through securing access, data transmission, application and device protection.

1.5 Research Objectives

The objectives of this study are as follows:

- To examine the current usage of mobile technologies and the benefits of integration mobile information communications in TN.
- To assess the risks posed by the usage of M-ICT to TN.
- To recommend enterprise application integration architecture for TN.

1.6 Significance of the study

AMICT-TN contributes towards a critical discussion on BYOD trend and M-ICT integration benefits and risks within the context of TN. In addition, the research will assist TN IT decision makers with a holistic EM strategy to integrate and improve M-ICT usage in TN.

Furthermore, AMICT-TN defines and proposes enterprise application integration architecture for TN that can serve as technical blueprint for EM infrastructure development. The development of EM architecture facilitates the acceleration of business processes, flexibility, responsiveness, communication, collaboration and reducing operational costs.

1.7 Limitations and Delimitations of the study

The study covered the analysis on current usage level of EM and how to integrate M-ICT to enhance the enterprise mobility strategy in TN. The study was limited to the technical aspects of enterprise application integration which can be applied to any organization. The technical areas covered are user spectrum, mobile equipment, access network, mobility infrastructure, backend systems and security. Specific technical integration aspects on the next level were not addressed as proposed architecture provides high level approach on integration areas.

Furthermore, there is limited literature and research in Namibia in this area of study and therefore the need to benchmark the study on enterprise mobility will contribute and extend the theoretical and practical understanding of EM in the Namibian context. It will further present accessible, relevant, and useful research results for the stakeholders interested in the topic of M-ICT in Namibia.

1.8 Outline of the Thesis

Chapter 1: Introduction

This chapter focuses on the discussion of the background of the study, the problem statement, the research objectives, and the significance of the study. The chapter provides an overview of the general background of the study. A chapter summary rounds off and prepares the reader for the next chapter.

Chapter 2: Literature Review

The chapter presents a literature review of EM on what other authors discussed and tackled issues related to the study. It provides a conceptual background on the topics studied and prepares the reader to the next chapter.

Chapter 3: Research Methodology

The chapter presents the approach and methodology used in the research that include the research approach, the research design, sampling, data collection, data analysis and ethical considerations. Finally, a chapter summary rounds off and prepares the reader for the next chapter.

Chapter 4: Results

Empirical results of the study are presented in this chapter. It includes the presentation of findings in both frequencies and graphic form. The validity and reliability of the results is also discussed in this chapter. It prepares the reader for the next chapter.

Chapter 5: Discussion of findings, Conclusions and Recommendations

The chapter discusses the research findings and links them with literature review where applicable. It also presents conclusions drawn from findings, reviews the research objectives provides recommendations for action and further research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

A crucial element of all research is the review of relevant literature to compare with other related studies. Hence this chapter represents review of the literature on EM and usages in M-ICT.

The literature review presents the current knowledge available that is relevant to the study aim and research questions outlined in chapter One. This chapter firstly introduces the different descriptions of EM and then discusses trends and usages of M-ICT in enterprises and the benefits of the M-ICT usage in business environment. The chapter concludes with a review of the different available integration models for EM and a summary. A collection of primary and secondary literature resources were used to obtain relevant facts and background information on different aspects of M-ICT that relates to the study.

2.2 Overview of EM

Academics and practitioners used the terms M-ICT and EM interchangeably, henceforth both terms will be used in this study in the same manner. Thus, this section looks at how others viewed EM to comprehend the M-ICT usage within business.

Kumar (2012) defined EM as a system that allows and facilitates communication within the company, regardless of the physical location. Similarly, Kornak et al. (2004) explained mobility as the application of mobile and wireless technology to enable communication, information access, and business transactions from any device, from anyone, from anywhere, at any time. In the same way, this study provides enterprise application integration architecture for TN that enables employees to access corporate resources using company provided and privately own devices irrespective of their physical at any time. Hence, AMICT-TN defines an enterprise application integration architecture that will enable TN employees to access corporate data at their fingertips and serve the customers better.

Furthermore, Basole (2007) described that EM was built on a foundation of processes and technologies allowing full access and instrumented insight to all organisational resources. He added that the results improved adaptability, access, and interaction amongst employees, customers, partners, and suppliers, independent of their location. In addition he stated that the mobile enterprise is an emerging organisational form that resulted in a paradigm shift of how business is done. Likewise, AMICT-TN consolidates mobile, application and IT infrastructure support practices within TN. In essence, the IT Department must coherently broaden its IT support processes and technology landscape to enhance employee mobility, productivity, and flexibility. In addition, AMICT-TN enables the business transformation lead by mobile applications and devices that introduce new opportunities to communicate with their customers, partners and suppliers.

Consequently, this transformation benefit TN to use the Bring-Your-Own-Device (BYOD) trend will promote new business models, reduce costs, attract and retain talent, improve productivity, collaboration, and customer experience.

Basole (2008) observed that the point-solutions, such as mobile email, dominantly on basic communication and productivity improvements. He further noted that others defined EM more broadly and strategically thus focused on strategic and large-scale enterprise wide implementations. On the contrary, AMICT-TN does not focus on point solutions but on enterprise applications integration architecture which quickly respond to the needs of the TN and its employees to ensure growth and staff retention. Hence, AMICT-TN provide a forward-thinking integration architecture that grants mobile devices access to corporate resources on broader scale that can yield game-changing advantages to TN. For example, implementation of Mobile Customer Relationship Management (M-CRM) can enable TN to create new core competencies, defined new markets, gain and sustain competitive advantages.

According to Musolesi, et al., (2004), the definition of realistic mobility models was one of the most critical and, at the same time, difficult aspects of the simulations of applications and systems designed for mobile environments. In support of them, Chakrabarti, et al (2006) described the different types of mobility namely: user mobility, device mobility, and application mobility. They further stated that EM included movement inside the campus, between local and remote campuses of an enterprise. Furthermore,

Kakihara & Sorensen (2002) demonstrated that the conventional understanding of mobility, confined to geographic aspects, does not suffice for grasping the dynamic work practices of contemporary mobile professionals. On the contrary to Chakrabarti, et al, AMICT-TN caters for employee mobility demand; flexibility and productivity thus include geographic mobility which covers buildings in same town, the different towns in regions connected. This connectivity includes access via corporate Local Area Network (LAN), Wireless Local Area Network (WLAN), 3G/4G and Virtual Private Network (VPN) from any location from any device such as laptop, smartphone, tablets, etc.

In view of Kakihara & Sorensen (2002), user mobility in this study means an employee in logs on office desktop into Systems Applications Product (SAP) and then moves to a colleague's office following by logging from laptop onto SAP server. In this case, the employee authenticates and resumes session running on the SAP server as long as the employee is in the TN server domain. Meanwhile, Kakihara & Sorensen (2002) referred to device mobility when the device connects when network is available and starting the applications or simply reconnecting to the new network. From their illustrations examples can be cited firstly by checking email at the airport before taking off, secondly turning off the computing device, and then working off-line during the flight; turning off and again reconnecting the device to the network via wireless LAN, GPRS or 3G at the destination.

Lastly, application mobility can be achieved by using virtualization such application resides on a centralized server and is streamed as a single executable file to users, who

simply click to use. In other words, the application is “run” from a device without being “installed” on it. In support of Musolesi et al. (2004), AMICT-TN defined agnostic enterprise application integration architecture for TN that caters for each of the selected mobility types and future requirements.

In view of above, it is clear from the definitions that EM can be seen in multiple perspectives, and that it can be represented as mobility technologies, processes and models. It is also clear that each of these perspectives alone does not give a full description of what EM is. For the purpose of this research an integrative definition of EM will be adopted. Henceforth, this study defines EM as information and communication applications that run over a wireless network using a mobile device to provide employees, anywhere, anytime access to enterprise data.

The next section studies the mobile evolving mobile devices, and applications usage trends. It further observes the opportunities of integrating M-ICT in order to develop secure scalable enterprise application architecture for TN.

2.3 Trends and usage of M-ICT

Muneer and Sharma (2008) stated that the mobile industry is changing at a rapid pace and so is the behavior of employees which uses mobile technologies. They further said that one has to look at the technology trends by market, the competitive landscape, and the mobile worker adoption trends. In addition, PWC (2010) reported that 28 % of their

workforce is currently using personal devices for work-related tasks, and this percentage is expected to rise to 35 % by mid-2013. Similarly, TN observed that employees today are increasingly tech-savvy and self-empowered. They typical owned an assortment of laptops, smartphones, tablets and PCs that are often more advanced than what the company can offer. Hence, this trend forced TN to embrace "bring your own device" or BYOD trend to improve productivity, employee retention, enhanced mobility, a more flexible work environment and improved IT value to the business. In addition, BYOD trend prepared AMICT-TN to define device-agnostic strategy that leverages investments in the employee's devices to create a more mobile, agile and cost-effective platform for TN. Therefore, AMICT-TN considers these myriad of evolution trends and forecasts to design flexible enterprise application integration architecture for M-ICT in TN.

According to the Forrester Report (2013), the number of mobile devices now outpaced humans on this planet, it was estimated that there were 7.3 billion devices in the world in 2012 compared with just fewer than 7 billion people. In support, Kietzman et al. (2013) they noted that a major shift to mobility had been the main technological focus of IT development, is a new network structure, a facilitator of business activity and that more than 5 billion mobile service subscriptions support approximately 80% of the world's population that communicated on the go. In the case of Namibia, MTC (2013) announced that they had reached 2,042 million active subscribers in 2012 which accounts for 10% increase to the previous financial year. In view of Forrester, the World Bank (2011) recorded the country population of 2,324 million people in Namibia which demonstrates

that the growth of mobile subscribers versus population is also observable in the Namibian mobile consumer market. Looking at these statistics unleashed a multitude of potential opportunities to communicate and collaborate with customers, employees, and partners in TN. Henceforth, AMICT-TN builds an enterprise application integration architecture that empowers both internal and external users to maximize customer and partner interaction. Typically, external uses employ mobile marketing to advertise and communicate with partners and suppliers. Whereas the internal uses enables the mobile workforce to increase employee retention and improve productivity.

Horwitt, Nash and O'Neill (2012) reported that according to Gartner research report that the number of smartphones is projected to exceed 6.7 billion by 2015 worldwide, creating huge opportunities for consumer oriented businesses. Furthermore, the report stated that consumer facing mobile applications development will continue to outpace Web application development in general through 2014. Additionally, Yankee Group reported that the mobile and connected devices market offers unprecedented opportunities of global mobile services currently earned U$436 billion business. They further expect the sector to hit U$847 billion by 2016. Following, the Gartner and Yankee Group industry observations, AMICT-TN identifies the multitude opportunities of integrating M-ICT in TN can offer to its employees, customers, partners and suppliers. Furthermore, the reported trends demonstrate that mobile devices growth outpaces the human population, and mobile applications development produces more applications than what the consumers can use which will unlock new world of opportunities for TN. Hence, AMICT-

TN aims at leveraging available information regarding the location and activities of the user to deliver an application "experience" that is more appropriate, natural and useful than what has been the norm in the past. Henceforth, AMICT-TN recommends location aware applications to tap into the customer services to their clients and employees that will increase the bottom line.

As discussed above, AMICT-TN takes cognizance of the current technology trends and mobile usage to enhance current growth and prepare TN for future expansion through the use of M-ICT. Henceforth, comprehensive enterprise application integration architecture can strategically align IT and the business, delivering the innovation necessary to thrive in tomorrow's competitive market through the use of M-ICT in TN.

The next section discusses the possible benefits and challenges of M-ICT integration into a business.

2.4 Benefits and challenges of M-ICT integration

Kakihara and Sorensen (2002) stated that mobile communications could enable organisations to take advantage of a number of benefits including connectivity, flexibility and interactivity. They said that these benefits contributed to increased efficiency and effectiveness of fundamental activities in an organisation and helped to transform business processes. In the same manner, AMICT-TN enhances the ways employees communicate

and collaborate. For instance, greater access to their email and calendars along with voice, video and messaging applications such as Microsoft Lync facilitates employee-to-employee (E2E) communication in TN. Furthermore, AMICT-TN grants remote access to content such as dashboard reports and enterprise applications such SAP using mobile devices allows employees to take full advantage of their out-of-office time. Hence, an employee whose work is field-based by design to spend their working hours out of the office M-ICT enhances their productivity by bringing the office assets to the field.

According to Ferrer et al. (2012) mobile and wireless technologies were becoming increasingly pervasive. They observed that mobile devices were replacing the desktops in everyday tasks performed by users. Furthermore they stated that it was a paradigm shift that had a direct impact on the way that people communicated, runs business and the wireless communication networks were protagonists in this shift. They added that the current enterprise mobility solutions addressed the most significant problem for both consumer and enterprise mobile users' accessibility to information. Similarly, TN employees find themselves on the move, away from traditional fixed telephones and enterprise systems. Nonetheless they need to be reached and to contact others but also to access information on the go. Not surprisingly, many employees prefer to access corporate resources using their own technology because it is familiar, powerful and already an integral part of their everyday lives. Thus, AMICT-TN ensures the accessibility of enterprise applications such as email, SAP, CRM/Billing data by the employees from any device regardless of their location and time.

According to IBM (2009), benefits of enterprise mobility span the business-to-employee (B2E), business-to-business (B2B) and business-to-consumer (B2C) spectrums. In view of IBM, AMICT-TN improves TN employees' productivity, enhanced customer relationships and streamlined supply chain management in the B2B spectrum. In case of B2E, TN's mobile enterprise applications could provide sales staff with updated information about their customers and new ways for field forces to work more effectively. Henceforth, AMICT-TN enables employees to work from anywhere, and TN can lower individuals' carbon footprints. Lastly, in the B2C arena TN can sell their products and services directly through the mobile devices. In this case the information on where the cell phone or tablet user is located and what he or she is doing gave businesses a significant edge in determining how to present their products and services to that consumer. In addition, AMICT-TN enables IT management to select strategic enterprise application integration initiatives across B2B, B2C, and B2E spectrums that will improve employee, customer satisfaction and retention levels.

Ferret et al. (2012) stated that the companies needed to consider new ways of doing business, and updating their information structures and therefore their technological platform. In support of the latter, AMICT-TN will explore the new ways of doing business and enhance communication, collaboration and interaction among B2B, B2C and B2E spectrums. Furthermore, AMICT-TN will examine the current status of mobile communication technologies and mapped out integration architecture for EM implementation to enhance M-ICT in TN.

Nevertheless, Marsh (2011) conducted a survey in the United States and Europe by Yankee Group which realized that the three main drivers for enterprise mobility are the improvement of responsiveness to customers, productivity, and operational efficiencies. In the contrary they said that besides all these benefits there are also many challenges related to enterprise mobility. Likewise, Basole (2007) stated that some challenges are related to privacy, security, management and integration. Consequently, AMICT-TN address challenges that transform business processes and deliver tangible business value to TN. AMICT-TN recommends an infrastructure that allows secure access from a large set of device types. Hence, AMICT-TN provides a device-agnostic enterprise integration strategy where security is integrated into the design; it is not, as with traditional infrastructure, an overlay. Typically, an enterprise integration strategy requires that TN apply the controls found on endpoint devices to the network layer. As a result, a comprehensive device-agnostic approach can simplify and strengthen security of networks, data and applications.

Lastly, AMICT-TN can use virtualization technologies such as application and desktop virtualization, coupled with network segmentation to limit the impact radius of attacks. Furthermore the mobile devices are is isolated from direct contact with application servers and business data, essentially quarantined. Hence, the device is viewing the network but is not actually interacting with the application.

EMC Security for Business Innovation Council Report (2009) stated that the risks that organisations were faced with seemed to be growing due to rapid change in mobile markets including physical loss or stolen devices causing sensitive data loss, mobile malware for malicious purposes, software vulnerabilities exploitation, end-user behaviour problems, compliance and regulatory issues. They further noted that accessing corporate network by untreatable connections increased the likelihood of malware entering the corporate network which could result in data and financial loss including other negative consequences. For that reason, AMICT-TN develop device-agnostic enterprise application integration architecture can help mitigate security risks and compliance. Typically, AMICT-TN involves Human Resources and Legal Departments to ensure that the mobility policies are acceptable to employees and also meet TN's requirements for data security and compliance mandates. Moreover, AMICT-TN promotes adoption of mobility user agreements before being allowed to access resources using a personal device. Participants must understand that they may be required to relinquish some rights to control of the device, such as requirements to install a mobile device management client, encryption of email or the device itself, and use of strong passwords. In addition to mobility policies and agreement is the education of the users through continuous security awareness programme.

Similarly, Forrester (2012), revealed in their survey that network and customer data security concerns are top issues. They suggested that as momentum for supporting employee-owned devices, firms must consider the security implications of allowing

personal mobile technologies into the office. Furthermore, device security is an issue as new types of mobile equipment and operating systems are supported. As an increasing number of firms open their doors to new types of mobile devices, operating systems and solutions, there is increased demand on ensuring security across all types of devices. Henceforth, they recommend that enterprises must ensure that the security of new types of mobile devices, form factors and operating systems for example iPhones, Android and iPads. In support of Forrester, AMICT-TN assesses the current types of devices and OS footprint to ensure security on the different type of devices.

The next section discusses some enterprise application integration approaches related to the study.

2.5 Enterprise Application Integration Approaches

For many people, a mobile application is only the application installed on the end-user mobile device. However, very often these applications need to communicate with enterprise systems to execute some business logic or to exchange data. Silva (2012) reported that one of the most important challenges is related to the integration between mobile applications and enterprise systems. In view of Silva, AMICT-TN defines mobility integration architecture to facilitate the seamless integration between mobile enterprise applications and enterprise systems in TN which will be introduced in following sections.

Tao and Chen (2010) presented a technical architecture for mobile information systems composed by four layers, which consisted of the presentation layer, the mobile communication layer, the mobile business platform layer and the foundation business layer. They explained that the first layer corresponded to the mobile client application. The second layer is the mobile network which could be considered as part of the public and enterprise network infrastructure. The third layer represented the mobile middleware, and the last one represents the enterprise systems. Correspondingly, Wu, et al., 2010) identified the common elements of mobility enabled architecture is the mobile clients, mobility mid-tier and the backend applications. On the contrary, AMICT-TN presents a secure device agnostic layered architecture with encompasses mobile clients, mobility middleware, enterprise backend applications and security infrastructure.

In a similar manner, Trowbridge, et al., (2004) presented system integration patterns to connect layered applications, i.e. integration through the presentation, functional or data layer. The integration pattern has to be selected according to the restrictions imposed by the existing technical architectures of each application. They reported that the functional integration is preferred, because it allows components to access data and functionality of other components, in a distributed manner, through well-defined interfaces, i.e. through application programming interfaces (APIs). They said that, sometimes this is not possible due to a lack of APIs, or simply because the functionality and data are not exposed with the required granularity level. Hence, AMICT-TN does not recommend using integration

patterns for mobile enterprise application integration because of the exponential growth of mobile applications and availability of APIs.

According to Irani, et al., (2003) a broader perspective was considered in the taxonomy for enterprise application integration where the authors identify three levels of solutions for enterprise application integration according to the scope and impact of application integration. They described the three levels are the intra-organization application integration focused on integration of B2E or internal applications; the inter-organization application integration linked to B2B applications; and the hybrid application integration concerned on the integration of the previous two to support B2C applications. In support of Irani et al., AMICT-TN primarily focuses on B2E and B2C applications but also to form a scalable architecture for B2B applications.

On the contrary to the above, Basole (2005) argues that little research on the impact, value, and best practices of enterprise mobility exists and most research focused their attention on the enablers and drivers of mobile ICT in enterprises. Nonetheless, he stated that while an understanding of the factors that lead to mobile ICT assimilation and the identification of potential application areas is important, an equally critical research issue is the examination of the transformational capabilities of mobile solutions and their long-term impact. Correspondingly, AMICT-TN adopts a conceptual multi-phase framework of mobile transformations to provide insights into the dynamics of the transformation processes. These multi-phase framework include firstly a mobilization phase which aims

at higher level of user convenience through access to information and communication flexibility. Secondly, enhancement phase shift from mobilizing existing data to applications to enhance existing and create new business processes that leverage the unique functionalities and capabilities of mobile technologies. Typically, such processes include two key elements: 1) mobility (do it anywhere) and 2) immediacy (do it now) for example sales force automation, field service force automation, customer service oriented application, etc. Thirdly, the reshapement phase where mobile solution begins to reshape business models and strategies to enable business capability become a critical element in the overall business model. For example in context of this study, wireless sensors could enable TN to move from selling mobile handsets to a model in which TN provides surveillance services, and enters into a contract with surveillance companies such as G4S to perform continuous monitoring to any subscriber who requests 24/7 surveillance services for themselves, families and or for their properties within an agreed range. Last phase of transformation framework is where mobile solutions create new core enterprise competencies such that entire business models and strategies are based and revolve around enterprise mobility and subsequently to a redefinition of entire markets and industries.

2.6 Summary

Whilst the academic and industry cadre uses the terms M-ICT and EM exchangeable, it is notable that there is no uniform definition of EM. Hence the study embraces an integrative approach which encompasses both an individual and enterprise mobility that relies on wireless technologies, as well as device and application mobility management solutions

and mobility business processes. Moreover, this approach ensures the broad view of mobility namely information access from any device, from anyone, from anywhere and at any time.

After defining EM, the study moves to amplified usage of M-ICT in order to gauge the technology trends by market, current technology trends and mobile usage to enhance current growth and prepare TN for exponential expansion through the use of M-ICT. Furthermore, the study highlights the benefits of integrating M-ICT into business and identify the appropriate use cases that provide sustainable benefits for external and internal users. Finally, different enterprise application integration approaches are introduced in order to comprehend and develop an appropriate enterprise application integration architecture for TN.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Rationale of the Methodology

This study is a quantitative research which investigates the current usage levels and possible use cases of M-ICT. Welman, Kruger and Mitchell (2005) stated that quantitative research examine the relationships that occur between two or more variables. In the same way, this study is a quantitative research which investigates the current usage levels and possible use cases of M-ICT by TN employees. Furthermore, the positivist research strategy was used for the quantitative non-experimental research survey that included the gathering and analysis of quantitative data for the study.

Cooper and Schindler (2004) indicated that quantitative studies are designed for breadth rather than depth. It attempts to capture a population's characteristics by making inferences from a sample's characteristics. Generalisations about findings are then made and presented based on the representativeness of the sample and the validity of the design. Henceforth, the study aims at making inferences of M-ICT usage within TN. On the other hand, Marlow (1993) stated that qualitative research differs from quantitative research in that the latter is characterized by the use of large samples, standardized measures, a deductive approach, and highly structured interview instruments to collect data for hypothesis testing. Hence, qualitative methods may be more useful in hypothesis-testing research which is not the intention of this research project.

The final reason for the choice of a quantitative research approach is based on the researcher's epistemology. According to Darlaston-Jones (2007), the ability to identify the relationship between the epistemological foundation of a research and the methods employed in conducting the study is critical in order for research to be truly meaningful. Therefore, the researcher adopted an interpretivist epistemological stance that aimed to identify benefits and assess risks of integrating M-ICT in TN, which is also consistent with a quantitative research mode.

In conclusion, the objectives of the research is to analyse usage, benefits and risks of M-ICT in TN. Moreover, AMICT-TN aims to develop an integrated enterprise application architecture to enhance the mobility. This first objective was attained through a literature review providing context and theory, followed by a mainly empirical research design utilizing primary data gathered by means of the questionnaire. The questionnaire data was analysed by using descriptive statistics to determine the breadth of the M-ICT and develop an integrated enterprise application architecture. The research results present the variety of mobile devices, Operating Systems (OS), applications and usage preferences of the sample population. Furthermore it provides better understanding of the benefits and risks which guides the development of an integrated enterprise application integration strategy to enhance the mobile communication in TN.

3.2 Research Design

The research employed a non-experimental research design that was descriptive in nature. Maree (2007) states that non-experimental designs are mainly used in descriptive studies in which the units that have been selected to take part in the research are measured on all the relevant variables at a specific time. In light of Maree, this study used the quantitative survey design. Furthermore, he argued that surveys are done in order to obtain quantitative information that can be used to describe or explore research topics. Therefore, this study used the descriptive strategy to discuss and interpret findings. By using descriptive research strategy, the study describes the relationship between the uses mobile devices, applications, and the possible threats it may bring into the company.

Furthermore, the survey is a technique widely used for quantitative data collection in IS/IT research (Straub, 1989; Pinsonneault and Kraemer, 1993) and can be used for exploration, description or explanation purposes (Pinsonneault & Kraemer, 1993). Bryman (2001) indicates that survey is an appropriate means of collecting data under three conditions: (i) when the goals of the research call for quantitative data, (ii) when the information sought is reasonably specific and familiar to the respondents, and (iii) when the researcher has considerable prior knowledge of particular problems and the range of responses likely to emerge.

3.3 Research Population

Research population is the entire group of persons or set of objects and events of interest to the researcher Sekaran & Bougie (2010). Therefore, the research population consisted of 1200 TN's employees. The five Departments are Strategy, Human Resources, Finance, Commercial and Technical respectively.

3.4 Sample frame

The sample size is generally determined by the population of the research to be surveyed. For this study, the sample was 80 employees, drawn from the TN members of technical department in nationwide using random probability sampling technique explained in following section. According to Leedy and Ormrod (2010) they argued that if the population is less than 100, do not sample or survey the entire population. In our case, if the population size is around 500 of Technical department, thus sample 100. Following this guideline, this study sampled 80 employees of technical staff which is less than 500. The sample size of 80 employees was regarded as sufficient and true representative of the whole population.

3.5 Sampling Procedure

Leedy and Ormrod (2010) define two main types of sampling methods that include probability sampling and non-probability sampling. In this study, simple random

probability sampling technique was used to select the sample frame from the TN population.

Welman et al. (2005) stated that random probability sampling enables each member of the population to have the same chance of being included in the sample. Similarly, simple probability sampling was used to select 80 information-rich TN employees for the survey. Names from the targeted population were listed numerically up to the last name on the list. Each of the TN employees on the list had a chance of being included in the study. However, the random number selection was applied to choose a sample of 80 respondents using the Excel spread sheet computer package until the desired sample size was selected. This procedure was used to ensure that each TN employee had a chance of being included in the sample.

3.6 Research Instrument

The questionnaires was administered via email and responses received through in corporate Survey Tracker Software on the Intranet from the desired sample frame. The questionnaire consisted of two sections namely, biographical information and survey dimensions. The survey dimensions consisted of three subsections namely Mobile Devices Distribution and Access, Mobile User Activity– Interaction Preferences, Mobile Security Awareness – Device Support.

Van Vuuren and Maree (1999) emphasises that questionnaires allow many respondents to complete the questionnaire in a short space of time. In this case it has an advantage since the research will use a relatively large sample size of 80 respondents. The research instrument was designed through the Likert Scale Model and Check List Format and had open ended questions that were meant to ascertain views of the targeted sample frame. These are universal accepted scientific models used to construct questions for eliciting data.

3.6.1 Questionnaire design

Denscombe (2003) indicates that questionnaires rely on written information supplied directly by people in response to questions asked by the researcher. The information in questionnaires tends to fall into two broad categories – facts and opinions - as indicated in Table 1. Both categories were used in the questionnaire designed for this study.

Table 3.1: Broad Categories of information

Facts	Factual information does not require much in the way of judgement or personal attitudes on the part of respondents. For example, their address, age, gender, marital status, number of children and so forth.
Opinions	Opinions, attitudes, views, beliefs and preferences reveal information about feelings, express values, weighed-up alternatives and, in a way, calls for a judgement about things, rather than the mere reporting of facts.

Source: Adapted from Denscombe (2003)

The questionnaire consisted of two sections (refer to Appendix A):

- Section A covered the biographical information details of the respondent, such as gender, age, department, duty station, job grade, and employment period. This can be viewed as factual information.
- Section B sought information relating to survey three perspectives towards mobile usage, in terms of aspects such as (A) Mobile devices distribution and access, (B) Mobile user activity and interaction preferences, (C) Mobile security awareness and device support.
    - Subsection A covered under mobile devices distribution and access can be viewed as factual information.
    - Subsection B covered under mobile user activity and interaction preferences can be viewed both facts and opinions.
    - Subsection C covered under mobile security awareness and device support can be viewed as opinions.

The questionnaire comprised mostly of closed-ended questions, as open-ended questions sometimes tend to provide data that is difficult to code and analyse (O'Leary, 2004). Moreover, closed-ended questions were utilised in order to retrieve the maximum amount of information without imposing on the time and resources of the respondents.

The question mostly consist of closes-ended questions:

- **Mark the correct space** type questions were used to obtain information regarding the biological information, mobile devices distribution and access as well as mobile user activity and interaction preferences.

Likert scale type questions where respondents were requested to indicate whether they strongly agree, agree, disagree or strongly disagree with statements under mobile security awareness and device support.

3.7 Data Collection

The final set of decisions regarding the survey related to determining which would be the best way to distribute the questionnaire to respondents. In order to optimise the response rate, it is vital to ensure that the questionnaire reaches all those in the sample (Anderson, 2004).

E-mail facilities were used to distribute the questionnaires. To ensure that the questionnaire reached the applicable respondents the questionnaires was coded and responses captured in corporate Survey Tracker software on the Intranet. The number of responses were tracked online in Survey Tracker to make sure that all questionnaires sent were returned. Each response received was checked to find out that all items were answered using real-time reporting feature in Survey Tracker software.

3.8 Data Analysis

Leedy and Ormrod (2010) stated that the important tool for organizing data is a software program that allows a researcher to manipulate data displayed in a table where it is widely used. Firstly, the emailed responses received were automatically captured in Survey Tracker Software. The software automatically summarized the responses and stored it in .sav file format.

Secondly, it was exported in .sav file format from Survey Tracker. Lastly, the data was imported into IBM SPSS 21 for further analysis. The responses to all items was classified and tabulated in different categories using the SPSS 21 software. The coded data was analyzed by means of One-Way Anova at significance level of .05 in order to determine the relationship of the variables. Significant variables to the study were identified and interpreted accordingly and where possible linked to literature review to gain a full understanding from both primary and secondary research data. The findings of the study were presented in chapter four of the research report.

3.9 Reliability and Validity

The questionnaire was developed under the Supervisor and a peer review by fellow students was performed. Furthermore, an expert from TN was identified and asked to rate the reliability of the questionnaire. The degree of agreement of the supervisor and the expert determined the reliability of the questionnaire. Welman et al. (2005) stated that if the research finding can be repeated, it is reliable. On the other note, Maree (2007) described reliability as the extent to which a measuring instrument is repeatable and consistent. Henceforth, the inter-rated reliability was used to rate uniformity of the questionnaire.

Maree (2007) defined content validity as the extent to which the instrument covers the complete content of the particular construct that it is set out to measure. In addition he stated that one widely accepted classification consists of three major forms of validity such as content validity, criterion-related validity and constructs validity. In view of Maree, face validity and content validity are the two forms of validity that was used to measure what was to be set out in the questionnaire. Moreover, the questionnaire was empirically tested for validity and reliability purposes through IBM SPSS 21 software package. A Cronbach's Alpha at coefficient of .7 was performed in order to test the reliability and validity of the questionnaire. Table 3.1 depicts the Cronbach's Alpha test.

Scale: ALL VARIABLES

Table 3.2

a. Listwise deletion based on all variables in the procedure

Case Processing Summary

		N	%
Cases	Valid	83	100.0
	Excluded[a]	0	.0
	Total	83	100.0

Source: Survey data

b. Reliability statistic

Reliability Statistics

Cronbach's Alpha	N of Items
.961	33

The Cronbach`s Alpha statistic shows that the research instrument was reliable at .961, that is 96% reliable. The results showed that the research instrument is very reliable since it is far above the standard coefficient value of .70.

3.10 Ethical Considerations

Welman, Kruger and Mitchell (2005) stated that ethical behaviour is important in research, as in any other field of human activity. In addition, Leedy and Ormrod (2010) stated that researchers should not expose research participants to unnecessary physical or psychological harm. Furthermore, Leedy and Ormrod (2010), stated that researchers must keep the nature and quality of participants' performance strictly confidential. This means that ethical issues of participants' rights and privacy need to be considered in a research. Therefore the information gathered in the study is confidential and identity anonymous.

3.11 Conclusion

This section dealt with the methodology to be used in this study. The research type and design have been described and clarified. The sampling procedures, data collection methods and data analysis to be used in this study have been elaborated in this section. The type of the research has been described and justified as quantitative. The study was empirically tested for validity and reliability purposes through IBM SPSS 21. The methods of collecting data by means of questionnaires have been illuminated. Finally, the need for ethical consideration when collecting data was also highlighted.

CHAPTER 4

DATA PRESENTATION AND ANALYSIS

4.1 Introduction

In this chapter the results of the data analysis are presented and interpreted. The data were collected and then processed in response to the problems posed in chapter 1 of this study. The first two research objectives drove the collection of the data and the subsequent data analysis and interpretation. This study focused on the analysis of M-ICT usage in TN and to identify the benefits as well as the risks of integrating M-ICT in TN. It sought to identify areas that need to be worked on and finally recommend areas which need to be perfected in the M-ICT integration at TN.

The primary data analysis consists of two parts. Firstly, the first part of the chapter deals with demographical data while the second part deals with a detailed One-Way Anova statistical analysis of the data followed with a presentation of results and findings. Data from the questionnaires was first coded and then entered into SPSS (Statistical Program for Social Scientists) by the researcher. In SPSS descriptive statistics such as frequencies were used to establish the data structure. Then pie charts, bar graphs and histograms were generated in Microsoft Excel to present the data.

4.2 Response Rate

A response rate of 42% was achieved from a target population of 200 (N=200), a sample size of 83 respondents (n=83) was chosen. The response rate although low is acceptable within research limits.

4.3 Primary Data Analysis

The aim of collecting primary data was to establish the respondents' views on M-ICT at TN, and use the data gathered to determine patterns and ultimately draw conclusions pertaining to the study.

In order to elaborate on the background of the organisations, Section A of the questionnaire (Questions A1 to A6) captured the demographic information of TN, including gender, age group, department, job grade, location and work experience period of the respondent within the organisation. The results, which are descriptive in nature, are indicated by means of frequency tables. Following section thus presents categorical variables which present the demographical data.

4.2.2 Gender N=83

Table 4.1

Statistics of Population by Gender

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	51	61.4	61.4	61.4
	female	32	38.6	38.6	100.0
	Total	83	100.0	100.0	

Table 4.1 indicates that 61% of the respondents are males and 39% are females. The male respondents outnumber the female respondents. Maybe this might have been caused by the respondents who responded to the online survey. In addition, there are more male employees in the company than females.

4.2.3 Age **N=83**

Table 4.2

Statistics of Population by Age

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 25 years	5	6.0	6.0	6.0
	26-44 years	54	65.1	65.1	71.1
	45-60 years	24	28.9	28.9	100.0
	Total	83	100.0	100.0	

Table 4.2 indicates that 6% of the respondents are less than 25 years, 65% are in the 26 – 44 year old bracket and 29% are in the 45-60 year old bracket. The age distribution of the respondents is well-balanced, since over 71% of the respondents are capable to serve the organisations for a long period of time. This is followed by 29% in the higher end age bracket of 45-60 years which indicates that there are more older employees compared the ones aged less than 25 years that is only 6% of the workforce.

4.2.4 Division **N=83**

Table 4.3

Statistics of Population by Division

Division

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Commercial Operations	26	31.0	31.3	31.3
	Technical Operations	44	52.4	53.0	84.3
	Human Resources and Strategic Training	4	4.8	4.8	89.2
	Internal Audit	2	2.4	2.4	91.6
	Corporate Governance, Legal and Regulatory Affairs and Corporate Strategy	1	1.2	1.2	92.8
	Finance and Administration	6	7.1	7.2	100.0
Total		83	100.0	100	

Table 4.3 indicates that 31% of the respondents work in the Commercial Department, 52% work in the Technical Department, 5% work in the Human Resources and Strategic Training, 2% work in the Internal Audit Department, 1% work in the Corporate Governance, Legal Regulatory Affairs and Corporate Strategy and 7% of the respondents work in the Finance and Administration Department. Technical Operations and Commercial Operations Departments outnumber the rest of the departments due to the nature of the organisation.

4.2.5 Job Grade **N=83**

Table 4.4

Statistics of Population by Job Grade

Job Grade

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A band	17	20.5	20.5	20.5
	B band	16	19.3	19.3	39.8
	C band	39	47.0	47.0	86.7
	D lower band	8	9.6	9.6	96.4
	D upper band	3	3.6	3.6	100.0
	Total	83	100.0	100.0	

Table 4.4 suggests that 21% of the respondents are in the A band, whilst 19% of the respondents are in the B band, 47% are in the C band, 10% are in the D lower band and 4% of the respondents are in the D upper band. The job grade distribution is well-balanced between C-Band and D-lower Band are majority of the commercial and technical employees from Sales and Field Services Departments in these salary grades.

4.2.6 Region **N=83**

Table 4.5

Statistics of Population by Region

Region

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Windhoek HQ	42	50.6	50.6	50.6
	Windhoek Central	9	10.8	10.8	61.4
	Hardap	3	3.6	3.6	65.1
	Karas	6	7.2	7.2	72.3
	North-East	12	14.5	14.5	86.7
	Erongo	11	13.3	13.3	100.0
	Total	83	100.0	100.0	

Table 4.5 indicates that 51% of the respondents work in Windhoek HQ, 11% in Windhoek Central, 4% in Hardap Region, 7% in Karas Region, 14% in North-East Region and 13% in Erongo Region. These finding indicates that Windhoek HQ employs over half of the staff. Majority of the Windhoek based employees are office based and has access to email facilities compared to the regional employees who spends most of their time outside the office either working or travelling.

4.2.7 Work Experience N=83

Table 4.6

Statistics of Population by Work Experience

Work Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 3 years	16	19.3	19.3	19.3
	3-5 years	9	10.8	10.8	30.1
	6-10 years	13	15.7	15.7	45.8
	11-20 years	22	26.5	26.5	72.3
	20 years+	23	27.7	27.7	100.0
	Total	83	100.0	100.0	

Table 4.6 above suggests that 19% of the respondents have less than 3 years' experience, whilst 11% of the respondents have between 3-5 years' work experience, 16% have 6-10 years' experience, 26% have 11-20 years' work experience and 28% have over 20 years' working experience. A total of 54% employees served the company between 11 and 20 years which indicates the highly committed and knowledgeable workforce using mobile devices. Furthermore, it indicates a high computer literacy among the long serving employees as the questionnaires were electronically administered.

4.3 Statistical Data Analysis

Following section presents the non-categorical or continuous variables. The listed critical results summary on table 4.7 below is derived from One-Way Anova statistical analysis generated in SPSS depicted in Appendix 2, below. According to Changarampatt (2011) One-way Anova is a way of presenting the calculations for the significance of a particular factor`s effect, especially for data in which the influence of several factors is being considered simultaneously. Furthermore, Changarampatt (2011) stated that it is useful to distinguish between fixed and random effects. Changarampatt (2011) added that Anova is a statistical method that divides the variance in an observation into the variance of and the rest of the variance called the within group or error variance. Each critical variable will be explained below.

Table 4.7

One Way Anova Statistics Results Summary

ANOVA					
Parameter	**Sum of squares**	**df**	**Mean Square**	**F**	**Sig**
Device owned	10.068	4:78	26.517	194.557	.000
Device company provided	106.068	4:78	26.517	194.557	.000
Tablet	113.081	4:78	28.270	252.697	.000
Smartphone	113.081	4:78	28.270	252.697	.000
Model tablet	113.081	4:78	28.270	252.697	.000
Smartphone device	113.081	4:78	28.270	252.697	.000
Tablet operating system	80.836	4:78	20.209	59.725	.000
Smartphone operating system	80.836	4:78	20.209	59.725	.000
Tablet activities	42.910	4:78	10.728	76.449	.000
Smartphone activities	42.910	4:78	10.728	76.449	.000
Table usage	9.466	4:78	2.367	32.304	.000
Smartphone usage	9.466	4:78	2.367	32.304	.000
Tablet applications downloaded	18.946	4:78	4.737	395.840	.000
Smartphone applications downloaded	18.946	4:78	4.737	395.840	.000
Mobile apps access interact	344.781	4:78	86.195	254.668	.000

Mobile website access interact	344.781	4:78	86.195	254.668	.000
Either mobile apps or mobile websites access interact	344.781	4:78	86.195	254.668	.000
I do not use mobile device for this activity access interact	322.268	4:78	80.567	225.819	.000
Mobile phone browsing	65.489	4:78	16.372	206.847	.000
Tablet browsing	74.960	4:78	18.740	151.212	.000
Home computer laptop browsing	74.960	4:78	18.740	151.212	.000
Mobile apps browsing	74.960	4:78	18.740	151.212	.000
IT Factory support	10.666	4:78	2.666	92.436	.000
Satisfied with support	157.698	4:78	39.425	123.239	.000
Risk of sensitive information	22.512	4:78	5.628	46.267	.000

Source: Primary Data

4.4 Results and interpretation of findings

Section B – Survey dimensions about M-ICT Usage

The questions in Section B of the questionnaire (refer to Appendix B) aim to determine:

- The usage of different mobile devices, brands, model distribution, OS and ownership employees use to access M-ICT.
- The employees' mobile user activities and interaction preferences to identify the possible use cases and benefits for integrating M-ICT within TN.
- The existence of mobile security risks and challenges with device support

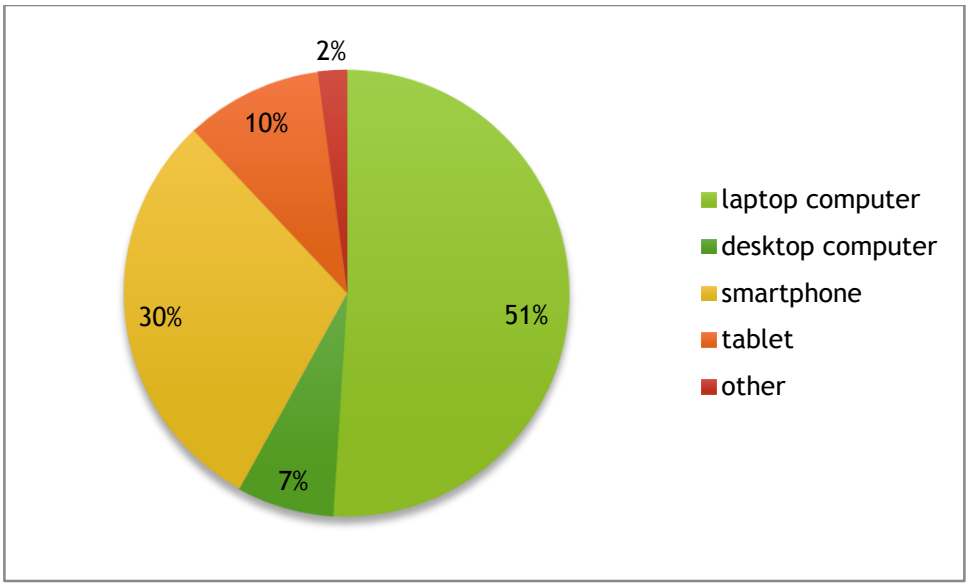
4.4.1 Mobile Devices Distribution and Access

The results depicted in this section covers Subsection A: Mobile Devices Distribution and Access of Section B in the questionnaire (refer to Appendix B). The questions (A7 to 12) elaborates on the usage of different mobile devices, brands, model distribution, OS and ownership employees use to access M-ICT.

4.4.1.1 Devices owned

Figure 4.1

Types of devices owned



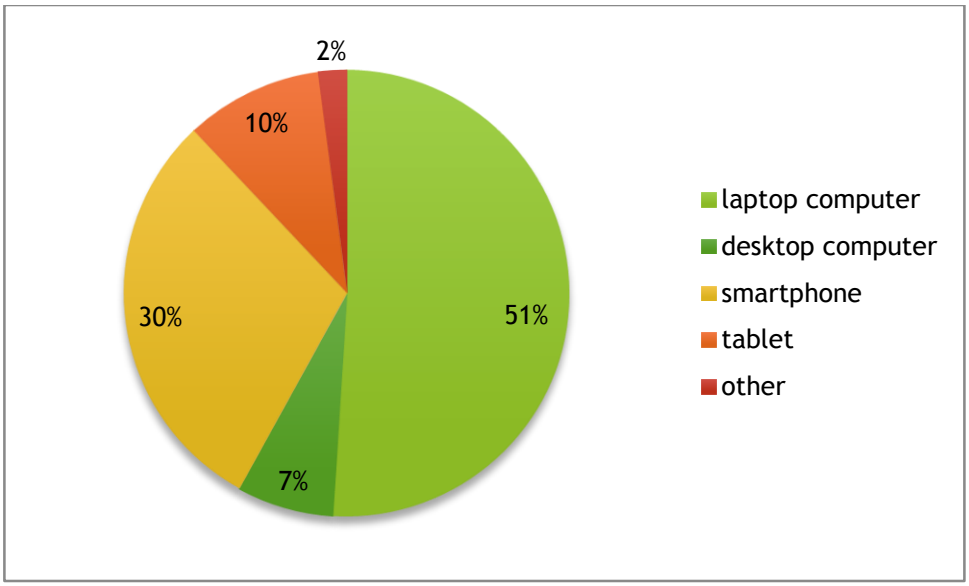
Source: Primary Data

Device owned has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant (P<0.05) refer to table 4.7.

4.4.1.2 Company provided devices

Figure 4.2

Types of company provided devices



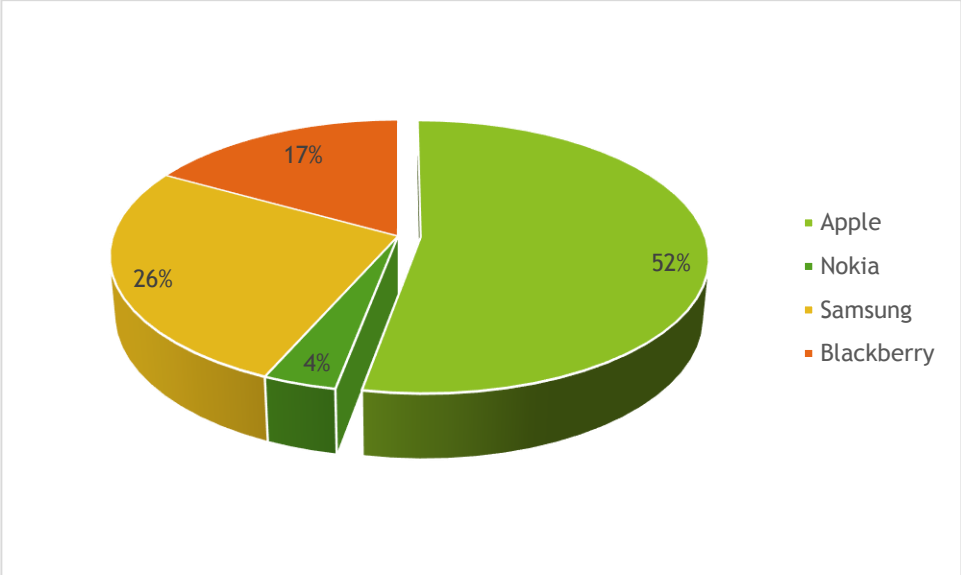
Source: Primary Data

Device company provided has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant (P<0.05) refer to table 4.7.

4.4.1.3 Brands of Tablets

Figure 4.3

Types of tablets brands owned by the population



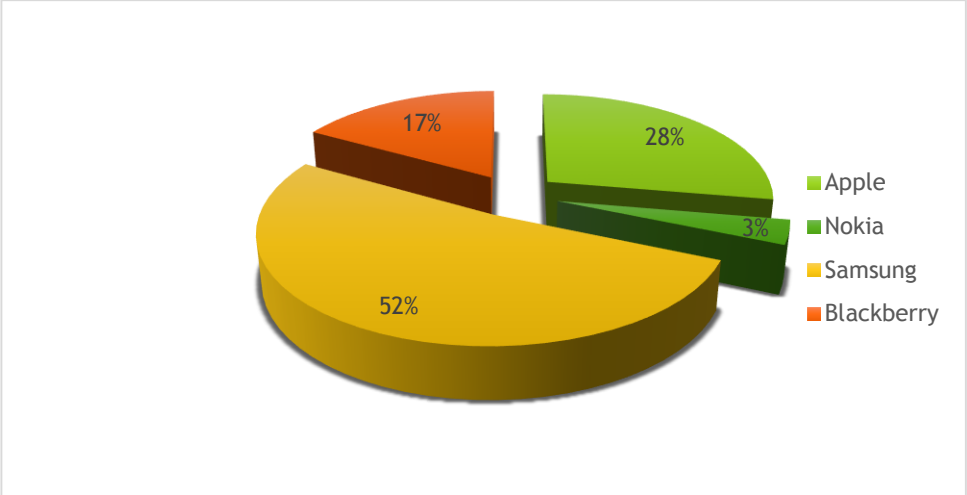
Source: Primary Data

Tablet has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant (P<0.05) refer to table 4.7.

4.4.1.4 Brands of smartphones

Figure 4.4

Types of smartphone brands owned by the population



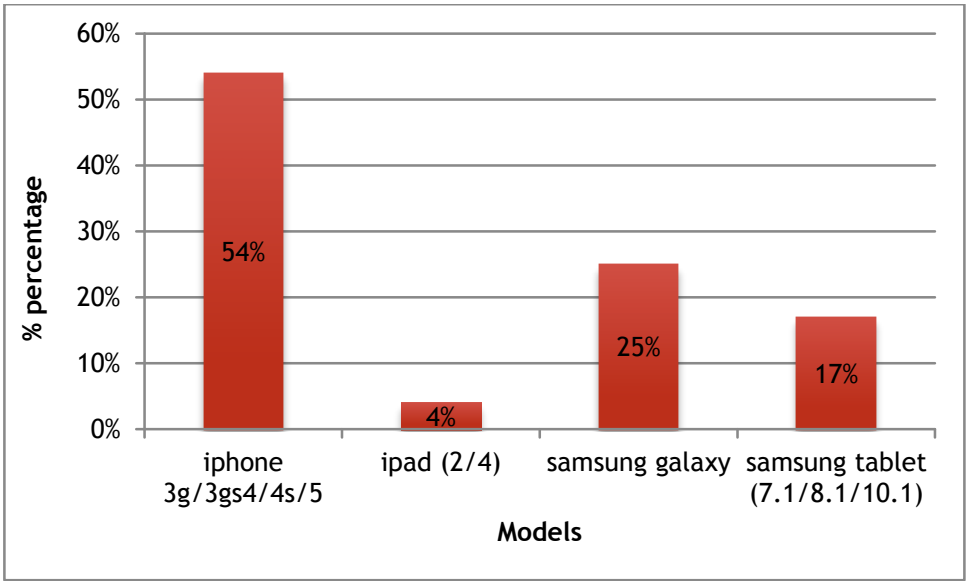
Source: Primary Data

Smartphone has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant ($P<0.05$) refer to table 4.7.

4.4.1.5 Tablet Models

Figure 4.5

Types of tablet models owned by the population



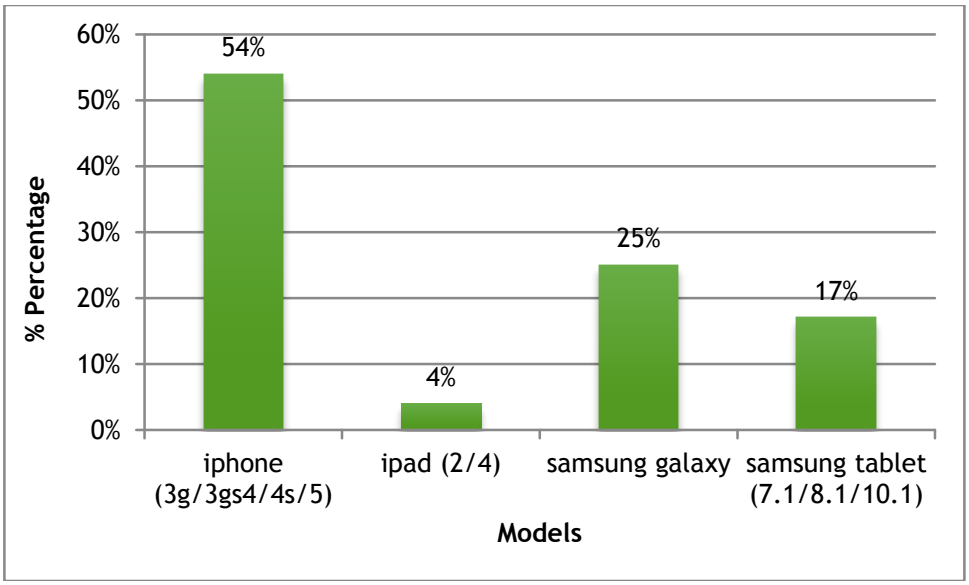
Source: Primary Data

Model Tablet has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant ($P<0.05$) refer to table 4.7.

4.4.6 Smartphone Device owned

Figure 4.6

Types of smartphone model owned by the population



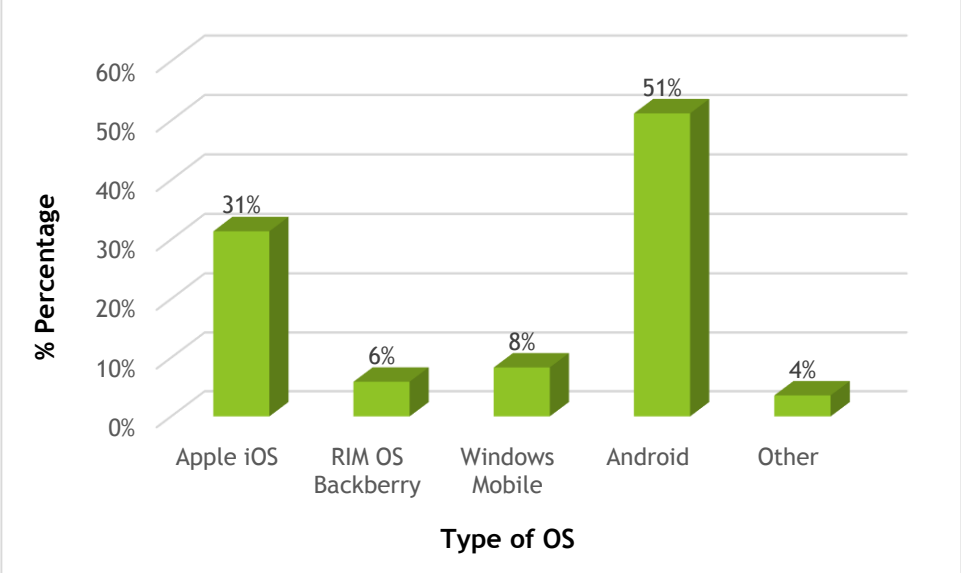
Source: Primary Data

Smartphone device has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant ($P<0.05$) refer to table 4.7.

4.4.1.7 Types of Tablet Operating System (OS)

Figure 4.7

Types of tablet OS used by the population



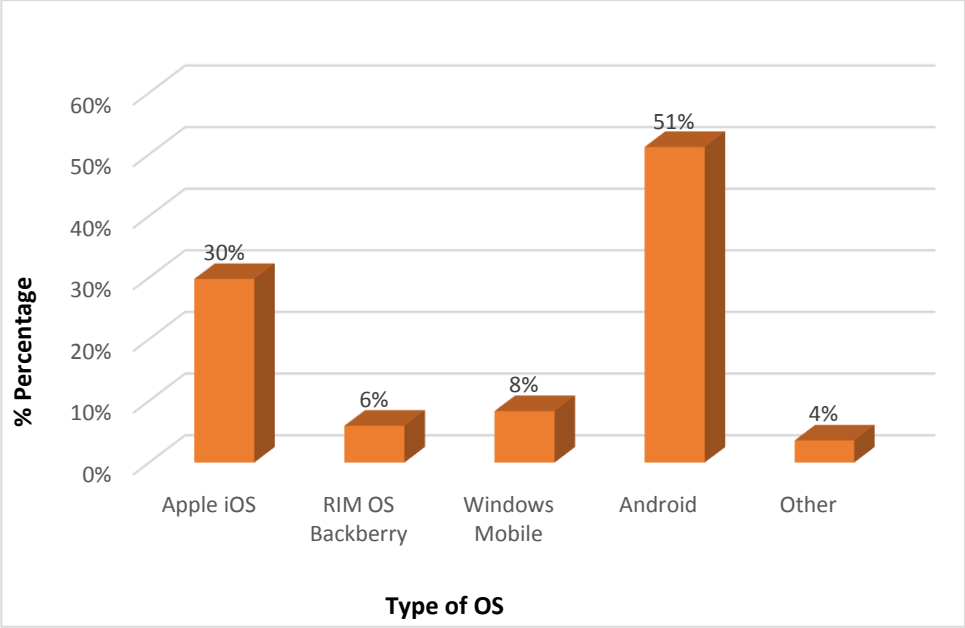
Source: Primary Data

Figure 4.7 indicates that tablet operating system has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant (P<0.05) refer to table 4.7.

4.1.8 Types of Smartphone OS

Figure 4.8

Types of Smartphone OS used by the population



Source: Primary Data

Smartphone operating system has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant (P<0.05) refer to table 4.7.

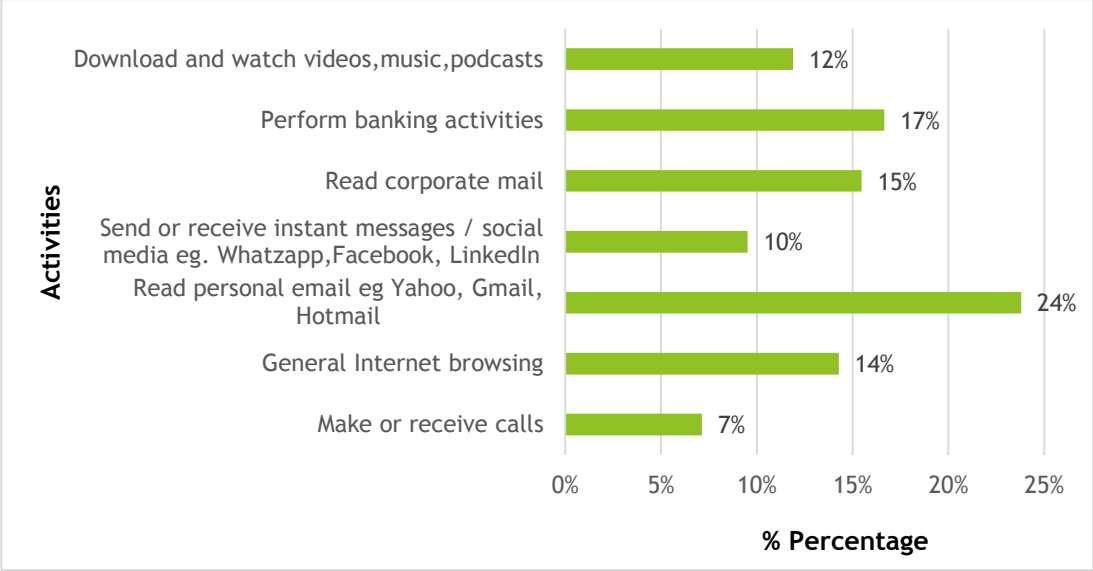
4.4.2 Mobile User Activity and Interaction Preference

The results depicted in this section covers Subsection B: Mobile Activity and Interaction Preference of Section B in the questionnaire (refer to Appendix B). The questions (B13 to B18) elaborates on the usage of different mobile devices, brands, model distribution, OS and ownership employees use to access M-ICT.

4.4.2.1 Type of activities done on tablets

Figure 4.9

Statistics of activities performed on tablets



Source: Primary Data

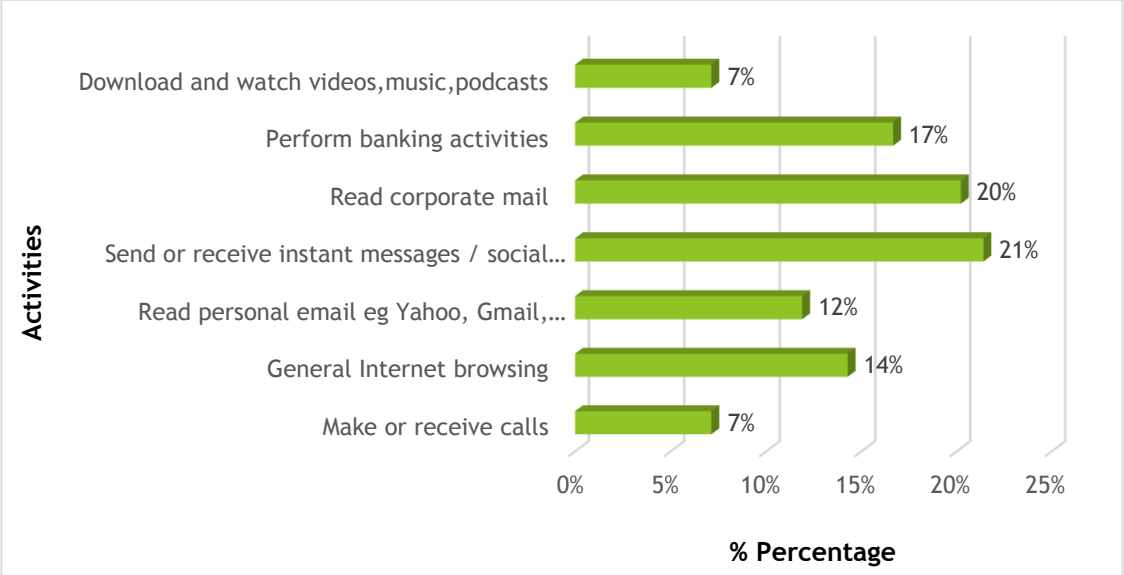
Tablet activities has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant ($P<0.05$) refer to table 4.7. Figure 4.9 suggest the top three activities that employees used

on their tablets are reading personal email (24%), perform banking activities (17%) and reading corporate email (15%).

4.4.2.2 Type of Activities done on Smartphone

Figure 4.10

Statistics of activities performed on smartphone



Source: Primary Data

Smartphone activities has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant ($P<0.05$) refer to table 4.7.

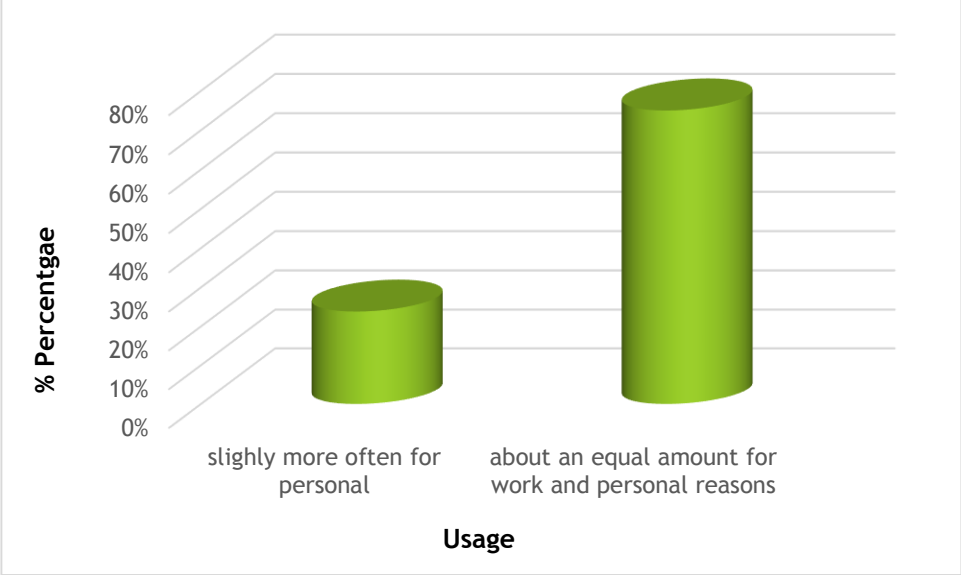
In Figure 4.10 the top three activities done on smartphones are send or receive instant messages/ social media(21%), read corporate mail (20%) and perform banking activities

(17%). This is almost similar to the respondents' usage on tablets apart from usage of instant messaging and social media on smartphones.

4.4.2.3 Tablet Usage for personal and or work

Figure 4.11

Statistics of tablet usage for personal and or work reasons



Source: Primary Data

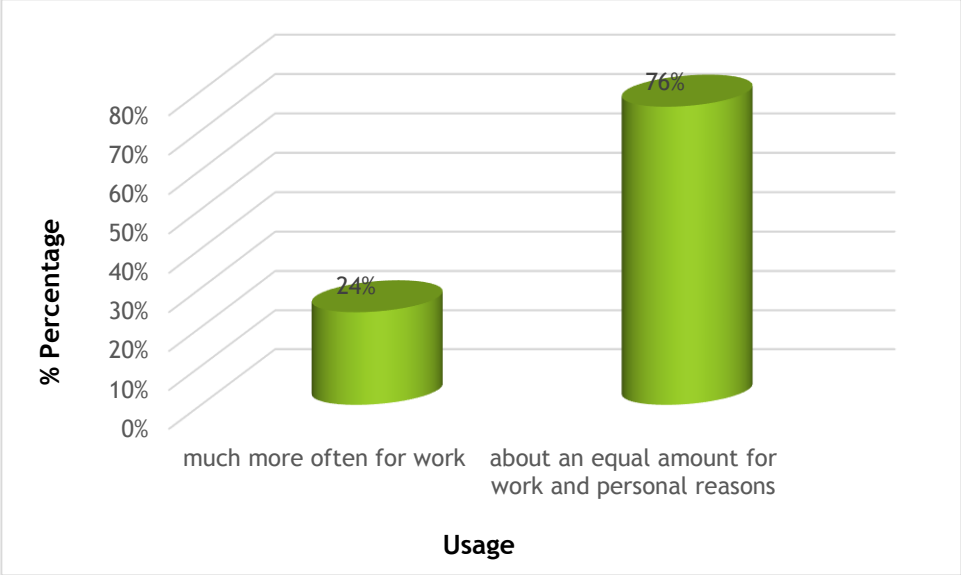
Tablet usage has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant ($P<0.05$) refer to table 4.7.

Figure 4.11 suggests that 76% of the respondents used their tablets an equal amount for work and personal reasons while 24% of the respondents indicated that they used their tablets slightly more often for personal reasons.

4.4.2.3 Smartphone Usage for personal and or work

Figure 4.12

Statistics of smartphone usage for personal and or work reasons



Source: Primary Data

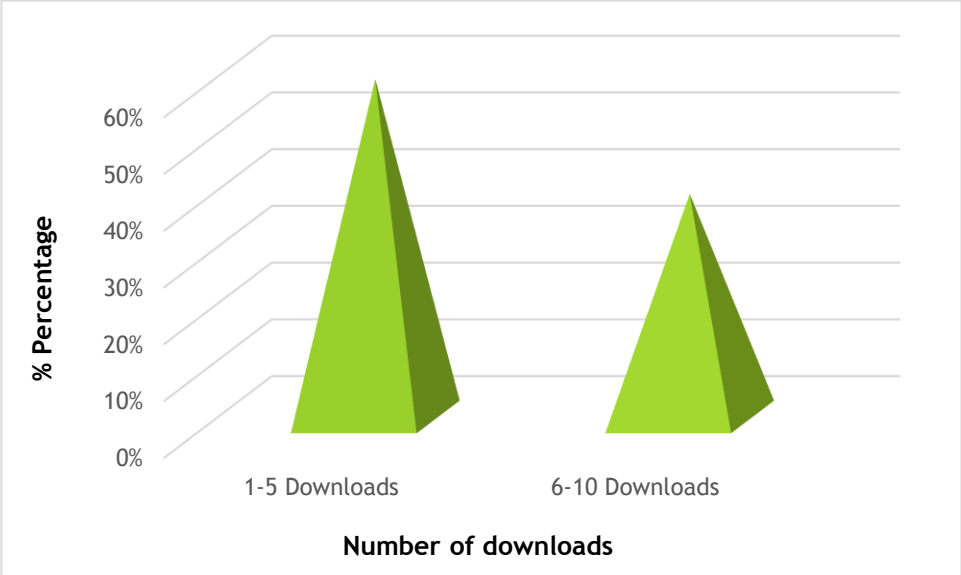
Smartphone usage has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant ($P<0.05$) refer to table 4.7.

Figure 4.12 suggests that 76% of the respondents use their smartphones for about an equal amount for work and personal reasons and 24% of the respondents used their smartphones much more often for work.

4.4.2.4 Tablet Applications Downloaded

Figure 4.13

Statistics of downloaded applications on tablets



Source: Primary Data

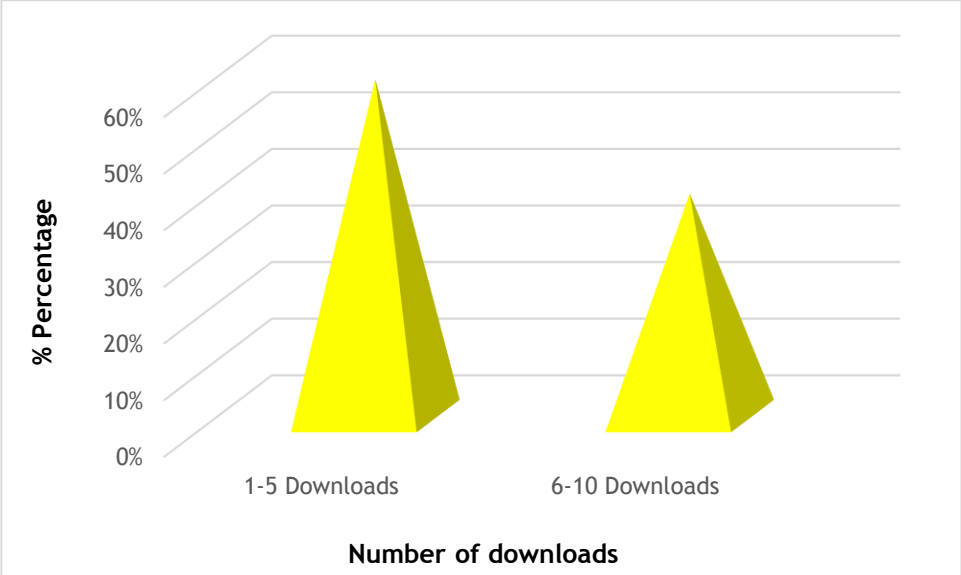
Tablet applications downloaded has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant ($P<0.05$) refer to table 4.7.

Figure 4.13 indicates that 60% of the respondents downloaded 1-5 applications on their tablets and 40% had downloaded 6-10 applications on their tablets.

4.4.2.5 Smartphone Applications Downloaded

Figure 4.14

Statistics of downloaded applications on smartphone



Source: Primary Data

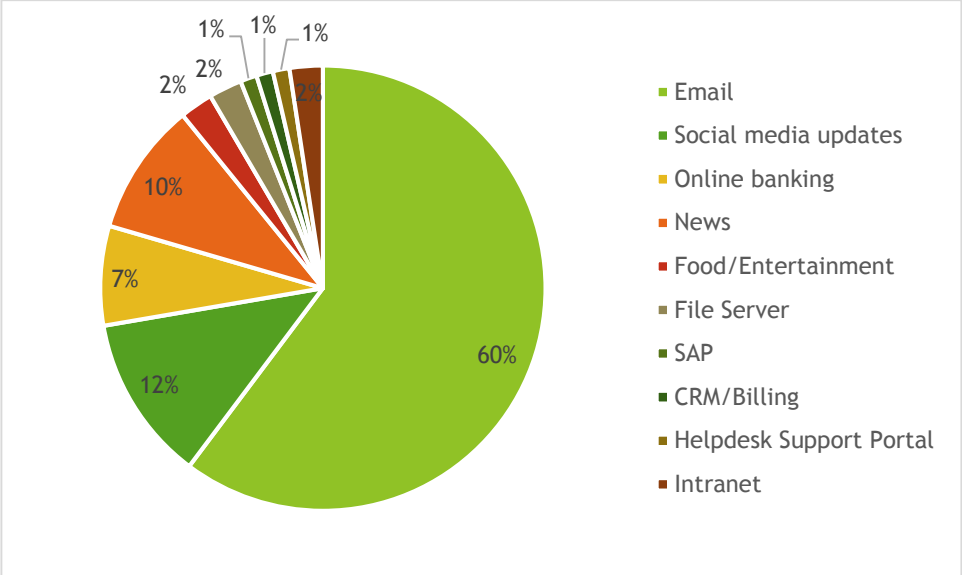
Smartphone applications downloaded has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant ($P<0.05$) refer to table 4.7.

Figure 4.13 indicates that 60% of the respondents downloaded 1-5 applications on their tablets and 40% had downloaded 6-10 applications on their tablets.

4.4.2.6 Mobile Applications/Websites Access Interact

Figure 4.15

Statistics of services accessed by mobile applications/websites



Source: Primary Data

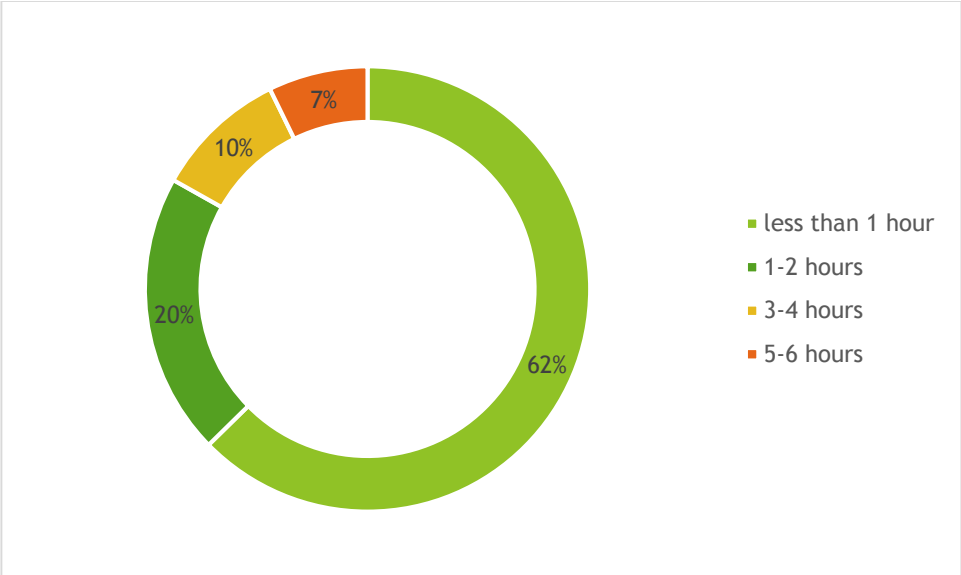
Either mobile apps mobile website access interact has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant (P<0.05) refer to table 4.7.

Figure 4.15 indicates that 60% of the respondents use their mobile devices to access/interact through Emails, 12% used it on Social Media updates, 7% on Online Banking, 10% on News, 2% on Food/Entertainment, 2% File Server, 2% SAP, 1% CRM/Billing, 1% Helpdesk Support Portal and 3% Intranet.

4.4.2.7 Time spend on web browsing using mobile phone

Figure 4.16

Statistics of time spend on web browsing using mobile phone



Source: Primary Data

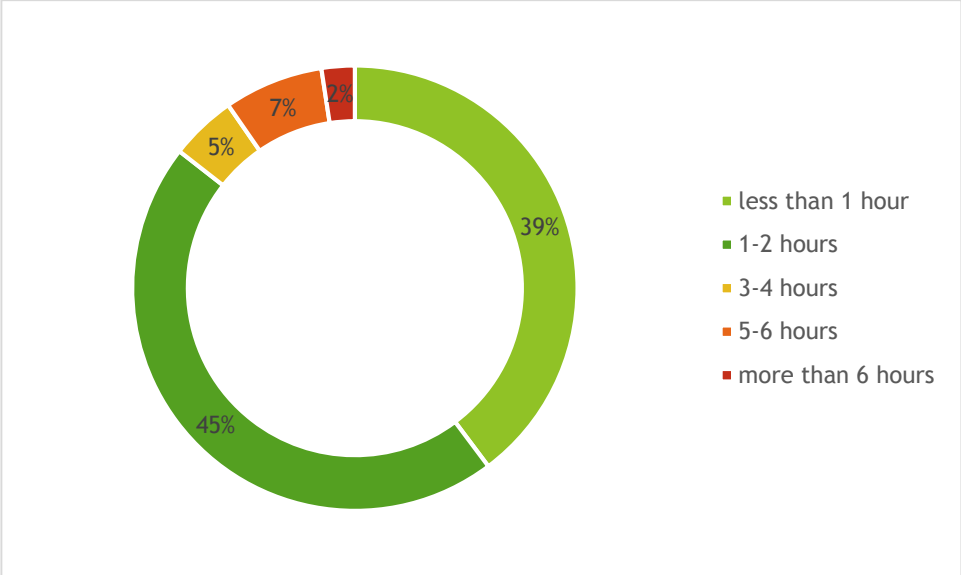
Mobile phone browsing has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant (P<0.05) refer to table 4.7.

Figure 4.16 indicates that 60% of the respondents use mobile websites to access/interact through emails, 12% used it on Social Media updates, 7% on Online Banking, 10% on News, 2% on Food/Entertainment, 2% File Server, 2% SAP, 1% CRM/Billing, 1% Helpdesk Support Portal and 3% Intranet.

4.4.2.8 Time spend on web browsing using tablet

Figure 4.17

Statistics of time spend on web browsing using tablet



Source: Primary Data

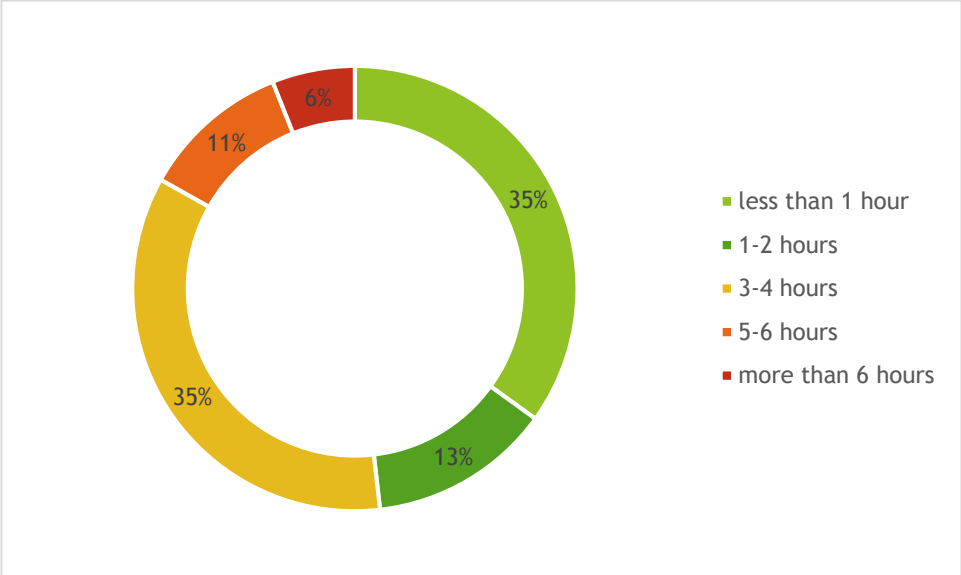
Tablet browsing has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant (P<0.05) refer to table 4.7.

Figure 4.17 indicates that 39% of the respondents spend less than 1 hour on tablet browsing, 45% spend 1 –2 hours, 5% spend 3-4 hours , 7% spend 5-6 hours and 2% more than 6 hours.

4.4.2.9 Time spend on home computer/laptop for web browsing

Figure 4.18

Statistics of time spend on web browsing using laptop



Source: Primary Data

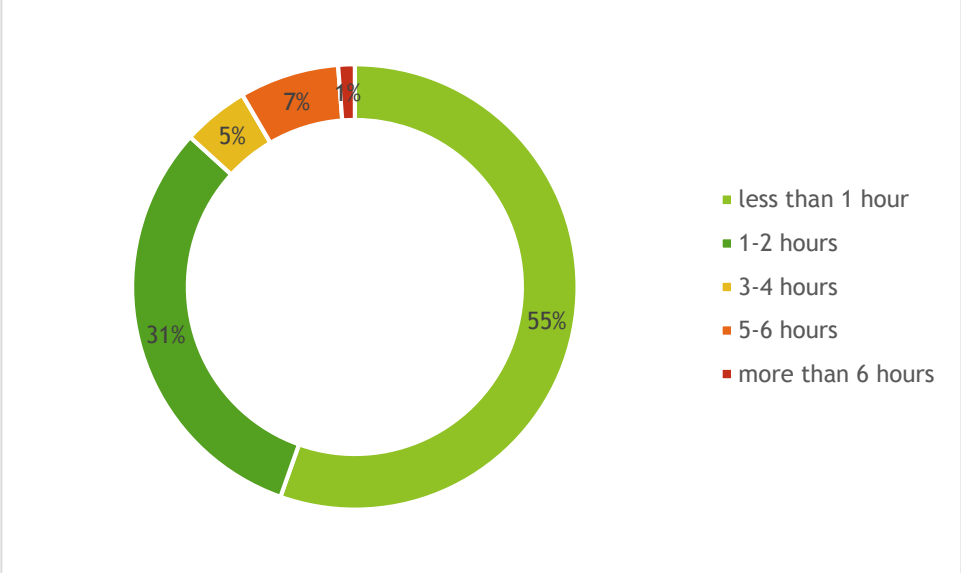
Home computer laptop browsing has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant (P<0.05) refer to table 4.7.

Figure 4.18 indicates that 35% of the respondents spend less than 1 hour on home computer laptop browsing, 13% spend 1 –2 hours, 35% spend 3-4 hours and 11% spend 5-6 hours and 6% spend over 6 hours on home computer laptop browsing.

4.4.2.10 Time spend on browsing using Mobile Applications (Apps)

Figure 4.19

Statistics of time spend on web browsing using mobile apps



Source: Primary Data

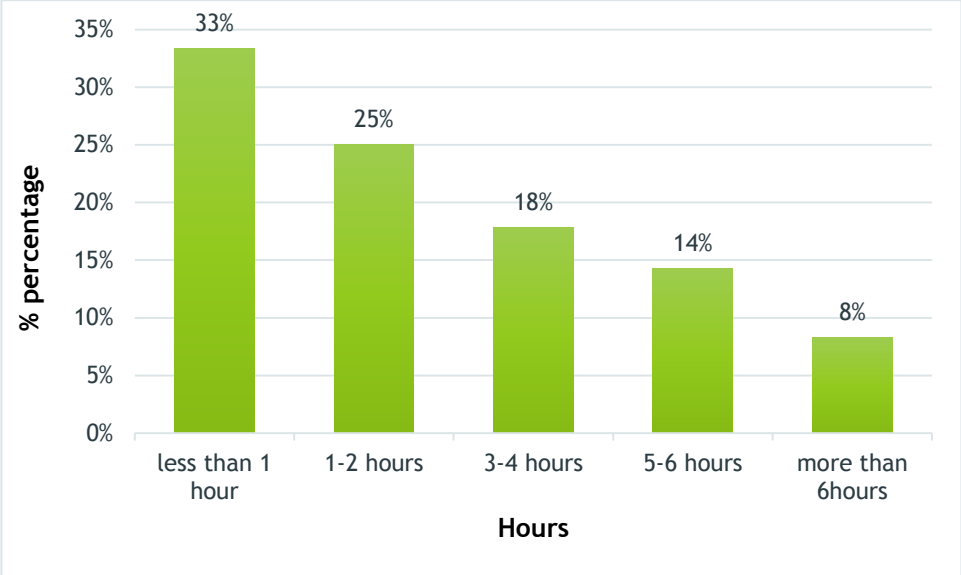
Mobile apps browsing has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant (P<0.05) refer to table 4.7.

Figure 4.22 indicates that 55% of the respondents spend less than 1 hour on mobile application browsing, 31% spend 1 –2 hours, 5% spend 3-4 hours and 7% spend 5-6 hours and 1% spend over 6 hours on mobile applications browsing.

4.4.2.11 Time Spent Outside Office Environment

Figure 4.20

Statistics of time spend outside of the office environment



Source: Primary Data

Time spent outside office environment has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant ($P<0.05$) refer to table 4.7.

Figure 4.23 indicates that 33% of the respondents spend less than 1 hour outside office environment, 25% spend 1 –2 hours, 18% spend 3-4 hours and 14% spend 5-6 hours and 8% spend over 6 hours outside office environment.

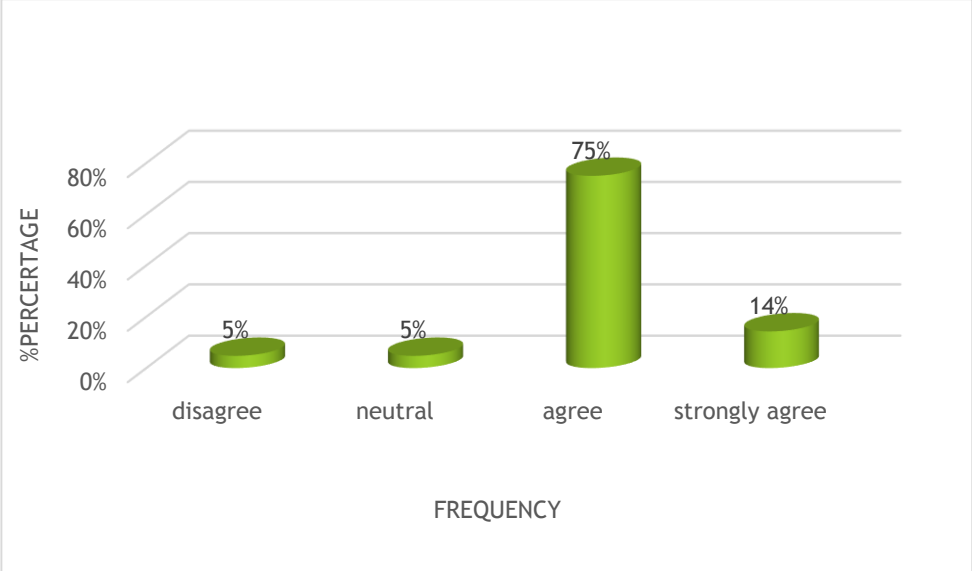
4.4.3 Mobile Security Awareness and Devices Support

The results depicted in this section covers the last Subsection B: Mobile Security Awareness and Devices Support of Section B in the questionnaire (refer to Appendix B). The questions (C19 and C20) to determine the possible risks and device support for M-ICT

4.4.3.1 Risk of Sensitive Information

Figure 4.21

Risk of sensitive information leaking



Source: Primary Data

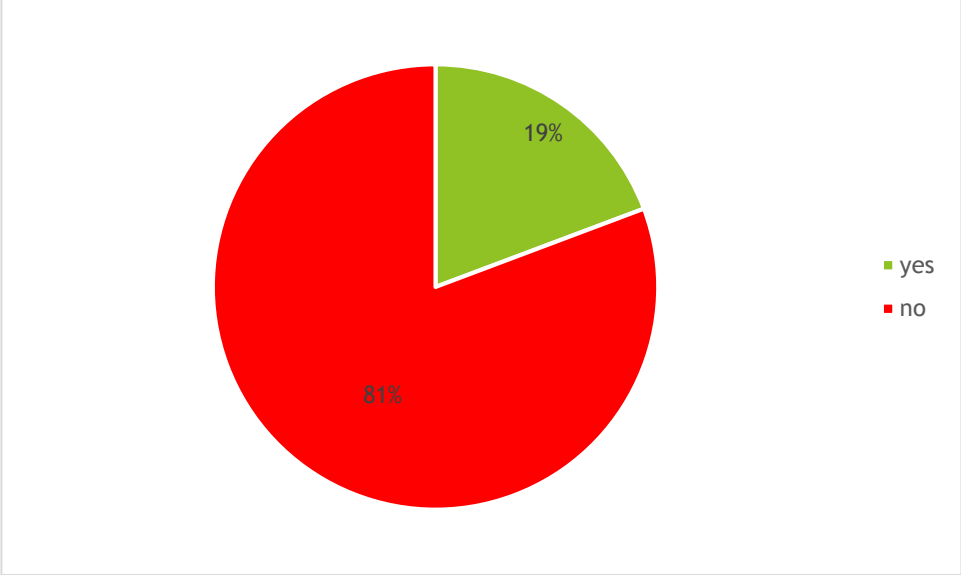
Risk of sensitive information has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant ($P<0.05$) refer to table 4.7.

Figure 4.21 states that 75% of the respondents agreed on the risk of sensitive information leaking from the company, 14% strongly agreed whilst 5% disagreed and 5% were neutral.

4.4.3.2 Usage of IT Support services

Figure 4.22

Usage of IT support for mobile devices



Source: Primary Data

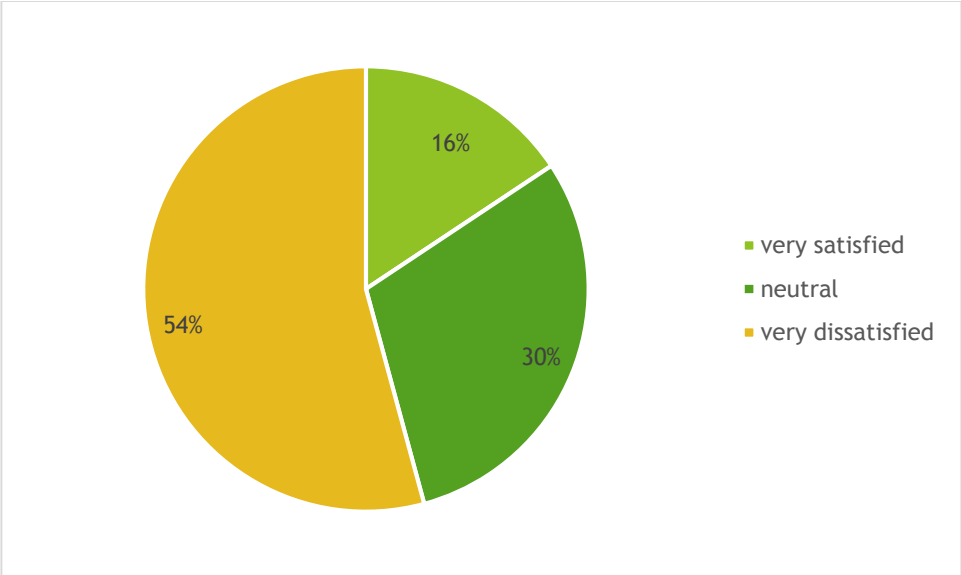
IT Factory support has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant ($P<0.05$) refer to table 4.7.

Figure 4.22 suggests that 81% of the respondents did not get IT Factory support on their mobile phones, whilst 19% agreed that they received the support.

4.4.3.3 Satisfied with Support

Figure 4.23

Satisfaction of IT Factory support on mobile devices



Source: Primary Data

Satisfied with support has a strong bearing to the study since the significance value of .000 is below the critical value of .05 and is relevant to the study as it is statistically significant ($P<0.05$) refer to table 4.7.

Figure 4.23 suggests that 54% of the respondents were very dissatisfied with support they got on their mobiles, whilst 16% were very satisfied and 30% were neutral.

4.4 Conclusion

The results indicates pervasive variety of mobile devices distribution and access, user activities and interaction preferences, high mobile security awareness and lack of mobile device support within TN. The data presented in this chapter will be examined more closely and more thoroughly interpreted in chapter five.

The interpretation of the data will allow for a discussion of the implications and recommendations generated through findings of the current research. Following a presentation of the implications, additional research questions will be identified based information that was not provided in the current study.

CHAPTER 5

SUMMARY, DISCUSSION AND RECOMMENDATIONS

5.1 Introduction

The purpose of this chapter is to summarize the study that was conducted. Included in this summary are a review of the purpose of the study, a revisit of the research objectives, the research methodology used, and a summary of the major findings, conclusions and discussion. Recommendations based on the findings of the study for further research and possible studies conclude this chapter.

5.2 Purpose and research objectives revisited

The purpose of the research was to analyse M-ICT in TN. The objectives of the study were:-

(i) To examine the current usage of mobile technologies and benefits of integration of mobile communications at TN.

(ii) To assess the risk(s) posed by the usage of mobile technologies to TN.

(iii) To recommend suitable integration architecture for M-ICT in TN.

5.3 Research Methodology

The researcher used descriptive research methodology and survey techniques to collect data from selected TN employees across the country. Data collected from the survey

respondents represented their perceptions and usage regarding M-ICT in TN. Respondents completed a survey questionnaire that assessed the M-ICT dimensions of distribution, access, interaction preferences, security awareness, and support (Appendix A). The sample in this study was disaggregated by six (6) departments as illustrated in Table 4.3 to address the fact that there is wide variance in the number of employees within each of the six (6) geographic duty stations identified in Table 4.5.

Data collection was preceded by request letter from supervisor to the Senior Manager: Corporation Communications and Public Relations (Appendix C). On approval of the request from Senior Manager: Corporate Communication online web survey from questionnaire in Appendix A was generated using Survey Tracker software. An email was send to the employees with a link to complete online survey. A response rate of 103% is achieved from a sample size of 83 respondents (n=83).

Data from the questionnaires was first coded and then entered into SPSS. Then descriptive statistics in SPSS such as frequencies were used to establish the data structure. Thereafter pie charts, bar graphs and histograms were generated in Microsoft Excel to present the data.

5.4 Summary of Major Findings

There is a lot that needs to be done in order to militate against the high risk of sensitive information leakage from the company due to amount of corporate documents being accessed from mobile devices. The fact that there is no control over the access of data

through the mobile devices makes the company information insecure. Without control measures in place renders the system susceptible and a lot of sensitive and classified information becomes exposed and accessible to people who are not supposed to have that information.

The summary of the major findings are that:

- 51% of the respondents owned laptop computers either company provided or privately
- 7% owned desktop computers
- 52% of the respondents have Apple tablets
- 52% of respondents have Samsung smartphones
- 51% of the respondents have Android smartphone operating systems
- 24% of the respondents use their tablets on reading personal email
- 21% of the respondents use their smartphone on send or receiving instant messaging / social media
- 76% of the respondents use their smartphones and tablets for about an equal amount for work and personal reasons
- 60% downloaded 1-5 applications on their tablets and smartphones
- 60% use their mobile devices to access/interact through email
- 60% use mobile websites to access/interact through emails
- 62% spend less than 1 hour browsing on their mobile devices
- 33% spend less than 1 hour outside of the office environment

- 75% of the respondents agreed on the risk of sensitive information leaking from the company
- 81% of the respondents did not get IT Factory support for their mobile phones.
- 54% of respondents were dissatisfied with the IT support they received.

The findings of this study indicates a positive trend that laptop computers usage is still the leading mobile devices followed by the smartphones and tablets. It noticeable that Android OS is dominant among the mobile operating systems. In terms of user activity majority of respondents used tablets for reading email while they use smartphones for instant messaging and social networking. High number of respondents indicated that they use their smartphones and tablets for about an equal amount for work and personal reasons. Furthermore, respondents downloaded various mobile applications on their tablets and smartphones. Respondents use their mobile devices to interact mainly through emails and mobile websites. In addition, it's recorded that employees spend less than an hour on Internet browsing from their mobile devices. Majority of the respondents agreed that there is a risk of information leakage from the company through the use of mobile devices. Most respondents indicated that they did not receive any mobile support from IT Department.

Above mentioned key findings the researcher recommends mobile integration architecture for TN as depicted in Figure 5.1

5.5 Discussion

Following the major findings the research objectives are revisited and discussions to the results are done.

5.5.1 Research Objective 1

The current usage of mobile technologies and benefits of integration of mobile communications at TN.

The usage of laptops, smartphones and tablets surpasses desktops as depicted in Figure 4.1 and Figure 4.2. The finding on this was similar to studies in other parts of the world (Ferrer et al., 2012, and PWC, 2010). Furthermore, it is noticeable that respondents owned more than one device hence BYOD is more inevitable. The prevalence of BYOD phenomena is provided in Figure 4.11 and Figure 4.12 thus TN workforce is currently using mobile devices for both personal and work-related tasks.

In addition to consumerisation of M-ICT, the study indicates that the benefits of mobile technologies are reaped mainly through email communication followed by instant messaging and social networks (Figure 4.19 and Figure 4.20). The finding indicates that there is lack of B2E, B2B, and B2C in TN mobile communications to take advantage of a number of benefits including connectivity, flexibility, interactivity, responsiveness to customers, productivity, and operational efficiencies as suggested by other researchers

(Kakihara, 2002, and Mash, 2001). Moreover, these benefits can only achieve through enterprise applications integration. The benefits of BYOD are undeniably compelling. Organizations that have embraced BYOD have reported improved productivity and employee retention, enhanced mobility, a more flexible work environment and improved IT value to the business. BYOD can enable virtual work environments that provide individual workers the freedom to work when and where they choose. That, ultimately, can help trim operating costs. However, there are also risks associated to the use of mobile devices to access company information through the internet.

5.5.2 Research Objective 2

Assessment of the risks posed by the usage of mobile technologies to TN.

The risks mainly posed by the usage of mobile technologies at TN are that some of the staff members who should have no access to certain information from the organisation can still access the information through internet on their mobile devices. There is no limit to what the employees can access especially through VPN. This causes a lot of problems since people can have access to classified information on the corporate LAN. Furthermore, usage of different mobile technologies poses different threats on the different models of devices, operating systems, applications, and access networks (Figure 4.3, Figure 4.4, Figure 4.5, Figure 4.6, Figure 4.7, Figure 4.8, Figure 4.13 and Figure 4.14). However the research also revealed that respondents did not get IT Factory support for their mobile devices in Figure 4.25. This may be caused by insufficient staffing and skills to support

the heterogeneous mobile devices, OS's and applications. This is worrisome result considering the number of possible threats such as data loss, mobile malware, software vulnerabilities, compliance, data and network security posed by mobile technologies (EMC, 2009 and Forrester, 2012). BYOD implies new challenges in security and IT support. It is a fraught with risk in the absence of a proper security strategy to support and enforce controls on heterogeneous mobile devices and applications.

5.5.3 Research Objective 3

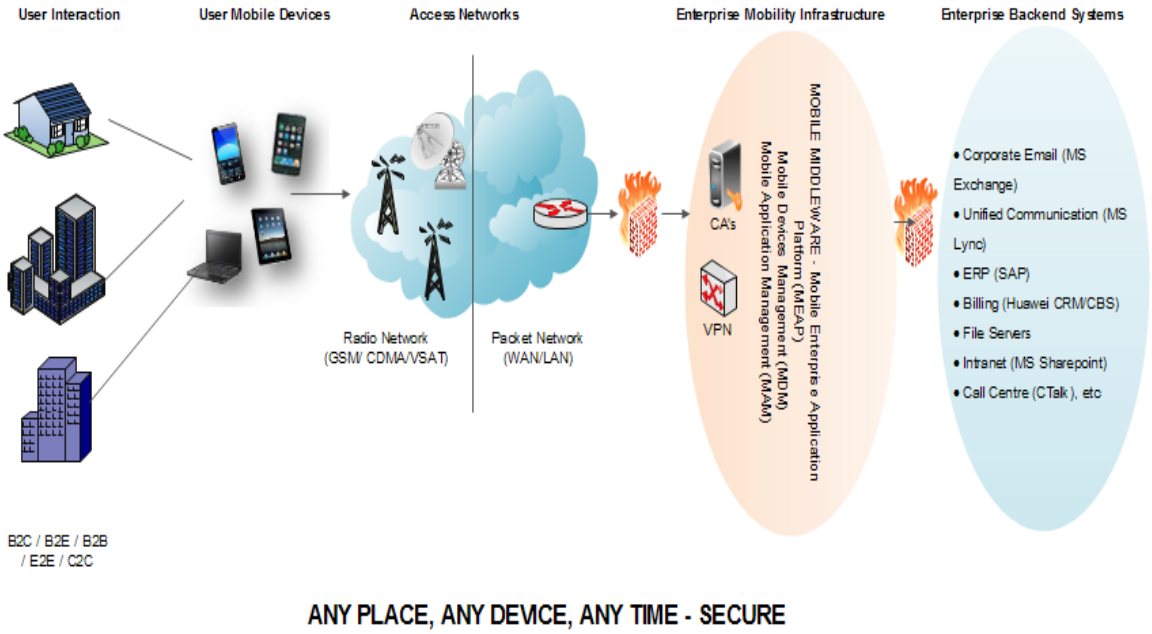
The recommended enterprise application integration architecture for M-ICT in TN.

Based on the findings of this study it is evident that majority of employees owns multiple mobile devices with variety of OS, mobile applications and uses it for both personal and work purposes. Furthermore, respondents indicated low usage (Figure 4.15 – Figure 4.18) with enterprise applications is attributed by little access to these systems from their mobile devices. This stresses more the need for M-ICT integration in TN to make enterprise applications accessible from mobile devices to empower employees and to reap the benefits of EM.

Subsequently, the study recommends device agonistic enterprise application integration architecture to ensure data integrity through secured enterprise mobility infrastructure. Below is high-level design of proposed TN Enterprise Mobility Architecture in Figure 5.1.

Figure 5.1

Proposed TN Enterprise Mobility Architecture



Following section explains the elements high-level design depicted in Figure 5.1

5.4 Defining the elements of Enterprise Mobility Architecture

- **User Interaction Spectrum** are communication channel among the different groups to enhance communication and collaboration such E2E, B2E, B2C, B2B, etc. irrespective of their physical location aimed at improvement of customer responsiveness, employee productivity and operational efficiencies (Irani, et al., 2003). This taxonomy is scalable and flexible to accommodate more communication channels.

- **User Mobile Devices** are mobile devices, including smartphones, tablets, laptop computers and other equipment that support multiple radio connectivity such as cellular and Wi-Fi. They also host voice and data applications on general purpose operating system (OS) environments such as Apple iOS, Android, RIM Blackberry, Windows Phone, and others as found in Figure 4.7 and Figure 4.8.

- **Access Networks** are mobile communication networks provided by cellular service providers such MTC, TN Mobile and Wi-Fi access systems e.g. public hotspots, which provide data, network connectivity (Tao & Chen, 2010). Whether service provider or corporately controlled, these networks provide "mobility" through wireless data network access and "immediacy" that enables use of TN enterprise applications from anywhere and anytime (Basole, 2007). Typically, TN is using wireless LAN within the campus area network which provides access between offices, buildings and towns thus can leverage on the existing Wi-Fi infrastructure.

- **Enterprise Mobility Infrastructure** provides the enterprise connection for all communications with user mobile devices. It includes call control to establish data connections with authorized mobile devices. Applications may be hosted here, or proxies/gateways may be provided to interact with mobile devices security applications and to route TN enterprise services traffic. Hence, the Enterprise Mobility Infrastructure will secure, mediate, and manage the interaction between

TN enterprise services and authorized mobile devices, applications and users. User requests for service are always routed to and handled by enterprise mediation; authentication and authorization decisions for access to secure data and services are made in the enterprise. The main component of the enterprise mobility infrastructure is the Mobile Enterprise Application Platform (MEAP) or mobile middleware with cross-form mobile development tools. MEAP as a platform includes following capabilities:

  - Comprehensive integration capabilities – Connectivity to corporate systems such as SAP, CRM, Billing, etc.
  - Mobile Application Development – Integrated Development Environment (IDE) for building mobile applications.
  - Mobile Device Management (MDM) capabilities – Support for device provisioning, secure transmission of data, remote configuration, mobile asset tracking, policy identification and adaptation, etc.
  - Mobile Application Management (MAM) capabilities – Support for provisioning and access control to mobile applications used in business settings (configuration settings, user authentication, push notification services, application usage analytics, etc.)

- **Enterprise Backend Systems** are the existing and evolving enterprise services provided for all TN users, including mobile users using enterprise applications. TN enterprise services include applications such as voice communications with evolved derivatives such as presence, chat, and conferencing using Microsoft

Lync; email using Microsoft Exchange; corporate data via file servers; Intranet via Microsoft SharePoint; ERP using SAP; CRM/Billing via Huawei CBS, CTalk Call Centre and Track IT Helpdesk.

5.5 Security

Security infrastructure of proposed enterprise mobile infrastructure ensures secure access between mobile devices, access networks, TN enterprise services and data. Henceforth, as depicted in Figure 5.1 security consists of firewalls between the access networks, Enterprise Mobility Infrastructure and backend systems. Furthermore, layers of encryption, authentication and authorization, boundary protection, possible hardening of devices, and mobile device provisioning and management all contribute to the overall security. In order to adequately protect sensitive information, the following cryptographic principles apply:

- To cross open access networks, two layers of approved commercial cryptography are required. One of these layers will be an Internet Protocol Security (IPsec) VPN which establishes a secured path between the mobile devices and the Enterprise Mobility Infrastructure. The other one is Public Key Infrastructure (PKI) to provide greater control over issuing, renewing, revoking, and managing Secure Sockets Layer (SSL) certificates while still gaining the advantages of using a trusted CA (Certificate Authority).

- The implementation of the two layers must be independent. Using two independent layers reduces the potential for compromise of classified or sensitive information in case of implementation errors.
- TN-issued PKI credentials should be used for mutual authentication in both layers. The mobile devices connect to the enterprise with layered encryption and authentication.
- All data between employees' mobile device and the Enterprise Mobility Infrastructure is protected in an IPsec VPN tunnel. The IPSec VPN connection must be established before connections to enterprise services are permitted. The VPN Gateway serves as the main entry point into the Enterprise Mobility Infrastructure and authenticates requested VPN associations using the Internet Key Exchange (IKE) protocol. A VPN client that cannot be identified or authenticated is denied access to the Enterprise Mobility Infrastructure and to all enterprise services.
- Within the VPN tunnel, application traffic is encrypted to provide an additional layer of protection. The inner layer may depend on the applications or services being used.

5.6 Recommendations

It is clear from the results of this study that the use of M-ICT in TN is widespread among the employees. However, the lack of M-ICT integration for TN enterprise services is

undesirable. Moreover, the study highlights inadequate M-ICT support provided by IT Department. It is, therefore, important for TN IT management to provide a unified and secure architecture as illustrated in Figure 5.1 to address the issues of heterogonous device, application management and security for multiple devices per user environments.

Based on the findings the following are recommended:-

- The management should adopt a conceptual multi-phase framework for M-ICT integration to provide insights into the dynamics of the BYOD transformation processes (Basole, 2005).
- The IT management at TN, in consultation with the rest of other Departmental Executives, should identify prioritise possible use cases to facilitate communication with suppliers, partners, employees, and customers (B2B, B2E, B2C) irrespective of the physical location.
- The IT management should redefine BYOD and security policies to safeguard user mobile devices, enterprise applications, and data.
- The management should investigate the legal, regulatory and privacy risk mitigation associated with corporate data made available on mobile devices.
- The management should introduce a security awareness program in TN to educate employees on the threats facing the organization and the potential impact thereof on the business.
- The management should re-engineer the IT support processes to accommodate the highly differentiated OS's, platforms, hardware/devices, and applications.

- The management should review the IT staffing and skill set requirements to support corporately provided and or employee owned devices.
- The management should deploy two layered data-in-transit protection to tunnel traffic from the mobile device to the TN enterprise back end systems for the attainment of architecture security in Figure 5.1. Thus all service requests and user traffic from a mobile device are mediated through the Enterprise Mobility Infrastructure.
- The management is encouraged to promote interoperability and use of a wide variety of commercial products by following guidelines:
    - Use open standards and protocols wherever possible.
    - Avoid vendor lock-in, such as use of proprietary protocols.
    - Use standards and service interfaces common with other clients (e.g., fixed, tactical) wherever practical.
    - Integration deployments should be done via MEAP.

5.7 Directions for Future Research

- This research study recommends that further research should be undertaken to determine other variables not covered in the scope of this study but are relevant and contribute to the achievement of the objectives of various corporates adopting M-ICT.
- Similar research may be conducted in areas not covered by this research.

- A further research with a change of methodology and widening of scope to cover a larger population would be recommended.
- Complimentary study in the areas such as internal staffing and skills required to support emerging mobility capabilities would be recommended.
- Further in-depth study on the BYOD transformation processes is also recommended.

5.8 Conclusion

This research had a worthwhile contribution to TN as well as other corporates with the more or less the same size as TN. Furthermore this recommended EM architecture can be adopted as an enterprise integration framework by any organisation using M-ICT with their company. The project will provide knowledge pertaining to the subject and solutions towards curbing the risks associated to sensitive information leakages in organization.

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Appendix A: Questionnaire

An Analysis of Mobile Information and Communications Technologies in Telecom Namibia (AMICT-TN): Enhanced Integration Strategy

The purpose of this questionnaire is to help collect data for the study. This survey has up to 20 questions and will take about 5-10 minutes to complete.

All responses are ANONYMOUS and CONFIDENTIAL.

SECTION A: BIOGRAPHICAL INFORMATION

Please ***tick*** on the box applicable to your response or ***write*** your responses in the spaces provided

1. Gender: ☐ Male ☐ Female
2. Age group: ☐ Less than 25 years ☐ 26 - 44 years ☐ 45 – 60 years
3. In which Division do you work in? ☐ Commercial Operations ☐ Technical Operations ☐ Finance and Administration ☐ Human Resources and Strategic Training ☐ Corporate Communications and PR Internal Audit ☐ MD's Office, Legal Office and Strategy
4. What is your job Grade? ☐ A-Band ☐ B-Band ☐ C-Band ☐ D-Lower ☐ D-Upper ☐ E-Band
5. In which Area/Region do you work in? ☐ Windhoek (HQ) ☐ Windhoek (Central) ☐ Erongo ☐ Hardap ☐ Karas ☐ Far North ☐ North-East
6. How long have you been working for TN? ☐ Less than 3 years ☐ Between 3 and 5 years ☐ Between 6 and 10 years ☐ Between 11 and 20 years ☐ More than 20 years

SECTION B: SURVEY DIMENSIONS

A. MOBILE DEVICES DISTRIBUTION AND ACCESS

7. Which of the following devices do you currently own? *[**Tick** where applicable]*
   ☐ Laptop computer ☐ Desktop computer ☐ Smartphone / touch phone ☐ Tablet
   ☐ Other: _____
8. Which of the following devices is company provided? *[**Tick** where applicable]*
   ☐ Laptop computer ☐ Desktop computer ☐ Smartphone / touch phone ☐ Tablet
   ☐ Other: _____
9. What brand is your mobile device (s)? *[**Tick** where applicable]*

Brand	Tablet	Smartphone
Apple	☐	☐
Nokia	☐	☐
Samsung	☐	☐
Blackberry	☐	☐
Motorola	☐	☐
Other:		

10. Specifically, what model is your mobile device (s)? *[**Tick** where applicable]*

Model	Tablet	Smartphone
iPhone(3G/3GS4/4S/5)	☐	☐
IPAD(2/4)	☐	☐
Samsung Galaxy	☐	☐
Samsung Tab (7.1/8.1/10.1)	☐	☐
Android (various models)	☐	☐
Blackberry (various models)	☐	☐
Nokia (various models)	☐	☐
Other:		

11. What operating system does your mobile device (s) use? ***[Tick** where applicable]*

Operating system	Tablet	Smartphone
Apple iOS	☐	☐
Android	☐	☐
RIM OS (Blackberry)	☐	☐
Windows mobile	☐	☐
Symbian OS	☐	☐
I don't know	☐	☐
Other:_____		

12. What kind of wireless data access do you currently have for your smartphone / touch phone?
☐ 3G ☐ 4G ☐ Wi-fi (Wireless Fidelity) ☐ No wireless access ☐ I don't know

B. MOBILE USER ACTIVITY– INTERACTION PREFERENCES

13. Which of the activities below do you typically perform on your mobile device? ***[Tick** where applicable]*

Activity	Tablet	Smartphone
Make or receive phone calls	☐	☐
Send or receive text messages (SMS)	☐	☐
Send or receive videos, photo	☐	☐
General internet browsing	☐	☐
Read personal email e.g. Gmail, Ymail, Hotmail, etc.	☐	☐
Participate in social media/networking sites e.g. Facebook, Twitter	☐	☐
Read news, food and entertainment	☐	☐
Send or receive instant messages e.g. whatzapp, gtalk	☐	☐
Take photos	☐	☐
Play music	☐	☐
Read corporate email	☐	☐
Research products and services	☐	☐
Map information	☐	☐
Download and watch videos/music/podcast	☐	☐
Perform banking activities	☐	☐
Purchase products and services	☐	☐
Read or post to blogs	☐	☐
Check sports news, scores, manage fantasy leagues	☐	☐
Read eBooks	☐	☐
Play games	☐	☐
Other:_____		

14. In a typical week, do you use your mobile device most often for work, for personal reasons, or about an equal amount on both? ***[Tick** where applicable]*

Usage	Tablet	Smartphone
Much more often for work	☐	☐
Somewhat more often for work	☐	☐
Slightly more often for work	☐	☐
About an equal amount for work and personal reasons	☐	☐
Slightly more often for personal reasons	☐	☐
Somewhat more often for personal reasons	☐	☐
Much more often for personal reasons	☐	☐

15. How many applications have you downloaded to your mobile device? *[**Tick** where applicable]*

Number of Apps	Tablet	Smartphone
0	☐	☐
1-5	☐	☐
6-10	☐	☐
11-15	☐	☐
16+	☐	☐

16. How do you prefer to access / interact with the following from your mobile device? *[**Tick** where applicable]*

Activity	Mobile App	Mobile Website	Either mobile app or mobile website	I do not use mobile device for this activity
Email	☐	☐	☐	☐
Social Media Updates	☐	☐	☐	☐
Map Information	☐	☐	☐	☐
Online Banking	☐	☐	☐	☐
News	☐	☐	☐	☐
Food/Entertainment	☐	☐	☐	☐
Online shopping	☐	☐	☐	☐
SAP	☐	☐	☐	☐
CRM / Billing	☐	☐	☐	☐
Helpdesk Support portal	☐	☐	☐	☐
Intranet	☐	☐	☐	☐

17. On average, how much time per day do you spend on web browsing/Internet from the following? *[**Tick** where applicable]*

Time spend	Mobile Phone	Tablet	Home Computer /Laptop	Mobile apps
Less than 1 Hour	☐	☐	☐	☐
1 – 2 hours	☐	☐	☐	☐
3 – 4 hours	☐	☐	☐	☐
5 - 6 hours	☐	☐	☐	☐
More than 6 hours	☐	☐	☐	☐

18. On average, how much time per day do you spend outside of the office environment?
☐ Less than 1 Hour ☐ 1 – 2 hours ☐ 3 – 4 hours ☐ 5 - 6 hours ☐ More than 6 hours

C. MOBILE SECURITY AWARENESS – DEVICE SUPPORT

19. Do you believe there is a high risk of sensitive information leaking from the company due to email/documents access from mobile devices?
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

20. How satisfied are you with the support on your mobile device (s) from IT Factory?
☐ Very Satisfied ☐ Somewhat Satisfied ☐ Neutral ☐ Somewhat Dissatisfied
☐ Very Dissatisfied

Thank you for taking time to complete our survey! We value and appreciate your feedback!

Appendix B: One –Way Anova Statistic Results

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
gender	Between Groups	17.929	4	4.482	201.705	.000
	Within Groups	1.733	78	.022		
	Total	19.663	82			
age	Between Groups	19.793	4	4.948	79.465	.000
	Within Groups	4.857	78	.062		
	Total	24.651	82			
division	Between Groups	240.246	4	60.061	136.261	.000
	Within Groups	34.381	78	.441		
	Total	274.627	82			
jobgrade	Between Groups	70.267	4	17.567	92.627	.000
	Within Groups	14.793	78	.190		
	Total	85.060	82			
arearegion	Between Groups	297.423	4	74.356	266.860	.000
	Within Groups	21.733	78	.279		
	Total	319.157	82			
workexperience	Between Groups	157.081	4	39.270	144.924	.000
	Within Groups	21.136	78	.271		
	Total	178.217	82			
deviceowned	Between Groups	106.068	4	26.517	194.557	.000
	Within Groups	10.631	78	.136		
	Total	116.699	82			
devicecompanyprovided	Between Groups	106.068	4	26.517	194.557	.000
	Within Groups	10.631	78	.136		
	Total	116.699	82			
tablet	Between Groups	113.081	4	28.270	252.697	.000
	Within Groups	8.726	78	.112		
	Total	121.807	82			
smartphone	Between Groups	113.081	4	28.270	252.697	.000
	Within Groups	8.726	78	.112		
	Total	121.807	82			
modeltablet	Between Groups	113.081	4	28.270	252.697	.000
	Within Groups	8.726	78	.112		

	Total	121.807	82			
	Between Groups	113.081	4	28.270	252.697	.000
smartphonedevice	Within Groups	8.726	78	.112		
	Total	121.807	82			
	Between Groups	80.836	4	20.209	59.725	.000
tabletoperatingsystem	Within Groups	26.393	78	.338		
	Total	107.229	82			
	Between Groups	80.836	4	20.209	59.725	.000
smartphoneoperatingsystem	Within Groups	26.393	78	.338		
	Total	107.229	82			
	Between Groups	.000	4	.000	.	.
wirelessdataaccess	Within Groups	.000	78	.000		
	Total	.000	82			
	Between Groups	42.910	4	10.728	76.449	.000
tabletactivities	Within Groups	10.945	78	.140		
	Total	53.855	82			
	Between Groups	42.910	4	10.728	76.449	.000
smartphoneactivities	Within Groups	10.945	78	.140		
	Total	53.855	82			
	Between Groups	9.466	4	2.367	32.304	.000
tabletusage	Within Groups	5.714	78	.073		
	Total	15.181	82			
	Between Groups	9.466	4	2.367	32.304	.000
smartphoneusage	Within Groups	5.714	78	.073		
	Total	15.181	82			
tabletapplicationsdownloaded	Between Groups	18.946	4	4.737	395.840	.000
	Within Groups	.933	78	.012		
	Total	19.880	82			
smartphoneapplicationsdownloaded	Between Groups	18.946	4	4.737	395.840	.000
	Within Groups	.933	78	.012		
	Total	19.880	82			
	Between Groups	344.781	4	86.195	254.668	.000
mobileappsaccessinteract	Within Groups	26.400	78	.338		
	Total	371.181	82			
mobilewebsitesaccessinteract	Between Groups	344.781	4	86.195	254.668	.000
	Within Groups	26.400	78	.338		
	Total	371.181	82			

eithermobileappsprmobilewebsitesaccessinteract	Between Groups	344.781	4	86.195	254.668	.000
	Within Groups	26.400	78	.338		
	Total	371.181	82			
idonotusemobiledevicesforthisactivityaccessinteract	Between Groups	322.268	4	80.567	225.819	.000
	Within Groups	27.829	78	.357		
	Total	350.096	82			
mobilephonebrowsing	Between Groups	65.489	4	16.372	206.847	.000
	Within Groups	6.174	78	.079		
	Total	71.663	82			
tabletbrowsing	Between Groups	74.960	4	18.740	151.212	.000
	Within Groups	9.667	78	.124		
	Total	84.627	82			
homecomputerlaptopbrowsing	Between Groups	74.960	4	18.740	151.212	.000
	Within Groups	9.667	78	.124		
	Total	84.627	82			
mobileappsbrowsing	Between Groups	74.960	4	18.740	151.212	.000
	Within Groups	9.667	78	.124		
	Total	84.627	82			
riskofsensitiveinformation	Between Groups	22.512	4	5.628	46.267	.000
	Within Groups	9.488	78	.122		
	Total	32.000	82			
itfactorysupport	Between Groups	10.666	4	2.666	92.436	.000
	Within Groups	2.250	78	.029		
	Total	12.916	82			
satisfiedwithsupport	Between Groups	157.698	4	39.425	123.239	.000
	Within Groups	24.952	78	.320		
	Total	182.651	82			