THE IMPORTANCE AND AFFORDABILITY OF INTEGRATED COMMUNICATION NETWORK IN ETHIOPIAN DEFENSE FORCE

By:

NEGASSI TIKUE (COLONEL)

June, 2017

Addis Ababa, Ethiopia

THE IMPORTANCE AND AFFORDABILITY OF INTEGRATED COMMUNICATION NETWORK IN ETHIOPIAN DEFENSE FORCE

By: Negassi Tikue (Colonel)

Advisor: Teklegiorgis Assefa (Ast. Professor)

Project thesis Submitted to Addis Ababa University, School of Commerce in Partial Fulfillment of the Requirements for the Award of Master of Arts Degree in Project Management/MAPM/

June, 2017
Addis Ababa, Ethiopia

ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

MASTER OF ARTS DEGREE PROGRAM IN PROJECT MANAGEMENT

THE IMPORTANCE AND AFFORDABILITY OF INTEGRATED COMMUNICATION NETWORK IN ETHIOPIAN DEFENSE FORCE

By: Negassi Tikue (Colonel)

Approved By Board of Examiners

External Examiner_____ Signature _____Date_____

Internal Examiner _____Signature _____Date_____

Advisor _____Signature _____Date_____

DECLARATION

I, Negassi Tikue, student of the faculty of Business and Economics school of commerce AAU, aware of my responsibility, declare and certify with my signature that my thesis work entitled "*Importance and Affordability of Integrated Communication Network for the Ethiopian Defense Force"* is entirely the result of **my own work.** The information presented in this paper is true and original to the best of my knowledge and understanding. Materials and Sources used have been acknowledged and the work had not been submitted to any educational institutions for the requirement of any degree or diploma.

Negassi Tikue Date

CERTIFICATE

This is to certify that the work incorporated in the thesis "*Importance and Affordability of Integrated Communication Network for the Ethiopian Defense Force" submitted* by Negassi Tikue was carried out by the candidate under my guidance. Such materials as has been obtained from other sources have been duly acknowledged in the thesis.

_____

Teklegiorgis Assefa (Ast. Professor)

Thesis Advisor

ACKNOWLEDGEMENT

The preparation of this thesis has taken many twists and turns and involved a number of people and departments whose support has made it possible. I would therefore like to acknowledge the help I have received. To this end, I wish to express my heartfelt appreciation to Ministry of National Defense Force, the FDRE that supported me to continue my graduate study and the staff members of the communication and information department and higher officials who take part on this research by providing me relevant secondary and primary data.

I would also like to express my gratitude to my advisor Teklegiorgis Assefa (Ast. Professor) for his unreserved guidance, patience, diligence and understanding that made this study possible. His constructive comments by reading the whole paper critically are really appreciated. I also appreciate his punctuality and respect he has shown for me. Moreover, I wish to extend my gratitude also to the college community who provide me the educational background and assistance during my stay at the University.

My sincere thanks go to my friends, who were assisting me during the course and thesis work specially, Dereje G/Michael (Senior Researcher) who was available to help for any question I asked during the research time.

Finally, I would like to dedicate this research work with profound gratitude to my family, particularly my wife, Major Seret G/Medhn who took all the responsibility of managing the house and social issues in addition to her office responsibilities. My children Seare, Danny and Delina your moral encouragement and motivation were unforgettable.

ABSTRACT

Military communications involve different actors and technologies that facilitate the effectiveness and efficiency of the army command and control system. The integrated communication network (ICN) is one of the recent global communication technologies which different countries are currently using. Conversely, the FDRE Ministry of National Defense Force couldn't introduce such centralized network system. Thus, this study was intended to describe the importance and affordability of the integrated communication network by a mixed research design or approach with descriptive methodology. Hence, 160 defense communication staffs and higher officials targeted as a study population and 114 sample respondents computed by Solvin's formula and structured in to two groups that account 70 technical staff and 36 higher officials and 8 key informants purposively selected to collect data by semi structured interview and open and closed ended questionnaire and substantiated with document analysis. The data analyzed in both quantitative and qualitative manner. The findings were; there are various challenges of the existing network system; there are better understandings on benefits of the ICN over its costs; comparatively ICN is better in its technique, mission and costs and stakeholders are willing to accept it. Based on the major findings it is concluded that, the integrated communication network is important and affordable to the Ethiopian National Defense Force. The network infrastructure found to be a leased line for current program and for the future it will be an independent network. The study also recommended that further cost benefit analysis or financial analysis on the Integrated Communication Network more important to show the affordability.

***Key words**: importance, affordability, integrated communication network (ICN)*

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIXES

ACRONYMS AND ABRIVIATIONS

CIS	Communication and Information System
COMSEC	Communications Security
C3	Command, Control and Communication
C4I	Command, Control, Communications, Computer, and Intelligence
C4ISR	Command, Control, Communications, Computer, Intelligence, Surveillance, & Reconnaissance
CR	Cognitive Radio
CRN	Cognitive Radio Network
CRCN	Cognitive Radio Cloud Network
DF	Degree of freedom
DJRP	Digital Joint Reconnaissance Pod
DoD	Department of Defense
DTE	Digital Terminal Equipment
EW	Electronic Warfare
FDRE	Federal Democratic Republic Of Ethiopia
GII	Global Information Infrastructure
IP	Internet Protocol
ICT	Information Communication Technology
ICN	Integrated Communication Network
IS	Information System
JFC	Joint Force Communication
N.D	No Date
NATO	North Atlantic Treaty Organization
SANDF	South African National Defense Force
SATCOM	Satellite Communication
SPSS	Statistical Package for Social Science
USA	United States of America
VOIP	Voice over Internet Protocol
RF	Radio Frequencies
Vs.	Versus
Wi-Fi	Wireless Fidelity

Table of Contents

CHAPTER ONE

1. INTRODUCTION

In this chapter, the background of the study, statement of the problem, research questions, objectives of the study, significance of the study, delimitation of the study, definition of key terms, and organization of the study and conceptual frameworks have been treated one after the other

1.1. Background of the Study

Defense organization across the world depends heavily on their communication capabilities to successfully complete a mission. Today's battlefield commanders rely on network of well-informed geographically dispersed forces to achieve an information advantage that can be translated to a competitive war fighting advantage. Battlefield communications have been dominated by push-to-talk radio technology since the 1940s. Today state- of-the-art digital radio Systems form a multitude of international suppliers and provide ruggedized solutions that meet the tactical requirement of military units around the world (Boed, 2000).

Military communications today are diverse and converged technology networks. According to Worth, (2008), Mullen, (2010), and Goldfein, (2014) the convergence of strategic and tactical networks around a broad range of technologies, including different types of radios, voice over IP (VOIP), Satellite Communication (SATCOM), cellular, cryptographic devices, WIFI, internet and others, make it a very challenging heterogeneous environment in which to deploy, network and operate.

In recent years, the acceleration of technological growth has propelled many advances in both civilian and military sectors. We now live in an information age where communication and data processing continue to rise at an increasing rate; technological boosts continue to enable many organizations to increase their operational capacity by several factors. With enhanced computing and information systems, organizations are able to operate at increased speeds and thus seize a time- critical advantage (Mullen, 2010).

Integrated Communications System is a collection of different communications networks, transmission systems, relay stations, tributary stations, and data terminal equipment usually capable of interconnection and interoperation to form an integrated whole (Boed, 2000).

Ethiopian Defense is mainly using Radio Communications System, Telephone System, Postal System, internet etc. as its means of communications. Each of these systems is having dedicated equipment. However, these systems are often unable to communicate with each other due to incompatibility & lack of integration. Now-a-days Defense Communication system has become a serious issue to find out a reliable Integrated Communication System.

According to Warsaw, (2012) the NATO countries are better benefiting from such centralized command and control system which facilitated better information communication technology and infrastructure. It helps with any Warfare and disaster management.

Digital Joint Reconnaissance Pod (DJRP) which is part of ICN, installed and integrated on the South African Gripen fighter aircraft to take high-resolution images of the battlefield as it flies overhead. Integrated Communication Networks served as Tactical intelligence solutions to the South African National Defense Force (SANDF) by providing radar and optic sensors, specially developed software, deployable infrastructure and specific types of communication equipment. These used to gather intelligence data in order to make strategic assessments of the way to engage hostile forces, assisting with obtaining quick intelligence and allowing the facilitation of processing large intelligence data to create map of enemy forces.
(www.thalesgroup.com/en/defense-1).

In order to compete in the international communities our country needs to design and implement Integrated Communication Networks in its defense forces and identifying the importance and affordability of this communication technology will help to improve their efficiency and effectiveness.

1.2. Statement of the Problem

According to Mullen, (2010) communication systems suffers with scattered networks, lack of integration, and difficulty for management, natural and manmade noise, break down of system, internal noise and intercept and attacked by the hostile Electronic Warfare /EW/.

The FDRE defense force communication department, evaluation report shows the Ethio-Eritrea war in 1997-1999, the operation was successful in over all aspects and defeated the enemy. But the friendly military communications were not able to communicate well and facilitate the chain of command and control system due to fragmented communication ways. This happened because the short range radio communication signal was highly degraded by the atmospheric layers and other factors. Furthermore, specific problems of the current defense communication system are: recorded data are vulnerable to damage, lost, theft and unnecessary modification. Due to diversified and fragmented networks it is difficult to access and control all means of communications at different levels.

As of Hurley (2012), in such conditions, quality and speed of the messages will be affected. So that searching and compiling information will be difficult and time taking also prone to error as well as vulnerable to be hacked.

On the other hand, USA according to the DoD cyber strategy, (2015) & worth, (2008), China as of Zhang. W. et al (2015), Australia as of Hurley, (2012), NATO member countries as of Warsaw, (2012) and South Africa, as of www.thalesgroup.com/en/defence-1 are strengthened by centralized command control system which integrates the various communication methods in to one system which uses better technology and knowledge. In the competitive global environment, if the defense force of Ethiopia didn't establish and continue communication with the existing network system, it is very difficult to manage the combat operation & protect the hostile electronics attacks. Hence, this study intended to describe the importance and affordability of the integrated communication network for Ethiopian defense forces to give an insight to stakeholders and decision makers.

1.3. Research Questions

1.3.1. General Questions

How is the integrated communication network important and affordable for the Ethiopian defense force?

1.3.2. Sub Questions

- What are the challenges of the existing communication system in defense force of Ethiopia?
- What are the understandings on relevant costs and benefits of the integrated communication network?
- What are the comparative advantages of integrated communication network system over the existing system in defense force of Ethiopia?
- What is the willingness to accept the integrated communication network?

1.4. Objectives of the Study

1.4.1. General objective

The main purpose of this research is to describe the importance and affordability of the integrated communication network for the Ethiopian defense force.

1.4.2. Specific Objectives

- To describe the challenges of the existing communication system of defense force of Ethiopia.
- To describe qualitative understandings on the relevant costs and benefits of the integrated communication network system.
- To show the comparative advantages of integrated communication network system over the existing system in defense force of Ethiopia.
- To identify the willingness to accept the integrated communication network by experts and higher officials of the Defense Force of Ethiopia.

1.5. Significance of the Study

The results of this study are important to the Ethiopian Defense Force institutions and stakeholders. It particularly helps the communication and information department to conduct cost benefit analysis with quantitative approach and determine the importance and affordability of the ICN in financial terms. It gives decision support tools to the higher officials and experts in the introduction of ICN.

Other military professionals and students will use it as a reference for further investigation on the military communication issues.

1.6. Scope of the Study

This descriptive study was conducted within the FDRE Ministry of National Defense. Professional staffs, department heads and higher officials of the Head quarter were contacted for primary and secondary data collection. The study also used mixed research approach in which qualitative and quantitative data collection and analysis were involved. The sampling procedure was a non-probability sampling, selected samples with judgmentally and to determine sample size by Solvin's sampling formula was used.

Finally descriptive analysis was done with SPSS 20 and results were displayed by simple descriptive statistics. Whereas, secondary data was collected from different books, websites journal articles, policy and other relevant documents and analyzed together.

1.7. Limitations of the Study

Busyness of the higher officials and key informants to conduct interview, lack of relevant references on the topic and short period of time available to conduct the research were the major challenges. The aforementioned things were among the limitation the study faced.

1.8. Operational Definitions

Affordability: the capacity to meet the financial obligations arising from buying integrated communication network.

Command: - the functional exercise of authority based upon knowledge to attain an objective.

Control: - the process of verifying & connecting activity such that the objective or goal of command is accomplished.

Command and control system:- is the facilities, equipment, communications, procedures, and personnel essential to a commander for planning, directing, and controlling operations.

Command, control & communication system: - is an information system employed within a military organization.

Command, control, communications, computer, intelligence, surveillance, and reconnaissance (C4ISR) is to provide capabilities that enable forces to generate, use, and share the information necessary to survive and succeed on every mission.

Communication in defense: - It is across the world depends heavily on their communication capabilities to successfully complete a mission.

Communication and information system (CIS) is an assembly of equipment, procedures and personnel organized to accomplish data transfer and information processing functions.

Communications network is an organization of stations capable of intercommunications, but not necessarily on the same channel.

Communication system: -the ability & function of providing the necessary liaison to exercise effective command between tactical or strategic units of command.

Communications security (COMSEC) **is** the protection resulting from all measures designed to deny unauthorized persons information of value that might be derived from the possession

Information and communications technology (ICT) is the applied science and engineering aspects related to the creation, manipulation, presentation, dissemination of data for the communication of information between users.

Integrated communications a property referring to the ability of diverse system & organization to work together /inter-operate.

Interoperability is the condition achieved between communications-electronics systems or equipment when data, information or services can be exchanged directly and satisfactorily between them and/or their users

Protocol: - is a set of rules that governs the communications between computers on a network.

Strategic: - broadly defined methods of accomplishing a goal. the readiness and passion of accept some thing

Tactical: - Narrowly defend methods of accomplishing objectives on route to a strategic goal

Willingness to Accept: people's desire or motive to accept and implement something.

1.9. Organization of the study

The thesis is organized around five chapters. The first chapter deals with the background, statement of the problem, the general and specific objectives, research question, the significance, scope and limitation of the study and some of the operational definition of terms used in the analysis. The second chapter reviews the related literature on integrated communications network, concepts, theories, definition, roles and activities. It also discusses the challenges of the existing communication networks. Chapter three presents the research design and methodology including the research sampling approach, data source and the means by which it is gathered and on the analysis methods employed. The fourth chapter presents data presentation, analysis and interpretation. Finally the study draws summery of finding; conclusion and recommendation from the discussion of the previous chapters which are presented in chapter five.

CHAPTER TWO

2. REVIEW OF RELATED LITERATURE

As stated in Warsaw, (2012) any decision making process in the military science and its effectiveness demands sound knowledge on the state or the processes of the communication activities typically provided through trusted communication network. In this chapter the researcher discussed some concepts and critical review of empirical studies related to military communications specifically, integrated communication networks.

2.1. Concepts on military science and defense forces

2.1.1. Military science

According to Lodewyckx, (2011) Military science concerns itself with the study of the diverse technical, psychological, and practical phenomena that encompass the events that make up warfare, especially armed combat. It strives to be an all-encompassing scientific system that if properly employed, will greatly enhance the practitioner's ability to prevail in an armed conflict with any adversary. To this end, it is unconcerned whether that adversary is an opposing military force, guerrillas or other irregulars, or even knows of or utilizes military science in return. Lodewyckx also stated that military science seeks to interpret policy into what military skills are required, which by employing military concepts and military methods, can use military technologies, military weapon systems, and other military equipment to produce required military capability.

2.1.2. Defense Forces

Defense force has a special contribution to make the security policy of a given nation to be implemented. The primary function of the Defense Force is to strengthen the domestic policy and foreign policy of a state with force or the threat of force. A loosely defense force a country is no longer able to offer security to its citizens. Even in the most perfect democracy, the existence of the military is a signal of the state's determination to retain its power and enforce laws, rules and regulations as well as to implement the policy (Girma, et al, 2014).

The Government of the Federal Democratic Republic of Ethiopia Defense Force has been established by decrees of proclamation no 27/1996 and has a mandate based on the constitution

to set objective, vision, and performing missions accordingly. And Girma, et al.(2014), while today's security mission require a capable, versatile, and agile forces and institutions that meet the requirements emanate from the challenges of non-state actors like terrorism, peace operation and non-conventional missions in general that highly demand professional army high performance.

2.2. Communication Related Concepts

The Australian government department of defense in its guide book entitled "your guide to the 2009 Defense white paper" stated the 21st century of the defense forces require to have access to and use of advanced military technology. This will include electronic and cyber warfare, precision targeting, stealth and information communication and management on the battlefield and as Hurley, (2012), all defense personnel, regardless of location, will be able to access and share information and collaborate with their counterparts in Defense, the Government and industry, and other allied or coalition partners, using social networking capabilities.

A communication system is a combination of procedures, infrastructure (facilities, radios, transmitters, receivers, antennas, power supplies, switches, data, etc.), and personnel (specialist operators and terminal users) that apply communications technology to the receipt, amplification, storage, processing and transmission of data of any type (analogue, digital, audio, video, image, etc.). A communication system provides communications between its sending and receiving users and may embrace transmission systems, switching systems and user terminal systems. It may also include storage or processing functions in support of information transfer (Hurley, 2012).

The communication process is complete once the receiver understands the sender's message communication systems convey information from one point to another via physical channels or wireless links that propagate electromagnetic, acoustic, particle density, or other waves. This information is usually manifest as voltages or currents; these may be continuous (often called analog) variables with an infinite number of possible values or discrete (often called digital) variables with a finite set of known possible values (Boed, 2000).

2.2.1. Defining Communication and Describing the Process

Communication is the process of transmitting information and common understanding from one person to another. The definition underscores the fact that unless a common understanding results from the exchange of information, there is no communication. Two common elements in every communication exchange are the sender and the receiver. The sender initiates the communication. In a school, the sender is a person who has a need or desire to convey an idea or concept to others. The receiver is the individual to whom the message is sent. The sender encodes the idea by selecting words, symbols, or gestures with which to compose a message (Lunenburg, 2010).

Goldefine, (2014) also stated communications as a system which has multiple roles. One role of the communications system is to ensure connectivity throughout the operational area, thus providing with the capability to effectively plan, conduct, and sustain joint operations. A second role is to provide the principal tool with which they collect, transport, process, protect, and disseminate information. Through the exchange of information, Communications system functions. Goldefine also agree on the communications system supporting military forces must have the capability to rapidly adapt to changing demands; to provide information that is needed (the right information); where needed (the right place); and when needed (the right time), protected from interception and exploitation and presented in an actionable format. By meeting these fundamental objectives, the communications system allows joint forces to seize opportunity and meet mission objectives.

Communications systems linking machines include telemetry systems that convey sensory data one way, networks that convey data two-way among multiple nodes, and memory systems that store and recall information. Communications system is a collection of individual communications networks, transmission systems, relay stations, tributary stations, and data terminal equipment (DTE) usually capable of interconnection and interoperation to form an integrated whole. The components of a communications system serve a common purpose, are technically compatible, use common procedures, respond to controls, and operate in union. A communications subsystem is a functional unit or operational assembly that is smaller than the larger assembly under consideration.

The communications system facilitates information sharing and decision support and is an essential building block in today's operational environment. Information systems that make up the communications system normally have the capabilities of acquisition, processing, storage, transport, control; protection, dissemination, and presentation (Mullen, 2010).

2.2.2. Types of communication Networks

Communication networks based on serial data transmission are the platform of up-to-date automation systems. Whether this is office automation or automation of manufacturing or process plants, the task remains always the same, exchanging data between different devices or participants within a system. Communication networks provide a number of advantages over systems in which a point-to-point line enables only two participants to communicate with each other (Samson, n.d)

The network topology describes the physical arrangement of the participants in relation to each other within a network. The term also describes the logical arrangement of the participants in relation to each other during communication, which is not necessarily the same as the physical arrangement. Accordingly, some of the network types Samson (n.d) stated that mesh topology, bus topology, tree topology, ring topology and star topology.

2.2.3. Military Communication

Modern military operations are conducted in a complex, multidimensional and disruptive environment. The challenging political and social environment of the operations necessitates establishing coalitions, consisting of many different partners of differing levels of trust. Dynamic environmental changes and limitations of the technical infrastructure assets create additional challenging issues for the effective collaboration of the coalition partners. The fragile nature of the communications infrastructure, especially at the tactical level, requires robust methods and mechanisms to deal with long delays, communication failures or disconnections and available bandwidth limitations (Warsaw, 2012).

But, Browne, (2014) stated that military communications technology must be developed for efficient use of available bandwidth, as well as for effective interoperability of equipment among the armed forces. Military communications today are diverse and converged technology networks. The convergence of strategic and tactical networks around a broad range of

technologies, including different types of radios, voice over IP (VOIP),satellite communication (SATCOM), cellular, cryptographic devices, WIFI, internet and others, make it a very challenging heterogeneous environment in which to deploy, network and operate, Battlefield Communications have been dominated by push-to-talk radio technology since the 1940s. Today state- of-the-art digital radio Systems form a multitude of international suppliers and provide ruggedized solutions that meet the tactical requirement of military units around the world.

A command, control, and communication(C3) system is an information system employed within a military organization, It is a general phrase that incorporates strategic and tactical systems, Consequently, a combat direction system, tactical data system, or warning and control system may each be considered C3 systems,. Command, control and communication (C3) network provide end-to-end solutions that enhance, net enable, and integrated existing and future command and control systems for transformational communication networks. Joint forces (Air force and ground force) to gain and sustain an advantage across air, land, sea, and space with real-time information that improves command and control capabilities by allowing effects-Based on operations. Information superiority provides the capacity to collect, process, and disseminate information without interrupted by enemy who is not ability to do the same. It includes comprehensive knowledge of the battle space including the status and intentions of both adversary and friendly forces (Mullen, 2010).

2.2.4. Challenges of Military Communication System

Military communications system faces many challenges. Shea, (n.d) mentioned some like base stations of the military are not easy and fixed rather must be mounted on trucks to move with troops and Location of the base station cannot be pre-specified as base stations of commercial communication systems. Communication between base stations must use lower-capacity wireless links and it can be easily targeted to disrupt communications. Radio networks also can be used and the challenge is each radio talks to directly to adjacent radios or that may not be immediate neighbor. Shea (n.d) also stated that military communications signals must be designed so that they cannot be received and decoded by enemy forces (Low Probability of Interception) – In some cases, the signal must be designed so that is difficult for enemy forces to detect anything has been transmitted (Low Probability of Detection). If the signal can be detected, it is often valuable to design it so that it is difficult to triangulate the source (Low Probability of Position-

Fix). The other challenge mentioned military communications must deal with enemies intentionally jamming the signal full and partial and each military communication system often spreads its signal over the entire bandwidth available to the system.

2.2.5. Integrated communication Network

Tactical Integrated Communication Systems interconnects all your communication technologies regardless of radio band, frequency and hardware, reduces effort, reduce risk and increase tempo. The system is scalable from one to several operator positions or communication interfaces and makes up the centerpiece in remote controlled setups from single radio to complete operations. It constitutes a robust and highly survivable system with no single point of failure, which will let you handle voice- and data communication, red as well as black, in a fast and efficient manner (Saab, n.d).

Experiences from recent wars against nations and global terrorism have identified a need for a much higher degree of information sharing and joint decision making among various intelligence agencies, different armed forces, and the central command and control structure. Meeting this need calls for an orders-of-magnitude increase in computing and communications capacities and replacement of current stove-piped information systems and networks by an integrated infrastructure and service creation environment for the department of defense (DOD), intelligence, and homeland security communities (Doshi, 2005).

To improve the communication in any defense institutions, Zhang, et al (2015) recommends that integration of the existing terrestrial and satellite networks that allows sensors achieving ubiquitous information exchange between geographically-separated sites at an affordable cost. How to design and optimize the integrated sensor and satellite network schedules provides the first step in order to have a seamless and efficient integration between different technologies.

Integrated Communications system is a collection of different communications networks, transmission systems, relay stations, tributary stations, and data terminal equipment usually capable of interconnection and interoperation to form an integrated whole Communication is a purposeful activity of exchanging information and meaning across space and time using various technical or natural means, whichever is available or preferred. Communication requires a

sender, a message, a medium and a recipient, this process uses different communication devices that use civil society & military organization (Boed 2000).

Integrated or Interoperability is the ability of two or more systems or components to exchange information and to use the information that has been exchanged. Interoperability is key to the joint force gaining Information system (IS) in today's network enabled environment. Interoperability facilitates rapid availability of the communications system and enables collaboration among joint forces and other mission partners. Common policies and standards and to some extent procedures is the preferred method of achieving interoperability. Other methods to achieve some degree of interoperability include: commonality, compatibility of equipment, and liaison. Equipment and systems are common when they can be operated and maintained by personnel trained on any one of the systems without additional specialized training and their repair parts and consumable items (components or subassemblies) are interchangeable. Compatibility of equipment is the capability of two or more items or components of equipment or material to exist or function in the same system or environment without mutual interference. All forms of compatibility, including electromagnetic compatibility and frequency supportability, must be considered at the earliest conceptual stages and throughout the planning, design, development, Standardization (Worth, 2008).

2.2.6. The Importance of Integrated Network

The much higher importance of security in military communication, More widely varying (spatially and temporally) radio frequencies (RF) conditions, which make the basic resource itself unpredictable, a much larger fraction of communication over mobile ad hoc networks, which have not matured in commercial networking. A much higher degree of infrastructure mobility (a few miles per hour at sea to a few tens of miles per hour on the ground to a few thousand miles per hour in the air) in addition to user mobility, An operational model that has elements of the public internet as well as those of a large enterprise intranet (Mullen, 2010).

Command and control functions are performed through an arrangement of personal equipment communications facilities and procedures employed by a commander in penning directing coordinating and controlling forces and operations in the accomplishment the mission (Worth, 2008).

In modern battle field fast and secured information exchange is needed to win the battle. Since we now live in an information age the superiority of information makes the battle easy. To have information superiority, faster communication system must be available. But traditionally the range of radio is limited using telephone line also impossible for those mobile units (formation). A secure and robust communications system gives the joint force communication (JFC) the means to assimilate information and to exercise authority and direct forces over large geographic areas and a wide range of conditions. A communications system that provides connectivity throughout the battle space is vital to planning, conducting, and sustaining operations. Tactical operations routinely require long-range, mobile communications. The JFC must maintain reliable and secure communications with superior and subordinate commanders during all phases of an operation. The communications system must be of sufficient scale, accessibility, capacity, reach, and reliability to support evolving operational and training missions (Mullen, 2010).

The communications system is the JFC's principal tool to collect, transport, process, protect, and disseminate information. Given the criticality of information, the security of the communications system is paramount to ensuring the JFC can trust the information it provides. Effective C2, through the exchange of information, integrates joint force components, allowing them to function effectively across vast distances in austere or complex environments and in all weather conditions. The mission and structure of the joint force drives specific information flow and processing requirements. The location and information requirements of the joint force drive the specific configuration of the JFC's communications system. The goal is to provide rapid information sharing to facilitate a common understanding of the current situation. Processes and procedures help ensure information availability and access across the operational environment, and facilitate: flexible enough to meet the ever-changing requirements demanded by joint and multinational operations (Goldfein, 2014).

2.3. The needs for Integrated Communication Network

The acceleration of technological growth has propelled many advances in both civilian and military sectors. We now live in an information age where communication and data processing continue to rise at an increasing rate; Technological boosts continue to enable many organizations to increase their operational capacity by several factors. With enhanced computing

and information systems, organizations are able to operate at increased speeds and thus seize a time- critical advantage. The strategic vision for command, control, communications, computer, intelligence, surveillance, and reconnaissance (C4ISR) is to provide capabilities that enable forces to generate, use, and share the information necessary to survive and succeed on every mission(Mullen, 2010).

The Army network is being renovated to include the latest technologies to meet future war-fighting needs. Several ongoing programs are jointly shaping the future Army tactical networks. By including a multitude of emerging technologies in these programs, the future tactical networks become more versatile and rapidly deployable, and they can be set up on demand. The ultimate goal of this renovation process is to modernize army networks to support DOD's vision of network centric warfare.

There are many advantages that can be gained from integrating Cognitive Radio (CR) with cloud computing. Most of these advantages offer a cognitive radio network (CRN) performance increase while not affecting the security in a positive manner. The security threats associated with cloud computing may be a necessary risk in order to facilitate CRNs at large-scale. In addition, the CRN can provide benefits that would improve the accessibility of a cloud platform. If the challenges of integration can be overcome, a cognitive radio cloud network (CRCN) may replace traditional methods of radio operation (Rizvi, et al. 2015).

The availability of accurate and timely information is fundamental to the effective prosecution of military action. As, Rizvi, et al. (2015), Mullen, et al. (2010), Boed, (2000) this comes from the integration of the different network systems which deliver the right information to right place, at the right time, to the right person and in the right form and the authors stated there is strong needs of integrated the existing networks of communications regardless of its available technology.

2.4. Affordability of Integrated network

An assessment of affordability is a key factor in analyzing proposed weapon and sensor systems and has become exceedingly important to DOD programs. Affordability analysis is an integral part of the system engineering approach. Closely coupled to understanding technical issues, it seeks to use a common set of methods. Analysis can focus on the subsystem, system, and mission levels and is performed for the entire program life cycle. Typical products of an

affordability analysis include cost-effectiveness analyses, risk analyses, and total ownership cost estimates. An affordability analysis synthesizes information from three basic areas: mission analysis, technical analysis, and cost analysis (Kroshl and Pandolfini, 2000).

Mission analysis covers the operational environments and operating concepts (e.g., "What is the system supposed to do?" and "How is the system going to do it?"). From technical analysis comes a functional work breakdown structure (the system description) and system performance models (describing the system's essential performance). Cost analysis provides cost breakdown structures (relating cost elements to the system description) and cost estimating models (relating cost data to the system's elements and performance). No single formula precisely defines an "affordable system." (Kroshl & Pandolfini, 2000).

2.5. Challenges of Integrated Communication Network

According to Hurley,(2012) the challenge of integrated communication system is a combination of procedures infrastructure / facilities, radio transmitters, receivers, antennas, power supplies, wire and wireless, switches, data and voice message quality and speeds etc.) that apply communication technology to the receipt strengthen communication which is analog, digital, audio, video image etc. also communication system provides communication between its sending & receiving users & may embrace transmission systems, switching systems and user terminal systems.

The communication tasks to be performed vary in co-network would therefore not yield optimum results. So the market offers very different networks and bus systems that are more or less tailored to a specific application (Samson, n.d).

The ongoing development of new information and communication technology (ICT) capabilities is also creating emerging and relatively inexpensive ICT capabilities that might need to use will also be available to adversaries and the public. Deploy and exploit advanced ICT to operate successfully in this future operational environment. Defense will leverage ICT capabilities to plan for and implement the full spectrum of tasks assigned to it by government, connecting whole-of-nation capabilities in an environment of increased uncertainty and reduced warning times (Hurley, 2012).

Integration communication system at any system has its own limitation. Since this system is used Global information infrastructure (GII) it may easily be attacked network hacker. To protect from different network attackers we can use different techniques of network protection system at the gateway we can see a firewall and fusion network protection system (Hurley, 2012).

2.6. Critical Review of Empirical Study

The essence of this part of the literature review was aimed at to find out the research gap that could be related to the inclusion or omission of certain independent variables, strength of the methodology that could be adopted or adapted, measure the conformance of dis conformance of the findings of the study with other findings.

An empirical study on military integrated communication network has less well reported. A few researches in the area have explored the importance of the integration in the communication networks and tools.

The study conducted by worth, (2008) on command, control, communications, computer, and intelligence (C4I) systems interoperability: are we there yet? Found that its allies and coalition partners need further improvements in order to master the many moving parts required for true coalition C4I systems interoperability. Clearly, acquisition, development, testing, and fielding must be fully integrated into either a joint or coalition solution.

The study conducted by Lieutenant Colonel Heather K. Meeds (2006), concluded that the destruction caused by Hurricane Katrina increased dramatically due to communications failures caused undue death and destruction in the affected areas. The first responders were unable to coordinate search and rescue operations efficiently and effectively without communications to guide them to the locations requesting assistance. Supplies and assistance from other states all could not be delivered in a timely manner due to lack of integrated communications. Lack of interoperability or integration of communications equipment presented another problem.

The research conducted by Houéto, et al (2002) analyzed the reliability aspects of some access network topologies to insure a certain level of quality of service at the lowest cost for the end users. Hence, the objective was determining the cost the users are ready to pay to benefit from services and applications provided by these multiservice networks. As a

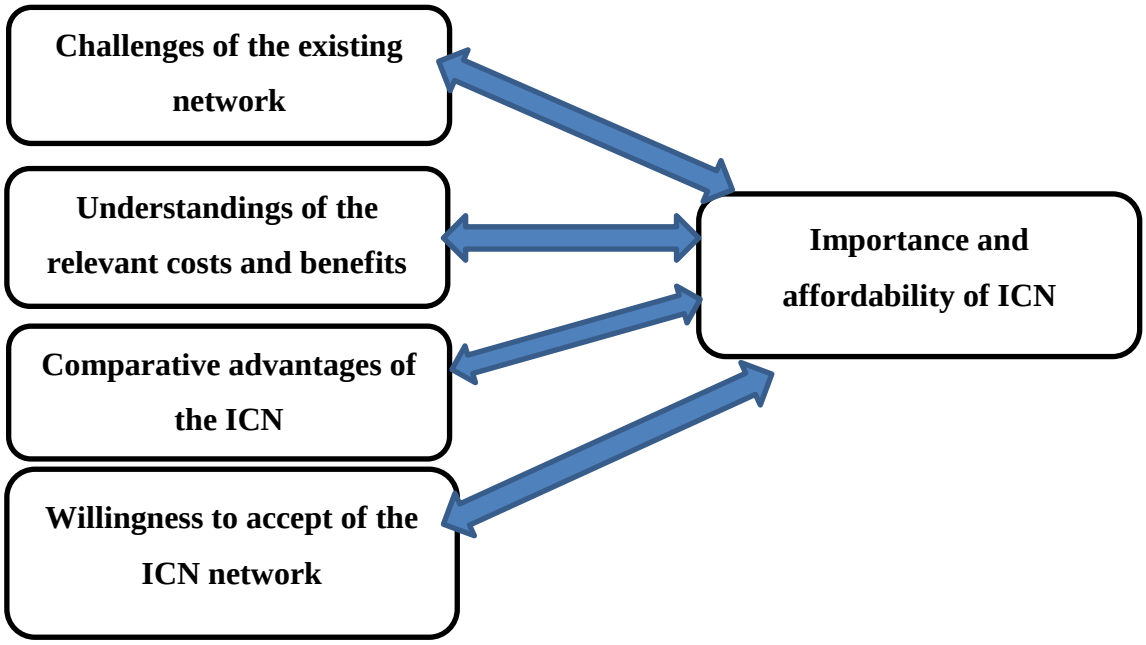
methodology, the relative behavior of 3 access-network topologies is studied: the tree with parallel backup links, the ring, and the partially meshed topologies. And come up with the results of In ring topology, simulation results show that a great connectivity in the access network is not justified in terms of reliability requirements; the partially meshed topology, even if it has redundant links which affect its cost, outperforms the tree with parallel backup links; and the ring topology is more reliable in terms of disconnected sessions than the tree topology. By considering both reliability and cost, a tree with parallel backup links appears the best topology for the access network and its cost is acceptable for the end user. Finally the research recommended that establishing the cost as a function of the quality of service; optimizing the partially meshed topology for more reliable networks; and defining a (shaping) policy to deal with a variety of traffic schemes.

Topological standpoint, the multiservice networks in this paper is heterogeneous systems which integrate both a core and some wireless access networks into an infrastructure similar to third-generation wireless networks. Such networks require reliable and cost-effective solutions to the problem of selecting access technologies for satisfying performance and quality of service requirements related to the services and applications envisioned (Houéto et al, 2002).

2.7. Conceptual Framework

The challenges of the existing network, understanding of the related costs and benefits, comparative advantages and willingness to accept were conceptualized and used by the research to come up with the results of the study.

Figure 1 Conceptual Framework



Source: Own Survey, 2017

The above conceptual frame work shows the conceptual foundations of the research. Thus, the four variables indicated in the conceptual frame work (the challenges, understandings of the relevant costs and benefit, comparative advantages and willingness to accept) were the dimensions in which the importance and affordability of the ICN described. If the increase in challenges of the existing network, understandings on the benefits exceeds costs of the ICN, its comparative advantages and the positive willingness to accept would indicate the importance and affordability of the ICN and vice versa.

CHAPTER THREE

3. RESEARCH DESIGN AND METHODOLOGY

This chapter focused on the research designs and methodologies applied mainly on the location, target population, sampling technique, data source, collection tools and techniques and data analysis that were used in this study.

3.1. Research Location

The research site is located in Addis Ababa, FDRE Ministry of National Defense. This organization is working on ensuring peace and sovereignty of the country, as well as development, innovation and technology transfers. According to the ministry's 2016 report, 160 employees work in defense communications and information department.

3.2. Research Design

The general approach or design of the study according to Creswell, (2009) was mixed, quantitative supported by qualitative. Its methodology according to Kothari, (2004) was descriptive in nature. Kothari (2004) traced that, when the purpose of a study is accurate description of a situation or of an association between variables, accuracy becomes a major consideration. This research designed as a mixed (quantitative and qualitative) approaches because Creswell (2009) recommends that mixed method is useful when either the quantitative or qualitative approach by itself is inadequate to best understand a research problem or the strengths of both can provide the best understanding.

3.3. Population and Sample Size

The target Population refers to the entire group of people; event or organizations that a researcher wants to study (Yalew Endaweke, 2011). Hence 160 defense communication personnel, higher officials and related staffs were a target population. In order to select sample Solvin's formula were employed.

$n = \frac{N}{1+N*e^2}$ So that

n = sample size

N= total population

e = margin of error or error tolerance

$$n = \frac{160}{1+160*0.05*0.05} = \frac{160}{1.4} = 114$$

3.4. Sampling Techniques/Procedures

The study employed a non-probability sampling technique which all participants will be selected purposefully or judgmentally. When working with small samples and wish to select cases that are particularly informative, Saunders et al, (2009) recommends convenient (purposive) sampling. The advantage of the sampling techniques is that the participants have knowledge about the topic and they could give reliable information which helped to reach objectives of the study.

Hence the 114 sample size clustered in to two homogeneous groups and 70 of them from the experts and 36 of them were from the higher decision makers were contacted by open ended and closed ended questionnaire. Additionally 8 respondents selected purposively for key informant interview.

3.5. Source of Data and Collection methods

The major sources of data in this study were categorized into primary and secondary data sources. descriptive type of researches primary data collection tools could be obtained either through observation or through direct communication with respondents in one form or another or through personal interviews, through questionnaires, observation method etc. Hence, the researcher used personal observation, questionnaires and interviews for primary data collection while the secondary data was gathered from published and unpublished documents related to integrated communication network, including internet journals, thesis, different books, brochures, official reports, as well as, manuals used by concerned offices and other media outlets.

3.5.1. Personal Observation

The researcher went through different communication systems and departments and collect data by observing the existing network and communication methods.

3.5.2. Questionnaire

The study used open and close ended self-designed questionnaires, which allows the collection of qualitative and quantitative data to identify the importance and affordability of integrated defense communication network. The questionnaire was of two types (for professionals and higher officials) and each questionnaire included three parts. Part one contained questions about demographic characteristics of the respondents. Part two asked the respondents to give their opinions on the integrated communication network; while part three focus on the importance and affordability of integrated communication networks.

3.5.3. Interview

This research conducted a semi structured interview that there were a list of themes and questions covered based on the responsibility and role of the interviewee. Hence 8 key informants from communication department leaders, experts, and employees were respondents of the interview questions.

3.5.4. Document Analysis

In addition to the primary data, documentary evidence such as policies, Proclamations, published and unpublished documents related to integrated communication network, including internet journals, thesis, different books, brochures, official reports, as well as, manuals used by concerned offices and other media outlets were used to supplement and triangulate the study.

3.6. Validity and Reliability

The researcher employed multiple data collection instruments since, it helps the researcher to combine strengthen and amend some of the inadequacies and for triangulation of the data. A pre-test was made for reliability and validity and Cronbach's Alpha was calculated to test the reliability of the research instrument. According to statistical interpretation, the closer the reading of Cronbach's Alpha to digit 1, the higher the reliability is the internal consistency.

Table 3.1 Reliability Test statistics

Cronbach's Alpha	N of Items
.724	33

Source: own Survey, 2017

The above Cronbach Alpha statistics was used to test reliability of the scales used from the pre-test sample. An alpha coefficient of = 0.724 was obtained for all items and 10 response questioners were used for this study. Thus, the scale result showed us 0.724 is 72% reliable variance.

Table 3.2 Reliability test results on standardized Items

Standardized Items	**Cronbach's alpha**	**No of items**
Challenges of the existing communication network	0.72	10
Understandings of the relevant costs and benefits	0.73	7
Comparative advantage of the integrated communication network	0.71	10
Willingness to accept the integrated communication network	0.71	6

Source: own Survey, 2017

The above table showed that the Crombach Alpha test results on the standardized items computed as above 0.7 meaning that all of them have internal consistency and 70% variance in the scores are reliable variance.

3.7. Data Analysis and presentation

Depending on the nature of the research questions and the data collected, SPSS 20 was employed. Data collected from closed-ended questionnaires were analyzed with five – point Likert scales quantitatively in terms of frequency and percentage and simple descriptive statistics. Information obtained from open-ended questions and interview were analyzed qualitatively by Saunders, et al (2009) summarizing or condensing of meanings; categorizing or grouping of meanings and structuring or ordering of meanings.

3.8. Ethical Considerations

Access to defense communication data, materials and institutional information was vital to this study and therefore ethical aspects were involved. Since the very beginning, the approach to the Ministry of National Defense, the FDRE was supported by research proposal, which explained the research question, objective and information needed to accomplish it. Then after permission has given, the researcher conducted preliminary visits to the communication department to verbally explain the purpose and importance of the study.

Hence, careful designing and structuring the questionnaire and clear explanation about the purpose were done to both interview and questionnaire respondents. During data collection, all participants were assured of anonymity and confidentiality of their information by asking them not to include their names or any form of identification on the questionnaires. Additionally, before beginning each interview the objective of the research was reviewed with the interviewee and their consent was obtained. By this means, the important ethical issue raised by Creswell, (2009) such as lack of informed consent, was handed in this study.

Finally, data collected from both sources (primary and secondary) were used for this study purpose only.

CHAPTER FOUR

4. PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

This Chapter deals with the presentation, analysis and interpretation of the data collected through questionnaires, interview, and document analysis. It consists of two parts. The first part is concerned with the description of the background characteristics of the respondents. The second part is concerned with the analysis and interpretation of the main data.

4.1. Background Characteristics of the Respondents

The questionnaires were administered to 70 technical staffs and 36 higher officials clustered in to two groups. Totally 106 questioners were returned and used for analysis from the respective group. Additionally the views of 8 key informant interview respondents were included. The information collected from the two groups analyzed separately. Their demographic characteristics described here under.

4.1.1. Demographic characteristics of technical experts

Table 4.1 Demographic characteristics of technical respondents' statistics

		Respondents Sex	Respondent Age	Educational Level	Experience in communication	Area of specialty
N	Valid	70	68	70	69	70
	Missing	0	2	0	1	0
Mean			1.88		3.45	
Median			2.00		4.00	
Mode			2		4	
Std. Deviation			.587		.916	
Variance			.344		.839	

Source: Own Survey, 2017

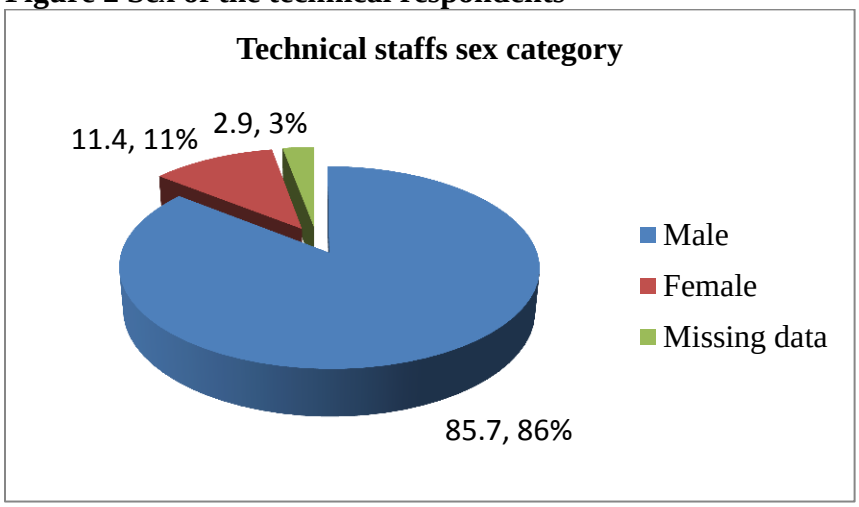
From the analysis table, Expert's age and experiences mean, median, mode and variance computed as 1.88 and 3.45, 2 and 4, 2 and 4 and finally 0.344 and 0.839. Here meaning that the average age of the technical respondents is between age group 18-35 and 36- 45. The highest frequency or observation is 36-45 for the age and above 10 years for experience. The variance indicates that the level of variation between scores. If it is zero there is no variation between scores.

Table 4.2 Frequency of experts' demographic characteristics

Variable	**Category**	**n**	**Percentage (%)**
Sex	Male	60	85.7
	Female	8	11.4
Age	18 – 35	16	23.5
	36- 45	44	64.7
	46 – 60	8	11.4
Educational level	Certificate	1	1.4
	Diploma	18	25.7
	Degree	44	62.9
	Masters	2	2.9
	Others	5	7.1
Experience years	Less than 1 years	4	5.8
	2 – 5	8	11.6
	6 – 10	10	14.5
	above 10	47	68.1
Areas of specialty	Communication leader	17	24.3
	Communication expert	28	40.1
	Non communication staff	2	2.9
	Others	22	31.4

Source: Own Survey, 2017

Figure 2 Sex of the technical respondents



Source: Own Survey, 2017

From the above pie chart sex of the technical respondents is 11.4% Female 85.8% Male the remaining 2.9% is missing data. From this, sex of technical respondents is male dominated.

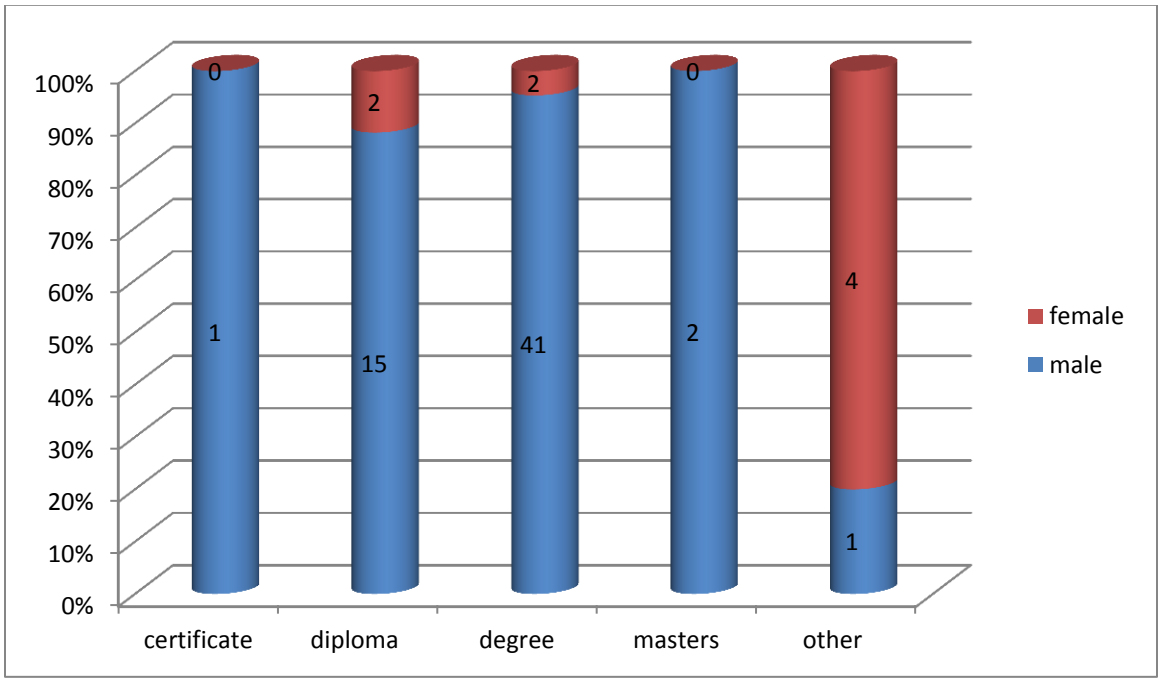
Table 4.3 Technical Respondents Sex and Educational Level Cross tabulation

Count

		Educational Level					Total
		1	2	3	4	5	
Respondents Sex		0	1	1	0	0	2
	1	1	15	41	2	1	60
	2	0	2	2	0	4	8
Total		1	18	44	2	5	70

Source: Own Survey, 2017

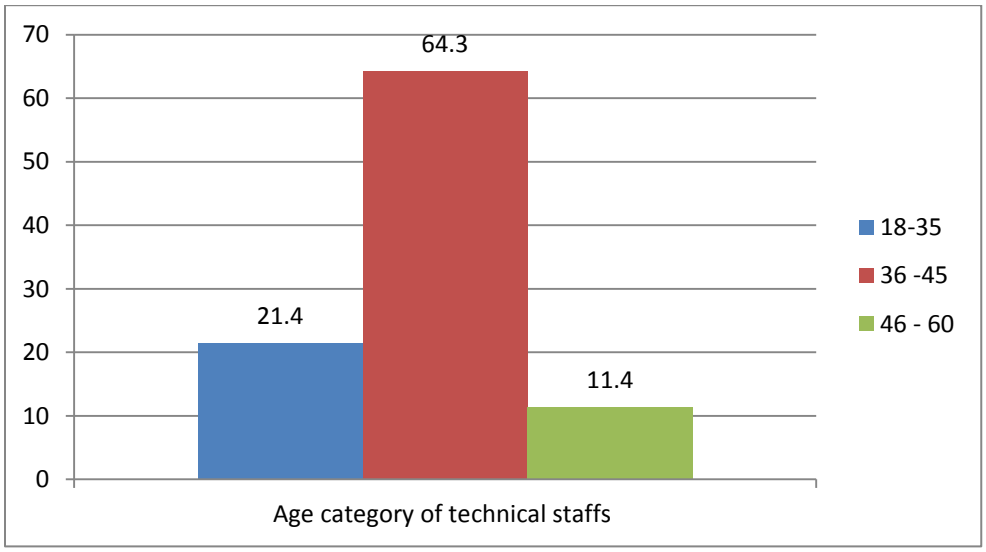
Figure 3 Sex and educational levels of the technical respondents



Source: Own Survey, 2017

From the above two cross tabbed table 4.3 and figure 3 data shows, technical respondents were 1 male with certificate, 15 with diploma ,41 with degree 2 with masters and 1 with other level and female respondents were 2 with diploma , 2 with degree and 4 with other levels. Hence the number of women technical experts is lower and also their educational level also is too low.

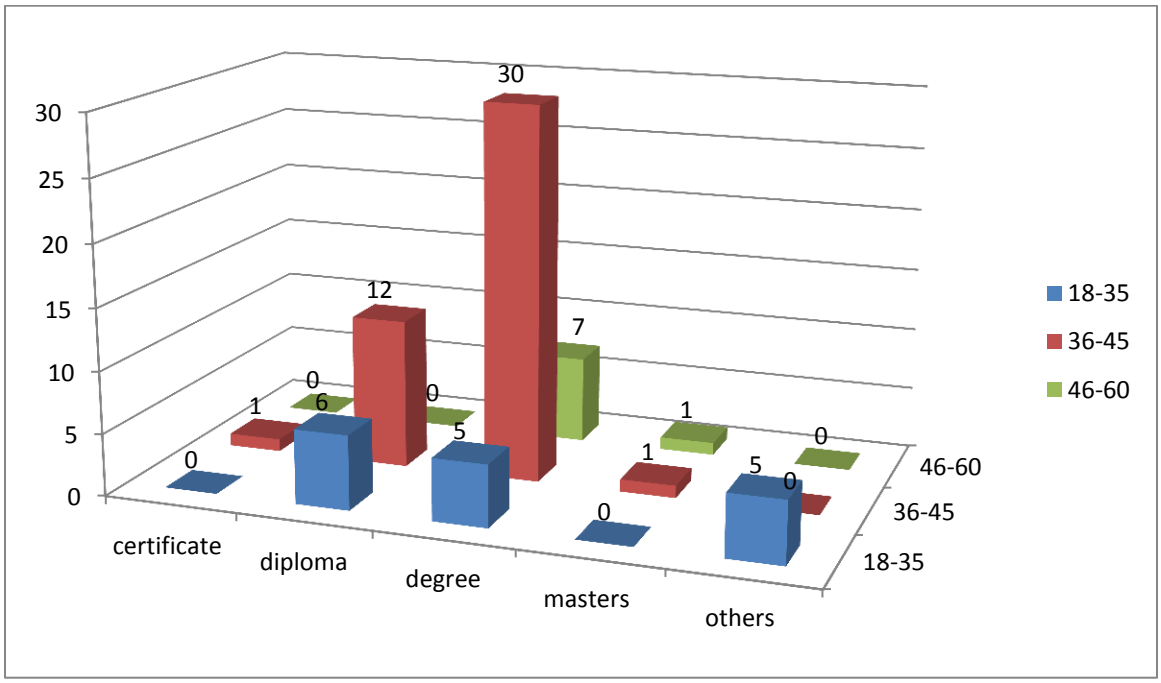
Figure 4 Age of the technical respondents



Source: Own Survey, 2017

The technical experts age is 64.3 % dominated by the adult (36-45) age category youth (18 -35) and elder age (46 – 60) accounts 21.4% and 11.4%.

Figure 5 Educational level and Age of the technical Respondents.



Source: Own Survey, 2017

The above cross tabulated graph shows that technical respondents whose age falls between 18-35 6 people have diploma level, 5 degree level of education ,respondents whose age falls between 36-45 years 1 person have certificate 12 diploma, 30 degree 1 masters an 5 other level. Respondents whose age category ranges 46-60 have 7 degree and 1 master's level. From this it can be understood that adults have more education than the youth and elders.

4.1.2. Higher officials' respondent's demographics

The higher officials were included in the study and analyzed their data independently and merged with the technical staff response. Here under the demographic related results presented, analyzed and interpreted.

Table 4.4 Higher officials demographic Statistics

		Sex	Age	Educational level	Experience	specialization
N	Valid	36	36	36	35	36
	Missing	0	0	0	1	0
Mean			3.28		3.54	
Median			3.00		4.00	
Mode			3		4	
Std. Deviation			.513		.657	
Variance			.263		.432	

Source: Own Survey, 2017

From the above table it can be seen that the higher official's most frequent age category is 41-50 or the mode value of age. The experience highly frequent in this study group is above 10 years' experience. The variance in both shows the variation between the scores. If it is zero there is identically of responses and scores.

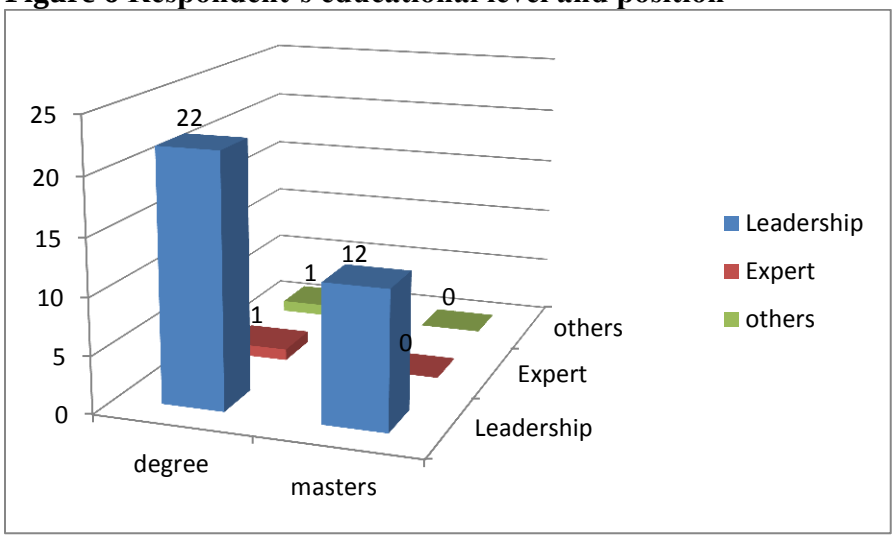
Table 4.5 Higher officials' demographics Summary

Variable	Category	n	Percentage (%)
Sex	Male	35	97.2
	Female	1	2.8
Age	31-4	1	2.8
	41 – 50	24	66.7
	Above 50	11	30.6
Educational level	Degree	24	66.7
	Masters	12	33.3
Experience years	2 – 5	3	8.3
	6 – 10	10	27.8
	above 10	22	61.1
Areas of specialty	leadership	34	94.4
	Expert	1	2.8
	Others	1	2.8

Source: Own Survey, 2017

Table 4.5 showed that the demographics of the higher officials category respondents. Hence sex data shows 97.2% male and 2.8 female age data was 41- 50 accounted 66.7% and above 50 accounted 30.6%. The educational status data indicated that 66.7 degree and 33.3 % masters. Experience data describes from 2-5 years 8.33%, from 6-10 years 27.8 and the remaining 61.1% were above 10 years experienced and 94.4% of the higher officials had leadership specialty.

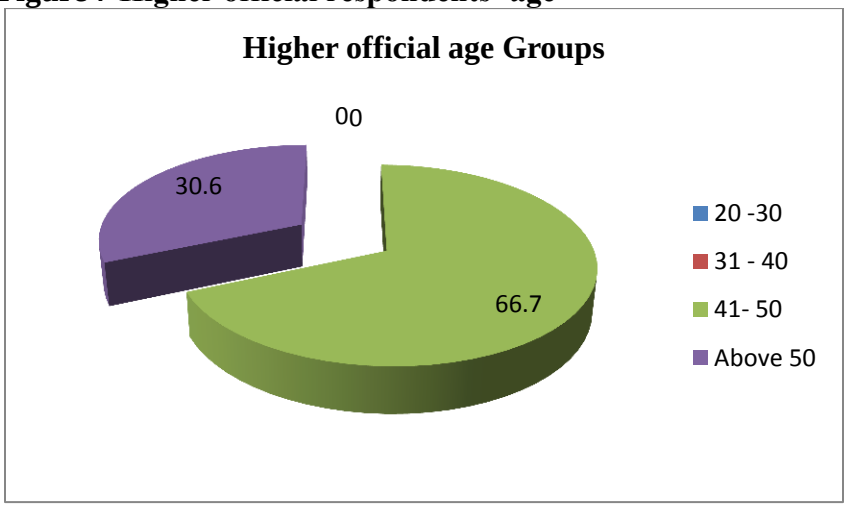
Figure 6 Respondent's educational level and position



Source: Own Survey, 2017

The graph shows 22 higher officials who have degree and 12 masters holders are in the leadership positions and the others were 1 expert and 1 other position. Experts in the higher officials are those who specialized in a specific task. Other in this context is the staffs of the higher officials.

Figure 7 Higher official respondents' age



Source: Own Survey, 2017

From the pie chart the higher officials frequent(66.7%) age category lies btween 41 and 50 years. Generally from the demographic data analysis result shows the communication workers in the defense force is a male dominated that Only 9 females in both respondents (experts and higher officials) who even have lower educational level, there is a limitation in empowering the youth in the defense communications that only a few youths are participating whereas the adult and elder age categories dominated the staff (64.7%) for experts and (66.7%) in higher officials. The educational level in the study population is first degree dominant in which 62.9 % for experts and 66.7% from the higher officials.

4.2. Analysis of the Data

In order to address the objective of the study some self-prepared open and closed ended questionnaires filled by the two groups and supplemented by the key informant interview information and document analysis based on challenge related concepts, understandings of the relevant costs and benefits, comparative advantages and the willingness to accept related data were collected from the two study groups and each groups data were presented and analyzed one after the other and combined for conclusions.

4.2.1. Challenges of the Exiting Communication Network System

Challenges in any circumstances push everyone to the alternative solutions and seeing such variables will motivate technical experts and higher officials to the integrated communication networks. Hence the following information collected and analyzed.

Table 4.6 Frequency of the technical expert respondents on challenges

No	Challenges of the existing network	Percent of technical staff Respondents				
		Strongly Disagree	Disagree	undecided	Agree	Strongly Agree
1	Fragmentation, variability and multi management system requirements are challenges of the existing network of the defense force of Ethiopia	1.4	1.4	17.1	60	18.6
2	The existing communication infrastructure isn't best to use	5.7	15.7	15.7	47.1	14.5
3	Communication systems are	-	11.4	12.9	40	35.7

	insecure and affected also by manmade and natural noises					
4	There exists a man power and material problem as it needs large number of professionals and materials for defense communications	4.3	5.7	17.1	47.1	24.3
5	Hostile signal intercept & break down of system is common in the existing network system	-	17.1	30	41.4	11.4
6	The operation, maintenance and management of the existing network in defense force are difficult.	7.1	31.4	18.6	31.4	11.4
7	The technology dynamism affects the existing communication network	4.3	12.9	15.7	44.3	21.4

Source: Survey, 2017

From Table 4.6 it can be understood that the technical expert 78.6 % of them agree with the fragmentation, variability and multi management system requirements of the existing network and for 61.6% of them it is not best to use. Also Fragmentation and variability accounted only 1.4% strong disagreement and multi management system requirement accounted strong agreement by 18.6% of technical experts. The other challenge of the existing network system in which 75.7% of technical experts agreed is the insecurity and affected also by manmade and natural noises. Its management also required large number of professionals and material resources and 71.4% of them mentioned this issue. Here, 4.3% of the technical experts strongly disagreed on the manpower challenges and 47.1% agreed on the material challenges of the existing network. According to 52.8% hostile signal intercept & break down of system also another challenges the defense communication that will impact negatively the operation and maintenance of the network system. Finally the 65.7% of the technical experts agreed that technology dynamism affects the existing communication network.

Table 4.7 Technical experts' educational level and understanding challenges.

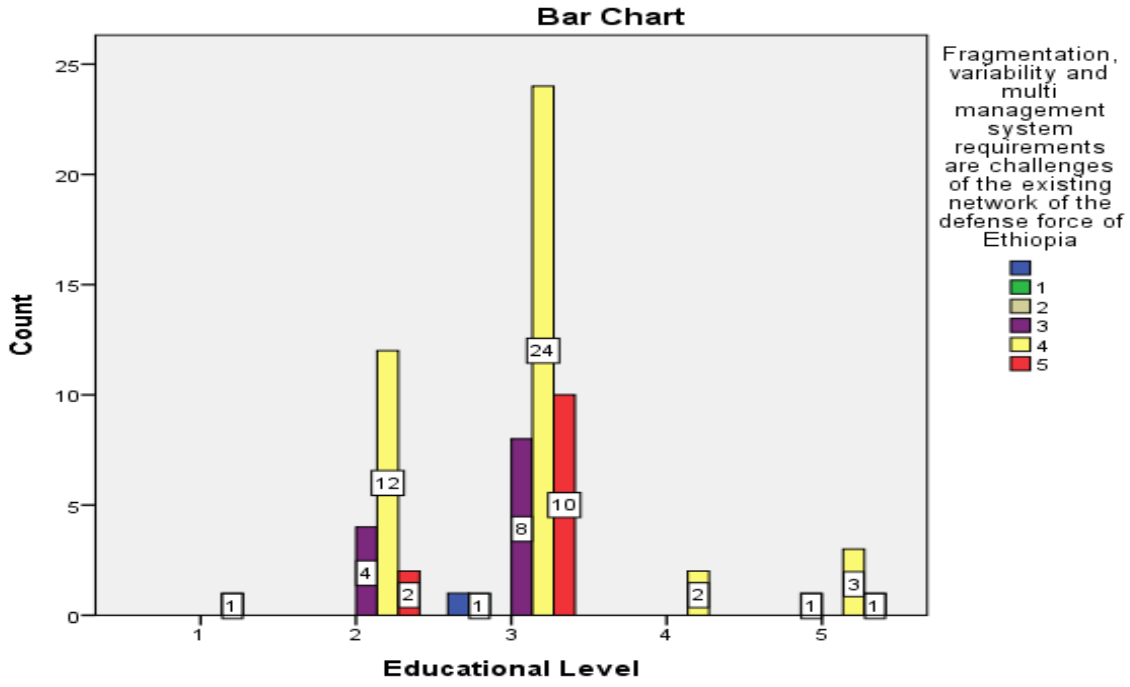
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.515[a]	20	.554
Likelihood Ratio	13.304	20	.864
N of Valid Cases	70		

a. 26 cells (86.7%) have expected count less than 5. The minimum expected count is .01.

Source: Own Survey, 2017

The above table indicates that 95% level of significant 0.05 given to the margin of error and Pearson Chi-Square statistic $x^2(20) = 18.51$, p= 0.55. So that Asymp.Sig or p- value (0.55) is greater than 0.05 (95% confidence interval), there is no significant association between educational level and understandings of the challenge that fragmentation variability and multi management system requirement. Because $p > 0.05$. If the p value less than 0.05 there be a significant association.

Figure 8 Educational level and challenges of the existing network



Source: Own Survey, 2017

Graph 8 showed that there is no any relationship because, 1 respondent with certificate responded that his/her agreement. 4 respondents with diploma undecided about, 14 with diploma agreed. Again 9 with degree undecided about, 34 degree holders agreed 2 masters holders agreed other respondents 1 disagreed, 3 agreed. From this result it can be seen that educational level doesn't have much association with the understanding of the above challenge of the existing network.

In addition to experts view the higher officials also responded challenge related questions. The flowing table traced 4 challenge related issues from them.

Table 4.8 Frequency of challenges by the higher officials

No	Challenges of the existing network	Percent of higher officials Respondents				
		Strongly Disagree	Disagree	undecided	Agree	Strongly Agree
1	I understood the challenges of defense communications in Ethiopia		5.6		80.6	13.9
2	Most of the times my messages or commands do not reach in the required quality to the receiver and there exists management issues.	5.6	16.7	16.7	41.7	19.4
3	Insecurity of communication system sometimes occurred on the different missions of the defense force of Ethiopia	-	5.7	31.4	48.6	14.3
4	There are complaints about the existing network system by technical experts, employees, departments and the army		8.3	5.9	50	30.6

Source: Own Survey, 2017

Table 4.8 described that higher officials who clearly understood the challenges in defense communication ranges 94.5% and most of the time their command and orders to the respective fellow staffs were not reaching in the required quality manner ranges 61.1%. Furthermore, 62.9% of the higher officials believe insecurity sometimes occurred during different missions and 80.6% of them accepted complaints about the existing network system.

Table 4.9 Higher officials Age VS challenge Understandings

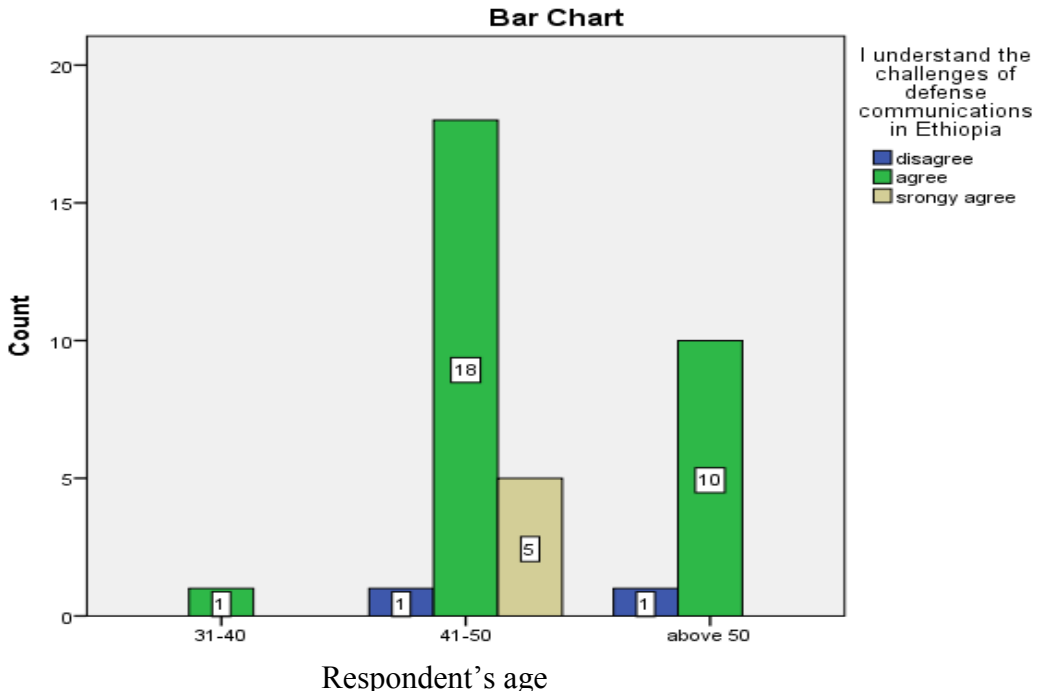
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.172[a]	4	.530
Likelihood Ratio	4.742	4	.315
N of Valid Cases	36		

a. 7 cells (77.8%) have expected count less than 5. The minimum expected count is .06.

Source: Own Survey, 2017

Pearson Chi-Square statistic $x^2(4) = 3.172$, p= 0.53 Since Asymp.Sig or p- value (0.53) is greater than 0.05 (95% confidence interval), there is no significant association between the higher officials Age and understandings of the challenge communication network challenge because p>0.05(95% Confidence interval). The number 4 are the degree of freedom.

Figure 9 Higher officials' age and challenge understanding



Source: Own Survey, 2017

From the above bar graph age category from 31 – 40, 1 respondent from 41 -50, 18 respondents above 50 years 10 respondents understands the challenges of defense communication.5 respondents strongly agreed on this but two respondents from 41-50 and above 50 disagreed. Age variation will not affect the response of the challenges.

The interview respondents also traced some challenges of the communication in the defense department. They classified them as technology based, process based, human resource based and the finance based challenges. Most of the interviewee mentioned that the interception by opposing groups, its management difficulty were the frequent challenges. Additionally the reports and office memos showed the presence of aforementioned challenges in the communication departments.

The researcher also observed that the functioning of the existing networks and different communication materials were some out of service, a lot of people here and there to transmit information in different media and channels. Also some information that must be encrypted was transmitting without encryption. This affects the communication network security.

4.2.2. Understandings of the relevant Costs and Benefits

The understandings of the relevant costs and benefits of the integrated communication network help in the analysis of the affordability of the system in the financial terms. The research investigated the understandings of the technical experts and higher officials on the issue. The following summary table shows us the data of experts.

Table 4.10 Technical expert's Understandings on cost and benefits

No	Understandings of related costs and benefits	Percent of technical staff Respondents				
		Strongly Disagree	Disagree	undecided	Agree	Strongly Agree
1	Costs associated with the implementation of integrated communication network (ICN) is lesser than its Benefits	7.1	10	17.1	47.1	18.6
2	Integrated communication network (ICN) reduces extra costs associated with the existing network services	-	5.7	11.4	54.3	28.6
3	Comparing the related costs and	-	12.9	20	52.9	12.9

	benefits of the integrated communication network (ICN) system is affordable.					
4	Techniques of integrated communication networks can be easily understood and operation is easy for technical experts and manageable with the existing human resource	2.9	30	21.4	34.3	11.4
5	The technical and strategic importance of the integrated communication network (ICN) is higher for the defense force	-	2.9	5.7	60	31.4

Source: Own Survey, 2017

Table 4.10 shows the results related to costs and benefits. Hence there is 65.7% qualitative understanding of the benefits of integrated communication network that exceeds its cost. According to 82.9% of the respondents it also reduces the high cost which the defense force incurring for the existing network management.

Furthermore, 91.4% of respondents believed its technical and strategic importance. Hence 65.8% of them agreed on its affordability to the organization. But there are 17.1% of the technical respondents don't want to decide or not clear with the relevant costs and benefits of the ICN and 17.1% of them disagreed on the issue. The other result of the study reveals that only 45.7% of them believed that its techniques and operation can be easily understood by defense expert. Here there is 30% disagreement with the idea and 21% undecided respondents. To compute cross tabs of the two independent categories in this questioner the following result came.

Table 4.11 Experience VS Cost Benefit Understandings

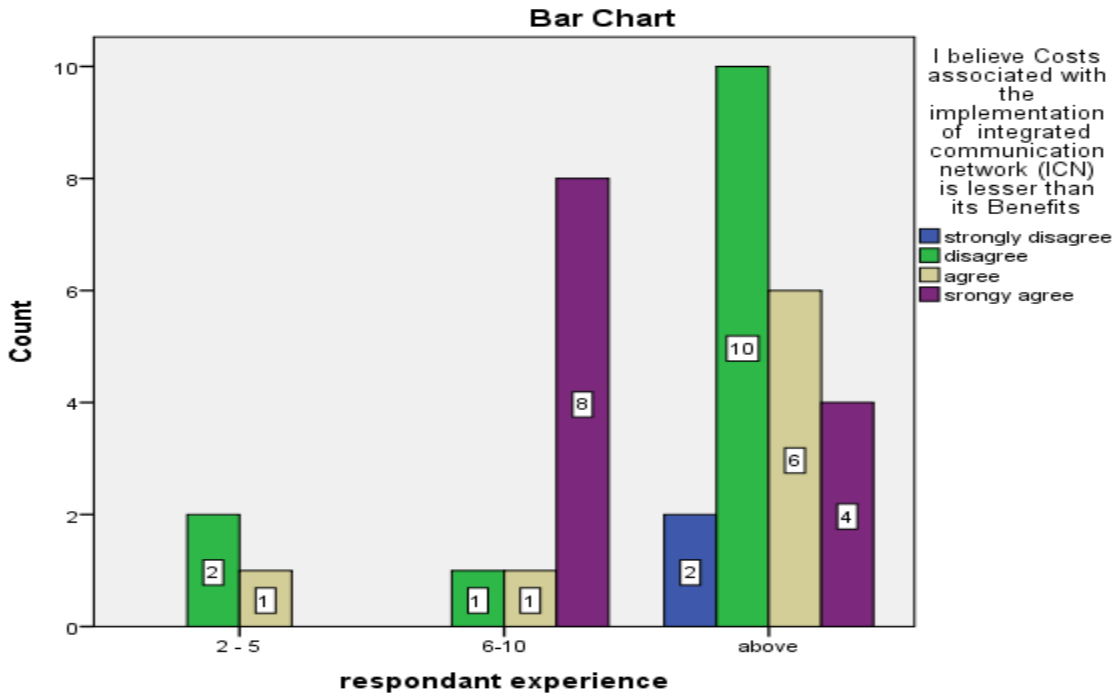
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.943[a]	12	.304
Likelihood Ratio	16.973	12	.151
N of Valid Cases	69		

a. 17 cells (85.0%) have expected count less than 5. The minimum expected count is .29.

Source: Own Survey, 2017

Pearson Chi-Square statistic $x^2(12) = 13.94$, p= 0.304 Since Asymp.Sig or p- value (0.30) is greater than 0.05 (95% confidence interval), there is no significant association between expert respondents experience and believe that benefits of ICN exceeds its costs. Because p>0.05 (95% Confidence interval).

Figure 10 technical respondents' experience and cost/benefit understandings



Source: Own Survey, 2017

From the above graph, 4 respondents, whose experience is less than 1 year level of agreement resulted strongly disagrees, undecided, agree and strongly agree. 8 Respondents whose experience lies between 2 and 5 years 3 of them strongly agreed and 5 of them agreed, respondents whose experience is from 6-10 were 4 undecided, 4 agreed and 2 strongly agreed. Finally respondents whose experience is above 10 years took 47 counts in which 4 strongly disagree 7 disagree 7 undecided 22 agreed and 7 strongly agreed. From this data it can be seen that experience didn't matter to understand the cost benefits of the ICN because there is no association between the two categorical groups.

To supplement the experts view the higher officials' responded to the cost benefit related questions summarized in the table 14.

Table 4.12 Higher officials' response on cost/benefit

No	Understandings of related costs and benefits	Percent of higher officials Respondents				
		Strongly Disagree	Disagree	undecided	Agree	Strongly Agree
1	I believe Costs associated with the implementation of integrated communication network (ICN) is lesser than its Benefits	5.6	36.1	-	25	33.3
2	I prefer the type of network suitable to Ethiopian defense is leased line communication networks	13.9	13.9	33.3	36.1	2.8
3	I prefer the type of network suitable to Ethiopian defense is independent net communication networks	-	8.3	13.9	19.4	58.3
4	Based on its importance, competitive strategy of the army and its services integrated communication network is preferable and affordable for the defense force	-	5.6	5.6	44.4	44.4
5	The management team and the higher officials will approve if any technology suitable to the effectiveness of the defense force.	-	8.3	11.1	61.1	19.4

Source: Own Survey, 2017

Table 4.12 shows that 58.3 % of the higher officials agreed on implementing integrated communication network costs lesser than its benefits 88.8% of them traced its importance and affordability with respect to competitive strategy of the army. The higher officials' network preference with regard to ICN is 77.7% leased line and 38.9% independent net communication network. Finally, 80.5 % of the higher officials will approve if any technology suitable to the effectiveness of the defense force.

Table 4.13 higher official experience VS Cost/Benefit understandings

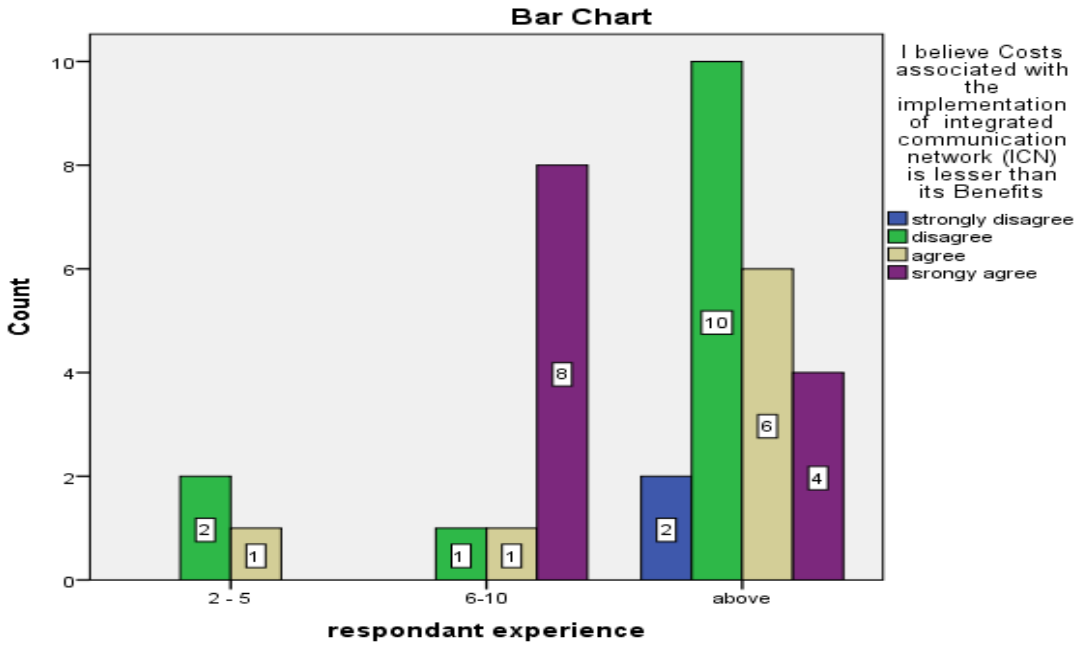
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.121[a]	6	.028
Likelihood Ratio	15.314	6	.018
N of Valid Cases	35		

a. 9 cells (75.0%) have expected count less than 5. The minimum expected count is .17.

Source: Own Survey, 2017

Pearson Chi-Square statistic $x^2(6) = 14.121$, p= 0.028 Since Asymp.Sig or p- value (0.028) is greater than 0.05 (95% confidence interval), there is no significant association between higher experience and believe that benefits of ICN exceeds its costs. Because p>0.05(95% Confidence interval).

Figure 11 technical respondents' experience Vs cost/benefit understandings



Source: Own Survey, 2017

The graph confirms that the results from experience didn't have relationship with the related cost/benefit understandings of higher officials the lower experiences have almost the same type of responses with the higher experiences.

An interviewee said that it is better to see affordability with respect to the country's economic growth and current status needs the ICN to better address the problems related to electronic warfare and cyber-attack. Most of the interviewee also believes that ICN is relatively affordable that required high initial investment and in the long run better to think the introduction of the ICN phase by phase strategy.

4.2.3. Comparative advantages of integrated communication network

Seeing Comparative advantages of the ICN over the existing network will results the additional inputs to its important and affordability. Hence the following summary table shows some relevant variables and their percentages.

Table 4.14 Comparative Advantages of the ICN by technical experts

No	Comparative Advantage of ICN	Percent of technical staff Respondents				
		Strongly Disagree	Disagree	undecided	Agree	Strongly Agree
1	Integrated communication network (ICN) creates smooth and fast communication than the existing old network	-	2.9	8.6	48.6	40
2	Integrated communication network (ICN) helps to well organized command and control system in the defense force of Ethiopia	-	1.4	8.6	41.4	48.6
3	Technical capacity of the integrated communication network (ICN) is better in accomplishing mission.		2.9	5.7	54.3	37.1
4	The integrated communication network (ICN) will reduce the long process of communication in the old network system.	-	2.9	4.3	51.4	41.4
5	The integrated communication network (ICN)'s degree of insecurity is better than the existing networks.	10	11.4	7.1	50	21.4

Source: Own Survey, 2017

From the table 4.14, 88.6% of the technical experts said that Integrated communication network (ICN) creates smooth and fast communication than the existing old network. 90% of them believe that it helps to create well organized command and control systems through, 91.4% believe in its technical capacity in accomplishing the mission. 92.8% agreed in the reduction of the long process of the old network system. Finally 71.4 % agreed on its degree of insecurity is lesser than the existing. On the other hand the question which ICN is not important to Ethiopia scored 92.9% disagreements from the technical experts.

Table 4.15 Experts Specialty Vs level of agreement on the technical capacity of ICN

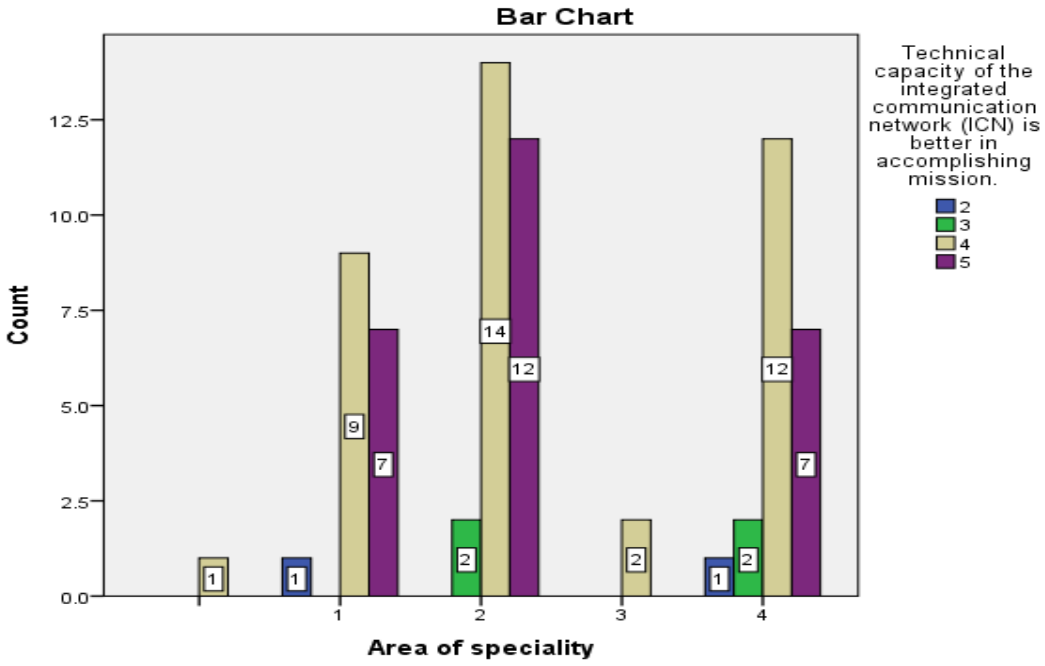
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.190[a]	12	.906
Likelihood Ratio	8.860	12	.715
N of Valid Cases	70		

a. 14 cells (70.0%) have expected count less than 5. The minimum expected count is .03.

Source: Own Survey, 2017

Pearson Chi-Square statistic $x^2(12) = 6.19$, p= 0.90 Since Asymp.Sig or p- value (0.90) is greater than 0.05 (95% confidence interval), there is no significant association between technical respondent specialty and knowing the technical capacity of the ICN is better. Because p>0.05(95% Confidence interval).

Figure 12 Experts Specialty Vs level of agreement on the technical capacity of ICN



Source: Own Survey, 2017

From the graph 12, communication experts who agreed on the capacity of the ICN is better accounts 9 and who strongly agrees were 7, who undecided about accounts 2, agreed 14 and strongly agreed 12. From the non-communication experts only 2 are agreed and finally from the other category of specialty 1 disagreement, 2 undecided 12 agreed and 7 disagreed accounted. There are 2 missing values in the above graph who accounted agree and disagree. Here there is no much difference in the understanding the technical capacity to accomplish defense mission by all specialties.

Table 4.16 Higher officials' specialty and level of agreement on the technical capacity of ICN

No	Comparative Advantage of ICN	Percent of higher officials Respondents				
		Strongly Disagree	Disagree	undecided	Agree	Strongly Agree
1	Integrated communication network is vital and Government have an interest on such investments	-	2.8	13.9	55.6	27.8
2	Integrated communication network will facilitate the effective functioning of all the systems of the defense force.	-	2.8	16.7	36.1	44.4
3	The introduction of integrated communication network absolutely help to solve the challenges of the existing network system.	-	5.6	16.7	41.7	36.1

Source: Own Survey, 2017

The study result reveals that 83.4% of higher officials them believe this system is vital and the government have an interest on such investments. Again, 80.5 % of them believe it will facilitate the effective functioning of all the systems and 78.8% respondents believe ICN will absolutely help to solve the current challenges of the defense communication. From the view of key informants the results obtained with respect to the importance of integrated communication network are reduces risks of insecurity; helps to smooth, easy and quick flow of information vertically and horizontally within the army; very important in the documentation and management; it avoids information fragmentation and communication barriers; it is a fast quick decision making tool for the defense force stakeholders.

The data from the annual workshop proceedings of the national defense force of Ethiopia since 2013 showed the concern of stakeholders on the importance of the ICN. But there is no action on it.

4.2.4. Willingness to Accept the Integrated Communication Network

The importance and affordability of ICN also bases on the rational decision that experts and higher official's willingness to accept. Here questions raised on his sub objective displayed here under.

Table 4.17 Frequency of Willingness to Accept by Technical experts

No	Willingness to Accept	Percent of technical staff Respondents				
		Strongly Disagree	Disagree	undecided	Agree	Strongly Agree
1	The existing defense communication network is not enough and need to be upgraded through technologies.	5.7	2.9	7.1	47.1	37.1
2	I am happy in the introduction of new communication networks and use my extra time to be familiar with.	-	-	5.7	55.7	38.6
3	Centralized network system is very important in the defense force of Ethiopia.	-	2.9	5.7	42.9	48.6
4	Whatever it costs integrated communication network is highly important to Ethiopian defense force.	2.9	2.9	7.1	50	37.1
5	The defense communication employees can easily adapt and work in the integrated communication networks.	2.9	10	25.7	45.7	15.7

Source: Own Survey, 2017

Table 4.17 indicates that the existing defense communication network needs upgrading and improvement by 84.2% technical expert agreement. The level of happiness in the introduction of the new communication network ranges 94.3%. Also 91.5% of them agreed on the importance of centralized network system and 87.1% technical experts believe that whatever it costs integrated

communication network is highly important to Ethiopian defense force. 61.4% of the communication experts believe that they can easily familiar with ICN.

For the question of the command and control system is ok and no need of changing with ICN got 80% disagreement and 8.6% undecided.

Table 4.18 Willingness to Accept Vs Sex of Technical Experts

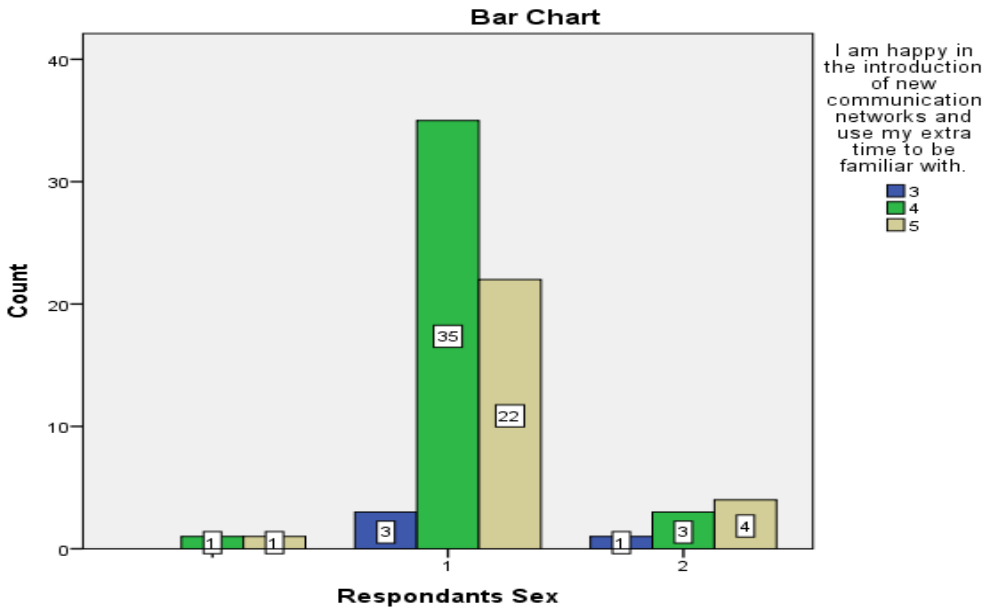
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.770[a]	4	.778
Likelihood Ratio	1.755	4	.781
N of Valid Cases	70		

a. 7 cells (77.8%) have expected count less than 5. The minimum expected count is .11.

Source: Own Survey, 2017

Pearson Chi-Square statistic $x^2(4) = 1.77$, p= 0.77 Since Asymp.Sig or p- value (0.77) is greater than 0.05 (95% confidence interval), there is no significant association between respondent experience and believe that benefits of ICN exceeds its costs. Because p>0.05(95% Confidence interval)

Figure 13 willingness to accept and sex of technical respondent



Source: Own Survey, 2017

From the graph two missing values with agree and strongly agree occurred. From the male category 3 of them undecided 32 agreed and 20 strongly agreed whereas from the female respondents 1 undecided, 3 agreed and five strongly agreed on that they are happy and use their extra time devoting to be familiar with the ICN.

Table 4.19 The ministry's higher official's willingness to accept the ICN

No	Willingness to Accept	Percent of higher officials Respondents				
		Strongly Disagree	Disagree	undecided	Agree	Strongly Agree
1	With respect to its importance, any decision making regarding the introduction of integrated communication network is accepted by the defense higher management body	-	-	27.8	55.6	13.9
2	Currently, I am happy if we invest on the integrated communication networks.	-	8.3	8.3	41.7	41.7
3	Since there is no much war and mission, investing on integrated communication network will not be much effective	25	27.8	38.9	5.6	2.8

Source: Own Survey, 2017

With respect to its importance any decision making in the introduction of the ICN 69.5% of the higher officials believed that the management body will accept and 83.4% of them also Happy by themselves if invested on ICN. On the contrary the question "Since there is no much war and mission investing on ICN will not be much effective" scored 52.8% disagreements and 38.9% undecided about.

Table 4.20 willingness to accept Vs higher officials educational level

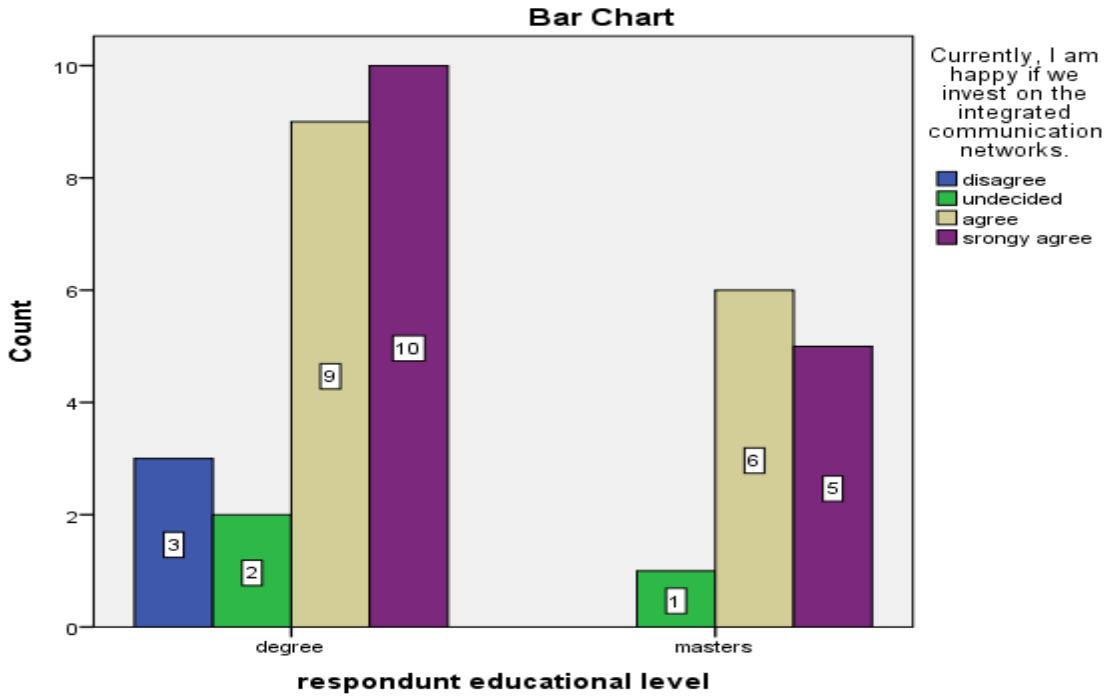
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.800[a]	3	.615
Likelihood Ratio	2.724	3	.436
N of Valid Cases	36		

a. 4 cells (50.0%) have expected count less than 5. The minimum expected count is 1.00.

Source: Own Survey, 2017

Pearson Chi-Square statistic $x^2(3) = 1.80$, p= 0.61 Since Asymp.Sig or p- value (0.61) is greater than 0.05 (95% confidence interval), there is no significant association between higher officials educational experience and their happiness if invested on the ICN technology. Because p>0.05(95% Confidence interval).

Figure: 14 willingness to accept Vs Sex of technical respondent



Source: Own Survey, 2017

The educational level of the higher officials and their willingness to accept doesn't have association each other. The increase in one variable doesn't affect the other.

According to the defense communication and information department's progressive reports 2009 and 2012, the integrated communication system is complex, tedious task & it takes longer time to implement. Communication system integration needs vast infrastructure over existing one and highly experienced human power. Spectrum management and security issues should be consider at design stage. Continuous flow up and protecting the gateways from hostile attack and physical distraction must be carried out. In addition to that, Leadership is necessary to ensure the coordinated functioning of the integrated communication as it interacts with a dynamic environment.

Thus, leadership, expert and employees are required to direct and guide organizational resources toward the strategic objectives of the defense force and ensure that the departmental functions are aligned with the dynamic of technological growth.

Most of the interviewee believes that the institution is always dreaming to satisfy the employee by integrating the communication system. But awareness creation work throughout the army is important due to some expected resistance to be familiar with the ICN. Some staff members may want to continue customarily using the old infrastructure.

Expected challenges mentioned by the interviewee to implement the ICN are cost and budget related constraints, man power related constraints, commitment related constraints among all stakeholders and lack of compatibility with the existing network.

System preference for the integrated communication network by higher officials and key informants lied on independent network system, meaning that having its own satellite and infrastructure. But due to the diversified development program of the country and budget scarcity, for the time being it is better to use leased line from the telecom infrastructure.

From the annual workshop proceeding data since 2013, it can be observed that most professionals, higher officials and other users have the willingness to accept the ICN technology.

CHAPTER FIVE

5. SUMMARIES, CONCLUSIONS AND RECOMMENDATIONS

On the basis of the analysis and interpretation of the data gathered through the instruments (questionnaires, interview and document analysis), the following summaries of the major findings, conclusions, and recommendations have been made.

5.1. SUMMARIES

The main purpose of this study was to describe the importance and affordability of the integrated communication for the defense force of Ethiopia. 160 employees and higher officials were the target population. As a result 114 sample respondents computed by Solvin's sampling formula and purposively clustered in to experts, higher officials and key interview informants. Questionnaires and interview were employed to collect the data from the sample and supplemented with observation and document analysis. Before conducting the actual study, the questionnaires were piloted to check the reliability of the items. Accordingly, Crombach alpha of item reliability was computed and relevant measures were taken.

Quantitative and qualitative design was used in analyzing the data obtained through the instruments. In the analyses of the quantitative data, percentages, frequencies, mean scores, mode, standard deviations and Pearson chi square test were computed. In the analyses of the qualitative data, descriptive statements were used. As a result, the major findings of the study are discussed hereunder.

5.1.1. Major Findings

Demographically the defense communication department is male and adult age group dominated staff that a little number of women are involved with lower capacity. The major findings in each sub topics will be discussed here under.

5.1.1.1 Challenges of the Existing Communication Networks

The current network of the defense force is challenged by; Fragmentation, variability, multi management system requirements, Hostile signal intercept, break down of system, vulnerable to cyber-attacks, affected also by manmade and natural noises, material and man power issues, the

technology dynamism. Most of the times messages or commands do not reach in the required quality to the receiver. Regarding the costs of managing the network and its operation and maintenance it is a big challenge and different complaints existed in the operation of the network from technical experts, employees, departments and the army. Due to the fact that the existence of the above challenges the existing network system it is not best to use.

5.1.1.2 Understandings of the relevant Costs and Benefits

Qualitatively, Costs associated with the implementation of integrated communication network (ICN) is lesser than its Benefits. ICN also reduces extra costs that are incurred for fragmented management system of the existing network. On the basis of Technical and competitive strategy of the army ICN have strong benefits. But above the mean of the respondents don't believe on its techniques and easily understandability and operation by the existing human resources. Finally thinking the relevant costs and benefits it is agreed on the ICN is affordable. The management team and the higher officials also will approve if any technology suitable to the effectiveness of the defense force comes.

5.1.1.3 Comparative Advantages over the Existing System

Comparing the ICN with the existing communication technology the study revealed that it creates smooth and fast communication than the existing old network that reduce the long process of communication in the old network system and help to the well-organized command and control system, degree of insecurity is better than the existing networks. So that it is better in accomplishing mission and vital for the defense force of Ethiopia that higher officials believe that government have an interest on such investments.

5.1.1.4 Willingness to accept the integrated communication network

The willingness to accept ICN shows how it is important to the organization. And the results of the analysis revealed that the challenges existed in the existing network drives the upgrading and the introduction of the ICN and most experts are happy to be familiar with ICN system and use their extra time to well operations that will create centralized network system. Experts also believed that whatever it costs it is highly important to Ethiopian defense force. Furthermore, the higher officials believed that it is also accepted by the management body and they are happy in

the introduction of ICN. In contrast the question that said since there is no war mission, investing on the ICN will not much effective raised 52.8% disagreements and 38.9% undecided. This indicates that there is no objection in the introduction of ICN.

5.2. Comparing Major Findings with Empirical Literature

The study have seen the affordability conditions on the cost, technique and mission strategies which is similar to kroshl and pandoflini (2000) view on affordability of the communication technology. Also the worths (2008) on his study about the C4I, described communication technologies should be fully integrated and this study focused on the ICN's importance and affordability.

The study conducted by the lieutenant colonel heather, Meeds (2006) concluded that the destruction caused by the hurricane Katrina increased dramatically due to communication failure and lack of integrity and this study found the communication failure and other additional challenges in the defense communication which is similar to the former findings. Generally, lack of integration in communication networks mentioned by different scholars, were also the findings of this study. Generally, Worth, (2008), Meeds (2006), Hurley, (2012) emphasized on the higher importance and advantages of the Integrated communication network for the defense current missions and tasks.

5.3. Conclusion

Based on the major findings on the challenges of the existing network, the related costs and benefits of the ICN, comparative advantages of the ICN and the willingness to accept of the technical experts and higher officials, the ICN is very important and affordable on the cost, mission and Techniques to the defense communication and information department of the Ethiopian defense force. In order to install the ICN, the infrastructure needed was independent network. However, due to the initial investment cost and resource availability leased line is better for the time being.

The other conclusion drawn from the data analysis is there is no association between different variables such as Educational level, age versus challenges of the existing network, experience versus cost/benefit understandings, willingness to accept and sex.

From the results, number of women expert and higher officials are low and their educational level also low. Young professionals are also few in numbers. This is due to judgmental or purposive sampling procedure that key and resourceful respondents were contacted for data collection.

5.4. Recommendations

Based on the results and conclusions made the following recommendations are raised:

- In order to improve and strengthen the communication and information department, the number of women and young professionals need to be continuously capacitated with communication technologies.
- The research concluded the affordability of the ICN based on the respondents views on costs and benefits qualitatively. Thus, defense communication department advised to further analyze the financial affordability the ICN's.
- This study has looked at 4 dimensions (challenges of the existing, cost benefits, comparative advantages, and willingness to accept) to describe the importance and affordability so that it can be recommended for other researcher to look in other dimensions and compare results.
- Even if the investment cost is initially higher, the integrated communication network is important and affordable to the Ethiopian defense force.
- Because of the telecom infrastructure arrangements of the country, the defense communication networks currently advised to be a leased line but through time it is advised to change in to independent network systems.

5.4.1. Direction For future Research

- Security analysis on the Integrated Communication Network.
- Infrastructure Suitability analysis for the Ethiopian defense force Integrated communication network.
- Comparative financial analysis on the importance and affordability of the integrated communication networks for the Ethiopian defense force.

REFERENCE

Australian government department of defense (2009).Your guide to the 2009 Defense white paper, Australia

Boed, V. (2000). Networking and integration of facilities automation system

Browne, J. (2014). Defense Electronics, Military Communications Embraces Many Technologies, California USA.

Creswell, J. (2009). Research Design: qualitative, quantitative, mixed methods approach. 3rd ed., SAGE Publications, Inc.

Saab Denmark (n.d).Tactical integrated communications. All Systems- one interface can be retrieved from www.saabgroup.com.

Doshi,T. B(2005). Global Secure Communications: Challenges and Opportunities. Johns Hopkins APL Technical Digest, Volume 26, Number 4.

Federal Negarit Gazeat of the Federal Democratic Republic of Ethiopia (1996). Proclamation number 27/1996, 2nd year no.15.

Goldfen, L.D (2014). Command & Control for joint land operation, USA.

Houéto, *F.*, Samuel, P., Beaubrun, *R.* and Lemieux, Y. (2002). Reliability and Cost Evaluation of Third-Generation Wireless Access Network Topologies: A Case Study. IEEE transactions on reliability, vol. 5, no. 2.

Hurley, D.J. (2012). Communication and Information Systems Series, Australian Defence Doctrine Publication 6.0, 2nd ed. Commonwealth of Australia.

http://sciencing.com/slovins-formula-sampling-techniques-5475547.html retrieved on April 26, 2017.

Kothari, C. R. (2004). Research methodology: Methods and techniques (2nd rev.ed). New Age International (p) Limited Company, New Delhi India.

Kroshl, M.,W.And Pandolfini, P.P(2000). Affordability Analysis For Darpa Programs, Johns Hopkins Apl Technical Digest, Volume 21.

Girma, T., Adonay, H., and Hagos,G.(2014). Effectiveness Of Training In Ethiopian Defense Force Army; The Case Of Northern Command Training Center, international journal of current research, vol vol6, issue 12

Lodewyckx,P. (2011). Defence sciences: do they exist? Royal Military Academy, Brussels, Belgium.

Lunenburg, C. F (2010). Communication: The Process, Barriers, and Improving Effectiveness, vol 1, no 1, Sam Houston State University

Meeds, K.H (2006). Communication Challenges During Incidents of National significance: A Lesson from Hurricane Katrina, USAWC Strategy Research Project, and USA.

Mullen, M.G (2010). Joint communication system, U.S Navy. USA.

Saunders, M., Lewis, P. and Thornhill,A. (2009). Research Methods for Business Students, 5th ed., Pearson Professional Limited, England.

Shea,M.J.(n.d). Military Wireless Communications, University of Florida, USA.

United States of America, the department of defense cyber strategy, 2015. USA.

Warsaw, (2012). Military Communications and information Technology: A Trusted cooperation Enabler. Amanowicz, M (e.d), Military University of Technology Press, Warsazawa.

Rizvi, S. Howan,N. and Mitchell, J. (2015). Analyzing the Integration of Cognitive Radio and Cloud Computing for Secure Networking, Elsevier B, and USA.

Worth, J.B (2008). Command, Control, Communications, Computers, And Intelligence (C4i) Interoperability: Are We There Yet? A thesis presented to the Faculty of the U.S. Army Command and General Staff, Fort Leavenworth, Kansas.

www.thalesgroup.com/en/defence-1 retrieved on June 21, 2017.

Zhang,W., Zhang, G., Dong, F., Xie, Z. and Bian, D. (2015). Capacity Model and Constraints Analysis for Integrated Remote Wireless Sensor and Satellite Network in Emergency Scenarios. College of Communication Engineering, PLA University of Science and Technology, China.

ያለው እንዳወቀ፤ፕሮፌሰር (2006)፡፡የምርምር መሰረታዊ መርሆችና አተገባበር፡፡ 3ኛ እት‹ም፡፡ንግድ ማተሚያ ድርጅት፡አዲስ አበባ፡ ኢትዮጵያ፡፡

የመከላከያ መገናኛና ኢንፎርሜሽን ዋና መምሪያ የ2002 እና 2005ዓ/ም የተዘጋጀ የእድገት ጉዞ ሪፖርት

- **የመከላከያ መገናኛና ኢንፎርሜሽን ዋና መምሪያ የ2007 እና 2008 ዓ/ም አመታዊ ሪፖርት**

Appendixes 1 Interview Questions

Thank you for giving me your precious time for this interview. The purpose of this interview is to collect data for the research entitled "**Study on Importance and Affordability of Integrated Communication Network in Ethiopian Defense Force**." In addition to the researcher's endeavor and other related factors, the success of the study also depends upon your genuine responses. Thus, I kindly requests your sincerely responses to the interview and acknowledges your cooperation to a great extent.

1. What did you think the challenges of the existing defense communication ways?
2. How do you see the affordability of the integrated communication network
3. What do you believe on the willingness and acceptance of integrated communication network?
4. Which communication system is preferred for the defense force of Ethiopia based on its mission, techniques and strategy?
5. Just tell me what you know about the importance of integrated communication network?

Thank you for your time and information

Negassi Tikue

Appendixes 2 Questionnaire for technical experts and communication staff

Dear respondents,

I would like to express my heartfelt thanks and appreciation for your time and sincere cooperation to fill this questionnaire. The questionnaire is prepared to conduct a research entitled **"Study on the importance and affordability of integrated communication network in Ethiopian defense force".** The result and success of this study will highly depend on the quality of your response and I hope you will give accurate and honest responses to the items presented. Your response will be **kept confidential and used only** for this academic purpose.

Directions:

You are not required to write your name.

- Put a "√" mark in the space provided in front of each item.
- The questionnaire has 3 parts. Please try to fill all the items.

Part I: Demographic information

1. Sex: Male ☐ Female ☐
2. Age Range : 18 - 35 ☐ 36 – 45 ☐ 46 - 60 ☐ above 60 ☐
3. Educational Level :
   - Certificate ☐
   - Diploma ☐
   - Degree ☐
   - Master ☐
   - Other, Specify _____
4. How long have you been with the communication department?

   Less than 1 year ☐ 2- 5 years ☐ 6- 10 year ☐ above 10 years ☐

5. Areas of specialty / positions held
   a. Communication leader
   b. Communication Expert
   c. Non Communication Employee
   d. Other

Part II: **Use the following keys for agreement questions Key:** Strongly Disagree = 1, Disagree=2, Undecided = 3, agree=4, and strongly agree=5

No	Items	Extent of Your Agreement				
		1	2	3	4	5
1	**Items related to challenges in using the existing network**					
1.1	Fragmentation, variability and multi management system requirements are challenges of the existing network of the defense force of Ethiopia					
1.2	The existing communication infrastructure isn't best to use					
1.3	Communication systems are insecure and affected also by manmade and natural noises					
1.4	There exists a man power and material problem as it needs large number of professionals and materials for defense communications					
1.5	Hostile signal intercept & break down of system is common in the existing network system					
1.6	The operation, maintenance and management of the existing network in defense force are difficult.					
1.7	The technology dynamism affects the existing communication network					
2	**Items related to the understandings of relevant costs and benefits**					
2.1	Costs associated with the implementation of integrated communication network (ICN) is lesser than its Benefits					
2.2	Integrated communication network (ICN) reduces extra costs associated with the existing network services					
2.3	Comparing the related costs and benefits of the integrated communication network (ICN) system is affordable to Ethiopian defense force					
2.4	Techniques of integrated communication networks can be easily understood and operation is easy for technical experts and manageable with the existing human resource					
2.5	There is a high demand of the integrated communication network(ICN) for the current and future mission of the defense force of Ethiopia					

2.6	The technical and strategic importance of the integrated communication network (ICN) is higher for the defense force					
2.7	I believe that Integrated communication networks are affordable to the Ethiopian defense forces in the mission, technique and cost conditions.					
3	**Items related to the comparative advantages**					
3.1	Integrated communication network (ICN) creates smooth and fast communication than the existing old network					
3.2	Integrated communication network (ICN) helps to well organized command and control system in the defense force of Ethiopia					
3.3	Technical capacity of the integrated communication network (ICN) is better in accomplishing mission.					
3.4	Integrated communication network is not important in Ethiopian contexts					
3.5	The existing network are not well Established and enough to handle and all communication activities.					
3.6	Integrated communication network simplifies communication management than the existing communication networks					
3.7	The integrated communication network (ICN) will reduce the long process of communication in the old network system.					
3.8	The integrated communication network (ICN)'s degree of insecurity is better than the existing networks.					
4	**Items related to the willingness to accept**					
4.1	The existing defense communication network is not enough and need to be upgraded through technologies.					
4.2	I am happy in the introduction of new communication networks and use my extra time to be familiar with.					
4.3	Centralized network system is very important in the defense force of Ethiopia.					
4.4	The Ethiopian defense Command & control Systems are well organized and no need of changing the existing system.					
4.5	Whatever it costs integrated communication network is highly important to Ethiopian defense force.					
4.6	The defense communication employees can easily adapt and work in the integrated communication networks.					

Part III. **Discus the following Three questions.**

1. As a technical staff of the defense communication department can you generally explain the importance and affordability of the Integrated Communication Network? Discus briefly.

2. What do you think about the technical, cost and mission conditions of the integrated communication Network?

3. If you have any additional information you wanted to add use the following blank space

Thank you very much
Negassi Tikue

Appendixes 3 questionnaire for higher officials

Dear respondents, I would like to express my heartfelt thanks and appreciation for your and sincere cooperation to fill this questionnaire. The questionnaire is prepared to conduct a research entitled **"Study on the importance and affordability of integrated communication network in Ethiopian defense force".** The result and success of this study will highly depend on the quality of your response and I hope you will give accurate and honest responses to the items presented. Your response will be **kept confidential and used only** for this academic purpose.

Directions:

You are not required to write your name.

- Put a "√" mark in the space provided in front of each item.
- The questionnaire has 3 parts. Please try to fill all the items.
- Please choose the one which you think is the most appropriate response to each question.

Part I. Respondents Demographics

Higher Official and stakeholders Respondents Demographics		
What is your specialty: 1. Leader 2. Expert 3. Employee 4. Other	Level of Education /Specialty 1. Diploma 2. Degree 3. Masters 4. PhD 5. others	How long have you been in practice in your specialty? 1. less than 1 year 2. 2 to 5 years 3. 6 to 10 years 4. More than 10 years
Type of practice/Experience 1.Military leadership 2.Civilian 3 Other	Your Age: 1.20 to 30 2. 31 to 40 3.41 to 50 4. Over 50	Your Gender: 1.Male 2.female

Part II. Use the following keys for agreement questions Key: Strongly Disagree = 1, Disagree=2, Undecided = 3, agree=4, and strongly agree=5

No	Items	Extent of Your Agreement				
		1	2	3	4	5
1	**Items related to challenges in using the existing network**					
1.1	I understand the challenges of defense communications in Ethiopia					
1.2	Most of the times my messages or commands do not reach in the required quality to the receiver and there exists management issues.					
1.3	Insecurity of communication system sometimes occurred on the different missions of the defense force of Ethiopia					
1.4	I have the information and understandings about the integrated communication system					
1.5	There are complaints about the existing network system by technical experts, employees, departments and the army					
2	**Items related to relevant costs and benefits**					
2.1	I believe Costs associated with the implementation of integrated communication network (ICN) is lesser than its Benefits					
2.2	I prefer the type of network suitable to Ethiopian defense is leased line communication networks					
2.3	I prefer the type of network suitable to Ethiopian defense is independent net communication networks					
2.4	Based on its importance, competitive strategy of the army and its services integrated communication network is preferable and affordable for the defense force					
2.5	The management team and the higher officials will approve if any technology suitable to the effectiveness of the defense force.					
3	**Items related to the comparative advantages**					
3.1	Integrated communication network is vital and Government have an interest on such investments					
3.2	Integrated communication network will facilitate the effective functioning of all the systems of the defense force.					
3.3	The introduction of integrated communication network absolutely help to solve the challenges of the existing network system.					
4	**Items related to the willingness to accept**					
4.1	With respect to its importance, any decision making regarding the introduction of integrated communication network is accepted by the defense higher management body					

4.2	Currently, I am happy if we invest on the integrated communication networks.					
4.3	Since there is no much war and mission, investing on integrated communication network will not be much effective					

Part III: Short answer questions

1. What is your opinion in the introduction of the integrated communication network for the defense force of Ethiopia?

2. Is there any challenge you think with the introduction of integrated communication network?

3. If there is any additional comments and suggestions you are welcome

Thank you very much
Negassi Tikue