Developing Professionals' Capacity in Agricultural Extension Service Using Information and Communication Technologies (ICTs)

MOST. SANJIDA AKTER

DEPARTMENT OF AGRICULTURAL EXTENSION AND INFORMATION SYSTEM

SHER-E-BANGLA AGRICULTURAL UNIVERSITY, DHAKA-1207

DECEMBER, 2016

Developing Professionals' Capacity in Agricultural Extension Service Using Information and Communication Technologies (ICTs)

BY

MOST. SANJIDA AKTER

REGISTRATION NO. 15-06957

A Thesis

Submitted to the Faculty of Agriculture,

Sher-e-Bangla Agricultural University, Dhaka

In partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

IN

AGRICULTURAL EXTENSION AND INFORMATION SYSTEM

SEMESTER: JULY-DECEMBER, 2016

Approved by:

Md. Mahbubul Alam, PhD
Supervisor
Associate Professor
Department of Agricultural Extension
and Information System
Sher-e-Bangla Agricultural University
Dhaka-1207

Professor M. Zahidul Haque
Co- Supervisor
Department of Agricultural Extension
and Information System
Sher-e-Bangla Agricultural University
Dhaka-1207

Md. Mahbubul Alam, PhD
Associate Professor & Chairman
Department of Agricultural Extension and Information System
Sher-e-Bangla Agricultural University
Dhaka-1207

Department of Agricultural Extension and Information System
Sher-e-Bangla Agricultural University
Dhaka - 1207, Bangladesh

CERTIFICATE

This is to certify that the thesis enlighten, **"Developing Professionals' Capacity in Agricultural Extension Service Using Information and Communication Technologies (ICTs)"** submitted to the faculty of agriculture, Sher-e-Bangla Agricultural University, Dhaka in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE in AGRICULTURAL EXTENSION**, embodies the result of a piece of bona fide research work conducted by **MOST. SANJIDA AKTER, Registration no. 15 -06957** under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information, received during the course of this study has been dully acknowledgement.

Dated: December, 2016
Dhaka, Bangladesh

Md. Mahbubul Alam, PhD
Supervisor
Associate Professor
Department of Agricultural Extension and Information System
Sher-e-Bangla Agricultural University
Dhaka-1207

Dedicated to

My

Beloved Parents

ACKNOWLEDGEMENTS

One of the gratified moments of writing this acknowledgement is to look back the entire journey of my study and remember all the people, starting from my supervisor, co-supervisor to course instructors, friends and family, and above all Almighty Allah.

At first, I devote an extraordinary pleasure and respect to express my ardent appreciation, most profound feelings of gratefulness, best respects and significant obligation to my reverend supervisor, **Md. Mahbubul Alam, PhD**, Associate Professor, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka, without whom I would not have been able to come this far. He not only supervised this thesis but also guide me immensely to carry out this research work.

Second, I feel proud to express my deepest respect, sincere appreciation and immense indebtedness to my co-supervisor **Prof. M. Zahidul Haque**, Professor, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka, for his scholastic and continuous guidance during the entire period of course, research work and preparation of this thesis.

Third, I am happy to extend my heartfelt thanks to all the faculties of the Department of Agricultural Extension and Information System, SAU, for their valuable teaching, suggestions and encouragement during the period of the study.

I would like to extend my appreciations to Md. Sadekuzzaman Sarker, AEO and Md. Kurshed Alam, UAO, Mithapukur Upazila; Md. Abdullah Al Mamun, UAO, Gangachara Upazila; Md. Mahbubur Rahman, UAO, Badarganj Upazila; Mithu Chandra Adhikary, AEO, Pirganj Upazila; Md. Riazuddin, UAO & Md. Saiful Alam Additional AEO of Rangpur Sadar Upazila and all the SAAOs of the five upazilas, respectively for their cordial help and cooperation.

I would also like to thank my younger brother for his cooperation and dedication to help me out to conduct the surveys when travelling different upazilas.

Last but not least, I would like to express my sincere appreciation to my parents and all of my well-wishers.

The Author

TABLE OF CONTENTS

ACKNOWLEDGEMENTS ..... **i**
TABLE OF CONTENTS ..... **ii**
LIST OF TABLES ..... **v**
LIST OF FIGURES ..... **v**
LIST OF APPENDICES ..... **v**
ABBREVIATION AND ACRONYMS ..... **vi**
ABSTRACT ..... **vii**
CHAPTER I **1**
INTRODUCTION **1**
1.1 General Background 1
1.2 Statement of the Problem 3
1.3 Objectives of the Study 4
1.4 Significance of the Study 5
1.5 Scope and Limitations of the Study 5
1.6 Assumptions of the Study 6
1.7 Definition of the Terms 7
CHAPTER II **11**
REVIEW OF LITERATURE **11**
2.1 Professionals' Capacity Development and its Relation to ICTs 11
2.1.1 Concept of capacity building 11
2.1.2 Capacity building for professionals 13
2.1.3 ICTs and their roles to professionals' capacity building 15
2.2 Identification of the Salient Factors of ICTs Use by Professionals 17
2.3 The Conceptual Model and Hypotheses Development 20
2.3.1 ICT use and perceived capacity building 20
2.3.2 ICT Self-efficacy and ICTs use 21
2.3.3 ICT Ownership and ICT use 21
2.3.4 Perceived ease of use and ICT use 22
2.3.5 Facilitating condition and ICT use 22
2.3.6 Subjective norms and ICT use 22
2.3.7 Top management support and ICT use 23
2.3.8 Control variables 23
CHAPTER III **24**
METHODOLOGY **24**

3.1 Research Design 24
3.1.1 Locale of the study 24
3.1.2 Population and sampling frame 24
3.1.3 Instrument for data collection 25
3.1.4 Variables of the study 25
3.2 Measurement of Variables 26
3.2.1 Measurement of independent variables 26
3.2.2 Measurement of dependent variable 29
3.3 Data Analysis 30
3.3.1 Editing 30
3.3.2 Coding and tabulation 30
3.3.3 Categorization of data 30
3.3.4 Method of data analysis 30
CHAPTER IV 32
RESULTS AND DISCUSSION 32
4.1 Sample's Characteristics and Descriptive Statistics 32
4.2 Sample's Distribution based on the Salient Factors of Professionals' Capacity Building..... 33
4.2.1 ICT ownership 33
4.2.2 ICT Self-efficacy 34
4.2.3 Perceived ease of use 34
4.2.4 Facilitating condition 35
4.2.5 Subjective norms 35
4.2.6 Top management support 36
4.2.7 Extent of ICT use 36
4.2.8 Perceived capacity building 37
4.3 Reliability and Validity of the Measurement Model 37
4.4 Results of the Structural Model 39
4.4.1 Discussion of the research findings 41
4.5 Problems Faced by Extension Professionals to Use ICTs 43
CHAPTER V 45
SUMMARY, CONCLUSION AND RECOMMENDATION 45
5.1 Summary of the Findings 45
5.1.1 Selected factors influencing the extent of ICT use 45
5.1.2 Extent of ICT use 46
5.1.3 Perceived capacity building 46
5.1.4 Results of the theoretical model 46
5.1.5 Problems faced by extension professionals using ICT 47

5.2 Conclusion 47
5.3 Recommendations 48
5.3.1 Recommendations for policy 48
5.3.2 Recommendations for further studies 49
REFERENCES 51
APPENDIX- A 59
APPENDIX-B 63

LIST OF TABLES

Table 2.1 Major theories of technology acceptance and their core constructs 18
Table 2.2 Constructs and their operationalization of this study.....19
Table 3.1 Population and sample of this study 25
Table 4.1 Sample's characteristics (N=131) 32
Table 4.2 Descriptive statistics of constructs used in this study.....32
Table 4.3 Distribution of the respondents according to their ICT ownership 33
Table 4.4 Distribution of the respondents according to their ICT self-efficacy 34
Table 4.5 Distribution of the respondents according to their perceived ease of use ...34
Table 4.6 Distribution of the respondents according to facilitating condition 35
Table 4.7 Distribution of the respondents according to subjective norms.....35
Table 4.8 Distribution of the respondents according to top management support 36
Table 4.9 Distribution of the respondents according to their extent of ICT use.....36
Table 4.10 Distribution of the respondents according to their perceived capacity building….....37
Table 4.11 Measurement model validation and bivariate correlations 38
Table 4.12 Results of the structural model path coefficients with sig. levels.....40
Table 4.13 Summary of the proposed hypotheses 41

LIST OF FIGURES

Figure 2.1 The conceptual model of this study.....20
Figure 4.1 Results of the study model showing co-efficients and variance.....40
Figure 4.2 A thematic map showing key themes and codes with frequency 44

LIST OF APPENDICES

APPENDIX- A An English Vesion of Interview Schedule 59
APPENDIX-B Cross Loadings.....63

ABBREVIATION AND ACRONYMS

AEO	Agricultural Extension Officer
AIS	Agricultural Information Service
AVE	Average Variance Extracted
CTA	Technical Centre for Agricultural and Rural Corporation
DAE	Department of Agricultural Extension
FAO	Food and Agriculture Organization of the United Nation
ICT	Information and Communication Technology
IT	Information Technology
MAF	Ministry of Agriculture and Forestry
MDG	Millennium Development Goal
MMS	Multimedia Message Service
NAFES	National Agriculture and Forestry Extension Service
NGO	Non-Government Organization
SEM	Structural Equation Modelling
SIM	Subscriber Identity Module
SMS	Short Message Service
SPSS	Statistical Package for Social Science
SAAO	Sub- Assistant Agriculture Officer
SAU	Sher-e-Bangla Agricultural University
PLS	Partial Least Square
TAM	Technology Acceptance Model
TRA	Theory of Reasoned Action
TPB	Thoery of Planned Behavior
TMS	Top Management Support
UAO	Upazila Agriculture Officer
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UTAUT	Unified Theory of Acceptance and Use of Technology
WWW	World Wide Web

Developing Professionals' Capacity in Agricultural Extension Service Using Information and Communication Technologies (ICTs)

MOST. SANJIDA AKTER

ABSTRACT

Information and Communication Technology (ICT) has already been recognized as an efficient mean of communication which enables user to exchange information and knowledge in a comprehensive manner. Department of Agricultural Extension (DAE) is responsible for transferring farm-innovation to the rural clienteles in Bangladesh. However, little is known about the role of ICT in facilitating DAE's functions. Therefore, the key concern of this study was to determine the effect of ICT use to front-line extension professionals' (here, SAAO) capacity building in delivering effective extension service. Attempts were also made to determine the factors that contribute extension professionals' ICT use behavior and their problems faced to use ICTs in carrying out their services. A theoretical model was proposed based on the notion of well-known technology acceptance model, Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, et al., 2003) which incorporated with the concept of capacity building. Data were collected from 131 SAAOs of five upazilas of Rangpur district using a structured interview schedule during 15th July-30th July, 2017. Both qualitative and quantitative methods were used in accordance with the objectives of the study. Data were analyzed by Partial Least Square-based Structural Equation Modeling (PLS-SEM) using Smart PLS v2.0 whereas to analyze the qualitative data (i.e., *problems faced by extension professionals in using ICTs*), 'thematic analysis' (Boyatzis, 1998) was used. Results revealed that the extent of ICT use by extension professionals positively influenced and explained 13.1 percent of the variance of perceived capacity building. ICT ownership, ICT self-efficacy and perceived ease of use had positive influence and explained 67.3 percent of the variance of the extent of ICT use while top management support, facilitating condition and subjective norm were found to be non-significant to the extent of ICT use. Concerning the problems, 'high cost of ICT' was most frequently reported by extension professionals followed by 'lack of IT literacy' and 'poor IT infrastructure'. Finally, this study offered several theoretical and practical recommendations about the structuring of ICT applications in agricultural extension service.

CHAPTER I
INTRODUCTION

1.1 General Background

Information and Communication Technology commonly known as ICT is the set of technologies that facilitates communication, retrieval, processing, storage and transmission of digital contents (e.g., voice, text, animation, image, video) electronically (Uguru, 2001). The basic function of ICT to process, store and disseminate information that also foster information-related human activities (Salomon, et al., 1999). ICT and Information Technology (IT) is often used alternatively; however the former mainly focuses on communication technologies which includes computers, the Internet, geographical information systems, mobile phones as well as the traditional electronic media like radio, television and e-newspaper (Ajani, 2014). Besides, any computer-based applications and communication tools such as social media, digital information repositories and digital photography, web or mobile apps, blog should be considered as the ICT (Balaji, Meera, & Dixit, 2007). According to the Technical Center for Agriculture and Rural Cooperation (CTA, 2003) as cited by Arokoyo (2005), ICTs can broadly be defined as that technologies that facilitate communication, process and transmit of information by electronic means that includes the full range of ICTs from radio and television to telephones (fixed and mobile), computers and the Internet.

Adoption of ICTs is now has a proven record in many parts of the world and has been demonstrated a huge potential to achieve significant and sustained economic, social and environmental benefits at local, national and global levels (Gelb, et al., 2008). Similarly, ICTs' roles in agriculture and for rural development have already been documented in academics and practices literature. Effective agricultural development requires access to information on all aspects of agricultural production, processing and marketing and it seems likely that if anything this need is increasing (Jones, 1997). ICT has already been proven as an important tool to delivery time-sensitive farming information to its clients in both developed and developing countries. In fact, ICT's potentiality in agriculture lies in its facilitation to access to information resources that in other words enables effective knowledge sharing among its users. ICT helps its users to create, store, manage and transmit data, information and knowledge that have already been processed and adapted (Rao, 2007). It is now increasingly recognized that ICT can be a source of knowledge

for all people and bridges the gap between people and places. Anecdotal reports suggested that ICTs can function as an efficient means of knowledge sharing which refers to as "the interactive process of making the right information available to people at the right time in a comprehensive manner in order to act judiciously and enrich the knowledge base" (Nath, 2001).

The primary concern of agricultural extension service is to transfer farm-related knowledge to farmers, advice and educate them with farm-related problems and solutions, enable them to set and achieve their goals and possibilities and thus brings positive economic and social change in farm communities. In practice, extension service works as an "agents" who reports farmers' farm-problems to the research institutes and reaches farmers with the solutions generated from the research stations. Extension service is also responsible for transferring farm innovations to farmers' fields from research labs. Therefore, an extension worker plays a two-pronged roles. On one hand, she needs to be updated herself with latest technological innovations and farm information and on the other hand, she disseminates those information to the rural clienteles. Therefore, updating herself with latest information is the precondition for successful information dissemination.

Gakuru, et al. (2009), reported that most farmers access information from extension workers, libraries or websites. The number of extension workers are very less in accordance to the number of farmers in an area. So, each extension worker has to support a number of farmers they need to work in fairly large areas. It is so difficult for the extension workers to communicate with the bulk of farmers. The distance travelled by an extension worker to visit the clients have an effect on the number of farmers, farmer group and communities that are covered by extension workers in the study area. Therefore, communication gap between the extension worker and the farmer is a common consequence. Extension workers often fail to make regular visits to farmers' farms considering the numbers of farmers that they work with. However, although not completely this gap could now be reduced through innovative use of ICT tools such as computers and the Internet, mobile phones, and tabs.

ICTs may not only minimize communication gap between farmers and extension, but it also be used as one of the information sources for extension personnel. Meeting up the need of demand-driven agriculture, extension workers need to be updated themselves with new knowledge, innovation and practices. Weekly meeting at upazila headquarters,

farm-related publications (e.g., poster, leaflet, booklet), official circular letter, interaction with higher officials are the common information sources of field level extension workers which have been proven inadequate for efficient extension service. Rather depending on a static information or a face-to-face interaction, an ICT-based media might be a useful alternate information source for extension workers. Moreover, in demand of a time-sensitive extension service delivery, ICTs can greatly assist field level extension workers to seek, process and disseminate appropriate information. This is how ICTs can enable extension workers' capacity in delivering quality extension service. Therefore, the extension must consider ICTs as not only a knowledge sharing tool to external entities but also as a capacity enabler for Internet employees.

1.2 Statement of the Problem

Department of Agricultural Extension (DAE) is the largest public sector extension service provider in Bangladesh. The frontline extension officers popularly known as Sub-Assistant Agriculture Officer (SAAO) of DAE work in block level (the lowest administrative unit of extension service/sub-unit of upazila) and directly transfer technology to the farm level. The success of extension service is therefore largely depends on their knowledge, skills and performance to provide quality extension service to its clients. For seeking information and updating their knowledge and skills, extension workers use both interpersonal communication such as higher officials (Upazila Agriculture Officer (UAO), Agricultural Extension Officer (AEO) at upazila or district level, and mass communication media like printed materials (newspaper, bulletin, leaflet, other farm publication), radio and Television. Nevertheless, recent advancement of communication media especially mobile phone, computer, the Internet, digital information repositories are also regarded as the important information sources for extension workers to obtain necessary information and develop their capacity in providing extension service. The extension workers need to understand farmers' opportunities and problems and help them finding the best solutions for their agriculture. However, few studies confirmed (e.g., Arokoyo, et at., 2002) that despite village level extension agent is one of the important sources of information for farmers, they certainly do not the most efficient in terms of cost and coverage. The State Extension Leaders Network (SELN) (2006, p. 3) stated that "extension is concerned with building capacity for change through improved communication and information flow between industry, agency and community stakeholders". Hence, upgrading the skills and capacity level of

field extension workers should be given prime concern so that extension services can be effective in helping poor farmers. Therefore, by using ICTs, extension workers may updated their knowledge on a more regular basis than in the past, and may enhance their capacity to provide effective extension service to rural clienteles.

Developing professionals' capacity of an individual is fundamental to achieve desire objectives of an organization. Developing professionals' capacity may be facilitated as well as hindered by many factors. SAAOs are the grass root level extension worker, their better performance are highly positive factors towards the achievement of DAE's vision. Thus it is necessary to know how ICTs can facilitate extension professionals' capacity development which ultimately help them to achieve the objectives of DAE, improve living standard of rural people in general and the farming community in particular by increasing agricultural production. In this regard it is pertinent to know the answer of the following questions:

i. What factors influence extension professionals to use ICTs as a capacity development enabler?
ii. To what extent extension professionals use ICTs in updating their capacity in agricultural extension service?
iii. To what extent extension professional perceived capacity development in agricultural extension service using ICTs?
iv. What are the significant influence of the selected factors to extension professionals' use of ICTs and their perceived capacity development in agricultural extension service?
v. What the problems extension professionals' faced in using ICTs for developing their capacity in agricultural extension service?

In view of the above questions the researcher undertook a study entitled, "Developing Professionals' Capacity in Agricultural Extension Service Using Information and Communication Technologies (ICTs)".

1.3 Objectives of the Study

Based on the problem statements made in the section 1.2, the following research objectives were formulated to guide the research:

i. To determine the selected factors that influence extension professionals' use of ICTs in developing their capacity in agricultural extension service,

ii. To determine the extent of ICT use by the professionals in updating their capacity in agricultural extension service,
iii. To determine the extent of perceived capacity development by the extension professionals through ICTs,
iv. To determine the extent to which the selected factors influence extension professionals' use of ICTs and their perceived capacity development in agricultural extension service,
v. To identify the problems faced by the extension professionals in using ICTs in updating their capacity in agricultural extension service.

1.4 Significance of the Study

ICT has become a popular tool for disseminating information and for communication. It significantly reduces the costs of transmission and ensure timely delivery of information in efficient way. Moreover, it overcomes the constraints of time, space and resources by promoting instant communication among its users. In addition, it opens up a new avenue of knowledge acquisition, storage and dissemination. Therefore, it is expected that by studying professionals' use of ICTs for updating their professional knowledge and skills will show the present status of ICTs use by professionals in agricultural service delivery. In addition, by identifying the enablers and their effect to perceived capacity development would help to identify the prevailing factors for ICT interventions in Bangladesh agriculture. From academic perspective, findings of this study and the methodology used in this study would inspire other researchers to conduct further investigation. Finally, the findings of this study will hope to provide insights to the policy makers on how to develop effective ICT-based solutions for effective extension service in Bangladesh.

1.5 Scope and Limitations of the Study

The present study was undertaken with a view to assess the perceived capacity development of the SAAOs through ICTs and to identify the enabling factors that might influence SAAOs' ICTs use behavior for capacity development. Attempt was also made to find out the problems faced by the SAAOs to use ICTs in updating their professional skills. However, in order to make the study manageable and meaningful the following limitations have been considered throughout the study:

1. The study was confined in five upazilas namely Mithapukur, Rangpur Sadar, Gangachara, Badarganj & Pirganj under Rangpur district.
2. There are numerous factors that might influence extension professionals' perceived capacity development through ICTs, however only few factors which deemed important and consistent with the study context were considered for this study.
3. While designation and responsibility of extension professionals are varied, only front level extension workers (e.g., SAAOs) were considered as the respondents of this study.
4. This study used self-reflected measured of perceptual variables which might affect certain interpretations of the findings.
5. There are various aspect of capacity building performed by the SAAOs, however only few of them (i.e., 7) were considered for this study.
6. Given the research interest, determining professionals' capacity development through ICTs, longitudinal data might be a possible alternative to test the hypothesized relationships. However, considering the time and resources constraints, only cross-sectional data were used to test the model.

1.6 Assumptions of the Study

The researcher made the following assumptions undertaking this study.

1. The SAAOs included in the sample of the study were competent enough to satisfy the quarries designed by the researcher.
2. The information furnished by the respondents were correct and representative of the population and free from any bias.
3. The views and opinions furnished by the SAAOs included in the sample were the representative views and opinions of all the SAAOs of Rangpur district in Bangladesh.
4. Environmental conditions and organizational procedures under which the SAAOs work are generally similar throughout the study area.
5. Data furnished from the respondents were normally distributed.

6. Findings of the study will generally be applied to other parts of the country with similar personal, socio-economic and cultural conditions.

1.7 Definition of the Terms

This study intended to determine extension professionals' perceived capacity development through ICTs and the salient factors that might affect their ICTs use behavior. Before further discussion, some key concepts and definitions of the terms are presented in this section.

Concept	Definition
Information and Communication Technologies (ICTs) (Ajani, 2014; Balaji, Meera, & Dixit, 2007)	ICTs refer to as communication technologies which includes computers, the Internet, geographical information systems, mobile phones as well as the traditional electronic media like radio, television and e-newspaper. In this study, any computer-mediated communication media and applications such as mobile phones, Internet, social media, digital information repositories, ICT-assisted call centres, digital photography, web or mobile apps, blog consider as ICTs.
Internet (Laudon and Traver, 2014)	The Internet is an interconnected network of thousands of networks and millions of computers using standardized communication protocol (TCP/IP). It is a network of a computer networks that connects billion of webpages. The Internet carries an extensive range of information resources and services, such as e-mail, apps, shopping, instant messaging, music, videos, and news.
Computer (Norton, 2008)	Computer is a programmable electronic device that processes data and converting data into information that is useful to people. It performs high-speed processing of numbers.
Laptop	Laptop is a portable microcomputer having its main components (such as processor, keyboard and display screen)

	integrated into a single unit capable of battery-powered operation.
Smart phone	An electronic telecommunication device, often refers to as a cellular phone or cellphone. Mobile phones connect to a wireless communication network through radio wave satellite transmission. Smart phone provides voice communication, Short Message Service (SMS), Multimedia Message Service (MMS), and Internet services such as web browsing and e-mail.
Featured phone	Featured phones typically provides voice calling and text messaging. Sometimes it provides multimedia supports.
SMS	SMS means Short Message Service. This is a feature of a mobile phone that allows a user to send or receive text message or any kind of information.
MMS	MMS means Multimedia Message Service. This is a method of transmitting graphics, video or sound files, etc.
Capacity development (Hord, 1997; Linnell, 2003).	Capacity building refers to the activities that improve an organization's ability to achieve its mission or a person's ability to define and realize his/her goals or to do his/her job more effectively. Here, capacity development of extension professionals is defined as their perceived ability to upgrade their skills and knowledge in agricultural service delivery.
Extension professional	Agricultural extension professionals include all professional staffs working in the extension organization who provide farm-related extension support to its clients. However, only front-level extension professionals (i.e., SAAO) were considered as the respondents of this study.
Age	Age of the respondents is defined as the period of time from their birth to the time of interview.

Service experience	It referred to one's entire duration of service from the date of first joining in the Department of Agricultural Extension (DAE) till the date of interview.
ICT ownership	ICT ownership refers to as a respondent's possession of ICT devices like mobile phone, computer, laptop and the Internet.
Self-efficacy (Compeau & Higgins, 1995)	It refers to the judgment of one's ability to use a technology (e.g., computer) to accomplish a particular job or task. ICT self-efficacy in this study incorporates one's belief in his ability to upgrade his knowledge and skills to perform a job better using ICTs.
Ease of use (Davis, 1989; Venkatesh, et al., 2003)	Ease of use is the degree to which a person believes that using a particular system would be free of effort. It is related to the degree of simplicity associated with the use of ICTs. In this study, ease of use is defined as the degree to which an extension professional perceives using ICTs for information acquisition, process and dissemination require less effort.
Facilitating conditions (Venkatesh, et al., 2003)	Facilitating conditions are defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of an IT system. Here, facilitating conditions refer to as the degree to which extension professionals believe that there are sufficient organizational and technical infrastructure exist that facilitate them to use ICTs in updating their capacity.
Subjective norms (Fishbein and Ajzen 1975, p. 302)	Subjective norms refers to a person's perception that most people who are important to her think she should or should not perform the behavior in question. Therefore, this study defined subjective norms as the extent to which an extension professional perceives that her peers, colleagues and important others believe she should use ICTs.

Top management support (Hossain, Moon, Kim, & Choe, 2011; Chatterjee, Grewai, & Sambamurthy, 2002)	In the context of the current research, top management support is defined as the extent to which a person believes top management of her organization/department facilitates, encourages, deploys and uses of ICTs for business operations.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this chapter is to review of the results of some of the previous studies and popular articles having relevance to this investigation. This study is mainly related with the determination of perceived capacity building of SAAOs using ICTs. The researcher tried to collect needed information by thorough searching of related theses, literature, periodicals and the Internet. However, use of ICTs by professionals in agriculture for capacity building or for increasing job performance was rarely available. To address the research objectives, this study therefore reviews the existing literature which deemed relevant to the phenomenon of interest such as IT adoption literature, organizational behavior literature, and proposes a theoretical understanding of the current investigation into the three sections. The first section is concerned with the review of literature on the concept of capacity building and shows how ICTs facilitate capacity building. The second section identifies the salient factors that might influence extension professionals' use of ICTs for professional development. The third section proposes a conceptual model of this study based on the discussion presented in first two sections.

2.1 Professionals' Capacity Development and its Relation to ICTs

This section first presents the concept of capacity development and then discusses the importance of capacity building particularly for professionals. Lastly, it describes how ICTs play a pivotal role to develop professionals' capacity.

2.1.1 Concept of capacity building

Capacity means the power or ability of a system, association, group or individual to perform the tasks appropriately (UNDP, 1997). Capacity in people and their institutions enable a country to achieve its development goals and hence it a key factor for development (World Bank, 1997).

Development of human and institutional resources is the key to capacity development. Despite the meanings of capacity building is perceived differently by different people, typically it relates to enhancing or strengthening a person's or organization's ability to achieve what they want to achieve (Lusthaus and Perstinger, 1999). From a community perspective, capacity building is the ability of people, organization and society as a

whole to manage their affairs to achieve predefined goals (Issa & Issa, 2013). From an individual perspective, capacity is the mean or ability of a person to fulfill a task or meet an objective effectively (Hilderbrand, 2008). Thus, skills of a staff or strength of an organization refers to as the capacity of a person or organization.

Capacity building is a process improving an organization's ability to achieve its mission or a person's ability to define and realize his/her goals or to do job accordingly (Hord, 1997; Linnell, 2003, p.13). Kogut, et al. (1992) and Kuhl (2009) viewed capacity building as a way of acquiring new capabilities of an organization in order to increase its effectiveness and social impact, and achieve its goals and sustainability over time.

Capacity building focuses on the approaches, strategies, methods or activities that facilitate organization, group or individual to upgrade knowledge and skills so that they achieve their best outcomes. Similar like many development agencies, UNESCO (2006) reported that the centre of capacity building approach is to increase an individual and organization's abilities to perform core functions, solve problems, and objectively deal with developmental needs. With this reference, Horton (2002) argued that capacity building is a way of improving or upgrading the ability of the person, team and institutions to implement their functions and achieve goals over time.

There are different levels where capacity development may take place, individual, institutional and societal level (UNDP, 2011).

- ✓ **Individual level**: capacity building at individual level requires developing conditions that allow individuals to build and enhance knowledge and skills. In other words, establish conditions that engage individuals in the process of learning and adapting to change.
- ✓ **Institutional level**: capacity building at institutional level entails modernizing and supporting existing institutions in forming sound policies, organizational structures, and effective methods of management and revenue control.
- ✓ **Societal level**: capacity building at the societal level includes all the rule, laws, policies, power relations and social norms that supports people engagement. It is an environmental force that sets the overall scope for capacity development.

Therefore, capacity development is a process of change where people, institutional and societal capacities change over time. Capacity development help individuals and organizations to manage their local resources in an efficient way to achieve desired goals

(Stephen et al., 2006; Issa & Issa, (2013). However, this study only focuses at individual level capacity development for front-line extension professionals.

2.1.2 Capacity building for professionals

Since introduced capacity building has been considered as an important approach to development. Knowledge and skills are the preconditions for capacity development. Development is a continuous process of improving one's particular skills and expertise. Capacity development facilitates individuals or organizations to locate local resources with a view to increase and manage development goals in a sustainable way (Stephen, Brien & Triraganon, 2006). Organizations with skilled and knowledgeable staffs may achieve their goals more effectively. Horton (2002) reported that developing individuals' capacities will automatically lead to improved organizational capacity and performance. Mati (2008) compared employees' capacity building as valuable as capital investment and infrastructure.

Capacity development is not referred to a single entity rather it is important for all levels, from individuals to organizations as well as communities (Paul and Thomas, 2002). The emphasis should be on updating knowledge, skills and ability of people at various levels to be more effective to manage changes (Coutts, et al., 2005). Improving the capacity of individuals, groups, organizations and communities is necessary for rural development, poverty alleviation and environment protection (Degnbol-Martinussen, 2002)**.** Capacity development is often regarded as an effective and productive economic agent or a man-made physical capital **(**FAO, 2010).

Agricultural extension workers helps farmers to learn new developments, new technologies and new ways of managing their farms (Schroeter, 2006, p. 13). That mean's extension workers work as change agents for updating farmers' knowledge and skills. Extension is thus a major vehicle for rural development as it transfers new technical knowledge to farmers and upon receiving their feedback reports to the researchers (Dwarakinath, 2006). Therefore, developing extension workers' capacity is central to making extension services effective in helping poor farmers (Chikarie, et al., 2015).

Improving workers' capacity is important to upgrade their knowledge and skills. Extension workers should have good skills to help farming communities to manage their work better. Extension workers need not only agricultural technical skills to assist

farmers but also to have knowledge about finance, marketing and microenterprise development, social assessment and facilitation (MAF, 2008). Stur, et al. (2002) reported that the knowledge and skills of government extension staff is lacking in quality and quantity yet their ability to learn technical and extension skills is critical for effective extension service (NAFES 2005).

To meet the needs for demand-driven agriculture, particularly for commercial agriculture and provide time-sensitive information service delivery without any delay and resolve problems in the fields, there is no alternative of upgrading knowledge, skills, attitudes and ability of extension staffs to a very high level. Hence, having a well-developed technical skills across a broad range of farming systems and socio-political perspectives on the place of farming are prerequisites for effective extension service (Chikarie, et al., 2015).

Extension professionals are expected to be skilled in technical subject-matter, service administration, supervision and management, human resource development, program development process, pedagogical skills, communication strategies, and evaluation techniques (Issa, 2010). Elsewhere, Byrnes (2002) reported that extension worker must possess the basic disposition and attitude (congruency, empathy and appreciation), content competence (credible and knowledgeable in the subject matter), methodological competence (must know how to use specific communication techniques, appropriate media and communication aids) and managerial and organizational competence (able work within the framework of facilitation and guidance. A qualified and well trained extension personnel is more capable of transferring information to the farmers (Issa, 2010) and achieving development goals (Chikarie, et al., 2015). Byrnes (2002) further added that extension workers must be able to transfer technological know-how to all categories of farmers irrespective of their age, race, income and educational level and motivate them to adopt innovations. It has now been well evident that an organization's ability to bring positive change is largely reflected by its workers' capabilities. Either research or development organizations, capacity development is essential for all to be economically and socially sustained (Horton, 2002).

For developing staffs' capacity, four common approaches are believed to be effective, top-down organizational (e.g., policy); bottom-up organizational (e.g., staff training); partnership organizational, and community organizing approaches (Hartwig, et al., 2008). In an organization like agricultural extension, training is a common approach

enabling workers to posit them for the future responsibilities of the department (Issa and Issa, 2013). Building capacity of extension workers ensure that they receive sufficient trainings and develop certain capabilities to cope with sudden changes in demand and serve varying degree of needs of the rural clienteles (Chikarie, et al., 2015).

2.1.3 ICTs and their roles to professionals' capacity building

Public and private sector actors have long been on the search for effective solutions to address both the long and short-term challenges in agriculture, including farmers' information needs (Goyal, 2011). ICT is found to be a solution and shown a huge potential to improve agriculture. Swanson & Rajalahti (2010) stated that ICTs can promote and distribute new and existing farming information and knowledge among the farming community and thus facilitate agricultural and rural development.

In transforming agriculture into information driven, modern and competitive sector, ICTs' role are very prevalent (Jamwal and Padha, 2009). Their roles in human development has already been received attention among development practitioners, policy makers, government and civil society. E-mail, web sites, social media, database, web- and mobile phone-based applications are become increasingly popular for sharing of knowledge and information. The web-enabled ICT tools added a new dimension in agriculture provide farmers with quick and easy access to information which previously was difficult and expensive to obtain (Kiplangat and Ocholla, 2005). The recent advancement of ICTs can be utilized to provide accurate, timely, relevant information and service to the clients and thus to facilitate an environment for more economic friendly agriculture (Mahant, et al., 2012).

Use of ICTs in agriculture varies. In a study conducted in Kenya, Kiplangat & Ocholla (2005) reviewed that a large number of agricultural researchers (71.7%) used ICTs to communicate with extension workers, while only 35.3% of the extension workers used ICTs to communicate with agricultural researchers. A large number (81.1%) of agricultural researchers observed increased of their work productivity and creativity when using ICTs, while 61.8% of extension workers were either undecided or disagreed. Lack of ICTs skills and low physical access to ICTs were found to be more common in extension workers than agricultural researchers and thus was attributed to extension workers' low positive response in favor of ICTs. The study further added that majority

of the agricultural researchers had access to the Internet and email services, while the majority of extension workers lacked physical access to these ICT tools and services.

Nnadi, et al. (2012) observes that the impact of ICT in agricultural research is quite significant. Application of information systems in agriculture is having a profound impact on how information are communicated and disseminated. The development of web-based information systems has dramatically increased the possibility of accessing databases and information online.

ICTs has changed the way of traditional extension works. The use of electronic media for extension teaching can assist extension agents reach their clienteles across different location with agricultural information and thus foster agricultural development (Lucky, 2012). ICTs can be used in both upstream and downstream communication. In one hand, extension agents can directly communicate with the farmers and give necessary information by using ICTs without travelling to fields or wasting too much time, on the other hand, they can directly communicate with their higher officials in case of urgent queries. However, the success of using ICTs really depends on extension workers' willingness to use ICTs for updating their capacity (Dorothy, et al., 2014). Handheld devices particularly mobile phones and tabs were found to be the most popular and important ICTs used by extension professionals. These devices are comparatively less expensive, available and more ubiquitous.

Yckini and Hussein (2007) reported that transfer of technology for agricultural research and development is not optimal between the research institutions and the national extension systems, particularly to the end-users, i.e., farmers. This means that there is a divide in knowledge between delivery institutions and rural farmers. This problem can be moderately overcome by improving the capacity of field level extension staffs. Extension workers can use ICTs (e.g., mobile phone, computer, laptop, Internet) to directly contact with farmers and experts. Besides, they can directly retrieve information from the research institutions.

The common information sources for extension workers are training, project reports, text books, workshops, meetings, exposure visits, state/national sources, research, on-the job learning, and personal contact (e.g., friends, colleagues, higher officials) (Chikarie et al.,2015). However, in many instances, extension workers who work in remote areas found it difficult to seek necessary information due to poor infrastructure.

In a study conducted in Laos, Photakoun (2010) reported that the Laos government is trying to resolve this problem using mobile information packs (known as 'wisdom bags'), mobile phones and the Internet. In another project, the Savannakehet Provincial Government Livestock and Fisheries section in Laos have developed modules of learning packages which focus on district extension staff to facilitate learning at a distance. The extension staff can learn Basic English skills, fish culture techniques, how to conduct training, the establishment and system of field data management and other subjects. This capacity building method has become a model for other provincial areas in the southern region of Laos (Lithdamlong, Meusch & Innes-Taylor, 2002).

Electronic media viz. mobile phone, computer, Internet, online databases, web and mobile application can be very useful to get information even to the remote areas where it is very hard to make direct contact (Samanta, 1986). Internet-based medium is a fascinating source of information (Mahtab and Mokhtarnia, 2009) which allow extension workers to access to a knowledge resource anytime from anywhere without much delay and depending on the traditional information sources. ICTs has also been seen as a performance enabler in the workplace. Considering these arguments, it can be concluded that professionals' use of ICTs enable them to retrieve, process and disseminate information independently and therefore promote effective extension service to its clients.

2.2 Identification of the Salient Factors of ICTs Use by Professionals

Understanding professionals' use of ICTs in developing capacity for delivering effective extension service was the key focus of this study. Reviewed presented in Section 2.1.3 already reveals ICTs' roles to develop professionals' capacity in work setting. Therefore, it can be concluded that use of ICTs would be effective alternative for professionals to upgrade their knowledge and skills along with other traditional approaches. However, it is important to know what drives professionals to use ICTs in developing their capacity.

There are many factors that might have influence over user's decision to use any system. Rather than selecting the factors arbitrarily or using a grounding approach (Martin & Turner, 1986), this study adopted a theoretical approach to determine the drivers of ICTs use by extension professionals. There have been several models in agricultural extension, information system or technology adoption literature that explain why people use a particular system. Of the several technology acceptance models, Technology

Acceptance Model (TAM) (Davis, 1989) is the most used model which posits that user acceptance of an IT system is determined by the degree to which he perceives the system as usefulness and easy to use. Performance-expectancy and Social Cognitive Theory (Bandura, 1982) were the major foundations of TAM yet its theoretical understanding often overlapped with the Theory of Reasoned Action (TRA) (Fishein & Ajzen, 1975) and Thoery of Planned Behavior (TPB) (Ajzen, 1991). The prominent theories and their core constructs used in technology acceptance literature are presented in the Table 2.1.

Table 2.1 Major theories of technology acceptance and their core constructs

Theory/Model	**Core Constructs**
Theory of Reasoned Action (Fishein & Ajzen, 1975)	Attitude towards behavior Subjective norms
Theory of Planned Behavior (Ajzen, 1991)	Attitude towards behavior Subjective norm Perceived behavioral control
Diffusion of Innovation (Rogers, 1995)	Relative advantage Compatibility Complexity Trailability Observability
Social Cognitive Theory (Bandura, 1982)	Outcome expectancy Self-efficacy Affect Anxiety
Technology Acceptance Model (Davis, 1989)	Perceived usefulness Perceived ease of use Intention to use

Over the years, a number of modifications and changes have been observed in the theories of technology acceptance. One of the most prominent of these is Unified Theory of Acceptance and Use of Technology (UTAUT) proposed by Venkatesh, et al., (2003). UTAUT proposes four predictors of user's IT use intention viz. performance expectancy, effort expectancy, social influence, facilitating conditions and four moderators viz. gender, age, experience and voluntariness of use (Venkatesh, et al., 2003, p. 447). The conceptual framework proposed in the Fig 2.1 was based on the core concept of UTAUT model incorporates with perceived capacity building in work setting. In UTAUT, effort expectancy is overlapped with perceived ease of use (Davis, 1989), social influence is overlapped with the theoretical notion of subjective norm (Ajzen,

1991; Fishein & Ajzen, 1975). Therefore, perceived ease of use and subjective norm were considered instead of effort expectancy and social influence, respectively. Since user's use of a system in a voluntary work setting is contingent on user's access to and skills in an IT system, ICT self-efficacy (Bandura, 1982; Compeau & Higgins, 1995) and ICT ownership were added in the theoretical model. Facilitating condition, in UTAUT model, is defined as the degree to which a person believes that an organziational and technical infrastructure exists to support use of system. While facilitating condition refers to the availability of physical facility in favor of IT use, it does not suggest organziation's support to its employees to use IT for accomplishment of a task. Top management support (Chatterjee, Grewal, & Sambamurthy, 2002) has often been considered as an imporant determinant that play a crucial role in initiating IT adoption in any work setting and hence added in the model. Unlike UTAUT, no moderator was proposed in the model yet the effect of age and service experience to ICT use were controlled in the model. The constructs used in the model is presented in Table 2.2 along with their operationalization.

Table 2.2 Constructs and their operationalization of this study

Constructs	**Definitions**
ICT self-efficacy (Compeau & Higgins, 1995)	The degree to which an extension professional believes that he is able to use an ICT in the accomplishment of a job task.
ICT ownership	An extension professional's possession of the number and type of ICT device.
Perceived ease of use (Davis, 1989)	The degree to which an extension professional believes that using an ICT for accomplishing a task would be free of effort.
Facilitating condition (Venkatesh, Morris, Davis, & Davis, 2003)	The degree to which an extension professional believes that sufficient technical infrastructure exists to support use of ICTs to accomplish a task.
Subjective norm (Fishein & Ajzen, 1975)	The degree to which an extension professional perceives that most people who are important to his work believe that he should use ICTs for his job.
Top management support (Chatterjee, Grewai, & Sambamurthy, 2002)	The degree to which an extension professional believes that his organization articulates a stratgey, setting up a vision and support staffs to use ICTs for their work purpose.
ICT use	The frequencey of using ICTs by an extension professional for accomplishing a task.

Perceived capacity building	The degree to which an extension professional believes that he is able to update his knowledge and skills using ICTs.

2.3 The Conceptual Model and Hypotheses Development

Drawing on the insights presented in earlier sections, this section presents the research model of this study based on UTAUT model and concept of capacity development (Fig. 2.1). The model depicts that professionals' capacity building is positively influenced by their ICT use which however contingent upon six independent factors viz. ICT self-efficacy, ICT ownership, perceived ease of use, facilitating condition, subjective norm and top management support while the effect of age and service experience were controlled in the model.

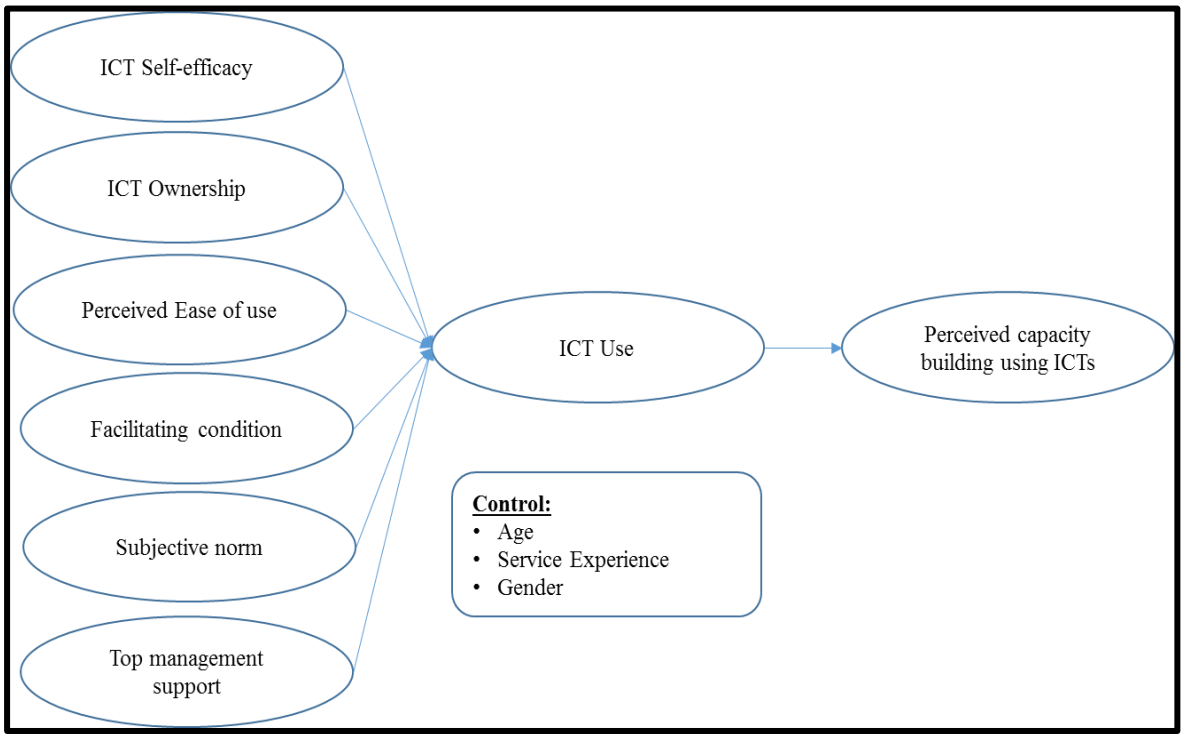

Figure 2.1 The conceptual model of this study

2.3.1 ICT use and perceived capacity building

The introduction of ICTs in work place is not only making the communication process faster but also bring positive changes in managerial functions. Timely and accurate information is vital for making efficient business decisions. A considerable number of researches have been conducted to find the impact of IT on employees work performance (e.g., Goodhue & Thompson, 1995; Delone & McLean, 1992; Igbaria & Tan, 1997). An

organizational capabililty is often reflected by its employees' capabilities. Therefore, increasing employees' job performance is a key concern for successful management operation. In an organization like DAE, front-level extension workers are so vital as they directly involve in technology dissemination process to the farmers. For a time-sensitive information search, a front-level extension worker can support farmers' better if information is readily available to him. Furthermore, ubiquitous ICTs like mobile phones, laptops, PDAs diminish the space and time limitation and provide better connectivity and flexibility to respond or to access to an information demand. Therefore, it was hypothesized that:

H1: With the increase of the extent of ICTs use by extension professionals, their perceived capacity building in delivering quality extension service is increased.

2.3.2 ICT Self-efficacy and ICTs use

Bandura (1982) stated that people might withdraw themselves from a task if they perceive a low sense of efficacy in a given domain. People's perception on self-efficacy may drive them to accomplish a difficult task irrespective of their other limitations otherwise. People with lower self-efficacy believe may frustrated more easily by the obstacles they face in accomplishing a task while people with higher self-efficacy believe may overcome those obstacles by their sense of efficacy and accomplish a task easily (Compeau & Higgins, 1995). Therefore, it can be concluded that:

H2: The higher the individual's ICT self-efficacy, the higher the use of ICTs.

2.3.3 ICT Ownership and ICT use

While ICT ownership does not assure ICT use by extension professionals yet adequate access to ICT resources should be guaranteed (Aramide, Ladipo, & Adebayo, 2015). Therefore, it is essential to make ICT devices available so that extension professionals can make use of it without much difficulties. Therefore, to ensure extension professionals' use of ICTs for accomplishing a task, they must have the access to those ICT resources. Hence, it was hypothesized that:

H3: The higher the ICT ownership, the higher the ICT use.

2.3.4 Perceived ease of use and ICT use

Frequent usage and exposure to ICT must be considered if someone wants to form a positive attitude towards ICT. When people frequently use and expose to ICT, it informed them that ICT was helpful, easy to use and beneficial to them thus creating a positive attitude towards ICT usage. There are enormous researches that have proven the effect of perceived ease of use to IT use. Among these, the most cited and used one is TAM (Davis, 1989) which was later revistied by many studies in various settings. Therefore, perceived ease of use is considered as a strong predictor of ICT use (D' Silva, et al., 2010).

H4: The higher the individual's perceived ease of use, the higher the use of ICTs.

2.3.5 Facilitating condition and ICT use

Facilitating condition refers to the organizational and technical infrastructure that support use of ICTs. Facilitating condition is specifically very important for extension professionals due to their job nature. They normally work in remote areas where they engage themselves in transferring technology to the farmers. Therefore, availability of adequate technical facilities such as low-cost computing devices, high speed and constant network coverage are much more important without which the extent of ICT use is greatly compromised. In a rural setting, facilitating condition may be varied across users. Hence, user with a lower level of control of the available ICT resources might use ICT less compare to user who has favorable access to ICT resources (Ajzen, 1991; Venkatesh, Thong, & Xu, 2012). Therefore, this study assumed that:

H5: The higher the individual's perceived facilitating condition in favor of ICT use, the higher the use of ICTs.

2.3.6 Subjective norms and ICT use

A number of studies proposed and proved the direct influence of subjective norms to user's intention to use a system. The concept of subjective norm (Ajzen, 1991; Fishein & Ajzen, 1975) is often matched with social influence (Venkatesh, et al., 2003) and social norms (Thompson, Higgins, & Howell, 1991). However, the notion of all the constructs refers to the individual's behavior that is influenced by the way he believes other view them as a result of using a system (Venkatesh, et al., 2003, p.451). Despite many studies reported the effect of subjective norms to system use is non-significant in voluntary work setting and only significant in mandatory work setting, this study

assumed subject norms might have influence over extension professionals use of ICTs for their work purpose. Hene, it was proposed:

H6: Extension professionals' use of ICTs in developing their capacity is positively influenced by subjective norms of using ICTs.

2.3.7 Top management support and ICT use

Top management support is one of the important factor that facilitates IT adoption in organization. Top management support positively influenced organization's IT assimilation which in turns create value for organization (Hossain, et al., 2011). Without the support of top management, introduction of IT in organization will fail. According to Igbaria, et al., (1997), top management support creates a more conducive environment for information system success. The Govt. of Bangladesh along with DAE have been working towards the digitalization process of citizen's services. Hence, ICTs are being introduced in various organizations and put into practices. Few ICT-based service delivery applications have already been developed and introduced by DAE. Despite ICT use has not yet been mandatory for extension professionals, a positive support from top management would encourage them to use ICT more for their job tasks. Therefore, it can be concluded that the more the support provided from the top management the more the uses of ICTs by the respondents and the more the perceived capacity building.

H7: The higher the top management support, the higher the individual's use of ICTs.

2.3.8 Control variables

Age might be an important indication in terms of using communication media, particularly for new media like ICTs. Prior studies have suggested mixed findings about the relationship between age and use of media. Bhuiyan (1988) and Nuruzzaman (2003) argue that with the increase of age, individuals' inclination to try new things decrease. Most of the research findings on age and use of ICTs showed that they either were of independent or had negative relationships. This means that age of the respondents do not possess any significant influence on their ICTs use to seek and delivery information to farmers. Besides age, the direct effect of service experience to system use in work setting is rarely studied yet proposed as a moderator (e.g., Venkatesh, et al., 2003). Nonetheless, age and service experience were not considered as predictor variables of ICT use but as control variables (Fig. 2.1).

CHAPTER III

METHODOLOGY

This chapter describes the procedures and methods used in this study. This chapter is divided into three sections. The first section describes the overview of research design. The second section describes the measurement of variables. Finally, the third section describes the methods applied in data analysis.

3.1 Research Design

3.1.1 Locale of the study

Rangpur district was purposively selected as the study area at least for two reasons. First, the socio-economic and farming condition of this area was well-known to the researcher. Second, she had a very good access to the potential respondents. Rangpur has eight upazilas. However, considering the time and budget limitation five upazilas, namely Mithapukur, Rangpur Sadar, Pirganj, Gangachara and Badarganj were randomly selected as the locale of the study.

3.1.2 Population and sampling frame

As the study concern about developing extension professionals' capacity in agricultural service delivery through ICTs, ideally all the upazila level extension workers could be constitute the population of this study. However, as SAAOs are the professionals who directly meet and transfer technologies to the farmers, this study deliberately considered them as the population of this study. Therefore, all the SAAOs in the selected five upazilas were constituted the population of the study. The list of all the SAAOs of the selected upazilas were collected. Thus, a total of 164 SAAOs constituted the population of this study (Table 3.1). Among them, five respondents were randomly selected for pre-test. The rest of the SAAOs (i.e., 159 persons) were considered as the sample of this study. All the respondents were informed beforehand to collect the data. However, based on their availability during the data collection period (15th July, 2017 to 30th July, 2017), a total of 131 respondents were interviewed.

Table 3.1 Population and sample of this study

Upazilas	Population	Sample size	Pre-test sample
Mithapukur	49	42	3
Rangpur Sadar	15	14	0
Pirganj	46	32	2
Gangachara	27	22	0
Badarganj	27	21	0
Total	**164**	**131**	**5**

3.1.3 Instrument for data collection

Since the purposes of this study were to test the hypotheses and measure the variances, a cross-sectional survey method was adopted for this study. Hence, data were collected by using a structured interview schedule. Keeping the objectives in mind, the study adapted validated measurement items from prior studies, whenever possible. The previously prepared interview schedule was pre-tested and necessary modifications were carried out. In most instances, closed form questions were used except for objective 5 (i.e., *'problems faced by extension professionals to use ICTs'*) an open-form question was administered. Validated measurement items of each construct with their literature sources were presented in an English version of the interview schedule as attached in the Appendix-A.

3.1.4 Variables of the study

Four variables were used for this study:

i. **Dependent variable**: is a variable that is the result or outcome or effect of other variables. This variable is often known as criterion or outcome variable. The value of the dependent variable depends on the value of the other variables, that is, independent variables. In this study, perceived capacity building by extension professionals in agricultural service delivery was considered as the dependent variable.

ii. **Independent variable**: is a variable that the researcher can control over or manipulate to predict other variable (i.e., dependent variable). Therefore, this variable is often called as predictor variable or causal variable. In an experimental setting, a researcher wants to manipulate the variable or introduce new variable to see its effect on the dependent variable. In this study, six independent variables were used. These were: ICT ownership, ICT self-efficacy,

perceived ease of use, facilitating condition, subjective norms and top management support.

iii. **Mediator variable**: is a variable that explains the relationship or provides a causal link between other variables. This is often known as intervening variable that accounts for the relation between the predictor and the criterion variables. Here, extent of ICTs use by extension professionals were used as mediator variable.

iv. **Control variable**: is a variable that the researcher does not want to test in a study and therefore she controls its effect on the other variables to be studied. Here, age and service experience were considered as the control variables.

3.2 Measurement of Variables

3.2.1 Measurement of independent variables

3.2.1.1 ICT Ownership

The ICT ownership score of a respondent was computed on the basis of his/her possession of the number and type of ICT devices. This considered both self and shared access. Scores for ICT ownership were assigned as follow:

Nature of Ownership	Score Assigned
Self	1
Shared	0.5
No Ownership	0

ICT ownership score was determined by summing the scores of all the four ICT devices. Thus, the score could range from 0 to 4, where 0 indicated no ownership and 4 indicated the high ownership of ICTs.

3.2.1.2 ICT self-efficacy

ICT self-efficacy was measured by a respondent's level of confidence to accomplish a job task by performing selected nine operations. The modified version of self-efficacy scales (Compeau & Higgins, 1995) was used for this instance. The respondents' responses were captured by using a five-point rating scale ranging from 'not at all confident' to 'highly confident' as follows:

Items	Score Assigned
Not at all confident	0
Little confident	1
Fairly confident	2
Confident	3
Highly confident	4

Thus the self-efficacy of a respondent could range from 0 to 36, where '0' indicates 'not confident at all' and '36' indicates 'highly confident' to complete the task by using ICTs.

3.2.1.3 Perceived ease of use

Perceived ease of use refers to the extent to which a respondent perceive use of ICTs would require less effort. The measurement items of this scale were adopted from Davis (1989). Respondents' responses were captured by a five-point rating scale ranging from 'strongly agree' to 'strongly disagree' as follows against four statements.

Items	Score Assigned
Strongly disagree	1
Disagree	2
Undecided	3
Agree	4
Strongly agree	5

Ease of use score was determined by summing the scores of all the four items. Thus, the score could range from 4 to 20, where '4' indicates strongly disagreement and '20' indicates strongly agreement.

3.2.1.4 Facilitating condition

A validated measurement scale of facilitating condition was adopted from Venkatesh, et al., (2003) and a five-point rating scale ranging from 'strongly disagree' to 'strongly agree' was used to capture respondents' responses against four statements.

Items	Score Assigned
Strongly disagree	1
Disagree	2
Undecided	3
Agree	4
Strongly agree	5

Facilitating condition score was determined by summing the scores of all the four items. Thus, the score could range from 4 to 20, where '4' indicates no facilitating condition and '20' indicates the highest facilitating condition.

3.2.1.5 Subjective norms

Scales of subjective norms were adopted from Ajzen (1991). Responses were captured using a five-point rating scale ranging from ‘strongly disagree’ to ‘strongly agree’ which is shown as follows:

Items	Score Assigned
Strongly disagree	1
Disagree	2
Undecided	3
Agree	4
Strongly agree	5

The subjective norm score was determined by summing the scores of all the four items. The score thus could range from 4 to 20, where ‘4’ indicates no influence of subjective norms and ‘20’ indicates high influence of subjective norms to their use of ICTs in developing their capacity.

3.2.1.6 Top management support

Scales of top management support were adapted from Hossain, et al. (2011). Responses were captured by using a five-point rating scale ranging from ‘strongly disagree’ to ‘strongly agree’.

Items	Score Assigned
Strongly disagree	1
Disagree	2
Undecided	3
Agree	4
Strongly agree	5

The top management support score was determined by summing the scores of all the four items. The top management support score could range from 4 to 20, where ‘4’ indicates low top management support and ‘20’ indicates high top management support.

3.2.1.7 Extent of ICT use

Extent of ICT use refers to the frequency of using ICT devices for accomplishment of a task. The respondents’ responses were captured as follows:

Items	Extent of Use	Score
Mobile Phone (voice call, SMS, MMS, Video, etc.)	Frequently (4-6 times/day) Often (1-3 times/day) Occasionally (5-6 times/week) Rarely (1-3 times/week) Not at all (No use)	4 3 2 1 0
Internet	Frequently (4-6 times/day) Often (1-3 times/day) Occasionally (5-6 times/week) Rarely (1-3 times/week) Not at all (No use)	4 3 2 1 0
Computer/laptop/tab	Frequently (4-6 times/day) Often (1-3 times/day) Occasionally (5-6 times/week) Rarely (1-3 times/week) Not at all (No use)	4 3 2 1 0
ICT-assisted Service Centre (e.g., AIS database/Krishi Jigassa/Krishoker Janala/Krishi-bangla.com/Krishoker Digital Thikana/Balainashok Nirdeshika	Frequently (1-2 times/day) Often (1-3 times/week) Occasionally (5-6 times/month) Rarely (1-3 times/month Not at all (No use)	4 3 2 1 0

Extent of ICTs use score was determined by summing the scores of all the four items. Thus, it could range from 0 to 16. Where '0'means no use of ICTs and '16' means frequently use of ICTs.

3.2.2 Measurement of dependent variable

Perceived capacity building of agricultural extension professionals was measured on the basis of opinion provided by the respondents. Based on the operationalization of the construct, a scale was developed comprised of seven statements. The respondents' responses were captured using a five-point scale (1-5) ranging from 'strongly disagree' to 'strongly agree'.

Items	Score Assigned
Strongly disagree	1
Disagree	2
Undecided	3
Agree	4
Strongly agree	5

The perceived capacity building score of a respondent was obtained by adding the scores and it could range from 7 to 35, where '7' indicates no perceived capacity building and '35' indicates high perceived capacity building through ICTs.

3.3 Data Analysis

3.3.1 Editing

Raw data were properly reviewed for omitting errors. The researcher made a careful scrutiny when she completed an interview so that all data were included to facilitate coding and tabulation.

3.3.2 Coding and tabulation

The researcher consulted with the research supervisor and co-supervisor**,** made a detailed coding plan. All responses were given in numerical score. The respondent responses were transferred to a master sheet to facilitate tabulation. In accordance with the objectives of the research, all of the data were tabulated.

3.3.3 Categorization of data

For coding operation, the collected data were classified into various categories. These categories were developed for each of the variables. The percentile function of SPSS software v.23 was used to categorize the variables. The procedure and categorization of a particular variable were further discussed in the chapter 4 in detail.

3.3.4 Method of data analysis

Data analysis required two phases. First, validation phase and second, result phase. The validation phase establishes the reliability and validity of the measurement items. Four tests need to be carried out to test the reliability and validity of the measurement model, internal consistency (composite reliability), convergent validity (average variance extracted), discriminant validity and indicator reliability (Hair, et al., 2014). Internal consistency is the value of Cronbach's alpha which assumes that all the indicators have equal outer loading on the relative constructs. It is expected that the outer loading for each indicator should be above 0.7. However, considering the explorative nature as well as the context, value equal to or greater than 0.65 was considered as accepted. Internal consistency can also be measured by observing the value (0.60-0.70) of composite reliability of a latent variable.

Convergenet validity shows whether the indicator can converge or share a high proportion of the variation of the constructs. Average Variance Extracted (AVE) is the common measure of convergent validity which is the grand mean of the squared loadings of a construct's indicators. A value greater than 0.50 is regarded as a satisfactory AVE

score, which says that the construct explains more than half of the variance of its indicators.

Discriminant validity shows the distinctiveness of one construct from others and this can be examined by the cross-loadings of the indicators. If the outer loadings of one indicator on the respective construct are higher than all of its loadings on other constructs assure that the construct has no discriminant validity problem. On the other hand, for indicator reliability, a bootstrapping[1] (a test that relies on random sampling with replacement) procedure needs to be performed. If it shows that the indicator's weight is statistically significant, then the indicator should be retained otherwise should be removed from the model.

To validate the measurement items and test the structural model, Partial Least Squares (PLS)-based Structural Equation Modeling (SEM) was used for this study (Hair, et al., 2014). Two factors were considered when selecting this modeling approach over traditional statistical tools like SPSS (Statistical Package for Social Sciences). First, PLS-SEM is regarded as a second generation statistical tool over the first generation tool like SPSS and therefore highly accepted to behavioral scientists and academics. Second, tool like SPSS is limited in its ability to measure multi-level path model. As the theoretical model of this study consists of six independent variables, one mediator variable, one dependent variable and two control variables, the confounding effect of one variable on other variables cannot be captured by SPSS and hence, SmartPLS v.2 software application was used to test the model of this study.

Five (5%) percent level of significance was used to test the significance level of each hypothesis. If the computed value of (β) was equal to or greater than the designated level of significance, than the hypothesis was supported and it was concluded that there was a significant contribution of the independent variables to the dependent variable. And if the computed value of (β) is smaller than the designated level of significance than the hypotheses was not supported. Therefore, it assumes that there was no significant contribution of the independent variables to the dependent variable. The results of the reliability and validity tests were given in Chapter Five.

[1] For detail please see, Hesterberg, et al., (2003)

CHAPTER IV

RESULTS AND DISCUSSION

This chapter presents the results of this study into five sections. First, selected characteristics of the sample and descriptive statistic of this study are presented. Second, sample's distribution based on their observed scores under each dimension are presented. Third, reliability and validity of the measurement items followed by results of the structured model are provided. Finally, extension professionals' problems concerning ICTs use in agricultural service delivery is discussed.

4.1 Respondent's Characteristics and Descriptive Statistics

In this section the respondent's characteristics and descriptive statistics are presented in Table 4.1 and Table 4.2. All the variables were categorized on the basis of their possible scores except age was categorized based on the classification provided by the Ministry of Youth and Sports, Government of the People's Republic of Bangladesh.

Table 4.1 Respondent's characteristics (N=131)

Characteristics	Frequency	Percent	Observed Range	Mean	Standard Deviation
Gender					
Male	108	82.4			
Female	23	17.6			
Age (in years)					
Young (up to 35)	49	37.4	26-59	42.42	10.498
Middle (36-50)	32	24.4			
Old (>50)	50	38.2			
Service experience (in years)					
Short (up to 10)	42	32.1	1-37	18.55	11.796
Medium (11-20)	31	23.7			
Long (>20)	58	44.3			

Table 4.2 Descriptive statistics of constructs used in this study

Constructs	Possible range	Observed range		Mean	Standard deviation
		Min	Max		
ICT Ownership	0-4	2	4	2.67	0.738
Self-efficacy	0-36	6	36	24.10	8.362
Ease of Use	4-20	7	20	15.54	3.177
Facilitating Condition	4-20	4	20	11.96	3.732
Subjective Norm	4-20	13	20	18.34	1.904
Top Management Support	4-20	8	20	15.76	2.914
Extent of ICT use	0-16	2	16	9.08	3.770
Capacity Building	7-35	22	35	31.79	3.318

Table 4.1 reveals that majority of the respondents (82.4%) were male and less than one-fifth (17.6%) were female. The mean of the respondents' age was 42.42 years with a standard deviation of 10.498. Based on the classification provided by the Ministry of Youth and Sports-Government of the People's Republic of Bangladesh, almost equal proportion of the respondents (37.4 and 38.2 percent) were young and old aged while around one-fourth of them (24.4 percent) were middle aged. Distribution of the respondents according to their length of service were found almost identical with their age distribution with a mean of 18.55 years. The highest proportions (44.3 percent) of the respondents had long service experience while 32.1 percent had short and 23.7 percent had medium service experience.

4.2 Respondent's Distribution based on the Salient Factors of Professionals' Capacity Building

Respondents' distribution based on the observed scores of the salient factors of professionals' capacity building through ICTs is presented in this section.

4.2.1 ICT ownership

The observed ICT ownership scores of the respondents ranged from 2 to 4. The average ICT ownership score was 2.67 and the standard deviation was 0.738. Based on the possible range of ICT ownership score (0-4), the respondents were classified into following three categories as shown in Table 4.3.

Table 4.3 Distribution of the respondents according to their ICT ownership

Categories	Frequency	Percent	Mean	Std.
Low ICTs ownership (up to 2 score)	63	48.1	2.67	0.738
Medium ICTs ownership (2.1-3 score)	44	33.6		
High ICTs ownership (>3 score)	24	18.3		
Total	131	100		

Data in Table 4.3 revealed that around half of the respondents (48.1 percent) had low ICT ownership where one-third (33.6 percent) of them had medium and less than one-fifth (18.3 percent) of them had high ICT ownership. The findings also revealed that an overwhelming majority (81.7%) of the respondents had low to medium ICTs ownership. A study conducted by Karanja (2014) found that 32.2% of the respondents had basic access to ICT devices at their work place while Agwu, et al. (2008) reported that 56% of the extension workers and 33% of the farmers had ICT ownership. It was also reported in this study that all the respondents had at least one ICT device, particularly mobile

phone. Therefore, comparing to earlier findings, the ICT ownership by extension professionals is progressing.

4.2.2 ICT self-efficacy

The observed ICT self-efficacy scores of the SAAOs ranged from 6-36. The average self-efficacy was 24.10 and the standard deviation was 8.362. The respondents were classified into following three categories based on their possible range of self-efficacy score (0-36) as shown in Table 4.4.

Table 4.4 Distribution of the respondents according to their ICT self-efficacy

Categories	Frequency	Percent	Mean	Std.
Low (up to 12 score)	16	12.2	24.10	8.362
Medium (13-24 score)	55	42		
High (>24 score)	60	45.8		
total	131	100		

Data in the Table 4.4 show that 45.8 percent of the respondents had high self-efficacy where 42 percent had medium and 12.2 percent had low self-efficacy, respectively. Therefore, majority (87.8 percent) of the respondents had medium to high ICT self-efficacy and considering the respondents' demographics, job status, service experience, formal education and on-the-job training, this finding is not surprising.

4.2.3 Ease of use

The observed ease of use scores of the respondents ranged from 7-20 with a mean of 15.54 and standard deviation of 3.177. The respondents were classified into following three categories based on the possible range of perceived ease of use (4-20) as shown in the Table 4.5.

Table 4.5 Distribution of the respondents according to their perceived ease of use

Categories	Frequency	Percent	Mean	Std.
Low (up to 7 score)	1	0.8	15.54	3.177
Medium (8-14 score)	43	32.8		
High (>14 score)	87	66.4		
Total	131	100		

Data in Table 4.5 reveal that two-thirds (66.4 percent) of the respondents perceived using ICTs as easy compared to one-third (32.8 percent) of the respondents perceived using ICTs as moderately easy to accomplish a task while less than one percent perceived as

difficult. Therefore, it can be concluded that the level of perceived ease of use of ICTs by extension professionals were satisfactory. Considering respondents' level of self-efficacy (Table 4.4), this finding was found to be consistent.

4.2.4 Facilitating condition

The observed facilitating condition scores of the respondents ranged from 4-20 with a mean of 11.96 and the standard deviation of 3.732. The respondents were classified into following three categories based on the possible range of facilitating condition (4-20) as shown in Table 4.6.

Table 4.6 Distribution of the respondents according to facilitating condition

Categories	Frequency	Percent	Mean	Std.
Low (up to 7 score)	11	8.4	11.96	3.732
Medium (8-14 score)	86	65.6		
High (>14 score)	34	26.0		
Total	131	100		

Table 4.6 indicates that majority of the respondents (65.6 percent) perceived that there existed medium level facilitating condition compared to 26.0 percent and 8.4 percent had high and low facilitating condition, respectively. It was observed that, a majority (91.6 percent) of the respondents possessed medium to high facilitating condition.

4.2.5 Subjective norms

The observed scores of subjective norms of the respondents ranged from 13-20 against the possible range of 4-20. The mean was 18.34 with a standard deviation of 1.904. The respondents were classified into following two categories based on their subjective norms score as shown in Table 4.7.

Table 4.7 Distribution of the respondents according to subjective norms

Categories	Frequency	Percent	Mean	Std.
Medium (8-14 score)	3	2.3	18.34	1.904
High (>14 score)	128	97.7		
Total	131	100		

Data in Table 4.7 show that the highest proportion (97.7 percent) of the respondents possessed high subjective norms in using ICTs for job tasks while only 2.3 percent of the respondents possessed medium subjective norms and none of them possessed low

subjective norms. Therefore, it can be said that respondents' ICT use behavior for accomplishing a task was highly influenced by their subjective norms.

4.2.6 Top management support

The observed top management support scores of the respondents ranged from 8-20 against the possible range of 4-20. The average score was 15.76 and the standard deviation was 2.914. The respondents were classified into two categories based on top management support scores in the Table 4.8.

Table 4.8 Distribution of the respondents according to top management support

Categories	Frequency	Percent	Mean	Std.
Medium (8-14 score)	35	26.7	15.76	2.914
High (>14 score)	96	73.3		
Total	131	100		

Data presented in Table 4.8 reveal that around three-fourths of the respondents (73.3 percent) and about one-fourth of the respondents (26.7 percent) had high and medium top management support respectively for using ICTs for their job purposes while none of them were found to be possessed low top management support. This finding articulates a strong willingness by top management of DAE in promoting ICTs in agricultural extension service.

4.2.7 Extent of ICT use

The observed extent of ICT use scores of the respondents ranged from 2-16 against a possible scores of 0-16. The average extent of ICT use score was 9.08 with a standard deviation of 3.77. The respondents were classified into following three categories based on their extent of ICT use score as shown in Table 4.9.

Table 4.9 Distribution of the respondents according to their extent of ICT use

Categories	Frequency	Percent	Mean	Std.
Low use (up to 5 score)	27	20.6	9.08	3.77
Medium use (6-10 score)	54	41.2		
High use (>10 score)	50	38.2		
Total	131	100		

Table 4.9 reveals that majority of the respondents (41.2 percent) had medium extent of ICT use, where 38.2 percent had high and 20.6 percent had low extent of ICT use, respectively. The data also revealed that an overwhelming majority (79.4 percent) of the respondents had medium to high extent of ICTs use. Therefore, there is a huge scope to

use ICT-enabled application for staff training and time-critical information dissemination purposes to extension workers. Respondents' extent of ICTs use also demonstrate a promise to introduce an ICT-enabled extension service.

4.2.8 Perceived capacity building

The observed capacity building scores of the respondents ranged from 22-35 with a mean of 31.79 and the standard deviation of 3.318. The respondents were classified into following three categories based on their possible range (7-35) of perceived capacity building scores as shown in Table 4.10.

Table 4.10 Distribution of the respondents according to their perceived capacity building

Categories	Frequency	Percent	Mean	Std.
Medium capacity building (17-25 score)	4	3.1	31.79	3.318
High capacity building (>25 score)	127	96.9		
Total	131	100		

Data in table 4.10 show that a majority (96.9 percent) of the respondents were perceived that effective using of ICTs helped in high capacity building while only 3.1 percent of the respondents perceived that effective using of ICTs helped in medium capacity building. Majority (96.9 percent) of the extension personnel involved in the study appreciated the advantages employing modern ICTs in agricultural extension services.

4.3 Reliability and Validity of the Measurement Model

PLS-SEM based analysis requires test of two models, measurement and structural models. Measurement model tests and reports reliability and validity of the measurement items while structural model shows the path-coefficients of the hypothesized relationships. To test the measurement model, first indicator reliability was assessed by observing the outer loadings of the measurement items. The threshold level of indicator is (0.70) however given the explorative nature of this investigation and research setting, a value equal to or greater than 0.65 was accepted in this study. The items which value were found less than this threshold level[2], were dropped from the model. The rest of the items were well above the minimum acceptable level for outer loadings[3].

[2] Items marked by asterisk (*) in the attached interview schedule in Appendix-A were dropped due to lower threshold level.
[3] A detailed table with each item's cross-loading is attached in the Appendix-B.

The internal consistency reliability (i.e., composite reliability) (Table 4.11) demonstrates that all the constructs had high levels of internal consistency (>0.70). Convergent validity of the constructs are assessed by the value of Average Variance Extracted (AVE). The minimum requirements of AVE is 0.50. Two constructs, self-efficacy (0.477) and top management support (0.459) were found to be little lower than the threshold value (Table 4.11) yet close to 0.50. Therefore, it can be concluded that the convergent validity of all the constructs were satisfactory indicates that the constructs explained at least 50 percent of the variance among the indicators.

Table 4.11 Measurement model validation and bivariate correlations

	AVE	**ICR**	**Cap**	**EoU**	**FC**	**Norm**	**Own**	**SE**	**TMS**
Cap	0.713	0.945	**0.845**						
EoU	0.633	0.871	0.358	**0.796**					
FC	0.554	0.831	0.156	0.091	**0.744**				
Norm	0.746	0.922	0.512	0.353	-0.024	**0.864**			
Own			0.242	0.414	0.130	0.125			
SE	0.477	0.885	0.309	0.503	0.110	0.257	0.695	**0.691**	
TMS	0.459	0.736	0.434	0.296	0.018	0.409	0.064	0.127	**0.677**
Use			0.394	0.560	0.182	0.248	0.769	0.759	0.164

- Constructs: Cap (Perceived capacity building), EoU (Ease of use), FC (Facilitating condition), Norm (Subjective norm), Own (ICT ownership), SE (ICT self-efficacy), TMS (Top Management Support), Use (Extent of ICT use).
- ICR= Internal Consistency Reliability (Composite Reliability); AVE = Average Variance Extracted
- 'Use' and 'ICT ownership' were used as single-item (i.e., composite) construct in the model.
- Diagonal elements are the square root of AVE and off-diagonal elements are correlations.

Two steps were used to test the discriminant validity of the constructs. First, the cross-loadings of the indicators and second the Fornell-Larcker criterion (Fornell & Larcker, 1981). The cross-loadings of the constructs (Appendix-B) showed that the loadings of

all the indicators on their respective constructs were higher than all of their cross loadings with other constructs. According to Fornell-Larcker criterion, if the square root of the AVE of each construct is higher than the construct's higher correlation with other constructs, it demonstrates discriminant validity. Table 4.11 indicates that the square roots (diagonal element in Table 4.11) of all the constructs were higher than their correlations with other constructs in the model except the correlation between extent of use and self-efficacy was found higher than the square root of self-efficacy. However, since extent of use was used as a signle-item construct in the model, the discriminat validity of self-efficacy construct should be satisfactory. Therefore, it can be summarized that the cross-loadings and the Fornell-Lacker test provided support that the model had satisfactory discriminant validity. In addition to that, a Variance Inflation Factors (VIFs) test revealed that multicollinearity between the constructs was not a concern for this thesis.

4.4 Results of the Structural Model

The theoretical model and hypothesized relationships were tested by using Smart-PLS v2.0. The explanatory power of the model was assessed by the R^2 of the dependent variable. Hypotheses were assessed by calculating the t-statistics for the standardized path co-efficient at the 5% level of significance. The model (Fig 4.1) predicts that extension professionals' perceived capacity building through ICTs (i.e., dependent variable) were determined by their level of ICTs use (i.e., mediator variable) which further contingent upon six exogenous factors, ICT self-efficacy, ICT ownership, perceived ease of use, facilitating condition, subjective norm and top management support.

Extent of ICT use was used as only one predictor which explained 13.1% of the variance of perceived capacity building of extension professionals (Fig. 4.1) with a path co-efficient of 0.361 ($p<0.00$) (Table 4.12). Thus, it proves that ICT use was the key determinant of perceived capacity building of extension professionals in delivering effective extension service.

Among the determinants of the extent of ICT use, three constructs, ICT self-efficacy, ICT ownership and perceived ease of use were found to be significant predictors of ICT use with a path co-efficient of 0.351 ($p<0.00$), 0.418 ($p<0.00$) and 0.133 ($p<0.03$), respectively which jointly explained 67.3% of the variance of extent of ICT use. The

rest of the constructs, facilitating condition, subjective norms and top management support were found to be statistically insignificant with the extent of ICT use. A summary of the propose hypotheses is presented in Table 4.13.

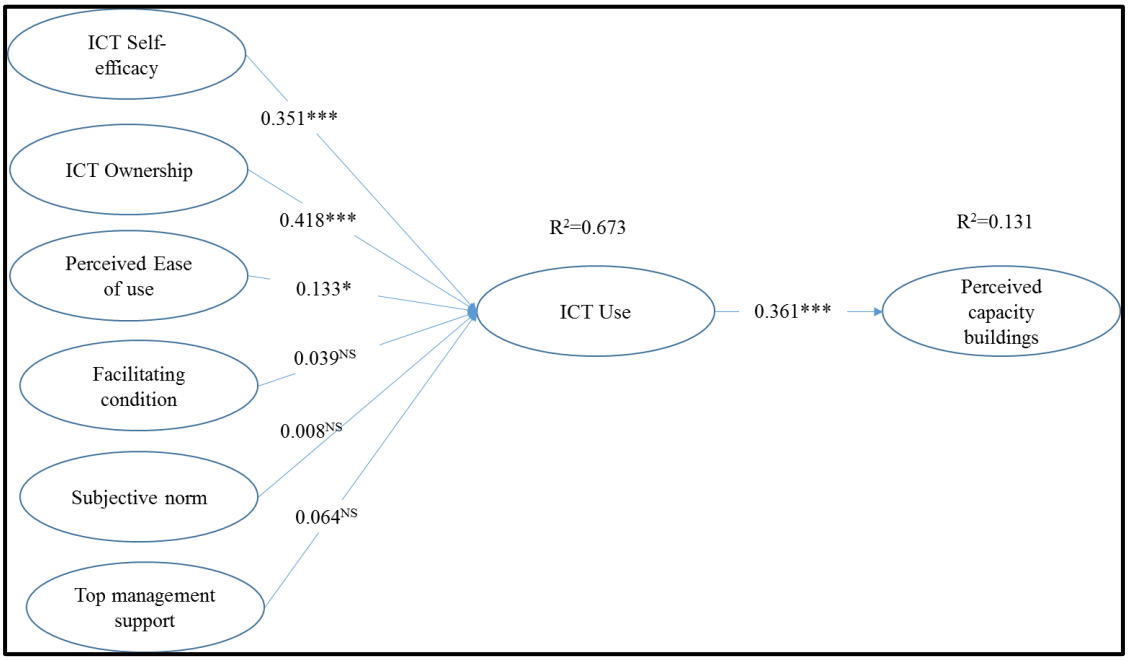

Figure 4.1 Results of the study model showing co-efficient and variance

Table 4.12 Results of the structural model path coefficients with sig. levels

Relationships	**Path Coefficients**	**t values**	**Sig. levels**	**p values**
Self-efficacy->Use	0.351	4.191	***	0.00
Ownership->Use	0.418	5.440	***	0.00
Ease of use->Use	0.133	2.189	*	0.03
Facilitating condition->Use	0.039	0.754	NS	0.45
Subjective norm->Use	0.008	0.135	NS	0.89
Top management support->Use	0.064	1.250	NS	0.21
Use -> perceived capacity building	0.361	5.154	***	0.00
NS=Not significant	*p<0.05	**p<0.01	***p<0.001	

Table 4.13 Summary of the proposed hypotheses

No	Hypothesis	Supported
H1	With the increase of the extent of ICTs use by extension professionals, their perceived capacity building in delivering quality extension service is increased.	Yes
H2	The higher the individual's ICT self-efficacy, the higher his use of ICTs.	Yes
H3	The higher the ICT ownership, the higher the ICT use	Yes
H4	The higher the individual's perceived ease of use, the higher his use of ICTs.	Yes
H5	The higher the individual's perceived facilitating condition in favor of ICT use, the higher his use of ICTs.	No
H6	Extension professionals' use of ICTs in developing their capacity is positively influenced by subjective norms of using ICTs.	No
H7	The higher the top management support, the higher the individual's use of ICTs.	No

4.4.1 Discussion of the research findings

A total of seven hypotheses were proposed in this study, of which four hypotheses were supported. This section provides the discussion of the key findings as follows:

4.4.1.1 Contribution of the extent of ICT use to perceived capacity building

Extent of ICT use was found to be significant predictor of perceived capacity building (Fig. 4.1) which constitute 13.1% of the variance. The relationship between these two constructs was also supported by respondents' responses on the effectiveness of ICTs for capacity building. Data in descriptive analysis reported that a majority (96.9%) of the respondents perceived ICTs as a highly effective medium for capacity building while only 3.1% of the respondents perceived that ICTs was moderately effective for capacity building purpose. This finding is also supported by Karanja (2014), reported that the majority of the respondent (98%) acknowledged the effectiveness of ICTs to improve work efficiency while only 2% were found not to be confident enough in ICTs' roles in improving work efficiency. The findings present a remarkable improvement in relation to the finding of a study by Kiplangat & Ochola (2005) showed only 38.2% of extension personnel acknowledged that modern ICTs improved work efficiency against 61.8% of the respondents who were undecided or thought otherwise.

4.4.1.2 Contribution of ICT ownership to the extent of ICT use

Among the determinants, ICT ownership was found to be the strongest predictor of the extent of ICT use (β=0.418, $p<0.00$). ICT ownership is one of the important

preconditions like literacy for using ICTs. Ownership indicates an individual's possession as well as access to various ICT tools without which their extent of ICT use would be greatly compromised.

4.4.1.3 Contribution of ICT self-efficacy to the extent of ICT use

ICT self-efficacy was found to be the second highest contributor of the extent of ICT use by extension professionals (β=0.351, $p<0.00$). Self-efficacy indicates respondent's confident in using various ICT tools. An individual with high level of confident in operating different devices enable them to grow more desire for multiple uses of ICTs compared to a person with low confident in using ICTs.

4.4.1.4 Contribution of perceived ease of use to the extent of ICT use

Perceived ease of use of ICTs was found to be the third highest contributor of the extent of ICT use by extension professionals (β=0.133, $p<0.02$). The structural linkage between perceived ease of use and user's intention to use a system has been tested in many instances. That is, ease of use is an important attribute of a system without which user might abundant the system to be used. When a person finds a system easy to use enable him to use the instrument more. Ease of use is related to the degree of simplicity associated with the use of ICTs. Another possible explanation of this relationship could be because the extension officers were embracing ICTs not from a mandatory setting as yet DAE has not made it mandatory to use for their jobs. Despite DAE has already made few initiatives to promote ICTs in extension service and provided electronic gadgets at pilot basis, extension professionals embrace ICTs as their own initiatives. Their interests translate to them viewing ICTs as easy to learn and use. It is therefore concluded that as extension professionals find it easy to use that positively impact their use of ICTs for building their capacity.

Despite descriptive statistics of this study revealed that facilitating condition, subjective norms and top management support were found to be perceived highly influential for extension workers to use ICT more for their jobs, the path analysis did not show any statistically significant relationship among the concerned variables. This might be caused due to the stronger effects of other predictors such as self-efficacy, ownership, ease of use. Therefore, further investigation would be necessary to test the generalizability of this finding.

4.5 Problems Faced by Extension Professionals to Use ICTs

Rather than following a conventional Problem Faced Index (PFI) determination, this study used an open-formed question to identify the problems faced by extension professionals to use ICTs in developing their capacity. The respondents responded to this interview's questions with free-form answers and each respondent was allowed to mention multiple responses concerning his/her difficulties to use ICTs for job task. Since the responses were made in raw form, a well-known qualitative data analytic method namely "thematic analysis[4]" was adopted to obtain the 'key message' of their responses. Thematic analysis is a method of developing 'theme' from the raw "codes" based on their 'commonalities' which provides better understanding and interpretation of the concerned subject. Thus, a total of 411 responses were recorded from which initially thirteen (13) raw codes were identified. These codes were derived from the key words and syntax of the raw information. Later, codes were grouped based on their commonalities to obtain an overarching theme. Overall, five themes were obtained as the key problems faced by the extension professionals to use ICTs in agricultural service delivery. According to the frequencies of responses, these themes were: high cost, lack IT literacy, poor IT infrastructure, access barrier and lack of motivation. The thematic map of this study is shown in Fig. 4.2.

[4] For details of thematic analysis and code development procedure, see Boyatzis (1998); Braun & Clarke (2006).

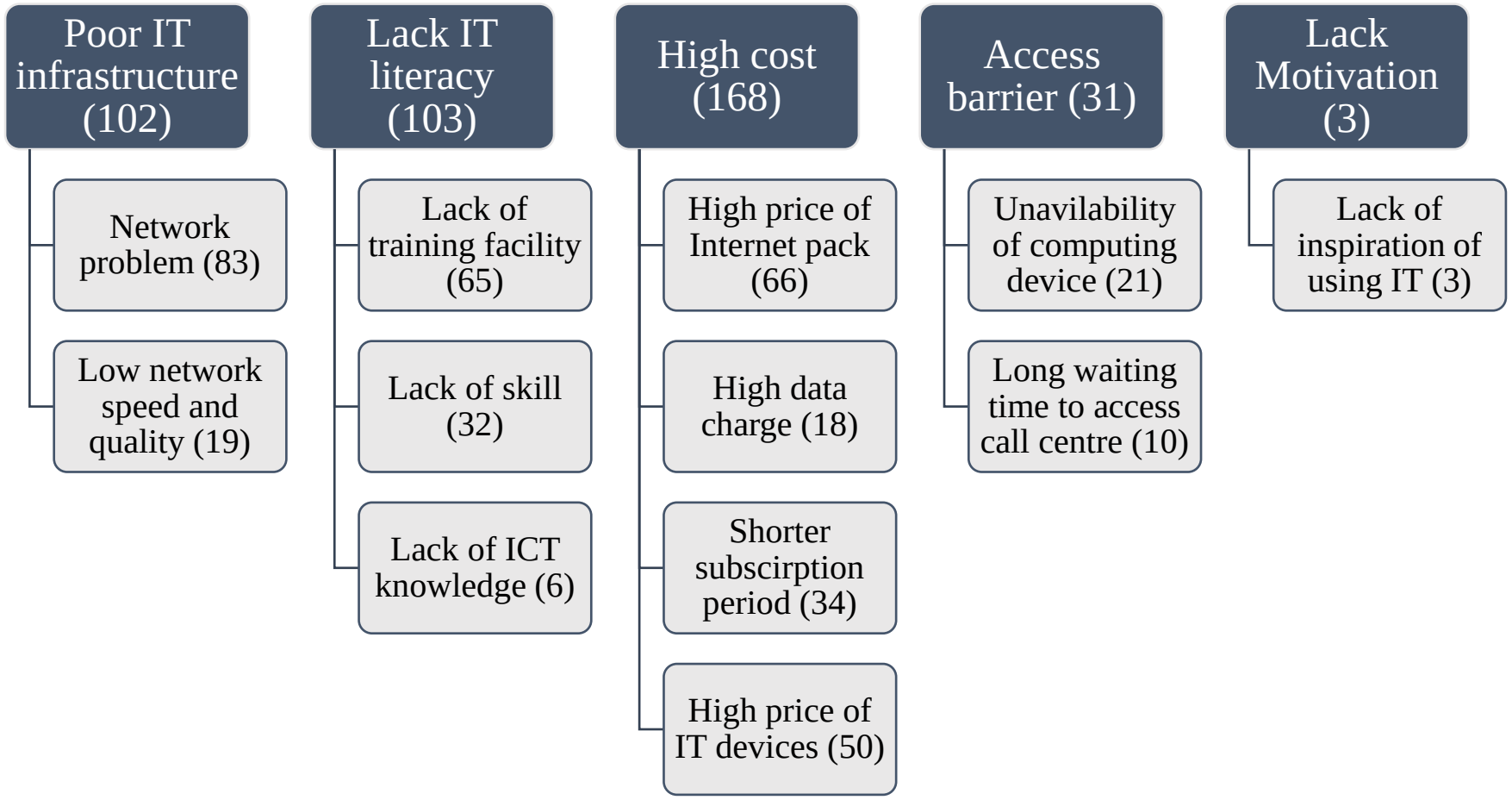

Figure 4.2 A thematic map showing key themes and codes with frequency

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATION

The overarching aim of this study was to understand the influence of ICT use by extension professionals to their perceived capacity building in agricultural extension service. The study adopted a theoretical approach and based on one of the well accepted models of technology acceptance, UTAUT (Venkatesh, et al., 2003) incorporating with the concept of capacity building, this study proposed a model which depicts extension professionals' perceived capacity builiding was positively influenced by their extent of ICT use which further contingent upon six independent factors. Data were collected using a cross-sectional survey methodology and analyzed by PLS-SEM using SmartPLS v2.0. In this chapter, the summary of this study was presented.

5.1 Summary of the Findings

The major findings of the study are summarized below:

5.1.1 Selected factors influencing the extent of ICT use

5.1.1.1 ICT Ownership

Nearly half of the respondent (48.1 percent) had low ICT ownership where one-third (33.6 percent) had medium and less than one-fifth (18.3 percent) had high ICT ownership. It was observed that all the respondents had access to mobile phones.

5.1.1.2 ICT self-efficacy

The highest proportion (45.8 percent) of the respondents had high self-efficacy in ICT where 42 percent had medium and 12.2 percent had low self-efficacy. The findings also revealed that a majority (87.8 percent) of the respondents had medium to high ICTs self-efficacy. Consistent with ICT ownership most of the respondents were found well capable of using mobile phone-based applications compared to computer program.

5.1.1.3 Perceived ease of use

Two-thirds (66.4 percent) of the respondents perceived using ICTs are easy to use compared to one-third (32.8 percent) of the respondents perceived moderately easy. Less than one percent (0.8 percent) of the respondents possessed that using ICTs is not easy for them.

5.1.1.4 Facilitating condition

Two-thirds of the respondents (65.6 percent) perceived medium followed by 26.0 percent perceived high and 8.4 percent perceived low facilitating condition in favor of ICT use for accomplishing job tasks. It was observed that an overwhelming majority (91.6 percent) of the respondents perceived medium to high facilitating condition.

5.1.1.5 Subjective norms

The highest proportion (97.7 percent) of the respondents possessed high peer influence and only 2.3 percent of the respondents possessed medium peer influence for their use of ICTs for job related purposes. The finding indicates all the respondents were influenced by their peer groups in using ICT for accomplishing job tasks.

5.1.1.6 Top management support

Nearly three-fourths (73.3 percent) of the respondents agreed that they possessed high management support compared to 26.7 percent of them possessed medium management support for using ICTs for their work. The findings also revealed that all the respondents possessed medium to high management support from their organization for using ICTs.

5.1.2 Extent of ICT use

Majority of the respondents (41.2 percent) had medium extent of ICT use while 38.2 percent had high and 20.6 percent had low extent of ICT use, respectively. The data also revealed that an overwhelming majority (79.4 percent) of the respondents had medium to high extent of ICTs use.

5.1.3 Perceived capacity building

A vast number of the respondents (96.9 percent) perceived that effective using of ICTs highly helped them in capacity building while only 3.1 percent perceived that ICTs' effects were medium in developing capacity. Majority (96.9 percent) of the extension personnel involved in the study appreciated the advantages employing modern ICTs in agricultural extension services.

5.1.4 Results of the theoretical model

There were seven hypotheses were proposed in the model. Four (4), out of seven were found to be statistically significant while three hypotheses were found to be unsupported. A summary of the findings of the proposed hypotheses are presented as follows:

5.1.4.1 Contribution of the extent of ICT use to perceived capacity building

Extent of ICT use was proposed as a single predictor of extent of ICT use by extension professionals and it was found to be significant predictor of perceived capacity building which constitute 13.1% of the variance (R^2=0.131). The relationship between these two constructs was also supported by respondents' responses on the effectiveness of ICTs for capacity building. Data in descriptive analysis reported that a majority (96.9%) of the respondents perceived ICTs as a highly effective medium for capacity building while only 3.1% of the respondents perceived that ICTs was moderately effective for capacity building purpose.

5.1.4.2 Contribution of the exogenous factors to the extent of ICT use

Among the six predictor variables, ICT ownership, ICT self-efficacy and perceived ease of use were found to be the significant contributors on the extent of ICT use while facilitating condition, subjective norms and top management support were found to be non-significant. ICT ownership was the strongest contributor (β=0.418) followed by self-efficacy (β=0.351) and ease of use (β=0.133) which jointly explained 63.7% of the variance of the extent of ICT use (R^2=0.637).

5.1.5 Problems faced by extension professionals using ICT

Problems faced by extension professionals using ICT was identified by using a well-known qualitative data analytic tool, 'thematic analysis' which revealed five key problems. These were: high cost, lack IT literacy, poor IT infrastructure, access barrier and lack of motivation.

5.2 Conclusion

Findings of the present study and the logical interpretation of other relevant facts prompted the researcher to draw the following conclusions:

- ✓ ICT ownership significantly contributed to the extent of ICT use. Therefore, it can be said that ICT ownership is one of the important predictors of the extent of using ICTs. ICT ownership indicates the respondents' access to various ICT tools. Access is one of the important preconditions of ICT use. Therefore, it can be concluded that higher ownership might lead to higher use which in turns lead to higher capacity building.
- ✓ ICT self-efficacy had second highest contribution to the extent of ICT use. This facts lead to the conclusion that any arrangement made to increase ICT self-efficacy of the respondents would ultimately increase use of ICTs in agriculture.

- ✓ Ease of use of ICTs had a significant contribution to the extent of using ICT. Therefore, it may be concluded that when the ease of use of an ICT is high its extent of use is also high.
- ✓ Finally, using ICTs had significant contribution on perceived capacity building of extension professionals like SAAOs. ICTs enable them to improve their knowledge and skill. Furthermore, they can provide time-sensitive farming information and suggestion to the rural clients whenever and wherever needed.
- ✓ Among the problems, high cost of ICT devices and high price of voice call and Internet was reported mostly by extension professionals followed by lack of IT skill and poor IT infrastructure.

5.3 Recommendations

On the basis of the findings revealed from the study, the following recommendations are put forwarded that might guide the policy formulation:

5.3.1 Recommendations for policy

- ✓ As therefore, more mobile phone-based service should be launched to target groups. Number of mobile apps should also be increased and the contents provided through the apps should be more relevant and specified. Images and pictures that are provided in the apps should be more clear.
- ✓ ICT ownership had a significant contribution on capacity building through using ICTs and almost all the respondents had access to ICTs, particularly mobile phone. Therefore, more mobile phone-based service should be launched to target groups. Number of mobile apps should also be increased and the contents provided through the apps should be more relevant and specified. Therefore, SAAOs can easily access to those applications and use ICT-based services.
- ✓ ICTs should be promoted as a platform for accessing and sharing of agricultural information among rural agricultural extension personnel because of their versatility. Therefore, they should be trained on relevant computer applications and other ICT devices.
- ✓ The Ministry of Agriculture (MoA) and other institutions like DAE who undertaking agricultural extension services should promote the use of the Internet and other modern

ICT devices to source and share agricultural information and should mainstream e-extension within their operational set-up.

- ✓ ICT self-efficacy had the second highest contribution to use ICTs in agriculture. Therefore, it was recommended that attempts should be taken by DAE to increase ICTs self-efficacy of the SAAOs through organizing basic and intermediate ICT trainings.
- ✓ Institutions involved in providing agricultural extension services should work towards increase access of available ICT devices for extension workers. This can be done by decentralizing and establishing of computer/ICT rooms to enhance sharing of the existing ICT gadgets. DAE should offer extension personnel financial assistance to buy ICT devices on a loan basis.
- ✓ Since ease of use is very important for a user to access to any ICT application or service, the developers of ICT-based service and policy makers should careful enough to design more user-friendly applications, particularly mobile-based application.
- ✓ Since 'high cost' was mentioned most frequently faced problems by extension professionals, Bangladesh Telecommunication Regulatory Authority (BTRC) along with other concerned departments should work towards to offer reliable network service to the rural areas in low price.

5.3.2 Recommendations for further studies

- ✓ The study was conducted in Rangpur district as the area was well known to the researcher. Among the eight upazilas considering the time and budget, five upazilas (Mithapukur, Rangpur Sadar, Pirganj, Gangachara & Badarganj) were randomly selected as the study area. Moreover, a cross-sectional survey methodology, as used in this study, is limited in generalizing the findings. Therefore, repeating this study at the other parts of our country and compare the findings would be effective and helpful for policy formulation.
- ✓ Once selection of the variables, this study considered factors from UTAUT model, such as ease of use, facilitating condition, subjective norms and ICT use while this study added three more enablers deemed important to the research context, top management support, ICT ownership and self-efficacy. Top management support indicates institutional willingness to introduce IT in job setting while the latter two variables indicate user's accessibility to the ICTs, important preconditions for user acceptance of technology. As opposed to performance expectancy from UTAUT model, a predictor

of user intention to use, capacity building through ICT use was proposed as the endogenous variable which was determined by the extent of ICT use. Despite age and service length were controlled in this study, unlike UTAUT model, no moderation test was carried out. Therefore, future research might be undertaken to identify the moderators and their effect to perceived capacity building in agricultural service delivery.

- ✓ Extent of ICT use and perceived capacity building were measured by subjective responses of extension professionals, however further study should be designed to measure these constructs objectively.
- ✓ Since this research was particularly interested to identify the factors and their contribution on perceived capacity building, respondents' demographic variables like age and service length were controlled in the structural model. Besides, the effect of other demographic factors such as gender to the extent of ICT use might be tested.
- ✓ Theoretically, this study have already made at least two contributions. First, adding up capacity building concept with well-known technology acceptance model. Second, the theoretical approach and statistical tools used in this study were so far unique in the discipline of Agricultural Extension. In fact, this study combined the notion of two disciplines, Agricultural Extension and Information Systems, in a single study.
- ✓ Unexpectedly, no significant relationship were found between facilitating condition, subjective norms, top management support and perceived capacity building of the respondents through ICTs. So, further verification is necessary.

REFERENCES

Agwu, A, E., Uche-Mba, U. C., and Akinnagbe, O. M. (2008). Use of Information Communication Technologies (ICTs) among Researchers, Extension Workers and Farmers in Abia and Enugu States: Implications for a National Agricultural Extension Policy on ICTs. *Journal of Agricultural Extension*. 12(1).

Ajani, E. N. (2014). Promoting the Use of Information and Communication Technologies (ICTs) for Agricultural Transformation in Sub-Saharan Africa: Implications for Policy. *Journal of Agricultural & Food Information*. 15:42-53.

Ajzen, I. (1991). The Theory of Planned Bahavior. *Organizational Behavior and Human Decision Processes*. 50(2):179-211.

Aramide, K. A., Ladipo, S. O., & Adebayo, I. (2015). Demographic Variables and ICT Access As Predictors of information Communication Technologies' Usage among Science Teachers in Federal Unity Schools In Nigeria. *Library Philosophy and Practice*, from, http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=3208&context=libphilprac. Retrieved from Library Philosophy and Practice : http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=3208&context=libphilprac

Arokoyo, T. (2005). ICTs Application in Agricultural Extension Service Delivery. In Agricultural Extension in Nigeria, edited by Adedoyin F. S., 245–250. Illorin, Nigeria: AESON.

Arokoyo, T., Chikwendu, D., & Ogunbameru, K. (2002). A study of the access of Rural Women to Public and Private Extension Service in Nigeria. Report of a study commissioned and funded by CTA.

Balaji, V., Meera, S. N., & Dixit, X. (2007). ICT-enabled Knolwedge Sharing in Supportt of Extension: Addressing the Agarian Challenges of the Developing World Threatened by Climate Change, with a Case Study of India. *SAT eJournal*. 4(1):1-8.

Bandura, A. (1982). Self-Efficacy Mechanism in Human Agency. *American Psychologist*. 37(2):122-147.

Bhuiyan, M. S. L. 1988. Use of Communication Media by the Farmers in the Adoption of Selected Improved Farm Practices in Rice Cultivation. M.Sc. (Ext. Ed.) Thesis, Department of Agricultural Extension and Teacher’s Training, Bangladesh Agricultural University, Mymensingh.

Boyatzis, R. E. (1998). Transforming Qualitative Information: Thematic Analysis and Code Development. CA: Thousand Oaks.

Braun, V., & Clarke, V. (2006). Using Thematic Analysis in Psychology. *Qualitative Research in Psychology*. 3:77-101.

Byrnes, P., Petter, J., Choi, D L., Fegan, F., & Miller, R. (2002). Dimensions and patterns in employee empowerment: Assessing what matters to street-level bureaucrats. *Journal of Public Administration Research and Theory.* 12(3): 377-400.

Chatterjee, D., Grewai, R., & Sambamurthy, V. (2002). Shaping up for e-Commerce: Institutional Enablers of the Organizational Assimilation of Web Technologies. *MIS Quarterly*. 26(2):65-89.

Chikarie, J.U., Ani, A.O., Atoma, C.N., and Tijjani, A.R. (2015). Capacity Building: Key to Agricultural Extension Survival. *Scholars Journal of Agriculture and Veterinary Science.* 2(1A):13-21.

Compeau, D. R., & Higgins, C. A. (1995). Computer Self-efficacy: Development of a Measure and Initial Test. *MIS Quarterly*. 19(2):189-211.

Coutts, J., Roberts. K., Frost, F. and Coutts, A. (2005). The Role of Extension in Building Capacity-What Works, and Why. Available at www.fao.org./sd/exdirect/Exan0015.htm.

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly.* 13(3): 319-339.

Degnbol-Martinussen, J. (2002). Development Goals, Governance and Capacity Building: Aid as a Catalyst. Development and Change. 16 (11):1705 – 1713.

Delone, W., & McLean, E. (1992). Information Systems Success: The Quest for the Dependent Variable. *Information Systems Research*. 3(1):60-95.

Dorothy, W. K., Sakwab, D.M., & Iravoc, D. M (2014). Assessing Use of Information Communication Technologies among Agricultural Extension Workers in Kenya Using Modified UTAUT Model. *International Journal of Sciences: Basic and Applied Research (IJSBAR).* 16(2). 11-22.

D' Silva et *al*., 2010. Teleuse on a Shoestring: Poverty reduction through telecom access at the 'Bottom of the Pyramid. Centre for Poverty Analysis Annual Symposium on Poverty Research. Colombo, Sri Lanka.

Dwarakinath, R. (2006). Changing Tasks of Extension Education in Indian Agriculture. In A.W. Van den Ban, and R.K. Samanta, (Eds.), Changing Roles of Agricultural Extension in Asian Nations (pp. 56-79). Delhi: B.R. Publishing.

FAO (2010). World Agriculture towards an FAO Study. Food and Agriculture Organization, Rome. 1995.

Fishein, M., & Ajzen, I. (1975). *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research.* Reading, MA: Addison-Wesley.

Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*. 18(1):39-50.

Gakuru, M., Winters, K., & Stepman, F. (2009). An inventory of Innovative Farmer Advisory Services. In Forum for Agricultural Research in Africa.

Gelb, E., Maru, A., Brodgen, J., Dodsworth, E., Samii, R., & Pesce, V. (2008). Adoption of ICT Enabled Information Systems for Agricultural Development and Rural Viability. In Pre-Conference workshop summary, The AFITA, IAALD and WCCA Conference in Atsugi, Japan.

Goodhue, D., & Thompson, R. (1995). Task-Technology Fit and Individual Performance. *MIS Quarterly*. 19(2):213-233.

Goyal, A. (2011). ICT in Agriculture Sourcebook: Connecting Smallholders to Knowledge, Networks, and Institutions. World Bank.

Hair, J. F., Hult, G. M., Ringle, C. M., & Sarstedt, M. (2014). *A Primer on Partical Least Squares Structural Equation Modeling (PLS-SEM).* California: Sage Publications, Inc.

Hartwig, K.A., Humphries, D., & Matebeni, Z. (2008). Building capacity for AIDS NGOs in southern Africa: evaluation of a pilot initiative. Health Promotion International. 23(3). Retrieved 15 April 2009 from http://heapro.oxfjournals.org/cgi/reprint/23/3/251

Hesterberg, T., Monaghan, S., Moore, D. S., & Clipson, A. (2003). Boostrap Methods and Permutation Tests. New York: W.H. Freeman and Company.

doi:http://hsta559s12.pbworks.com/w/file/fetch/50747070/Hesterberg.Bootstrappng.chpt18.pdf

Hilderbrand, ME. (2008). Capacity for Poverty Reduction: Reflection on Evaluations of System Efforts: IN Capacity Building for Poverty Eradication Analysis of and Lessons from Evaluations of UN System Support to Countries. New York, United Nations.

Hossain, M. D., Moon, J., Kim, J. K., & Choe, Y. C. (2011). Impacts of Organizational Assimilation of E-government Systems on Business Value Creation: A Structuration Theory Approach. *ELectronic Commerce Research and Applications*, 10:576-594.

Hord, SM. (1997). Professional learning communities: Communities of continuous inquiry and improvement.

Horton, D. (2002). Planning, Implementing, and Evaluating Capacity Development. International Service for National Agricultural Research (ISNAR) Briefing Paper 50.

Igbaria, M., & Tan, M. (1997). The Consequence of Information Technology Acceptance on Subsequent Individual Performance. *Information and Management*, 32:113-121.

Igbaria, M. & Zinatelli, N., and Zinatelli, P. & Cavaye, A. L.M. (1997). Personal Computing Acceptance Factors in Small Firms: A SEM, *MIS Quarterly*.

Issa, F.O. (2010). Agricultural extension administration and operations (AEM 412). Samaru College of Agriculture, Division of Agricultural Colleges, Ahmadu Bello University, Zaria.

Issa, F. O. and Issa, M. A. (2013). Building the capacity of agricultural extension personnel for effective implementation of agricultural transformation agenda in Nigeria. *Journal of Agricultural Extension*. 17(1).

Jamwal, S. & Padha, D (2009). A Study of Information and Communication Technology in the area of Agriculture and Rural Development in J&K state. Proceedings of the 3rd National Conference; INDIACom-2009. .

Jones, G. E. (1997). The history, development and the future of agricultural extension in B.E. Swanson, R.P. Bentz and A.J. Sofranko (1997) Improving agricultural extension – a reference manual. Rome: FAO

Karanja, B. K. (2014). Use of Modern Communication Technologies among Rural Agricultural Extension Personnel to Disseminate Agricultural Information: Case Study of Machakos

County. M.Sc. Thesis in Agricultural Information and Communication Management, University of Nairobi, Nairobi.

Kiplangat, J., and Ocholla, D. N. (2005). Diffusion of Information and Communication Technologies in communication of agricultural information among agricultural researchers and extension workers in Kenya. *SAJnl Libs & Info Sci.* 71.

Kogut, B., and Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization science*. 3(3):383-397.

Kuhl, S. (2009). Capacity Development as the Model for Development Aid Organizations. Development and Change. 40(3): 551-577.

Laudon, K. C., & Traver, C. G. (2014). E-commerce. New Jersey: Pearson.

Linnell, D. (2003). Evaluation of Capacity Building: Lessons from the Field. Washington, DC: Alliance for Nonprofit Management.

Lithdamlong, D., Meusch, E., & Innes-Taylor, N. (2002). Promoting *Aquaculture* by Building the capacity of Local Institutions: Developing Fish seed Supply networks in the Lao PDR. Rural aquaculture 155-165.

Lucky, A.T. 2012. Department of Library and Information Science, Ahmadu Bello University, Zaria, Kaduna State, Nigeria.

Lusthaus, C., Adrien, M.H. & Perstinger, M. (1999). Capacity development: definitions, issues and implications for planning, monitoring and evaluation. Universalia Occasional Paper N35, 1999.

MAF (2008). Strategy for reform in the Agriculture and Forestry Colleges towards 2020. Vientiane, Lao PDR.

Mahant, M., Shukla, A., Dixit, S., & Patel, D. (2012). Uses of ICT in Agriculture. *International Journal of Advanced Computer Research (ISSN).* 2(3):46-49.

Mahtab, P., and Mokatarnia, M. (2009). Investigating Factors Influencing Use of Internet by Agricultural Faculty Members for Educational and Research Activities. Department of Agricultural Extension and Education, Faculty of Agricultural and Development, University of Tehran, Karaj, Iran. http:// www. 1. org/ aejaes/jaes5 (3)/15.pdf

Martin, P. Y., & Turner, B. A. (1986). Grounded Theory and Organizational Research. *The Journal of Applied Behavioral Science*. 22(2):141-157.

Mati, B. M. (2008). Capacity Development for Smallholder Irrigation in Kenya. Nairobi, Kenya: International Crops Research Institute for Semi-Arid Tropics (ICRISAT). Retrieved 15 April 2009 from http://www.interscience.wiley.com

NAFES (2005). Consolidating Extension in the Laos PDR. Vientiane, Lao PDR: National Agriculture and Forestry Extension Service. Retrieved 25 October 2007, from http://www.laoex.org/Docs/Consolidating-Extension-Engl.pdf

Nath, V. (2001). Empowerment and Governance through Information and Communication Technologies: Women's Perspective. *International Information and Library Review Journal*. 33(4):317-339.

Norton, P. (2008). Introduction to Computers. New York: The McGraw-Hill.

Nnadi, F. N., Chikaire, J., Atoma, C. N., Egwuonwu, H. A., & Echetama, J. A. (2012). ICT for Agriculture Knowledge Management in Nigeria: Lessons and Strategies for Improvement. *Science Journal of Civil Agricultural Research & Management*.

Nuruzzaman, M. (2003). Use and Preference of Mass Media in Receiving Agricultural Information by the Farmers. M.S. (Ag. Ex. Ed.) Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

Paul, C. and Thomas, W. (2002). The Participatory Change Process: A Capacity Building Model from a US NGO. Development in Practice. 10 (2): 240 – 244.

Photakoun, V. (2010). The Role of Capacity Building for Livestock Extension and Development in Lao PDR. M.Sc. Thesis, Charles Sturt University, Australia.

Rao, N. H. (2007). A Framework for Implementing Information and Communication Technologies in Agriculural Development in India. *Technological Forcasting and Social Change*. 74:491-518.

Rogers, E. M. (1995). Diffusion of Innovation. New York: Press Press.

Salomon I., Cohen G., Nijkamp P (1999). ICT and urban public policy: does knowledge meet policy? Research Memorandum.
47. http://degree.ubvu.vu.nl/repec/vua/wpaper/pdf/19990047.pdf.

Samanta, 1986. A Comparative Study of Adoption of UYV Program by the Farmers' of TV and non-TV Villages. *Indian Journal of Extension Education*. 9 (3&4):92-101.

Schroeter, A. (2006). LEA - Learning for Equitable Agriculture: Further developments in the Lao Extension Approach. Rural Development News. 2: 11-16. Available from http://www.agrideanternational.ch/fileadmin/10_International/PDF/RDN/RDN_2006/L EA.pdf

SELN (2006). Enabling change in rural and regional Australia: The role of extension in achieving sustainable and productive futures- A discussion document produced by the State Extension Leaders Network of Australia. State Extension Leaders Network. Retreived on 26/4/09 from http://www.seln.org.au

Stephen, P., Brien, N., & Triraganon, R. (2006). Capacity Building for CBNRM in Asia: A regional Review. Retrieved 29 October 2007, from http://www.recoftc.org/site/fileadmin/docs/CABS/idrc_review.pdf

Stur, W., Gray, D., & Bastin, G. (2002). Review of the Livestock Sector in the Lao People's Democratic Republic. Prepared for the Asian Development Bank. International Livestock Research Institute, Manila, Philippines. Retrieved 29 October 2007, from http://www.ciat.cgiar.org/asia/pdf/adb_livestock_review.pdf

Swanson, B. E., & Rajalahti, R. (2010). Strengthening Agricultural Extension and Advisory Systems: Procedures for Assessing, Transforming and Evaluating Extension Systems. The World Bank.

Thompson, R. L., Higgins, C. A., & Howell, J. M. (1991). Personal Computing: Toward a Conceptual Model of Utilization. *MIS Quarterly*. 15(1):124-143.

Uguru, F. N. (2001). Information Technology Access, Capabilities and Use Among Administrators of Agro-technology transfer Programmes in South Eastern Nigeria. Nsukka, Nigeria: Doctoral Thesis, Department of Agricultural Extension, University of Nigeria.

UNDP (1997). Capacity Development (Technical Advisory Paper 2). United Nations Development Program. Available from http://mirror.undp.org/magnet/cdrb/Techpap2.htm

UNDP (2011). Supporting Capacity Building the UNDP approach. United Nations Development Program.

UNESCO (2006). Guidebook for Planning Education in Emergencies and Reconstruction (Chapter 3) Capacity Building. Retrieved 29 October 2007, from http://www.unesco.org/iiep/eng/focus/emergency/guidebook.htm

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*. 27(3):425-478.

Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer Acceptance and Use of Information Technology: Extending The Unified Theory of Acceptance and Use of Technology. *MIS Quarterly*. 36(1):157-178.

World Bank (1997). The World Bank Annual Report 1997. Retrieved 12 April 2009 from www.worldbank.org

Yekini, O. T., and I. A. Hussein (2007). An Assessment of the Relevance of Information Communication Technologies (ICTs) to Agriculture and Rural Development by Research and Extension Personals in South-Western Nigerian. *Journal of Rural Sociology*. 1: 79-88.

APPENDIX- A

English Version of the Interview Schedule

Department of Agricultural Extension & Information System
Sher-e-Bangla Agricultural University,
Dhaka-1207

Interview Schedule for data collection for the Research on

Developing Professionals' Capacity in Agricultural Extension Service Using Information and Communication Technologies (ICTs)

(This interview schedule is entitled for a research study. Collected data will only be used for research purpose)

Serial No.

Name of the respondent:

Block: Upazila: District:

1. **Age:** Please mention your current age_____ (years)
2. **Gender:** i) Male ii) Female
3. **Service Experience:** How long have you been working as Sub-Assistant Agricultural Officer (SAAO)?_____(years)
4. **ICT Ownership:** Please mention your possession and access to the following ICTs

Items	Possession Items		
	Self	Shared Access	No access
i. Mobile Phone			
ii. SIM Card			
iii. Internet			
iv. Computer/Laptop/Tab			

5. ICT Self-efficacy: How confident you are to operate or use the following ICTs to complete a particular task by yourself without the help of others.

Items	**Not at all confident**	**Little confident**	**Fairly confident**	**Confident**	**Highly confident**
i. Receiving a mobile phone call*					
ii. Calling someone using mobile phone*					
iii. Receiving SMS*					
iv. Sending SMS					
v. Receiving MMS					
vi. Sending MMS					
vii. Watching video					
viii. Operate computer/tab/ laptop/other similar devices*					
ix. Complete a task using Internet					

SMS = Short message service or text message. **MMS** = Multimedia messaging service. Message that contains both text and image.

*Items dropped due to lower loading.

6. Ease of use: Please mention your degree of agreement or disagreement with the following statements.

Items	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
i. Learning to operate ICTs (mobile, computer, laptop, tab, Internet) is easy for me.					
ii. It would be easy for me to become skilled at using various ICTs (mobile, computer, laptop, tab, Internet).					
iii. I find using ICTs (mobile, computer, laptop, tab, Internet) is easy.					
iv. I find ICTs (mobile, computer, laptop, tab, Internet) to be flexible to use with.*					

7. Facilitating condition: Please mention your degree of agreement or disagreement with the following statements.

Items	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
i. ICT device (mobile, computer, laptop, Internet are available.					
ii. Low- cost computing /mobile devices are available.*					
iii. The network coverage is wide and available to all.					
iv. The speed and quality of network is good.					

8. Subjective norms /Peer influence/Social influence: Please mention your degree of agreement or disagreement with the following statements.

Items	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
i. My colleagues think I should use ICTs (mobile, computer, laptop, tab, Internet etc.).					
ii. My peers think I should use ICTs (mobile, computer, laptop, tab, Internet etc.).					
iii. People whom I interact with think I should use ICTs (mobile, computer, laptop, tab, Internet etc.).					
iv. My higher officials think I should use ICTs (mobile, computer, laptop, tab, Internet etc.).					

9. Top management support: Please mention your degree of agreement or disagreement with the following statements.

Items	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
i. My department (here, DAE) actively articulates a vision for using ICTs.					
ii. My department actively participate in formulating a strategy for using ICTs.					
iii. My department facilitates for using ICTs in my job.					
iv. My department motivates me to increase use of ICTs in my job.					

10. Extent of ICTs use: Please mention your frequency of using the following ICTs for your working purpose.

Items		Not at all	Rarely	Occasionally	Often	Frequently
i.	Mobile phone (Voice call, SMS, MMS, Video, etc.)	No use	1-3 times/ week	5-6 times/week	1-3 times/day	4-6 times/day
ii.	Internet	No use	1-3 times/ week	5-6 times/week	1-3 times/day	4-6 times/day
iii.	Computer/laptop/tab/apps/ other communication device	No use	1-3 times/ week	5-6 times/week	1-3 times/day	4-6 times/day
iv.	ICT-assisted Service Centres (e.g., AIS database/Krishi Jigassa/KrishokerJanala/ Krishi Bangla.Com/ Balainashok Nirdeskika/ Krishoker Digital Thikana etc.	No use	1-3 times/ month	5-6 times/ month	1-3 times/ week	1-2 times/day

11. Perceived capacity building through ICTs: Please mention your degree of agreement or disagreement with the following statements.

Items		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
i.	I find ICTs help me to increase effectiveness of my job					
ii.	Due to ICTs I have to spend less time on routine job tasks					
iii.	I could increase the quality of output of my job due to use of ICTs					
iv.	I find I could provide better services to the farmers using ICTs					
v.	I think ICTs positively help me to increase my working capacity					
vi.	ICTs help me to be updated with farming information					
vii.	ICTs help me to keep maintaining my professional network					

12. Mention the problems you have faced in using ICTs in your work.

a) **b)**

c) **d)**

e) **f)**

Thank You.

Name and Signature of the Interviewer:

APPENDIX-B

Cross Loadings

	Cap	EU	FC	Norm	SE	SuP
CAP1	0.659	0.283	-0.017	0.509	0.229	0.244
CAP2	0.743	0.211	0.040	0.520	0.178	0.139
CAP3	0.871	0.263	0.124	0.435	0.230	0.141
CAP4	0.895	0.195	0.204	0.437	0.268	0.100
CAP5	0.916	0.317	0.122	0.390	0.262	0.183
CAP6	0.907	0.186	0.228	0.393	0.174	0.158
CAP7	0.887	0.225	0.213	0.357	0.199	0.223
EoU1	0.327	0.848	0.210	0.266	0.489	0.368
EoU2	0.217	0.926	0.021	0.237	0.442	0.330
EoU3	0.195	0.851	0.052	0.157	0.409	0.332
FC1	0.223	0.164	0.803	0.154	0.111	0.127
FC3	0.043	0.063	0.858	-0.194	0.102	0.054
FC4	0.107	-0.095	0.676	-0.092	-0.011	0.006
NORM1	0.393	0.300	-0.001	0.849	0.271	0.271
NORM2	0.439	0.117	-0.043	0.831	0.100	0.221
NORM3	0.478	0.198	-0.003	0.905	0.214	0.180
NORM4	0.449	0.208	-0.081	0.861	0.141	0.157
SE4	0.279	0.275	0.238	0.236	0.652	0.130
SE5	0.091	0.442	0.080	0.158	0.924	0.280
SE6	0.129	0.423	0.080	0.133	0.923	0.293
SE7	0.238	0.440	0.245	0.160	0.799	0.242
SE9	0.367	0.506	-0.056	0.269	0.819	0.304
SUP1	0.280	0.357	-0.047	0.297	0.359	0.863
SUP2	0.226	0.380	0.064	0.245	0.271	0.897
SUP3	-0.086	0.290	0.255	-0.006	0.129	0.660
SUP4	0.084	0.180	0.169	0.108	0.143	0.687

Note: Item loadings less than 0.65 were dropped from the analysis