An Investigation of the Factors that Impact the Intention to Adopt and Use mICT in the Libyan Construction Industry

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This thesis is presented for the degree of Doctor of Philosophy of Murdoch University

2016
I declare that this submission is my own work and it contains no materials previously published, written or submitted for a degree at any tertiary education institution by another person.

Signed .................................................................

Name   Jamal Mohamed Sheglabo
Abstract

Work in the construction industry is mainly fieldwork with workers being highly mobile. Information flows between construction sites can be facilitated by the use of mobile technologies. Although several studies have investigated the use of mobile technology (mICT) and how it can be used to improve business processes in the construction industry (e.g. Bowden, Dorr, Thrope & Anumba, 2006; Zou, Ye, Peng, & Chen; 2006; Vilkko, Kallonen, & Ikonen, 2008), the amount of mICT use in the construction industry continues to be low compared to other sectors due to several factors such as financial constraints and the lack of techniques for evaluating ICT benefits (ABS, 2012). This research is intended to inform users and future researchers about obstacles that could hinder the adoption and use of mobile technologies in Libya.

The major aims of this thesis are: 1) to investigate the factors that affecting the intention of stakeholders to adopt and use this technology in the Libyan construction industry, 2) to explore the benefits that could be gained from adopting and using mICT and 3) to investigate the current uses and the future prospects regarding adopting and using this technology.

A research model based on the broader technology acceptance literature was developed to provide a framework for this research. The model was designed to provide a better understanding of the inter-relationships between constructs proposed as likely to have a significant role in mICT technology acceptance in the construction industry. The research model includes a set of constructs believed to influence the intention to adopt and use mICT in the construction industry. These are: perceived usefulness of mICT, perceived ease of use of mICT, perceived credibility of mICT and perceived high cost of technology, perceived mICT self-efficacy and facilitating conditions.
The research strategy for this study was survey research and combined both quantitative and qualitative research. Questionnaires and semi-structured interviews were used for collecting the data. A sample of 202 respondents representing the main types of stakeholders in the construction industry was obtained from construction companies in three Libyan cities and 25 of them were also interviewed.

The model was tested using Partial Least Square and the results were used to address the first research question, “What are the factors that could influence the intention to adopt and use of mICT by stakeholders in the Libyan construction industry?”. To answer the other two research questions, a qualitative analysis approach was used which was mainly based on the procedures used by Silverman (2006).

The study found that the intention to adopt and use mICT in the Libyan construction industry was directly affected by perceived usefulness of mICT and perceived ease of use of mICT and indirectly by perceived mICT self-efficacy and facilitating conditions. The study also showed that mICT is very beneficial to the stakeholders in the construction industry in numerous areas such as reduction of work time, cost and effort. Moreover, mICT was found to be important to stakeholders for interacting, monitoring, exchanging information and organising and completing work. In addition, the study has also identified the construction industry stakeholders’ perspectives on what the future holds for mICT adoption and use in the construction sector, and the necessity for government support in increasing the number of mobile service providers, establishing investment contracts with international mICT technology suppliers and adopting training programs for stakeholders.
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Chapter 1. Introduction

1.1. Research background

The construction industry can be considered as a complex and fragmented sector of the economy. Fragmentation in construction arises within construction work process (design and construction) and construction structure itself (Abadi, 2005). Critical factors such as low productivity; low competitiveness; slow information flow and inadequate performance have been seen as a result of that fragmentation (Xiaolong, Yaowu & Qiping, 2007). However, in recent years, the construction industry environment has begun to change due to the advances in technology. Information and communication technology (ICT) has been identified as a vital means for enhancing communications among construction project processes, and its use offers investment opportunities in the construction industry (Walker & Betts 1997). Kajewski, Weippert, Remmers and McFallan (2004) stated that some types of ICT such as desktop computers, mobile phones, scanners, fax and digital cameras are widely used in the construction industry and stakeholders have also made use of other forms of technologies such as handheld and tablet computers, Wi-Fi and video conference equipment.

In construction projects, a large amount of information needs to be exchanged and tracked by the workers and administrators (stakeholders) during project phases such as design and implementation. ICT provides benefits in reducing the number of information flow processes through the utilisation of innovations such as Internet or Intranet, to help enable electronic tendering (eTender), to help enable electronic archiving of documents (eArchiving) and to help gain increased efficiency (improved productivity) (Kajewski, Weippert, Remmers, & McFallan, 2004). Harindranath, Dyerson, and Barnes (2008) found evidence for the value of ICT investments such as enhancing joint working collaborative ventures, increasing staff satisfaction, increasing...
operational efficiency, improving and enhancing customer technologies, keeping up with competitors and enhancing customer service.

Although many studies indicate a growth in the rate of ICT usage (Peansupap, 2004), the amount of ICT use in the construction industry continues to be low compared to other sectors due to several factors such as financial constraints and the lack of techniques for evaluating ICT benefits (ABS, 2012). Modifying the construction industry using ICT, raises concern for both partitioners and researchers in the construction domain. These concerns include privacy and security, reluctance of management to adopt new technologies, amount of investment required and evaluation of ICT benefits (Peansupap & Walker, 2006; Froese, THan, & Alldritt, 2007). Such concern has led research in developing countries in order to investigate and explore the constraints that prevent the adoption and usage of these innovations. For example, a study in Nigeria found that factors such as insufficient /erratic power supply, high costs of hardware/software, scarcity of professional software that could be used in construction, low return on investment in ICT and fear of ICT making professionals redundant can negatively affect the uptake of ICT in the construction industry (Oladapo, 2006).

In Libya, researchers have studied the level of technology use in certain Libyan sectors such as telecommunications, oil and gas, and banking (Twati & Gammack, 2006), but few studies have addressed this issue in the construction sector. Ngab (2007) investigated the challenges and problems that impede the development of the construction industry in Libya. However, although the study identified the lack of technical and managerial capabilities, it did not specifically consider the role of ICT. Furthermore, there was no discussion about what sort of strategies and policies should be adopted to solve the mentioned issues. Identifying the benefits that can be gained
from using innovations in construction industry, exploring the current use and future prospects for use and investigating the challenges and factors that could hinder stakeholders to adopt and use such these innovations in Libyan construction industry are the focus and target of this study.

Mobile technology is one of the technologies that have recently been used in the construction domain. However, as stated by Leskinen (2008), there are conflicting beliefs on the value of mobile applications and their use in the construction industry and this can be attributed to a lack of knowledge of their technological capabilities. Work in the construction industry is mainly fieldwork with workers being highly mobile. Information flows between construction sites can be facilitated by the use of mobile technologies. Enhancements such as faster data transfer rates can be attributed to the strong coverage that mobile networks offer without any need to construct or build new infrastructure (Vilkko, Kallonen, & Ikonen, 2008).

Several studies have shown an increased interest in the use of mobile technology and how it can be used to improve business processes in the construction industry. A paper by Bowden, Dorr, Thrope and Anumba (2006) reported that some improvements such as reductions in construction time, defects, capital cost of construction, waste, accidents, operation and maintenance costs can be achieved from using mICT in the construction industry. Zou, Ye, Peng, and Chen (2006), in a study to investigate the benefits that can be gained from using mobile phones in construction sites, reported that mobile technology as an IT solution has a significant role in reducing the need to redo work and money wastage. In addition, mobile technologies in construction have been developed to enhance the productivity and on-site communications (Zou, Ye, Peng, & Chen, 2006). Moreover, it could play a vital role in improving the efficiency of construction processes (Venkatraman & Yoong, 2009).
Libya is a developing country. Its mobile-cellular telephone system became operational in 1996 and has approximately 9.59 million mobile phones in use (CIA World Factbook, 2012). This research is intended to inform stakeholders and future researchers about obstacles that could hinder the adoption and use of mobile technologies in Libya.

1.2. The problem statement and significance of the study

Although a number of research projects have studied the factors and constraints that influence the use and impact of ICT in the construction industry in developing countries, there has not been any research that has specifically tackled this issue in Libya, and no research has been specifically published on the impact of mobile Information and Communication Technology (mICT) use by the stakeholders in the Libyan construction industry. Moreover, mICT and its use in the construction industry is new, so stakeholders have little experience with it. This study will provide a baseline understanding of the use of this technology in the Libyan construction industry. It will also provide a basis for further research in this field.

Libya recently has been involved in a truly serious civilian war which destroyed much of the buildings and infrastructure; the reconstruction of the country is therefore one of the most important targets of the government (DBISFCO, 2011). Identifying and analysing the factors that affect the intention to adopt and use mICT will help the authorities who are involved in the construction industry to avoid obstacles not only in Libya but in other countries that have similar circumstances.

1.3. Research aims and questions

Libya is a developing country and the construction industry is of vital importance to its future. However, no research exploring the potential benefits of mICT to the construction industry or the factors that limit the intention to adopt and use this
technology has been carried out in this domain. Investigating factors that might influence the adoption and use of mICT, exploring the benefits that could be gained from adoption and use of mICT and investigating the current uses and the future prospects of using this technology will support the stakeholders in the Libyan construction industry as they reconstruct the country.

To achieve the aim of increasing the knowledge and understanding of mICT adoption and use in the Libyan construction industry the research addresses the following research questions:

RQ1: What are the factors that could influence mICT adoption and use in the Libyan construction industry?

RQ2: What are the benefits that could be gained from mICT adoption and use in the Libyan construction industry?

RQ3: What are the current uses of mICT and the future prospects of using mICT in the Libyan construction industry?

1.4. Research method

To achieve the aim of determining the factors that influence adopting and using mICT in the Libyan construction industry a model was tested. This model is based on the Technology Acceptance Model (TAM) (Davis, 1989), Theory of Planned Behavior (TPB) (Taylor & Todd, 1995b), TAM2 (Venkatesh & Davis, 2000), and the extended TAM (Luarn & Lin, 2005). The research investigated and analysed the views of construction stakeholders in Libya in order to determine the factors that influence the intention to adopt and use of mICT in the Libyan construction industry and the benefits that can arise from this adoption and use. The research involved both quantitative and qualitative approaches: through a questionnaire, and then through a series of semi-
structured interviews. The sampling frame for the study was Libyan construction industry stakeholders. In the first stage, 202 participants were sought, and in the second stage approximately 25 semi-structured interviews were held. Measuring the constructs of the research model was based on those used in previous studies with minor rewording to suit the construction domain. To test the research model Partial Least Squares (PLS) was used.

In the qualitative part, Interviews were undertaken with potential mICT users in the construction industry. The responses were inspected for the statements that addressed the research questions 2 and 3. The statements were classified into general themes representing the participants’ point views regarding the benefits and future prospects of adopting and using mICT in the construction industry. The themes were allowed to arise from the data. The interviews have transcribed into English and tabulated using Microsoft Word Tables. Each interview was tabulated in an interview sheet which is divided into three columns; guide question number, interview question and in the last column provided the participant’s response to each question.

1.5. Organisation of the thesis

This thesis is organized in six chapters. This chapter provides general background followed by the problem statement, significance of the study and research aims and questions. It also introduces the research methodology and is ended by a summary of the thesis structure.

Chapter 2 reviews the literature on technology adopting in general and innovation adoption in the construction industry in particular. It explores the benefits and outcomes of ICT use and discusses the factors that may influence ICT adoption and use in construction industry. The models reviewed in this chapter form a basis for the development of the model tested in the research and described in this thesis.
Chapter 3 introduces the research model. It describes the proposed constructs, research hypotheses and model.

Chapter 4 describes the research methodology used in the study, including the data collection methods, the choice of participants and data analysis approaches.

Chapter 5 reports on the quantitative and qualitative findings of the study. The results of measurement and structural model analysis are presented. The chapter concludes by presenting the results of hypothesis testing and the analysis of the benefits of mICT and future prospects of stakeholders in the Libyan construction industry.

Chapter 6 presents a discussion of the research results, limitations and implications of the study for research. The chapter then presents the research conclusion that summarizes the research main points.
Chapter 2. Literature Review

2.1. Introduction

The purpose of this chapter is reviewing the previous relevant research on the impact of the use of information and communication technology (ICT) by stakeholders in the construction industry. This review particularly aims to elaborate on the manner in which ICT innovations have been adopted and factors that have a significant impact on the use of ICT in the construction industry. Therefore, this chapter has been structured and divided into four sections. Firstly, the literature review starts by explaining issues connected to technologies and innovations in the construction industry. Secondly, the chapter discusses the outcomes and benefits of ICT innovation for the construction ICT innovation. Thirdly, an appraisal of the impediments and barriers hindering the adoption and use of ICT is given. Fourthly, the chapter introduces several ICT adoption theories and models that are relevant to this thesis and establishes the need for the role of the factors in these models to be investigated in the Libyan construction industry.

2.2. Technologies and innovations in the construction industry

The construction industry seems to have unique features due to the number, variety, activities, and processes that the industry is involved in. The next section will introduce the construction industry and describe how innovations have been introduced into project processes.

2.2.1. The construction industry history and nature

The construction industry was brought into being when buildings were built by humans using the available natural resources. A significant contribution has been made by the construction industry to many national economies. For example, the Australian Bureau of statistics (ABS, 2012) reports that the construction industry sector contributed 8.5% of Australia’s GDP, it employed 1.023 million people and accounting for 9.7% of the
total employment in the Australian economy. In 2012 in the UK, the construction industry contributed approximately £83.0 billion to the UK economy and in the fourth quarter of 2013, the industry employed around 2.15 million people (Rhodes, 2014). In developing countries, the construction industry considered one of the most important contributors to the national economy. For example in Libya, the construction industry plays a significant role in economic growth of the country, it contributed 5.2% of the Libyan Gross Domestic Product (DGP) in 2006 and employed approximately 3.2% of the total workforce in 2006 (Ngab, 2007).

The end products of the construction industry are mostly roads, public buildings and other civil works and due to the significant role that the construction industry plays in supporting the economies of nations, it can be considered an essential industry which holds a prominent position all over the world (Khan, 2008).

The nature of the construction industry has been characterised as being fragmented, unique and complex due to a variety of reasons. First, construction projects comprise many phases; for example, feasibility, design and implementation. Second, each phase involves many project participants such as contractors, clients, designers, consultants and suppliers which lead to difficulties in information exchange and communication (Peansupap, 2004). In addition to the role that workers play in the construction industry, the techniques and innovations that are used are also essential in maintaining high levels of process quality.

Libya is an Arabic country located on the North African coast of the Mediterranean Sea and dominated by a dry and hot climate. The area of the country totals about 1,750,000 square kilometres and this makes it the fourth largest country in Africa (Grifa, 2006). Moreover, The population of Libya was around 6.202 million in 2015, and the Arabic language is the national and official language; however English and Italian are used in
the trade and construction professions (CIA World Factbook, 2015). As a result of foreign oil company investment in 1960s the construction industry started to play a prominent role in economic development.

During the boom of 1970s and the early 1980s, the Libyan construction industry employed about 16% of the total workforce in the country (Wells, 1986).

Nevertheless, the Libyan construction industry is similar to that in most developing countries in that it faces various difficulties and challenges. For example, it operates with low productivity and high overall costs due to the high prices of construction materials such as cement and steel and cost of labours as well.

Grifa (2006) stated that the weakness of the Libyan construction industry was that it was characterised by traditional processes of operations and this attributed to the low levels of educational qualifications in construction but believed that it would flourish in the future due to laws that encourage foreign investment in construction.

Therefore, it is important for construction organisations to adopt and use technology and innovations (Twati, 2008). Even though studies have considered the factors affecting adoption and uses of technology in the construction industry in other countries, the focus has not been on developing countries such as Libya. Thus, comprehensive study on these factors is essential.

2.2.2. **The construction industry and ICT**

In recent decades, the construction industry has seen many technological developments and strategies because of the increasing awareness among practitioners of the benefits of adopting and using ICT (Hosseini, Chileshe, Zuo & Baroudi, 2013). Many researchers have studied the role of ICT in the construction domain. Kivrak, Arslan and Cagatay (2010) reported that companies that had already changed their traditional work methods
by adopting and using ICT were more likely to be successful than their competitors. Kang, O’Brien, Thomas and Chapman (2008) also found that using ICT is generally correlated with improved performance.

Many types of ICT innovations have been studied related to the construction industry. For example, Skibniewski and Nitithamyong (2004) found that Internet plays a significant role in making information transfer occur faster and effectively, providing new opportunities for the development of systems across organizations. In the case of computers, Onyegiri, Nwachukwu and Onyegiri (2011) found that computer aided drafting (CAD) systems facilitate techniques to production of drawings and models of the finished buildings. They also found that CAD assists in improving collaboration and communication for successful performance by contractors and designers. Other types of ICT applications have been successfully used in construction industry such as email, electronic document management systems (EDMS), intranet and extranet, mobile electronic data interchange (EDI), etc (Tam, 1999; Skibniewski & Abduh, 2000; Ahmad, Azhar, & Ahmed, 2002; Skibniewski & Nitithamyong, 2004).

Many studies and research studies have investigated the benefits and outcomes that can be gained from ICT use. The benefits of ICT in construction will be now addressed.

2.3. ICT use benefits and outcomes in construction

The construction industry is an important contributor to the GDP of every country and ICT is one type of technology that can contribute to the development of the construction industry (Love, & Irani, 2004). Developing this sector by adopting new sophisticated technologies is important to the decision makers in the construction industry sector (Brewer & Gajendran, 2012). Many research studies have researched potential benefits to be gained from adopting and using ICT in the construction industry. For example, and from the construction operation viewpoint, studies by Marsh and Flanagan (2000),
Gunasekaran, Love, Rahimi and Miele (2001), Nitithamyong and Skibniewski (2006) and Oladapo (2006) have demonstrated that using ICT can help in reducing costs such as operating costs, increasing profit levels and also enable better financial control. Also, ICT applications can help enhance and increase aspects of project quality such as quality of documents and project performance (Marsh & Flanagan, 2000; Gunasekaran, Love, Rahimi & Miele, 2001; Nitithamyong & Skibniewski, 2006). ICT provides opportunities for real time access to information, it supports collaboration between project team members and supports information integration among construction processes that helps to reduce the time to complete project processes, increases speed of work, improves ease of capturing meaningful information and faster delivery of technologies (Nitithamyong & Skibniewski, 2006; Gunasekaran et al., 2001; Pamulu, 2004).

Other significant benefits of ICT have investigated. For example, ICT provides the ability to handle more enquiries (Pamulu, 2004). Shaharudin, Ibrahim and Ismail (2010) found that the Internet as a type of ICT is the most important and useful technology for the construction sector and its powerful accessibility from anywhere and anytime, changes and influences the way work is accomplished and provides an opportunity to make information about the organisation available to other users, allows access to current data offered on the Internet by suppliers and consultants and a fast inexpensive means to communicate with multiple users across the globe.

To determine the benefits from using ICT in some Arabic nations, El-Saboni, Aouad and Sabouni (2009) studied ICT usage in different construction firms in the United Arab Emirates (UAE) and categorised the benefits into 4 types. These are 1) benefits from implementing ICT in UAE client organisations such as governance, enhanced competency of decision making and transparency; 2) benefits from implementing ICT
in project management firms, which include more effective and better control of documentation; 3) benefits for consultant firms, such as quality assurance, and more organized flow of work; and 4) benefits for contractors in terms of tracking of submittals and timely approvals.

2.4. Barriers and constraints to ICT use in construction

As there was a growth in ICT investment (Colecchia & Schreyer, 2001), many studies have focused on the potential role that ICT could play for the good of the construction industry (Kivrak, Arslan & Cagatay, 2010; Gajendran & Brewer, 2012). But the construction industry has lagged behind other industries in terms of adoption and use ICT for a long period (Peansupap, 2012). In this regard, various studies have tried to diagnose the obstacles and difficulties that could hinder the adoption and use of ICT and they have categorised them into: 1) barriers and constraints at the organisational level; for example, fear of change and uncertainty, low technology literacy of managers, lack of ICT awareness and management reluctance to invest in innovations due to their high cost, 2) barriers and constraints at the project level such as security system threats (hacks and identity theft, etc.), and tight project time frames (Stewart, Mohamed & Marosszeky, 2004; Peansupap, 2004; Peansupap & Walker, 2006).

Studies in developing countries also appear to experience additional constraints. For example, a study in Nigeria found that factors such as insufficient or erratic power supply, high costs of hardware and software, scarcity of software professionals, low return on investment in ICT and fear of ICT making professionals redundant can negatively affect uptake of ICT in the construction industry (Oladapo, 2006). In addition, Alaghbandrad, Asnaashari and Preece (2012) studied the problems with, and barriers to, ICT utilisation in Iranian construction sites and categorised the barriers they identified as belonging to different levels; some are at the organisational level, such as
lack of and poor ICT infrastructure, complicated administrative processes for ICT improvement, and poor backup systems in remote sites. Some problems are relevant to individuals, such as local personnel unfamiliarity with ICT in remote construction sites and lack of the desire to use electronic tools like video conferencing software.

2.5. Factors influencing ICT adoption and use

As an emerging technology, the success or failure of ICT depends on many factors. This section provides insights into the definitions of these factors and also introduces the relationships between them and the adopting and using of ICT.

Nowadays, ICT is seen as an essential innovative facility that could help organisations to enhance and organise work processes. The fundamental influence of ICT on the process of how the business proceedings are carried out has been specifically studied in the construction industry (Pamulu, 2004). Certain factors related to users’ characteristics, organizational characteristics and technology characteristics can affect ICT adoption and use in the construction industry (Peansupap, 2004). Skibniewski and Nitithamyong (2004) reviewed and categorised the factors that essentially affect the implementing of web-based project management technologies into three categories. Firstly, managerial factors such as collaborative maturity and difficulties in quantifying costs and benefits. Secondly, technological factors such as system reliability, system security, lack of software interoperability, density of communication channels and Internet access and bandwidth problems. Thirdly, individual factors include resistance to change. Sidawi and Omairi (2010) highlighted the barriers to implementing web-based project management systems (WPMS) as ICT support for remote construction sites in Saudi Arabia and found these factors are the low levels of IT infrastructure of the organization and other parties, staff resistance to changing work methodology and processes, low computing proficiency levels of senior management and staff preference.
for old style paper-based/existing management protocols, and concern for major investment without guarantee of success and/or returns. The following sections review the literature on the main factors.

2.5.1. Factors relevant to individual characteristics

Characteristics of individuals that are considered to affect their ICT adoption and use can include self-efficacy, skills in ICT, adequacy of training, and resistance to change.

2.5.1.1. ICT self-efficacy

The construct of self-efficacy has been defined by many authors. For example, computer self-efficacy has been defined as “an individual’s perceptions of his or her ability to use computers in the accomplishment of a task” (Compeau & Higgins, 1995 p 191). Compeau and Higgins (1995) also studied the effect of individual’s computer self-efficacy on computer use and found that individuals with high computer self-efficacy have a greater outcome expectation of performance and less anxiety of using computers. Computer self-efficacy has also been shown to increase of users’ intentions to use ICT (Agarwal, Sambamurthy & Stair, 2000; Chau, 2001; Johnson & Marakas, 2000). A number of studies have considered the relationship between self-efficacy and ICT adoption and use. A study in Malaysia done by Sam, Othman and Nordin (2005) found a positive relationship between the level of software usage and the Internet self-efficacy.

For most ICT users especially non-ICT professionals, adequate training is essential for every new ICT system they need to use. Adequate training has a significant role in reducing computer anxiety and creating personal self-efficacy to use ICT. Lack of training is one of major contributors of ICT implementation failure, consequently users should be actively provided with enough training to improve their skills using ICT (Martocchio, 1994; Wilder & Davis, 1998 p 41; Akins & Griffin 1999). Level of ICT
skills was found to be one of key factors influencing diffusion and intention to adopt and use ICT in the construction industry (Peansupap & Walker, 2006).

2.5.1.2. Resistance to change

People are naturally resistant when they encounter change and a gentle effort may be needed to convince them to defeat the fear of uncertainty, particularly if it is an innovation or technology issue (Love, Irani, Cheng, & Tse, 2001). In the construction domain at enterprise level, research indicates that managers are reluctant to invest in ICT and they evolved limited strategies to ensure the efficient implementation of ICT; this is attributed to their lack of perceived return on investment on ICT expenditure (Stewart et al., 2004). In a study to investigate the barriers that hinder integration of ICT in the construction industry, Anumba, Dainty, Ison and Sergeant (2006) found that employees view the adopting of new technologies as a change that can threaten their security. Moreover, Henderson and Ruikar (2010) found that fear of change and uncertainty has a significant effect on the success of ICT implementation in construction organisations.

Although ICT is used as a solution to address problems in construction, users described resistance to adopting ICT and change as key barriers to improving the organisational processes (Froese et al., 2007). Even though some studies have shown that reluctance or resistance to change from users in lower levels in the organisational hierarchy can be addressed by using appropriate training or pilot schemes, reluctance from senior management is hard to address due to their powerful position in the organisation (Stephenson & Blaza, 2001).

2.5.2. Factors relevant to technology characteristics

According to Peansupap (2004), adoption and use of ICT can be influenced by characteristics that have a direct relationship to the technology itself. ICT adoption can
be influenced by different technological characteristics such as lack of system compatibility, security and privacy issues, and high cost of technology (Stewart & Mohamed, 2002; Alshawi & Ingirige, 2003; Nitithamyong & Skibniewski, 2003; Stewart et al., 2004; Oladapo, 2006; Harindranath, Dyerson, & Barnes, 2008).

2.5.2.1. Security and privacy concerns

Security concerns are due to technology risks, which could be real, or perceived (Khalifa, Irani, & Baldwin, 1999). Security and privacy concerns associated with ICT adopting and using in organisations are threats from hackers and intruders, threats from viruses, high cost of security applications and unauthorised external and internal access to systems and information (Gefen, Warkentin, Pavlou, & Rose, 2002; Lambrinoudakis, Gritzalis, Dridi, & Pernul, 2003).

In developed countries, risks associated with security and privacy of data are considered one of the essential barriers to using ICT in the construction industry (Oladapo, 2006). In a study to investigate the link between ICT barriers and coping strategies in the Australian construction industry, Stewart et al., (2004) found that security and privacy issues scored as one of the most significant barriers that impede the implementation of ICT at the project level. Likewise, security and privacy have been mentioned as significant concerns in developing countries. Oladapo (2006) found that the security of professional software was assessed as one of the important constraints to adopting and using ICT in Nigeria’s construction industry.

2.5.2.2. Perceived high cost of technology

The cost of technology can include the cost of software and hardware, the cost of ongoing updating of the technology, the cost of staff development. The initial cost of the ICT technology was rated the most second important barrier to adopt and use ICT across projects in construction organizations (Brewer & Gajendran, 2012). In the
construction industry, the diffusion of ICT has been hindered by several significant factors such as the high cost of ICT software and hardware and the high cost of engaging computer staff (Oladapo, 2006). Harindranath et al., (2008) in a study to investigate the factors that affect the adoption and use of ICT in small to medium enterprises (SMEs) in Southeast England found that cost presented the biggest obstacle to continued adoption of ICT. Chong and Pervan (2007) reported that one of the major barriers for adoption of information sharing systems using information technology is the cost. Similarly, Carlsson, Hyvonen, Repo and Walden, (2005) found that financial costs are one of the greatest barriers to using mobile technologies.

2.6. Information technology adoption behavioural models

To identify the key factors that influence the adoption and use of innovations, this section reviews several behavioural models that are relevant to ICT and this followed by a discussion of the factors that may affect the adoption and use of mICT in the construction industry.

The main key factors in adopting, accepting and using any new technology are the users and their own perceptions of use of the technology, and identifying these factors and targeting them can avoid resistance and increase the chances of successful technology implementation (Shih & Chen, 2013). There is a large volume of published studies describing the role of the perceptions of users in accepting any new technology in terms of the Technology Acceptance Model (TAM) (Davis, Bagozzi, & Warshaw, 1989), Technology Acceptance Model 2 (TAM2) (Venkatesh & Davis, 2000) and Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003), so each is discussed below.
2.6.1. Technology Acceptance Model (TAM)

Since the mid-1980s, research on ICT adoption has focused on developing and testing models to predict intention to use and/or actual usage of ICT by individuals and organizations (Olson & Boyer, 2003; Legris, Ingham, & Collerette, 2003). TAM, which was modified from the Theory of Reasoned Action (TRA) of Fishbein and Ajzen (1975) deals with behavioural intentions to use IT systems (see Figure 2.1). Two particular beliefs are used in TAM: perceived ease of use (PEOU), which was defined as “the degree to which a person believes that using a particular system would be free of effort” (Davis, 1989, p. 320), and perceived usefulness (PU) which was defined as “the degree to which a person believes that using a particular system will enhance his/her job performance” (Davis, 1989, p. 320). TAM postulated that intention to use a system is jointly determined by the perceptions of system usefulness and individual attitude towards using the system. In TAM, PU is hypothesised and predicted by PEOU (Davis, et al., 1989). In the case of mobile technology, several models have been developed based on TAM to investigate the adoption of such technology. These include models from Luarn and Lin (2005) and Pedersen (2005) which are discussed in section 2.7.

![Technology Acceptance Model (Davis, 1989)](image)

Figure 2.1 Technology Acceptance Model (Davis, 1989)
2.6.2. Technology Acceptance Model 2 (TAM2)

As shown in Figure 2.2, TAM2 is an extension of TAM that includes additional key determinants of the usage intention and PU constructs (Venkatesh & Davis, 2000). These additional constructs are social influence (subjective norm, image and voluntariness) and cognitive instrumental processes (output quality, result demonstrability and job relevance). TAM2 illustrates and encompasses the impact of social processes on a user’s opportunity to accept or refuse a new system. TAM2 was developed because TAM has some limitations that it couldn’t go beyond the items that measured PU and PEOU and in terms of explanatory power TAM2 explains and reaches 60% whereas TAM explain only 40% to 50% of variability in usage intentions and behaviour (Venkatesh & Davis, 2000). Many studies have used TAM2 in terms of ICT context. For example, Wu and Wang (2005) have empirically tested a model which was developed based on TAM2 in terms of mobile commerce acceptance.

Figure 2.2 Technology Acceptance Model 2 (TAM2) (Venkatesh & Davis, 2000)
2.6.3. Unified Theory of Acceptance and Use of Technology (UTAUT)

UTAUT was developed by Venkatesh et al., (2003) based on other technology acceptance models such as TAM (Davis et al., 1989), the Theory Planned Behaviour (TPB) (Ajzen, 1991), a model combining TAM and TPB (Taylor & Todd, 1995b), the TRA (Ajzen & Fishbein, 1980), the model of PC Utilization (Thompson, Higgin, & Howell, 1991), Social Cognitive Theory (Bandura, 1986), Diffusion of Innovations Theory (Rogers, 1983) and the Motivational Model (Davis, Bagozzi & Warshaw, 1992). Besides underscoring the individual main factors that affect technology acceptance, UTAUT (see Fig. 2.3) was developed to identify the contingencies that would amplify or constrain the effects of these factors on the intention to use a new system (Venkatesh & Zhang, 2010). Four constructs that are believed to have a direct effect on behavioural intention to use ICT were included by UTAUT. These constructs are effort expectancy, social influence, performance expectancy and facilitating conditions. Four contingencies (i.e., age, voluntariness, gender and experience) that could alter the effect of the determinants on behaviour and/or intention were also included (Venkatesh et al., 2003).

![Figure 2.3 Unified Theory of Acceptance and Use of Technology (UTAUT)](image-url)
The theory holds that four key constructs are direct determinants of usage intention and behaviour. These are 1) performance expectancy which equivalent to PU which is defined as “the degree to which an individual believes that the using of a new system will assist in achieving substantial rewards” (Venkatesh et al., 2003, p 447). Performance expectancy was found to be a significant construct of behavioural intention (Venkatesh & Zhang, 2010); 2) effort expectancy (PEOU) which is defined as “the degree of ease associated with the use of the system” (Venkatesh et al., 2003, p 450). The effect of effort expectancy on behavioural intention varies with age and gender among individuals; 3) social influence that has been defined as “the degree to which an individual perceives the importance of others believe that they should use a new system” and; 4) Facilitating conditions which is as “the degree to which individuals believe that an organisational and technical infrastructure exists to support use of the system”.

2.7. Mobile technology in the construction industry

The construction industry has an enormous amount of information that needs to be transferred and moved among the various project activities. Although the past decade has seen the rapid development and dissemination of ICT in many construction fields, these technologies are highly specific in use and have a lack of simplicity and functionality (Nourbakhsh, Zin, Irizarry, Zolfagharian, & Gheisari, 2012). Investigating recent ICT technologies and innovations to determine the potential benefits and factors that impede the adoption and use of these technologies in the construction industry has concerned some researchers (Peansupap, 2012). mICT is one of these technologies that has been recently adopted in the construction domain and has been identified as a significant component within the overall ICT support for construction project sites (Ahsan, El-Hamalawi, Bouchlaghem & Ahmad, 2007). mICT provides the possibility for establishing a dynamic mode of communication that will significantly improve
communication and cooperation for the management of construction projects; in other words, mobile ICT ensures that users have the right information at the right time and in the right place (Suman, Ursic, Psunder & Veselinovic, 2009).

Work in the construction industry is mainly fieldwork, with workers being highly mobile. Information flows between construction sites are facilitated by the availability of mobile technologies. Communications enhancements in the construction industry, such as faster data transfer rates can be attributed to the strong coverage that mobile networks can offer without any need for construction companies to construct or build new infrastructure (Vilkko et al., 2008). Moreover, research studies have shown an increased interest in mobile technology practice and how it can be used to improve business processes in the construction industry (Ahsan et al., 2007; Chen & Kamara, 2011; Bowden, Dorr, Thorpe, & Anumba, 2006; Anumba, Aziz, & Obonyo, 2003).

Recently, the construction sector has witnessed many developments by adopting and using various types of mobile device on construction sites. For example the use of Personal Digital Assistant (PDAs) grew rapidly in the construction industry due to their features which include browsing the Internet, wireless access, synchronizing data between PDA and desktop PC and access to calendars and address books (Tserng, Dzeng, Lin, & Lin, 2005). Mobile devices have been employed and utilized in many areas in the construction industry such as to support collaboration and information sharing platforms (Pena-Mora & Dwivedi, 2002), to support field inspections (Sunkpho & Garrett, 2003) and to access data capture for piling works (Ward, Thorpe & Price 2003). Moreover, mICT has diverse applications that can also be used to view and modify work in construction, for example, CAD which can be used in drawings during the construction project lifecycle (Chen & Kamara, 2011). The next section will widely illustrate those benefits.
2.7.1. Mobile benefits in the construction industry

There are many areas in which mobile technologies can be beneficial in the construction industry. Bowden et al. (2006) and Zou et al. (2006) reported that improvements such as reductions in construction time, reductions in defects, reductions in the capital cost of construction, reductions in waste, reductions in accidents (by undertaking safety inspections), reductions in operation and maintenance costs and enhancements in productivity can be achieved from using mICT in the construction industry. Moreover, Leskinen (2008) reported that a number of benefits could be generated when mobile applications are used, such as support for the construction process, reduction in paperwork and more accurate work monitoring.

In another major study, Heck (2004) found that mICT usability could improve operational efficiency, provide higher user flexibility and also enhance user communications. In conclusion, a considerable amount of literature has been published on mICT benefits in the construction industry. These studies have agreed that mICT usage in the construction industry can be beneficial to improve productivity, save time and costs. The next section will look specifically to the factors that influence mobile adoption and usage in the construction industry.

2.7.2. Factors influencing mICT adoption and usage

Before thinking of adopting and using any new system, organizations are supposed to know and understand the factors that could hinder willingness to adopt and use this system. Companies in the construction industry could benefit from knowing the obstacles that could impede the adoption and use of mobile technologies. Many researchers have studied the use of mICT and have proposed many models to test the factors that have significant influences on mICT usage and although these models have been used in some other industries, they still can be used for the same purpose in the
construction industry. For example, Pedersen (2005) slightly modified the version of the decomposed TPB model of Taylor and Todd (1995) (see Fig. 2.4) and based on his conviction that traditional adoption models need to be modified to be used for mobile technologies. The model includes many of social determinants of end-user adoption and proposes some direct links such as the link from subjective norm to behavioural attitudes and the model also proposes an effect of the subjective norm on both attitudes towards use and behavioural intention to use the service (see Fig. 2.5). Pedersen (2005) has tested the model empirically and found that the proposition to modify the decomposed TPB was supported in that if clarified the adoption and use of mobile technologies. Pedersen’s study also found that behavioural control and subjective norm are important in mICT adoption.

![Decomposed TPB model of Taylor and Todd (1995)](image)

**Figure 2.4 Decomposed TPB model of Taylor and Todd (1995)**
Luarn and Lin (2005) successfully investigated a modified TAM model in the mICT context and analysed the impact of perceived ease of use, perceived usefulness, perceived credibility, perceived self-efficacy and perceived financial cost on behavioural intention to use mICT and found that perceived ease of use, perceived usefulness, perceived financial cost and self-efficacy have a significant effect on the behavioural intentions to use mICT. Moreover, they found that perceived self-efficacy significantly influenced perceived ease of use which in turns influenced perceived credibility and perceived usefulness (see Fig. 2.6).
In addition, Son, Park, Kim and Chou (2012) also applied and modified TAM’s model towards an understanding and acceptance of mobile computing by construction professionals and found that determinants of perceived usefulness such as social influence, top management support, result demonstrability and job relevance, and determinants of perceived ease of use such as, training, technological complexity, and organisational issues such as top management support and technical support are factors that are critical to the success of adopting and use mobile computing technology in construction industry (see Fig. 2.7).
2.7.3. Factors influencing mICT adoption and usage in the construction industry

Although many benefits can be gained from using mICT in the construction industry, it is becoming significantly important to investigate the factors that may restrict this adoption and usability. Ahsan et al. (2007) carried out a number of investigations into potential barriers to the adoption and use of mobile technologies in construction sites. Cost was found to be the main obstacle they identified specifically in terms of investment return. Another barrier investigated was the complexity of the technology which sometimes required specialised knowledge and skills. These results are consistent with Leskinen’s (2008) study.
Other studies have also elaborated other constraints and barriers that hinder the adoption and use mobile support for construction process improvement. For example, Bowden, et al. (2006) identified a number of barriers that can hinder the adoption and use of mobile support for construction process improvement. These factors include: lack of clear leadership, the fragmented nature of the industry, ease of use, resistance to change, and security and privacy concerns. Saidi, Haas, and Balli (2002) also revealed barriers to using mobile technology in construction which related to the mobile hardware, such as screen visibility and screen size and organisational barriers including low-risk tolerance.

To conclude, besides the TAM determinants: perceived ease of use, perceived usefulness and behavioural intention to use, authors have highlighted other factors such as hardware limitations (Saidi, Haas, & Balli, 2002), high technology cost (Ahsan et al., 2007; Anumba et al., 2003), the fragmented nature of the construction industry (Saidi et al., 2002; Bowden et al., 2006) and organisational issues (Son, Park, Kim & Chou, 2012) are the obstacles to using mobile ICT in the construction industry. Other factors such as resistance to change and security and privacy concerns have also significantly affected the adoption and use of mICT (Bowden et al., 2006). Most of these various factors have not yet been studied properly in the context of mICT adoption and use in Libyan construction industry. In the following chapter, the factors that are relevant to the context of this study will be clearly identified and summarized and a review of the literature on each of them will be also provided.

2.8. Summary

The literature concerning mICT and research questions has been reviewed in this chapter. The chapter also discussed the benefits that can be gained from using ICT in the construction industry and illustrated the factors that could influence the adoption
and use of ICT. Models and theories of adoption of technology were also discussed in the chapter in order to elaborate on the relationship between the factors that have a significant effect on the adoption and use of ICT in construction domain. mICT has been identified in this chapter as a significant component of enhancing work in construction projects due to its important role that plays in transferring and receiving data. Most studies that have been cited in this chapter have argued that the intention to adopt and use mICT is increased based on the benefits that mICT provides to the stakeholders in the construction domain.

Chapter 3 presents the designed and proposed research model. It also shows the constructs and hypotheses which will be tested in this study.
Chapter 3. Research Model

3.1. Introduction

This chapter provides the research questions for this study and introduces the proposed research model and associated hypotheses. This chapter is divided into six main sections. Section 3.2 presents the research questions and aims. Definitions of each major construct of interest are presented in Section 3.3. Section 3.4 presents the proposed research model and explains how it was designed and developed. Section 3.5 introduces the hypotheses which are associated with the model and provides the justification for each hypothesis. A summary of the chapter is presented in Section 3.6.

3.2. Research aims and questions

Investigating and analysing factors that might influence the adoption and use of mICT, exploring the benefits that could be gained from adoption and use of mICT and investigating the current uses and the future prospects of using this technology are the aims of this study. The outcomes of the research are intended to support the stakeholders in the Libyan construction industry and provide a baseline understanding of mICT adoption that will help in avoiding obstacles when adopting and using of mICT, it is also provide a basis for further research in this field. The research addresses three proposed significant questions to achieve the aims of the study. These questions are:

RQ1): What are the factors that could influence mICT adoption and use in the Libyan construction industry?

RQ2): What are the benefits that could be gained from mICT adoption and use in the Libyan construction industry?
RQ3): What are the current uses of mICT and the future prospects of using mICT in the Libyan construction industry?

Based on the literature review in Chapter 2, a number of factors that might have a significant role in influencing stakeholders’ intentions to adopt and use mICT were identified and they are discussed in the following section.

3.3. Constructs of interest

Based on the literature review in Chapter 2, the research examines a number of factors that are believed most likely to play a role in influencing stakeholders’ intentions to adopt and use mICT in the Libyan construction industry. These factors are: perceived usefulness of mICT, perceived ease of use of mICT, perceived high cost of technology, perceived credibility of mICT, perceived mICT self-efficacy and facilitating conditions. The majority of these factors have not been tested and studied in terms of mICT adoption in the construction industry.

3.3.1. Perceived usefulness of mICT

Perceived usefulness as a key determinant of intention to use information technologies and has been defined in many studies. For example, Venkatesh and Davis (1996, p.452) defined it as “the user’s perception of the degree to which using the system will improve his or her performance in the workplace”. Luarn and Lin (2005, p. 876) defined perceived usefulness as “the extent to which a person believes that using a particular system will enhance his or her job performance”. Consistent with previous literature, this study defines perceived usefulness of mICT as the degree to which a user (client, project manager, contractor, consultant or worker) believes that adopting and using mICT would improve the the construction industry.
3.3.2. Perceived ease of use of mICT

Perceived ease of use has been defined as “the degree to which a person believes that using a system will be free of effort” (Davis, 1989 p. 320). It is also defined by Luarn and Lin (2005) as the extent to which a person believes that using a particular system will be free of effort. *Perceived ease of use of mICT* is defined in this study as the degree to which a user (client, project manager, contractor, consultant or worker) believes that using mICT in the construction industry would be free from effort.

3.3.3. Perceived high cost of technology

The specific focus of many construction projects is cost reduction, which includes cost of construction materials and costs of construction processes (Manley, Marceau & Hampson, 2001). Technological costs also include the cost of software programs and hardware, the cost of updating the technology and the cost of staff development. In the construction industry, the diffusion of ICT has been hindered by several significant factors such as the high cost of software and hardware and the high cost of engaging computer staff (Oladapo, 2006). This study defines *perceived high cost of technology* as the degree to which a user (client, project manager, contractor, consultant or worker) believes that the costs associated with using mICT in the construction industry are high.

3.3.4. Perceived credibility of mICT

Credibility is a trust-based construct and lack of perceived credibility is manifested in people’s concerns regarding the privacy of their personal information when using mobile systems (Luarn & Lin, 2005). Perceived credibility is a construct that reflects security and privacy concerns associated with the acceptance of ICT (Wang, Wang, Lin & Tang, 2003). Security refers to “the protection of systems or information from outflows or unsanctioned intrusions” (Wang et al., 2003 p, 508), and privacy refers to “the protection of various types of data that are collected during users’ interactions with...
Internet systems” (Wang et al., 2003 p. 509). Security and privacy are important
dimensions of perceived credibility and have been identified in many studies as
determinants of the intention of users to adopt Internet-based systems (Wang et al.,
2003). For example, Warrington, Abgrab and Caldwell (2000) argued that users are
concerned about the level of security present when providing sensitive information
online and will perform transactions only when they develop a certain level of trust in
the system. Likewise, Ong, Lai and Wang (2004) proposed that systems with
affirmation that users are free of privacy and security threats is expected to affect their
willingness to accept it and results of their study confirmed that perceived credibility
had a positive effect on behavioural intention to use information system.

Perceived credibility of mobile technology has been defined as the extent to which a
person believes that using mobile technology will not have any security or privacy
threats (Wang et al., 2003). For the study described in this thesis, *perceived credibility
of mICT* is defined as the degree to which a user (client, project manager, contractor,
consultant or worker) believes the use of mICT in the construction industry will have no
security or privacy threats.

**3.3.5. Perceived mICT self-efficacy**

Kinzie, Delcourt, and Powers (1994) stated that self-efficacy reflected an individual’s
confidence in his/her ability to performance behaviour needed to produce outcomes and
it has been defined as “an individual’s perceptions of his/her ability to use computers in
the accomplishment of a task” (Compeau & Higgins, 1995 p.191). Computer self-
efficacy is considered an important variable that influences an individual’s decision to
accept or use information technology.

Davis et al., (1989) discussed computer self-efficacy as one of two basic mechanisms
that affect attitudes and behavioural intentions. Computer self-efficacy has been
examined in the IS literature (e.g. Compeau, Higgins, & Huff, 1999) which has confirmed the significant role that it plays in the response of individuals to information technology. For the study described in this thesis, *perceived mICT self-efficacy* is defined as a user's (client, project manager, contractor, consultant or worker) belief about his or her ability to use mICT in order to enhance performance in the construction industry.

### 3.3.6. Facilitating conditions

Facilitating conditions is defined as “the degree to which an individual believes that an organisational and technical infrastructure exists to support use of the system” (Venkatesh & Zhang, 2010 p.7). Facilitating conditions represent the resources needed to use a particular system and such resources include ICT-related resources and financial resources (Pedersen, 2005). Kripanont (2007) stated that facilitating conditions provides two dimensions of control beliefs which may constrain usage: one relates to technology compatibility issues (technology facilitating conditions) and the other relates to resource facilitating conditions (e.g. time and money). The absence of facilitating conditions represents barriers and may hinder the formation of intention and usage (Kripanont, 2007).

*Facilitating conditions* is defined in this study as the degree to which a user (client, project manager, contractor, consultant or worker) believes that an organisational and technical infrastructure exists to support use of mICT in the construction industry.

### 3.3.7. Intention to adopt and use mICT

According to the TRA (Fishbein & Ajzen, 1975), a person’s intention to perform behaviour is introduced as a function of two basic determinants. The first, personal in nature, is the individual’s positive or negative evaluation of performing the behaviour. The second is reflecting social influence which concerns a person’s perception of social
pressure to perform or not perform the behaviour. Ajzen (1985) stated that behavioural intention is an indication of an individual’s readiness to perform a given behaviour. Intention to use a system has also been defined as “a measure of the strength of one's intention to perform a specified behaviour” (Suh & Han, 2003, p. 138). Behavioural intention has been considered an indicator of establishing the desire to accept and adopt new systems (Venkatesh & Davis, 2000; Suh & Han, 2003; Cater & Belanger, 2005).

This study defines intention to adopt and use mICT as the degree to which a user (client, project manager, contractor, consultant or worker) is willing and ready to adopt and use mICT in the construction industry.

Table 3.1 presents the research main constructs and their definitions based on the previous discussion.

Table 3.1 Constructs definition

<table>
<thead>
<tr>
<th>Construct</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived usefulness of mICT</td>
<td>The degree to which a user (client, project manager, contractor, consultant or worker) believes that adopting and using mICT would improve the construction industry.</td>
</tr>
<tr>
<td>Perceived ease of use of mICT</td>
<td>The degree to which a user (client, project manager, contractor, consultant or worker) believes that using mICT in the construction industry would be free from effort.</td>
</tr>
<tr>
<td><strong>Perceived high cost of technology</strong></td>
<td>The degree to which a user (client, project manager, contractor, consultant or worker) believes that the costs associated with using mICT in the construction industry are high.</td>
</tr>
<tr>
<td><strong>Perceived credibility of mICT</strong></td>
<td>The degree to which a user (client, project manager, contractor, consultant or worker) believes the use of mICT in the construction industry will have no security and privacy threats.</td>
</tr>
<tr>
<td><strong>Perceived mICT self-efficacy</strong></td>
<td>A user’s (client, project manager, contractor, consultant or worker) belief about his or her ability to use mICT in order to enhance performance in the construction industry.</td>
</tr>
<tr>
<td><strong>Facilitating conditions</strong></td>
<td>The degree to which a user (client, project manager, contractor, consultant or worker) believes that an organisational and technical infrastructure exists to support use of mICT in the construction industry.</td>
</tr>
<tr>
<td><strong>Intention to adopt and use mICT</strong></td>
<td>The degree to which a user (client, project manager, contractor, consultant or worker) is willing and ready to adopt and use mICT in the construction industry.</td>
</tr>
</tbody>
</table>
3.4. The research model

The research model was proposed to provide a framework for this research and to introduce the research boundary (see Figure 3.1). The model is designed to provide a better understanding of the inter-relationships that prevail between constructs proposed as likely to have a significant role in mICT technology acceptance in the construction industry. The model was designed and built based on prior studies that have integrated TAM (Davis, 1989), TPB (Ajzen, 1991), TAM2 (Venkatesh & Davis, 2000), UTAUT (Venkatesh et al., 2003), and especially the model by Luarn and Lin (2005) which represents the influence of factors that might impact the adoption and use of mICT and demonstrated an ability to explain and predict behavioural intention to use mICT.

The research model includes a set of constructs believed to influence mICT adoption and use as indicated in Figure 3.1. Many studies have simplified the original TAM by dropping attitude and studying the direct relationships between perceived ease of use and intention to use and perceived usefulness and intention to use because findings about the effects of attitude have not always been significant (Lederer, Maupin, Sena, & Zhuang, 2000; Teo, Lim, & Lai, 1999; Gefen & Straub, 2000) and due to its weak role as a mediator between beliefs and behavioural intention (Yi, Jackson, Park & Probst, 2006). From the perspective of explaining mobile technologies adoption and use in the construction industry, the study adds a set of factors that are expected to influence behavioural intention in an mICT context. These factors are: perceived mICT self-efficacy; to reflect users’ concerns about their knowledge of mICT and their ability to use mobile ICT; perceived credibility of mICT to reflect users’ concerns about the risks due to transferring data and information through mICT; perceived high cost of technology to reflect users’ concerns about financial resources needed to use mICT; and facilitating conditions to represent the resources required to use mICT (e.g.
infrastructure or other ICT-related resources). The majority of these factors have not been studied yet in the context of mICT in the construction industry.

The proposed model has 11 associated hypotheses and each of the hypothesized relationship is presented and justified in the next section.

### 3.5. Research hypotheses

Extensive previous research provides evidence that adoption and usage intentions are significantly affected by perceived usefulness (Agarwal & Prasad, 1999; Davis, 1989; Hu, Chau, Sheng, & Tam, 1999; Jackson, Chow, & Leitch, 1997; Venkatesh, 2000; Venkatesh & Davis, 1996, 2000; Venkatesh & Morris, 2000). TAM (Davis, 1989), TPB (Ajzen, 1991), TAM2 (Venkatesh & Davis, 2000) and UTAUT (Venkatesh et al., 2003)
also include relationship between perceived usefulness and intention to accept and use ICT. Perceived usefulness has been shown to be a significant factor of accepting and using information technology systems (Pavlou, 2003; Venkatesh et al., 2003; Zampou, Saprikis & Vlachopoulou, 2010). Pagani (2004) also found that perceived usefulness is an important factor in the decision to adopt mobile technologies. Therefore and consistent with previous literature, this relationship was included in the research model and the following hypothesis was proposed:

**Hypothesis H1**: Perceived usefulness of mICT will positively affect the intention to adopt and use mICT in the construction industry.

Over the past decades extensive research provides evidence that usage intention is significantly affected by perceived ease of use (Agarwal & Prasad, 1999; Davis et al., 1992; Hu et al., 1999; Jackson et al., 1997; Venkatesh, 2000; Venkatesh & Davis, 1996, 2000; Venkatesh & Morris, 2000). Perceived ease of use is believed to directly affect the intention to use ICT and as well as indirectly through perceived usefulness (Davis et al., 1992; Venkatesh, 1996). TAM (Davis, 1989), TPB (Ajzen, 1991), TAM2 (Venkatesh & Davis, 2000) and UTAUT (Venkatesh et al., 2003) specifically address the relationships between perceived ease of use and the intention to use ICT, and perceived usefulness and the intention to use ICT.

Other studies have also addressed the relationship between perceived ease of use and perceived usefulness. For example, Cheng, Lam, and Yeung (2006) and Yaghoubi and Bahmani (2010) stated that perceived usefulness is predicted by perceived ease of use and the relationship between them was found to be significant. In the case of using mobile computing acceptance Pagani (2004) found that perceived ease of use rated as the second most important factor in determining of the adoption of mobile technology. In the construction industry, perceived ease of use was found to have a direct positive
impact on perceived usefulness (Son et al., 2012). These relationships were included in the proposed research model for this study.

**Hypothesis H2a**: Perceived ease of use of mICT will positively affect the intention to adopt and use mICT in the construction industry.

**Hypothesis H2b**: Perceived ease of use of mICT will positively affect the perceived usefulness of mICT in the construction industry.

In many studies, high cost has been rated as an important barrier affecting adoption and use of technologies. For example, Brewer and Gajendran (2012) found that high cost was rated the second most important barrier to engaging ICT across projects in the construction organization. These findings are consistent with other previous studies’ results such as Chong and Pervan (2007) and Harindranath et al. (2008).

In terms of mobile technology, adoption and usage has also been found to be affected by obstacles such as high cost (Pagani, 2004). Consistent with this, Luarn and Lin (2005) reported that perceived cost had a significant negative effect on behavioural intention to use mobile technologies. Consequently, the study proposed the following hypothesis:

**Hypothesis H3**: Perceived high cost of technology will negatively affect the intention to adopt and use mICT in the construction industry.

The level of security has concerned users who provide sensitive and personal information (Warrington, Abgrab & Caldwell, 2000). This view is supported in the domain of mICT by Luarn and Lin (2005) and Wang et al. (2003) who found that perceived credibility significantly influences the behavioural intention to use mobile internet. This influence has not been previously studied within the context of mICT in construction domain. However, it is hypothesised that:
**Hypothesis H4:** Perceived credibility of mICT will positively affect the intention to adopt and use mICT in the construction industry.

In terms of the importance of the ability to adopt and use information systems in any domain, Compeau and Higgins (1995) stated that higher levels of self-efficacy will lead to higher levels of behavioural intention and IT usage. Empirical studies have found a relationship between self-efficacy and behavioural intention to use information technology. For example, Beckers, Mante and Schmidt (2001), Hsu and Chiu (2004) and Vijayasarathy (2004) found that perceived self-efficacy had a positive significant effect on intention to use information system such as computers, etc.

In terms of using mobile technology, Luarn and Lin (2005), Sripalawat, Thongmak and Ngarmyarn (2011) and Dasgupta, Paul and Fuloria (2011) also found that perceived self-efficacy had a positive effect on behavioural intention. Consistent with the previous research it is expected that, the more self-efficacy the stakeholders in the construction industry have the more intention to adopt and use mICT they will have. Therefore, based on the theoretical and empirical support from the literature, the following hypothesis is proposed:

**Hypothesis H5a:** Perceived mICT self-efficacy will positively affect the intention to adopt and use mICT in the construction industry.

There is also empirical evidence in many studies for a relationship between self-efficacy and perceived ease of use. For example, Igbaria, Iivari and Maragahh (1995), Venkatesh and Davis (1996) and Venkatesh (2000) found that self-efficacy significantly affects perceived ease of use. These results were supported by the findings of Luarn and Lin (2005) that provided evidence of a significant positive effect of perceived self-efficacy on perceived ease of use of mobile banking. Therefore, it is expected that the more self-
efficacy the stakeholders in the construction industry have the easier to use mICT will be. The following hypothesis is proposed:

**Hypothesis H5b:** Perceived of mICT self-efficacy will positively affect the perceived ease of use of mICT in the construction industry.

There also exists empirical evidence of a causal link between perceived self-efficacy and perceived usefulness of technology (e.g. Agarwal et al., 2000; Wang et al., 2003), where users who have a higher self-efficacy in using information systems are more likely to believe that they useful. Based on this previous research it was hypothesized that:

**Hypothesis H5c:** Perceived mICT self-efficacy will positively affect the perceived usefulness of mICT in the construction industry.

Wang et al. (2003) also argued that self-efficacy might be positively related to the existence of concerns regarding security and privacy of online exchanges. Ong et al. (2004) stated that the more experience one acquires online, the more important are concerns of control over personal information and that those with more experience possibly see the limitations and lack of privacy and security of information systems, implying self-efficacy will have a negative influence on perceived credibility.

The findings of their study provided evidence of a significant negative effect of self-efficacy on the perceived credibility of online information systems. Therefore, it is proposed that:

**Hypothesis H5d:** Perceived mICT self-efficacy will negatively affect the perceived credibility of mICT in the construction industry.

Facilitating conditions are important to increase of the technology acceptance rate and have been found in many studies to have a significant effect on behavioural intention to
use information systems (Dwivedi, 2005; Dwivedi, Khoumbati, Williams & Lal, 2007; Ooi, Sim, Yew & Lin, 2011). However, some other studies have found the relationship to be non-significant, such as Venkatesh et al., (2003) and Kripanont (2007).

In the case of exploring factors associated with mobile technology acceptance, Lu, Lu, Yu and Yao (2014) hypothesized a direct relationship between facilitating conditions and the acceptance of mobile technology however the results revealed only weak support for this hypothesis. Although there have been mixed results about the role that facilitating conditions could play in accepting and using information technologies in other domains, this discussion reveals a need to ascertain the role of facilitating conditions in the construction industry where it is anticipated that it will play an important role in enabling up take of mICT (Venkatraman & Yoong, 2009). Based on this, the study proposes that facilitating conditions construct will have a direct positive effect on the intention to adopt and use of mICT in construction industry. Therefore, the following hypothesis is posited:

**Hypothesis H6a**: Facilitating conditions will positively affect the intention to adopt and use mICT in the construction industry.

As facilitating conditions are perceived enablers or barriers that influence a person’s perception of ease or difficulty of performing a task (Teo, 2010), the relationship between facilitating conditions and perceived ease of use has been studied and tested. For example, Teo, Lee and Chai (2008) and Teo (2010) found that facilitating conditions have a significant influence on perceived ease of use. Consistent with previous studies which have established the important role that facilitating conditions play in influencing the ease or difficulty of use of technology, this study hypothesized that:
**Hypothesis H6b**: Facilitating conditions will positively affect the perceived ease of use of mICT in the construction industry.

Table 3.2 provides a summary of the research hypotheses.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Description of hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td><em>Perceived usefulness of mICT</em> will positively affect the <em>intention to adopt and use mICT</em> in the construction industry.</td>
</tr>
<tr>
<td>H2a</td>
<td><em>Perceived ease of use of mICT</em> will positively affect the <em>intention to adopt and use mICT</em> in the construction industry.</td>
</tr>
<tr>
<td>H2b</td>
<td><em>Perceived ease of use of mICT</em> will positively affect the <em>perceived usefulness of mICT</em> in the construction industry.</td>
</tr>
<tr>
<td>H3</td>
<td><em>Perceived high cost of technology</em> will negatively affect the <em>intention to adopt and use mICT</em> in the construction industry.</td>
</tr>
<tr>
<td>H4</td>
<td><em>Perceived credibility of mICT</em> will positively affect the <em>intention to adopt and use mICT</em> in the construction industry.</td>
</tr>
<tr>
<td>H5a</td>
<td><em>Perceived mICT self-efficacy</em> will positively affect the <em>intention to adopt and use mICT</em> in the construction industry.</td>
</tr>
<tr>
<td>H5b</td>
<td><em>Perceived mICT self-efficacy</em> will positively affect the <em>perceived ease of use of mICT</em> in the construction industry.</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td>---</td>
<td>-------------</td>
</tr>
<tr>
<td>H5c</td>
<td><em>Perceived mICT self-efficacy</em> will positively affect the <em>perceived usefulness of mICT</em> in the construction industry.</td>
</tr>
<tr>
<td>H5d</td>
<td><em>Perceived mICT self-efficacy</em> will negatively affect the <em>perceived credibility of mICT</em> in the construction industry.</td>
</tr>
<tr>
<td>H6a</td>
<td><em>Facilitating conditions</em> will positively affect the <em>intention to adopt and use mICT</em> in the construction industry.</td>
</tr>
<tr>
<td>H6b</td>
<td><em>Facilitating conditions</em> will positively affect the <em>perceived ease of use of mICT</em> in the construction industry.</td>
</tr>
</tbody>
</table>

### 3.6. Summary

This chapter began with highlighting the aims and the main research questions of this study. The main constructs of this study were defined in the third section of this chapter. Seven constructs were defined and presented as the factors most expected to influence directly and indirectly the intention to adopt and use mICT in the Libyan construction industry. These factors are *perceived usefulness of mICT*, *perceived ease of use of mICT*, *perceived high cost of technology*, *perceived credibility of mICT*, *perceived mICT self-efficacy* and *facilitating conditions*. The proposed model was then presented and its derivation explained. Finally, the chapter introduced the research hypotheses to be tested and the justifications for each hypothesis.
In the next chapter, the research methodology and the data collection procedures and techniques are discussed.
Chapter 4. Research Methodology

4.1. Introduction

The chapter discusses the research methodology that was used for the study. Section 4.2 provides the research approach and design. The population and sample is described in Section 4.3. The design of the questionnaire data collection instrument is described in Section 4.4. Section 4.5 provides an overview of the quantitative data collection procedures and the qualitative data collection procedures are described in Section 4.6. Section 4.7 discusses the research quantitative data analysis. Section 4.8 presents the qualitative data analysis and lastly, the chapter is finalised in Section 4.9 which is the summary.

4.2. Research approach overview and design

The unit of analysis for this research was individual construction stakeholders. Both quantitative and qualitative approaches (mixed methods) were used for collecting the data in this research. Mixed methods is an approach in which the investigator gathers both quantitative and qualitative data and brings together the advantages of both qualitative and quantitative methods (Plano Clark & Creswell, 2011). Mixed methods provide the advantages of being able to generalise the findings and results to a large group and also have the advantage of hearing the voices of the respondents in the context of the study (Creswell, 2013).

There were two main reasons for choosing a mixed methods approach for this research: firstly, to obtain differing perspectives about the topic and research questions being answered in the research. Quantitative data is used to address the first research question as a research model is tested, and open-ended qualitative data is used for the other
research questions which are more exploratory. In other words mixed method enables the researchers to simultaneously answer confirmatory and exploratory questions.

Secondly, all research methods have both weakness and strengths, and the combination of the strengths of both (quantitative and the qualitative) provides a good rationale for using mixed methods (Creswell, 2013).

Moreover, the use of mixed methods of data collection provides a broad form of triangulation that yields greater utility, as strength and weakness are counterbalanced and richer and more comprehensive data can be provided (Molina-Azorin, 2007; Abowitz & Toole, 2010). Using mixed methods helps to increase reliability and validity of the data and the likelihood that the research will make a significant contribution to the literature (Abowitz & Toole, 2010). Added costs for both research and researcher in terms of time and money could be considered demerits of mixed methods.

Mixed methods gives a chance to test reliability and validity in quantitative and qualitative research. They are two factors that using for judging the quality of designing and analysing results of a study. Realiability and validity in qualitative research are to eliminate bias and increase the reesearcher’s trustfulness of a proposition about some phenomenon and form themes or categories in a study (Creswell &Miller, 2000, p.126).

Questionnaires have advantages over some other types of surveys; for example, large amounts of information can be gathered from a large number of participants in a relatively cost effective way and in a short period of time and the results of questionnaires can usually be easily and quickly quantified and provide data for testing hypotheses (Douglas, McClelland, Davies, & Sudbury, 2009). Questionnaires are also considered to be an efficient approach to obtaining clear viewpoints of participants in many locations, such as in this study. Questionnaires have been criticised in some areas of research because of the impossibility to check seriousness or honesty of answers and
also because misunderstandings can not be corrected in the questionnaires, but these
demerits have been solved and avoided in this research by supporting the quantitative
data collection with semi-structured interviews which allow the interviewer to detect and
correct misunderstandings. A questionnaire was therefore chosen as the quantitative
data collection approach for investigating the factors that affect the intention to adoption and use of mICT in the Libyan construction industry. Moreover, this approach was supported by focussed semi-structured interviews as a qualitative data collection approach to determine the opinions of stakeholders to answer the second two research questions: “RQ2: What are the benefits that could be gained from mICT adoption and use in the Libyan construction industry?” and “RQ3: What are the current uses of mICT and the future prospects of using mICT in the Libyan construction industry?”.

Interviews are considered a powerful way to gain insight into important issues through understanding the experience of the individuals (Seidman, 2013). Qualitative data collection by interviews can be gathered in many different types which include: structured interview, semi-structured interviews, unstructured interviews and non-directive interviews. As the interviews won’t be used to test a specific hypothesis (David, & Sutton, 2004, p. 87) in the qualitative analysis of this research, semi-structured interview has been chosen. Another advantage of this type of interviews is that questions can be changed depending on the direction of the interview and additional questions to interview guide can also be asked and this type also gives the opportunity to the interviewer to conduct the conversation for giving explanation if the answer is not clear.
4.3. Study population and sample

The population of interest for this study was stakeholders of all construction companies in Libya. The sampling frame was construction companies in three different cities. These companies were from different sectors: public sector, private sector and self-employment. Self-employment in Libya means, that all employees who are operating and working in the company are the owners of that company. This approach is very common in Libya both in the construction industry and in other domains (Abdussalam, 1985). The unit of analysis is consultants, project managers, contractors and workers. A sample of at least 200 participants was necessary for the data analysis technique, Partial Least Squares (PLS). The sample was recruited from 15 construction companies in the three selected cities. This sample was selected to meet specific criteria: participants who were 18+ years old, owned or used mobile phones and other mobile technologies, and had been using them for more than three years and were involved in the construction industry.

4.4. Data collection instrument

The questionnaire for this study was designed to meet the research aims and to obtain the most complete and accurate information possible by ensuring that respondents fully understand the questions and were less likely to refuse to answer. The questionnaire was designed in English and translated to Arabic. Both versions of the questionnaire were sent to an independent person, fluent in both English and Arabic, to check the grammar, construction of sentences and wording clarity of the Arabic version and to ensure its consistency with the English version. The information letter was also designed and written to obtain permission for distributing both versions (see Appendix A for the information letter). Both versions are provided in Appendix B and Appendix C.
The questionnaire started by providing the researcher contact details and to ease and minimize any possible ambiguity, definitions of key terms were provided. The questionnaire consisted of 48 items in eight sections. The following subsections describe the constructs that were measured using the questionnaire. Constructs’ items come from different instruments other authors that were presented in the literature review developed to measure the constructs and they were selected based on their suitability for using mICT in the construction industry.

4.4.1. Demographic and background participant information

Five items were used to collect participants’ demographic and background information as shown in Table 4.1. A three category scale (18-29; 30-39; 40-50+) was used to measure the age of participants. Level of education of the participants was measured by four categories (Primary; High School; Institute and University). Institute graduation includes people who complete from three to four years of intermediate education at vocational centres and studied various skills-based professions. People who finished these programs are awarded an Intermediate Training Diploma. A three category scale was used to measure the participants’ employment (Public; Private; Self-employment). Level of skills and experience using mICT was measured using three categories to represent the participant’s perception of their own level of skills and experience (Beginner; Intermediate; Advanced). Gender was also measured.

Table 4.1 Demographic and background participant information items

- How old are you?
- What gender are you?
- What is your education level?
- What sort of employment sector do you work in?
- Which of the following illustrates your skills and experience level of using mICT?
4.4.2. Perceived usefulness of mICT

Perceived usefulness of mICT is defined in this study as the degree to which a user (client, project manager, contractor, consultant or worker) believes that adopting and using mICT would improve the construction industry. The perceived usefulness of mICT construct was measured on a five-point Likert scale by the items listed in Table 4.2. Six items were developed for this study based on Bowden et al. (2006). In addition, four slightly reworded items were used to match the mICT field. These items are from Davis (1989), Cheong and Park (2005), Pedersen (2005) and Venkatesh and Davis (2000).

Table 4.2 Perceived usefulness of mICT items

<table>
<thead>
<tr>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using mICT would be useful for the construction industry (Davis, 1989)</td>
</tr>
<tr>
<td>Using mICT would help to get the necessary information when it is needed (Cheong &amp; Park, 2005)</td>
</tr>
<tr>
<td>Using mICT would reduce the time taken for construction activities (Pedersen, 2005)</td>
</tr>
<tr>
<td>Using mICT in my job would increase my productivity (Davis, 1989; Venkatesh &amp; Davis, 2000)</td>
</tr>
<tr>
<td>Using mICT would reduce the number of construction activity defects (Bowden et al., 2006)</td>
</tr>
<tr>
<td>Using mICT would reduce the number of accidents at construction project sites (Bowden et al., 2006)</td>
</tr>
<tr>
<td>Using mICT would reduce the capital cost and/or money wastage of construction projects (Bowden et al., 2006)</td>
</tr>
<tr>
<td>Using mICT would reduce operations and maintenance costs (Bowden et al., 2006)</td>
</tr>
<tr>
<td>Using mICT would support construction processes and reduce paperwork (Bowden et al., 2006)</td>
</tr>
<tr>
<td>Using mICT would make the interaction easier between workers at construction sites (Bowden et al., 2006)</td>
</tr>
</tbody>
</table>
4.4.3. Intention to adopt and use mICT

*Intention to adopt and use mICT* is defined in this study as the degree to which a user (client, project manager, contractor, consultant or worker) is willing and ready to accept and adopt mICT in the construction industry. Five items were used to measure *intention to adopt and use mICT* as shown in Table 4.3. Two of the questionnaire items were from Venkatesh and Davis (2000) and one item was from Luarn and Lin (2005). One item was from an instrument from Cheong and Park (2005). One extra item was developed particularly for the study. *Intention to adopt and use mICT* was measured on a five Likert scale from ‘strongly disagree’ to ‘strongly agree’.

Table 4.3 *Intention to adopt and use mICT* items

<table>
<thead>
<tr>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>I support the adoption and use of mICT in construction industry projects (Developed for the study)</td>
</tr>
<tr>
<td>I intend to increase my use of mICT to perform construction activities in the future (Luarn &amp; Lin, 2005)</td>
</tr>
<tr>
<td>Given that I had access to mICT, I predict that I would use it in construction industry projects (Venkatesh &amp; Davis, 2000)</td>
</tr>
<tr>
<td>Assuming that I have access to mICT, I intend to use it to perform construction activities (Venkatesh &amp; Davis, 2000)</td>
</tr>
<tr>
<td>I will recommend others to use mICT in performing construction activities (Cheong &amp; Park, 2005)</td>
</tr>
</tbody>
</table>

4.4.4. Perceived ease of use mICT

*Perceived ease of use of mICT* is defined in this study as the degree to which a user (client, project manager, contractor, consultant or worker) believes that using mICT in the construction industry would be free of effort. The items used to measure *perceived ease of use of mICT* are shown in Table 4.4. Three items were taken from Davis (1989). One item was used from Agarwal and Prasad (1999) and one item from Venkatesh and Davis (2000). The items were modified for mICT and the construction domain. The
items were measured on a five-point Likert scale from ‘strongly disagree’ up to ‘strongly agree’.

Table 4.4 Items to measure perceived ease of use of mICT

<table>
<thead>
<tr>
<th>Item</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning to use mICT to perform construction project activities would be easy</td>
<td>Davis, 1989</td>
</tr>
<tr>
<td>I would find it is easy to remember how to perform tasks using mICT in the construction industry</td>
<td>Agarwal &amp; Prasad, 1999</td>
</tr>
<tr>
<td>It would be easy to become skilful using mICT in construction projects</td>
<td>Davis, 1989</td>
</tr>
<tr>
<td>My interaction with mICT for construction activities would be clear and understandable</td>
<td>Davis, 1989</td>
</tr>
<tr>
<td>I would find it easy to get mICT to do what I want it to do</td>
<td>Venkatesh &amp; Davis, 2000</td>
</tr>
</tbody>
</table>

4.4.5. Perceived high cost of technology

Perceived high cost of technology is defined in this study as the degree to which a user (client, project manager, contractor, consultant or worker) believes that the costs associated using mICT in the construction industry are high. As shown in Table 4.5, five items were used to measure perceived high cost of technology. The first item was taken from Kim, Choi, and Han (2009). The second item was from Cheong and Park (2005). Other three items were developed by the researcher to suit this study and the construction domain.
Table 4.5 Items to measure *perceived high cost of technology*

- The cost of using mICT in construction projects would be reasonable (Kim, Choi & Han, 2009)
- Using mICT in the construction industry would be expensive overall (Cheong & Park, 2005)
- The cost of using mICT would be a burden to the construction industry (Developed for the study)
- It would be often have difficulties in paying mobile technologies bills (Developed for the study)
- mICT would be used in the construction industry even though there are financial barriers (Developed for the study)

### 4.4.6. Perceived credibility of mICT

*Perceived credibility of mICT* is defined in this study as the degree to which a user (client, project manager, contractor, consultant or worker) believes the use of mICT in the construction industry will have no security and privacy threats. Five items from Cheng et al. (2006) and one item from Wang et al. (2003) were used to measure *perceived credibility of mICT* in this study. The items were measured on a Likert scale from ‘strongly disagree’ to ‘strongly agree’. These items are shown in Table 4.6.
Table 4.6 *Perceived credibility of mICT items*

- Using mICT would not divulge work information in construction industry (Cheng et al., 2006)
- I would find mICT secure for transferring sensitive information in the construction industry (Wang et al., 2003)
- Overall, mICT is safe for transferring sensitive information (Cheng et al., 2006)
- I would feel secure sending sensitive information using mICT (Cheng et al., 2006)
- mICT is a secure means through which to send sensitive information in the construction industry (Cheng et al., 2006)
- I would feel totally safe providing private information when using mICT (Cheng et al., 2006)

### 4.4.7. Perceived mICT self-efficacy

The study defines *perceived mICT self-efficacy* as a user's (client, project manager, contractor, consultant or worker) belief about his or her ability to use mICT in order to enhance performance in the construction industry. *Perceived mICT self-efficacy* was measured using five items. Two items were taken from Pedersen (2005). Another two items were taken from Venkatesh (2000). These items were reworded to fit with this study. One item was developed for this study to suit the construction domain. *Perceived mICT self-efficacy* was measured on a five point Likert scale which ‘strongly disagree’ to ‘strongly agree’. The items used to measure *perceived mICT self-efficacy* are shown in Table 4.7.
Table 4.7 Perceived mICT self-efficacy items

- I am able to use mICT without the help of others (Pedersen, 2005)
- I could use mICT if someone showed me how do it first (Venkatesh, 2000)
- I could use mICT if I had just built-in help facilities for assistance (Venkatesh, 2000)
- I have the knowledge and skills required to use mICT (Pedersen, 2005)
- I can remain calm when facing mICT difficulties because I can rely on my coping abilities (Developed for the study)

4.4.8. Facilitating conditions

Facilitating conditions is defined in this study as the degree to which a user (client, project manager, contractor, consultant or worker) believes that an organisational and technical infrastructure exists to support use of mICT in the construction industry. Seven items were used to measure facilitating conditions of adopting and using mICT. Six items were taken from Pedersen’s (2005) data collection tool. An item from Thompson et al., (1991) was also added and re-worded for this study. These seven items are shown in Table 4.8. The items were measured on a Likert scale labelled from ‘strongly disagree’ to ‘strongly agree’.
Table 4.8 *Facilitating conditions* items

- I am given the necessary support and assistance to use mICT (Pedersen, 2005)
- I have the financial and technological resources required to use mICT (Pedersen, 2005)
- I have access to the software, hardware and network technologies required to use mobile technologies (Pedersen, 2005)
- The mICT I would use is well integrated and provided in a stable service infrastructure (Pedersen, 2005)
- My service provider/operator facilitates the use of mICT (Pedersen, 2005)
- There is no compatibility problems related to mICT I would use (Pedersen, 2005)
- When I need help to use mICT, specialized instruction is available to help me (Thompson et al., 1991)

### 4.5. Quantitative data collection procedures

The survey was conducted from May 25, 2013 to July 4, 2013. After contacting the Libyan Ministry of Housing and General Utilities branches in each selected city to obtain a list of the construction companies located there, fifteen companies were contacted and sent an information letter (see Appendix A for the information letter) to obtain the permission for distributing this study’s questionnaire. Potential participants were identified with the assistance of the administrators of each consenting construction company (see Appendix B for English version of the questionnaire). The questionnaires were then distributed to consultants, project managers, contractors and workers who met the criteria for participation by the administrators. An information letter was attached to the beginning of each questionnaire to describe the study, and clearly inform the participants that the completed questionnaires could be returned to the researcher either directly by email or by mail in a closed and stamped envelope.
Table 4.9 Questionnaire distribution

<table>
<thead>
<tr>
<th>No.</th>
<th>Company name</th>
<th>Forms Distributed</th>
<th>Forms Returned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aletqan for general contracting/Zawia</td>
<td>20</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>Alemad Alrafeia for general contracting and real estate investment/Zawia</td>
<td>30</td>
<td>17</td>
</tr>
<tr>
<td>3</td>
<td>Zaharat Elgharb for general contracting/ Zawia</td>
<td>25</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>Nasba Dhabia for general contracting and consulting engineers/Zawia</td>
<td>35</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>Ohran Libya for general contracting/Zuwara</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Al-Motawatted for general contracting/Zawia</td>
<td>20</td>
<td>11</td>
</tr>
<tr>
<td>7</td>
<td>National Consulting Bureau for general construction/Triploi</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>Az-zawia for general contracting works/Zawia</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>9</td>
<td>Assad for contracting and real estate investment/Zawia</td>
<td>30</td>
<td>18</td>
</tr>
<tr>
<td>10</td>
<td>Almanara –Zawia for general contracting and constructing and maintenances</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>Forsan Alghad for general contracting Inc./Zawia</td>
<td>20</td>
<td>13</td>
</tr>
<tr>
<td>12</td>
<td>Executive Appliance for Housing and Utilities /Tripoli</td>
<td>25</td>
<td>12</td>
</tr>
<tr>
<td>13</td>
<td>Executive Appliance for Housing and Utilities/Zawia</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>14</td>
<td>Maintenance and Technology for educational Facilities/Zawia</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>15</td>
<td>National Organisation for general contracting and Works/Zawia</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>302</td>
<td>202</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>100%</td>
<td>63%</td>
</tr>
</tbody>
</table>
The letter also informed them that participation in the research was totally voluntary and that all information given during the survey would be confidential and no names or other information that might identify the participant would be obtained in the questionnaire.

Three hundred and twenty questionnaire forms were distributed and 202 completed questionnaires were returned to the researcher’s mail box in closed envelopes and could be used for analysis. Table 4.9 lists the construction companies included in the quantitative data collection and the response rate from the construction companies that were surveyed.

4.6. Qualitative data collection procedures

It was considered that qualitative measures would usefully supplement and extend the quantitative analysis. Semi-structured interviews were chosen to allow the researcher to not only investigate opinions but to subsequently understand the meaning that underlies the opinions. Interviewing is considered most effective when the goal of research is to gain insight into the “subjective understanding” of those who will be interviewed (Seidman, 2013).

Figure 4.1 illustrates how the participants were recruited for the interviews and the qualitative data collection procedures. At the end of the questionnaire, the participants were asked if they agreed to be interviewed, and if so to contact the researcher via the contact information given at the beginning of the questionnaire. Participants who agreed to be interviewed were informed of the estimated time required for the interview (see Appendix D for interview information letter) and received the questions to be asked in advance (see Appendix E for interview guide questions). Arrangements were made and the interviews were conducted at the work sites of the participants in a suitable place. The interviews were tape-recorded with the consent of the participants (see Appendix F
for participant consent form). They were informed that the completion of the interview was voluntary and they could decide not to participate by simply ceasing to answer the questions. Also, they were informed that all information given during the interview was confidential, and that nothing that might identify the participant would be reported in this research. The interview guide had a number of questions to help and keep the researcher on track during the interview’s dialogue. The questions for the interview focused on the second two research questions which related to the benefits of adopting and using mICT in the construction industry and the future perspectives of stakeholders of using mICT (see Appendix E for interview guide questions). The guide then commenced with questions to obtain the demographic information of the participants. The guide went to the status of mICT understanding and benefits, importance and success in the construction industry in Libya followed by a number of questions related to security and privacy concerns about using mICT. The interview guide ended with a question to investigate the participants’ perspectives regarding the future of mICT in Libya’s construction industry.

For this study, 25 interviews were conducted at companies’ work sites in Libya. All interviews were digitally recorded, dated and the length of each interview was between approximately 15 to 25 minutes. After all interviews were completed and recorded, they were transcribed into English.
4.7. Quantitative data analysis

The techniques for analysing the quantitative data collected in the study are described in this section. Statistical Package for the Social Sciences (SPSS) version 21.0 was used to store the collected data and to produce the descriptive statistics and SmartPLS version 2.0 was used to test the model. SmartPLS is an alternative approach to traditional structural equation modelling that is designed to maximize predictions rather than fit (Fornell & Bookstein, 1982). PLS has been extensively used in information systems research and customer satisfaction studies. PLS can be a powerful method of analysis because of the minimal demands on measurement scales. Moreover, the most frequent reasons for using PLS are: it can be used for small sample sizes, its ability to use formative measures, and its focus on prediction (Hair, Sarstedt, Ringle, & Mena, 2012). In this study PLS was used to study the validity of the model’s main components and to
investigate the relationships among the main constructs of the proposed model. PLS as an analytical tool is usually used in two consecutive assessment steps for testing the proposed model: assessment of the validity of the measurement model, and assessment of the structural model. The first step of this approach is usually used to test the fit and construct validity of the proposed measurement model. Once a satisfactory measurement model is obtained, the measurement model is fixed when the structural model to evaluate interrelationships between the constructs is estimated as a second step (Fornell & Bookstein, 1982). This technique is usually used to assure the reliability and validity of the measurement model (Hair, Anderson, Tatham, & Black, 2006).

4.7.1. Measurement (outer) model assessment

The measurement model was assessed in terms of convergent validity and discriminant validity. Convergent validity can be shown when each measurement item has a strong correlation with its proposed construct and can be assessed by using the significance and loadings of items, composite reliability, Cronbach’s alpha and average variance extracted (Gefen & Straub, 2005). Items can be said to be convergent on the proposed latent construct when the criteria to evaluate convergent validity are achieved. The first criterion is item loading with a value of ≥ 0.70 (Hair, Tomas, Hult, Ringle, & Sarstedt, 2013). This criterion is used to show that items are loaded satisfactorily on their construct. In this study measurement items which did not load satisfactorily on their construct (≥ 0.70) were dropped from the measurement model. The t-values were also tested to ensure that each item loaded significantly on its latent construct. The t-values of the outer model loading should be above 1.96 (Gefen and Straub, 2005). The second criterion is composite reliability. Composite reliability is a general measure of reliability that uses the item loadings estimated within the model. Composite reliability is used to assess the internal consistency of the measurement model. Composite reliability should be 0.70 or above to be accepted (Hair et al., 2013). The third criterion is Cronbach’s
alpha coefficient which is used to measure the inter-correlation among items. Cronbach’s alpha coefficient should be 0.70 or above (Gefen & Straub, 2005). The fourth criterion tested is average variance extracted (AVE) which is used to reflect the overall amount of variance in the indicators accounted for by the latent construct. AVE is usually considered to be acceptable when its value is greater than 0.50 (Hair et al., 2013). These criteria are summarised and shown in Table 4.10.

Table 4.10 Convergent validity criteria

<table>
<thead>
<tr>
<th>Convergent validity criteria</th>
<th>Guideline</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item loadings</td>
<td>≥ 0.70</td>
<td>Hair et al. (2013)</td>
</tr>
<tr>
<td>t-value of outer loading</td>
<td>≥ 1.96</td>
<td>Gefen and Straub (2005)</td>
</tr>
<tr>
<td>Composite reliability</td>
<td>≥ 0.70</td>
<td>Hair et al. (2013)</td>
</tr>
<tr>
<td>Cronbach’s alpha coefficient</td>
<td>≥ 0.70</td>
<td>Gefen and Straub (2005)</td>
</tr>
<tr>
<td>Average variance extracted</td>
<td>≥ 0.50</td>
<td>Hair et al. (2013)</td>
</tr>
</tbody>
</table>

As previously stated, the discriminant validity for the measurement model should also be assessed. Discriminant validity in SmartPLS is tested by comparing AVE and inter-construct correlation. Discriminant validity shows that each measurement item correlates strongly with the construct which it is suggested to be associated with and weakly with all other constructs. This was tested in two procedures: the first procedure was comparing item cross loadings to construct correlations, where each item should load more highly on its construct that on other constructs and the second procedure was to compare the ratio of the square root of the AVE of each construct with the correlations of this construct with all other constructs (Gefen & Straub, 2005). The
square root of the AVE of each construct needs to be larger than any correlation between the construct and any other construct.

4.7.2. Structural (inner) model assessment

The structural model is used to allow testing of the relationships between the constructs in the research model; in other words, to determine how well the model fits the data. The structural model in this research was assessed in SmartPLS based on five criteria after it was confirmed that the construct measures were valid. These criteria are: 1) collinearity assessment, 2) path coefficients, 3) coefficient of determination ($R^2$), 4) effect size $f^2$, 5) predictive relevance $Q^2$. The following subsections introduce each criterion and describe how the structural model was evaluated.

4.7.2.1. Collinearity assessment

Collinearity assessment is used to check whether there are significant collinearity levels between each group of predictor constructs or not. In other words, to examine each set of predictor constructs separately for each subpart of the measurement model. Collinearity is indicated by the tolerance or variance inflation factor (VIF) guidelines. Each predictor variable’s tolerance should be higher than 0.2 and lower than 5 ($0.2 < \text{VIF} > 5$), otherwise, eliminating constructs, merging predictors into a single construct or building higher-order constructs should be considered (Hair, Tomas, Hult, Ringle, & Sarstedt, 2013). Two statistical programs needed to be used in assessing collinearity among the predictor constructs of the structural model: SmartPLS for importing latent variable scores to use them as an input in IBM SPSS which was used to compute the VIF values of each construct.

4.7.2.2. Path coefficients

Path coefficients are used to represent the hypothesized relationships among the constructs. The standard values of path coefficients are between -1 and +1. Estimated
path coefficients close to +1 represent strong positive relationships (and vice versa). The bootstrap procedures in SmartPLS with 5000 re-sample were used to calculate the t-values of path coefficients between the constructs (Hair et al., 2013).

Levels of significance of the relationships between the constructs were evaluated by comparing the empirical t-values to the critical t-values. When the empirical t value is larger than the critical value, the coefficient to be considered significant and has usually a value of $\geq 1.65$ (Hair et al., 2013).

By testing the t-value of the proposed relationships the structural model was evaluated on whether it reflects valid interrelationships. The path coefficients provided by SmartPLS were also used as an indicator to evaluate the strength of the relationship between constructs. Path coefficients which were less than 0.2 were considered to be weak in this study, correlations in the range of 0.2 to 0.5 were considered to be moderate and more than 0.5 was considered to be strong (Cohen, 1988).

4.7.2.3. Coefficient of determination ($R^2$)

The coefficient of determination ($R^2$) is a measure of a model’s predictive accuracy. It was used to evaluate the explanatory power of the research model and it is calculated as the squared correlation between a specific dependent construct’s predicted and actual values (Hair et al., 2013). $R^2$ was used to estimate how much of the variability of each dependent construct was explained by the independent constructs. $R^2$ ranges from 0 to 1, and higher levels indicate higher levels of predictive accuracy (Hair et al., 2013).

4.7.2.4. $f^2$ effect size

In addition to $R^2$, $f^2$ effect size was used to evaluate whether each of the predictor constructs had a substantive impact on the relevant dependent constructs. $f^2$ effect size measures the change in $R^2$ when a construct is removed from the model. The change in the $R^2$ values ($R^2_{included}$ and $R^2_{excluded}$) can be calculated by estimating the SmartPLS path
model twice. Guideline values for assessing $f^2$ effect size are: 0.02, 0.15 and 0.35 are respectively,

**4.7.2.5. Predictive relevance $Q^2$**

A predictive relevance assessment was made using Stone-Geisser’s $Q^2$ value (Geisser, 1974; Stone, 1974). This should be done when there is a need to evaluate the magnitude of $R^2$ values as a criterion of predictive accuracy for research models. Depending on the form of prediction, different forms of $Q^2$ could be obtained (Chin, 2010). In this study, a cross-validated redundancy approach was used to obtain $Q^2$ as recommended by Hair et al. (2013). $Q^2$ represents a measure of how well observed values are reconstructed by the model and its parameter estimates. $Q^2 > 0$ implies the model has predictive relevance whereas $Q^2 \leq 0$ represents a lack of predictive relevance.

As in the case of $f^2$, $q^2$ measures the changes in $Q^2$ when a construct is removed from the model and was used to evaluate the structural model’s relative effect on the observed measures for each dependent latent construct. $q^2$ values of 0.02, 0.15 and 0.35 as a relative measure of predictive relevance indicate that an independent construct has respectively, a small predictive relevance, medium predictive relevance and large predictive relevance (Hair et al., 2013).

**4.8. Qualitative data analysis.**

Qualitative data analysis was used in this research to complement the quantitative analysis undertaken to answer RQ1 and to minimize the disadvantage of a single research method. In addition, it was used to answer the second two research questions: “RQ2: What are the benefits that could be gained from mICT adoption and use in the Libyan construction industry?” and “RQ3: What are the current uses of mICT and the future prospects of using mICT in the Libyan construction industry?”. Interviews conducted in this study yielded digital recorded data.
As Vogel (2005) stated, interview data analysis is the process of moving from raw interviews (recorded interviews and other types of interview data) to evidence based interpretations which are used as a foundation for published results or report. The qualitative analysis approach used in this research was mainly based on the procedures used by Silverman (2006).

Many qualitative theorists have encouraged the use of qualitative data analysis software such as NUD*IST or NVIVO (Merriam, 2001; Patton, 2002; Basit, 2003). These kinds of software can be very helpful for research that involves large volumes of qualitative data. However, as the scale of the interview data in this study was relatively small, it was practical to undertake the qualitative analysis manually. The steps taken are described below.

**First step:** As the interviews were tape-recorded and in Arabic language the analysis was started by translating the interviews to English and transcribing them into separate documents using a word processing package.

**Second step:** In the interview transcripts, each response to a question from the interview guide was given a reference number consisting of the interview number, part and question number. This reference number was to be used to identify the quotations in this qualitative analysis (e.g. 6:C3 is the sixth interviewee’s response and number three is question number in part C in the interview guide (see Appendix G for the interview transcripts).

**Third step:** The interview transcripts were examined to identify concepts and themes which related to the second two research questions. Themes in the participants’ responses such as “saving time”, “saving cost”, “saving effort” and “I have been using it since the year 2000” were identified and highlighted using Microsoft Word competencies such as colour highlighting and word search, as shown in Appendix H.
**Fourth step:** All interviewees’ feedback relating to the benefits and current use and future perspectives of using mICT in the Libyan construction industry were summarized and synthesised (see Appendix I for examples of participants’ response). These synthesised findings were used to reflect the participants’ views on the second two research questions. This step aided the researcher to represent responses together within one consolidated table and to identify where the participants’ views were consistent and inconsistent.

**Final step:** The analysis from the prior steps (see Appendixes G, H and I) was utilized to link the synthesised responses to each of the second and third research questions.

### 4.9. Summary

This chapter described the research methodology used in this thesis. This research was conducted using quantitative and qualitative approaches (mixed methods). A questionnaire was used to collect the quantitative data and a qualitative approach was undertaken through semi-structured interviews. The reasons for the selection of these methods and how the participants were selected were elaborated on in this chapter. The chapter also explained how the questionnaire and semi-structured interviews were designed and the data analysis approaches used.

The next chapter presents the results testing of the research model and the analysis of the qualitative data.
Chapter 5. Results

5.1. Introduction

This chapter provides the results of the analyses undertaken to identify the factors that have an impact on mICT adoption and use and the benefits that could be gained from adopting and using mICT both now and in the future. Section 5.2. presents the quantitative findings which include: descriptive statistics of the measurement model testing, and structural model testing to answer the research hypotheses. Section 5.3. presents the qualitative results from the participants’ interviews. This section includes background information about the interviewees, presents findings about the expected benefits to be gained from adopting and using mICT in the Libyan construction industry, and the participants’ perspectives of the future success of mICT in the Libyan construction industry.

5.2. Quantitative findings

The results of the quantitative data collection and analysis that were carried out as described in Chapter 4 are presented in the following sections.

5.2.1. Descriptive statistics

A total of 202 questionnaires were returned and completed. This constitutes a response rate of 63% as previously mentioned in Section 4.5.

In the Libyan construction industry as in any other construction domain, most workers are males, which can be attributed the nature of work. In this study, only 26 females completed and returned the questionnaire (12.9%) while 176 respondents were males (87.1%).

The participants’ age distribution is shown in Table 5.1. It can be seen that the respondents who were between 30 and 39 formed the largest group (43.10%). The table
also illustrates that the category 40-50+ was the second largest (39.6%) followed by those in the 18 to 29 age range (17.3%). It seems that most of the sample ages are interested in the adopting and using of mICT.

Table 5.1 Age distribution

<table>
<thead>
<tr>
<th>Age ranges</th>
<th>Categories</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 - 29</td>
<td>35</td>
<td></td>
<td>17.3%</td>
</tr>
<tr>
<td>30 - 39</td>
<td>87</td>
<td></td>
<td>43.1%</td>
</tr>
<tr>
<td>40 - 50+</td>
<td>80</td>
<td></td>
<td>39.6%</td>
</tr>
<tr>
<td>Total</td>
<td>202</td>
<td></td>
<td>100.0%</td>
</tr>
</tbody>
</table>

The educational level of the participants is shown in Table 5.2. A substantial proportion of the respondents held at least a university degree (48%).

Table 5.2 Education background

<table>
<thead>
<tr>
<th>Education level</th>
<th>Categories</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>2</td>
<td></td>
<td>1.0%</td>
</tr>
<tr>
<td>High School</td>
<td>38</td>
<td></td>
<td>18.8%</td>
</tr>
<tr>
<td>Institute</td>
<td>65</td>
<td></td>
<td>32.2%</td>
</tr>
<tr>
<td>University+</td>
<td>97</td>
<td></td>
<td>48.0%</td>
</tr>
<tr>
<td>Total</td>
<td>202</td>
<td></td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 5.3 shows the level of experience participants had with using mICT at the time the survey was conducted. As can be seen, more than 86% of participants said that they had an intermediate level of experience in using mICT. The participants also indicated that 10.9% had advanced levels of experience with mICT. Only a few respondents (3.0%) stated that they were beginners in using mICT.
Table 5.3 Experience level

<table>
<thead>
<tr>
<th>mICT experience level</th>
<th>Categories</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner</td>
<td>6</td>
<td></td>
<td>3.0%</td>
</tr>
<tr>
<td>Intermediate</td>
<td>174</td>
<td></td>
<td>86.1%</td>
</tr>
<tr>
<td>Advanced</td>
<td>22</td>
<td></td>
<td>10.9%</td>
</tr>
<tr>
<td>Total</td>
<td>202</td>
<td></td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 5.4 presents the employment sectors of the research participants. Around half (50.5%) of the respondents were employed in the construction public sector followed by 46.0% in the private sector. There were only 3.5% who were employed in the self-employment sector. Table 5.4 clearly illustrates that most of the participants were from the public or private sector.

Table 5.4 Employment sector distribution

<table>
<thead>
<tr>
<th>Employment sector</th>
<th>Categories</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Public sector</td>
<td>102</td>
<td>50.5%</td>
</tr>
<tr>
<td></td>
<td>Private sector</td>
<td>93</td>
<td>46.0%</td>
</tr>
<tr>
<td></td>
<td>Self-employment</td>
<td>7</td>
<td>3.5%</td>
</tr>
</tbody>
</table>

The data in Table 5.5 below presents summary information about the research constructs. Most of constructs showed a wide range of values. The table clearly demonstrates that the most highly ranked construct was the intention to adopt and use mICT, that is, participants were keen to adopt the technology (mean: 4.80). It was also clear that most participants perceived that mICT will be very useful to them (mean: 4.23) and would be easy to use (mean: 4.29). Participants were, however, less confident in their ability to use the technology (perceived mICT self-efficacy mean: 4.07). It was also obvious for the perceived credibility of mICT construct that a large number of the
respondents don’t have major security concerns about adopting and using mICT and feel relatively secure sending sensitive information using mICT (mean: 4.14). Finally, the table shows that the participants were less sure about the perceived high cost of technology and facilitating conditions available (respectively, 3.49 and 3.95). It was also noticeable that perceived high cost of technology had the largest standard deviation, suggesting that participants had little consensus about the cost of the technology or about levels of facilitating conditions and perceived credibility of mICT.

Table 5.5 Summary information about constructs

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Min</th>
<th>Max</th>
<th>Std</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention to adopt and use mICT</td>
<td>4.80</td>
<td>2.40</td>
<td>5</td>
<td>0.44</td>
</tr>
<tr>
<td>Perceived ease of use of mICT</td>
<td>4.29</td>
<td>2.25</td>
<td>5</td>
<td>0.60</td>
</tr>
<tr>
<td>Perceived usefulness of mICT</td>
<td>4.23</td>
<td>1.33</td>
<td>5</td>
<td>0.71</td>
</tr>
<tr>
<td>Perceived credibility of mICT</td>
<td>4.14</td>
<td>1</td>
<td>5</td>
<td>0.92</td>
</tr>
<tr>
<td>Perceived mICT self-efficacy</td>
<td>4.07</td>
<td>1</td>
<td>5</td>
<td>0.71</td>
</tr>
<tr>
<td>Facilitating conditions</td>
<td>3.95</td>
<td>3.85</td>
<td>5</td>
<td>0.90</td>
</tr>
<tr>
<td>Perceived high cost of technology</td>
<td>3.49</td>
<td>1</td>
<td>5</td>
<td>0.97</td>
</tr>
</tbody>
</table>

5.2.2. Measurement model testing

As was discussed in Chapter 4, two main kinds of validity were considered in testing the measurement model: convergent validity and discriminant validity.
5.2.2.1. Convergent validity

As stated in Section 4.7.1, item loadings are one of the criteria used to assess convergent validity. Each measurement item should have a strong correlation with its proposed construct (Gefen & Straub, 2005). The initial measurement model, including the initial item loadings on their constructs, is shown in Figure 5.1. All measurement items that were used for this assessment are shown in Appendix J. Table 5.6 also shows the initial item loadings for each item in relation to its proposed construct.

Figure 5.1 Initial measurement model
Table 5.6 Initial values of item loadings

<table>
<thead>
<tr>
<th>Item loadings</th>
<th>Item loadings</th>
<th>Item loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>P.H.Cost1</td>
<td>0.610</td>
<td>P.H.Cost2</td>
</tr>
<tr>
<td>P.H.Cost3</td>
<td>0.791</td>
<td>P.H.Cost4</td>
</tr>
<tr>
<td>P.H.Cost5</td>
<td>0.665</td>
<td>P.S.Efficay1</td>
</tr>
<tr>
<td>P.S.Efficay2</td>
<td>0.596</td>
<td>P.S.Efficay3</td>
</tr>
<tr>
<td>P.S.Efficay4</td>
<td>0.840</td>
<td>P.S.Efficay5</td>
</tr>
<tr>
<td>P.Credibility1</td>
<td>0.822</td>
<td>P.Credibility2</td>
</tr>
<tr>
<td>P.Credibility3</td>
<td>0.942</td>
<td>P.Credibility4</td>
</tr>
<tr>
<td>P.Credibility5</td>
<td>0.953</td>
<td>P.Credibility6</td>
</tr>
<tr>
<td>P.Usefullness1</td>
<td>0.652</td>
<td>P.Usefullness2</td>
</tr>
<tr>
<td>P.Usefullness3</td>
<td>0.703</td>
<td>P.Usefullness4</td>
</tr>
<tr>
<td>F.Condition1</td>
<td>0.809</td>
<td>F.Condition2</td>
</tr>
<tr>
<td>F.Condition3</td>
<td>0.873</td>
<td>F.Condition4</td>
</tr>
<tr>
<td>F.Condition5</td>
<td>0.474</td>
<td>F.Condition6</td>
</tr>
<tr>
<td>F.Condition7</td>
<td>0.474</td>
<td>P.Usefullness5</td>
</tr>
<tr>
<td>F.Condition8</td>
<td>0.867</td>
<td>F.Condition9</td>
</tr>
<tr>
<td>F.Condition10</td>
<td>0.494</td>
<td>P.Usefullness10</td>
</tr>
<tr>
<td>P.Intention1</td>
<td>0.848</td>
<td>P.Intention2</td>
</tr>
<tr>
<td>P.Intention3</td>
<td>0.825</td>
<td>P.Intention4</td>
</tr>
<tr>
<td>P.Intention5</td>
<td>0.835</td>
<td>P.Intention6</td>
</tr>
</tbody>
</table>

Based on the assessment of item loadings, items that didn’t meet the criterion were dropped from the measurement model. An item can be retained if its outer loadings value is $\geq 0.70$ (Hair et al., 2013). The remaining items that satisfied the convergent validity first criterion as listed in Table 4.10 are shown in the following table and each construct is discussed below.
Table 5.7 Final values of item loadings

<table>
<thead>
<tr>
<th>Item loading</th>
<th>Item loading</th>
<th>Item loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>P.H.Cost2</td>
<td>0.788</td>
<td>P.Credibility6</td>
</tr>
<tr>
<td>P.H.Cost3</td>
<td>0.945</td>
<td>F.Condition1</td>
</tr>
<tr>
<td>P.H.Cost4</td>
<td>0.900</td>
<td>F.Condition3</td>
</tr>
<tr>
<td>P.S.Efficay1</td>
<td>0.879</td>
<td>F.Condition4</td>
</tr>
<tr>
<td>P.S.Efficay4</td>
<td>0.861</td>
<td>F.Condition6</td>
</tr>
<tr>
<td>P.S.Efficay5</td>
<td>0.873</td>
<td>P.Ease2</td>
</tr>
<tr>
<td>P.Credibility1</td>
<td>0.820</td>
<td>P.Ease3</td>
</tr>
<tr>
<td>P.Credibility2</td>
<td>0.939</td>
<td>P.Ease4</td>
</tr>
<tr>
<td>P.Credibility3</td>
<td>0.943</td>
<td>P.Ease5</td>
</tr>
<tr>
<td>P.Credibility4</td>
<td>0.953</td>
<td>P.Usefullness4</td>
</tr>
<tr>
<td>P.Credibility5</td>
<td>0.953</td>
<td>P.Usefullness5</td>
</tr>
<tr>
<td>F.Condition1</td>
<td></td>
<td>P.Usefullness6</td>
</tr>
<tr>
<td>F.Condition3</td>
<td></td>
<td>P.Usefullness7</td>
</tr>
<tr>
<td>F.Condition4</td>
<td></td>
<td>P.Usefullness8</td>
</tr>
<tr>
<td>F.Condition6</td>
<td></td>
<td>P.Usefullness9</td>
</tr>
<tr>
<td>P.Ease2</td>
<td></td>
<td>P.Intention1</td>
</tr>
<tr>
<td>P.Ease3</td>
<td></td>
<td>P.Intention2</td>
</tr>
<tr>
<td>P.Ease4</td>
<td></td>
<td>P.Intention3</td>
</tr>
<tr>
<td>P.Ease5</td>
<td></td>
<td>P.Intention4</td>
</tr>
<tr>
<td>P.Usefullness4</td>
<td></td>
<td>P.Intention5</td>
</tr>
<tr>
<td>P.Usefullness5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Perceived high cost of technology

Analysis of the perceived high cost of technology construct (P.H.Cost) showed that three of items did not meet the first criterion of convergent validity. Two of these items were dropped from the model. However, P.H.Cost2 was not dropped because its item loadings were almost 0.70 and deleting this item didn’t increase the composite reliability of the construct.

Perceived mICT self-efficacy

For the perceived mICT self-efficacy construct (P. S.Efficay) only three items out of five had loadings greater than 0.7. As the rest didn’t meet the criterion they were dropped from the measurement model.
**Perceived credibility of mICT**

All six items of the *perceived credibility of mICT* construct analysis (P. Credibility) were greater than 0.70 and were retained.

**Facilitating conditions**

Four items measuring *facilitating conditions* (F. Condition) had outer loadings above 0.70. Therefore, they were considered to be good indicators. Three items were dropped from the model as they didn’t meet this criterion of convergent validity.

**Perceived ease of use of mICT**

Only one of the *perceived ease of use of mICT* construct items was below 0.70. Hence, it was dropped. All other items were considered to be satisfactory on this criterion.

**Perceived usefulness of mICT**

After testing the item loadings of *perceived usefulness of mICT* (P. Usefulness) only six items were found to be greater than or equal to 0.7 and hence meet the first criterion of convergent validity and loaded satisfactorily on the construct. The rest didn’t meet the criterion and were dropped from the model.

**Intention to adopt and use mICT**

All items loadings of *intention to adopt and use mICT* (P. Intention) were more than 0.70, and hence were retained.

To ensure that each item loaded significantly with its latent variable, the t-values of the outer loadings for the retained items were also calculated. Table 5.8 shows that each construct’s items loaded significantly on their construct.
The other criteria used for evaluating convergent validity were composite reliability, Cronbach’s alpha and AVE. The values of these criteria are shown in Table 5.9. As can be seen from the table, all values of composite reliability were satisfactory at more than 0.70 (Fornell & Larcker, 1981). Likewise, all Cronbach’s alpha values were greater than 0.70. The last criterion that was assessed for convergent validity was AVE. As can be seen in Table 5.9, all values of AVE were more than 0.50. Consequently, all criteria to establish the convergent validity for the research constructs were met.
Table 5.9 Convergent validity measures

<table>
<thead>
<tr>
<th>Construct</th>
<th>Composite Reliability</th>
<th>Cronbach’s Alpha</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived usefulness of mICT</td>
<td>0.924</td>
<td>0.901</td>
<td>0.672</td>
</tr>
<tr>
<td>Perceived ease of use of mICT</td>
<td>0.882</td>
<td>0.823</td>
<td>0.653</td>
</tr>
<tr>
<td>Intention to adopt and use mICT</td>
<td>0.931</td>
<td>0.907</td>
<td>0.731</td>
</tr>
<tr>
<td>Perceived credibility of mICT</td>
<td>0.970</td>
<td>0.963</td>
<td>0.847</td>
</tr>
<tr>
<td>Perceived high cost of technology</td>
<td>0.911</td>
<td>0.868</td>
<td>0.774</td>
</tr>
<tr>
<td>Perceived mICT self-efficacy</td>
<td>0.904</td>
<td>0.841</td>
<td>0.758</td>
</tr>
<tr>
<td>Facilitating conditions</td>
<td>0.938</td>
<td>0.912</td>
<td>0.794</td>
</tr>
</tbody>
</table>

5.2.2.2. Discriminant validity

As described in Section 4.7.1, two procedures were used for assessing discriminant validity. The first procedure involved comparing item cross loadings to construct correlations where items should be strongly correlated with their construct and weakly correlated with the other constructs in the model. Table 5.10 shows the cross loadings for all items that were retained in the measurement model after convergent validity had been assessed.
It can be seen from Table 5.10 all values of the outer loadings of items on their construct are higher than the values of the cross loadings. This supports discriminant validity.

The second procedure for assessing discriminant validity involves comparing the ratio of the square root of the AVE of each construct to the correlations of the construct with the other latent variables correlations using SmartPLS. Table 5.11 shows that the square
root of AVE for each construct is greater than any correlation between the construct and any other construct. The numbers in bold on the diagonal provide the square root of AVE for each construct. Therefore, both criterion were satisfactory met and the discriminant validity of the model has been demonstrated.

Table 5.11 Discriminant validity

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Facilitating conditions</td>
<td>0.891</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Intention to adopt and use mICT</td>
<td>0.460</td>
<td>0.855</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Perceived credibility of mICT</td>
<td>0.614</td>
<td>0.407</td>
<td>0.920</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Perceived ease of use of mICT</td>
<td>0.577</td>
<td>0.584</td>
<td>0.516</td>
<td>0.808</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Perceived high cost of technology</td>
<td>0.461</td>
<td>0.214</td>
<td>0.334</td>
<td>0.270</td>
<td>0.880</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Perceived usefulness of mICT</td>
<td>0.587</td>
<td>0.612</td>
<td>0.571</td>
<td>0.526</td>
<td>0.299</td>
<td>0.820</td>
<td></td>
</tr>
<tr>
<td>7. Perceived mICT self-efficacy</td>
<td>0.657</td>
<td>0.388</td>
<td>0.436</td>
<td>0.615</td>
<td>0.285</td>
<td>0.424</td>
<td>0.870</td>
</tr>
</tbody>
</table>
The final item loadings on their constructs are shown in Figure 5.2.

![Final measurement model](image)

**Figure 5.2 Final measurement model**

### 5.2.3. Structural model testing

As discussed in Chapter 4, five aspects of the structural model were assessed: collinearity assessment, size and significance of path coefficients, coefficient of determination ($R^2$), $f^2$ effect size and predictive relevance $Q^2$. Figure 5.3 shows the research model and the tested hypotheses.
5.2.3.1. Collinearity assessment

As stated in Section 4.7.2.1, collinearity assessment is used to check whether there are significant collinearity levels between each group of predictor variables or not. The constructs which were assessed for collinearity of the structural model were divided into three groups as follows:

- **Perceived mICT self-efficacy** and **facilitating conditions** as predictors of **perceived ease of use of mICT** in the Libyan construction industry (see Figure 5.4).
- **Perceived ease of use mICT** and **perceived mICT self-efficacy** as predictors of **perceived usefulness of mICT** in the Libyan construction industry (see Figure 5.5).
• Perceived high cost of technology, perceived ease of use of mICT, perceived usefulness of mICT, perceived mICT self-efficacy, perceived credibility of mICT and facilitating conditions as predictors of intention to adopt and use mICT in the Libyan construction industry (see Figure 5.6).

Figure 5.4 Prediction of perceived ease of use of mICT

Figure 5.5 Prediction of perceived usefulness of mICT

Figure 5.6 Prediction of intention to adopt and use mICT
Table 5.12 shows the results of the collinearity (VIF) analysis among the predictor constructs of the structural model.

Table 5.12 Collinearity assessment

<table>
<thead>
<tr>
<th>Collinearity Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>First group</td>
</tr>
<tr>
<td>Predictors variables</td>
</tr>
<tr>
<td>Perceived mICT self-efficacy</td>
</tr>
<tr>
<td>Facilitating conditions</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Dependent variable: perceived ease of use of mICT</td>
</tr>
</tbody>
</table>

As can be seen from Table 5.12, the VIF analysis values of all predictor constructs in the structural model were below 5. Collinearity among the predictor variables was therefore not an issue in the structural model.

5.2.3.2. Path coefficients assessment

By evaluating the t–values of the hypothesised relationships, path coefficients were examined and assessed as one of the criteria of the structural model testing. T-values were generated using the PLS bootstrapping calculation technique (Hair et al., 2013).

Table 5.13 below lists the values for path coefficient, standard deviation, and t-value for each proposed relationship. The path coefficients are also shown in Figure 5.7. Only seven of the paths were significant.
### Table 5.13 Significance of path coefficients

<table>
<thead>
<tr>
<th>Path</th>
<th>Path Coefficient</th>
<th>Std. dev.</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1: Perceived usefulness of mICT → Intention to adopt and use mICT</td>
<td>0.429</td>
<td>0.090</td>
<td>4.723***</td>
</tr>
<tr>
<td>H2a: Perceived ease of use of mICT → Intention to adopt and use mICT</td>
<td>0.378</td>
<td>0.090</td>
<td>4.166***</td>
</tr>
<tr>
<td>H2b: Perceived ease of use of mICT → Perceived usefulness of mICT</td>
<td>0.427</td>
<td>0.090</td>
<td>4.771***</td>
</tr>
<tr>
<td>H3: Perceived high cost of technology → Intention to adopt and use mICT</td>
<td>-0.012</td>
<td>0.065</td>
<td>0.193</td>
</tr>
<tr>
<td>H4: Perceived credibility of mICT → Intention to adopt and use mICT</td>
<td>-0.040</td>
<td>0.086</td>
<td>0.459</td>
</tr>
<tr>
<td>H5a: Perceived self-efficacy → Intention to adopt and use mICT</td>
<td>-0.034</td>
<td>0.091</td>
<td>0.373</td>
</tr>
<tr>
<td>H5b: Perceived mICT self-efficacy → Perceived ease of use of mICT</td>
<td>0.415</td>
<td>0.086</td>
<td>4.689***</td>
</tr>
<tr>
<td>H5c: Perceived mICT self-efficacy → Perceived usefulness of mICT</td>
<td>0.161</td>
<td>0.078</td>
<td>2.062**</td>
</tr>
<tr>
<td>H5d: Perceived mICT self-efficacy → Perceived credibility of mICT</td>
<td>0.436</td>
<td>0.070</td>
<td>6.122***</td>
</tr>
<tr>
<td>H6a: Facilitating conditions → Intention to adopt and use mICT</td>
<td>0.042</td>
<td>0.091</td>
<td>0.461</td>
</tr>
<tr>
<td>H6b: Facilitating conditions → Perceived ease of use of mICT</td>
<td>0.305</td>
<td>0.088</td>
<td>3.468***</td>
</tr>
</tbody>
</table>

**p < 0.01

***p < 0.001

Paths which were significant are:

- From *perceived usefulness of mICT* to *intention to adopt and use mICT*.
- From *perceived ease of use of mICT* to *intention to adopt and use mICT*.
- From *perceived ease of use of mICT* to *perceived usefulness of mICT*.
- From *perceived mICT self-efficacy* to *perceived ease of use of mICT* and to *perceived credibility of mICT*.
- From *facilitating conditions* to *perceived ease of use of mICT*.
- From *perceived mICT self-efficacy* to *perceived usefulness of mICT*.

Paths which were not significant are:
- From *perceived high cost of technology* to *intention to adopt and use mICT*.
- From *perceived credibility of mICT* to *intention to adopt and use mICT*.
- From *perceived mICT self-efficacy* to *intention to adopt and use mICT*.
- From *facilitating conditions* to *intention to adopt and use mICT*.

The strength of the significant relationships was also of interest. The relationships were considered to be strong if the path coefficients were more than 0.5 and considered to be moderate if they were between 0.2 and 0.5 and weak if they were less than 0.2 (Cohen, 1988).

![Figure 5.7 Research structural model](image-url)
The assessment of the strength of the significant relationships of the research model showed that the relationships between constructs were either moderate or weak. There were no strong relationships.

The **moderate strength** relationships were between:

- **Facilitating conditions and perceived ease of use on mICT.**
- **Perceived mICT self-efficacy and perceived ease of use of mICT.**
- **Perceived mICT self-efficacy and perceived credibility of mICT.**
- **Perceived ease of use of mICT and perceived usefulness of mICT.**
- **Perceived ease of use of mICT and intention to adopt and use mICT.**
- **Perceived usefulness of mICT and intention to adopt and use mICT.**

The one **weak strength** relationship was between:

- **Perceived mICT self-efficacy and perceived usefulness of mICT.**

In addition to having a direct influence on each other as shown in Table 5.13, some constructs have an indirect influence on other constructs (see Figure 5.7). The sum of direct and indirect impacts on the dependent latent variable is the total effect (Hair et al., 2013). Table 5.14 shows the corresponding results for the total effects assessment of the independent constructs on the dependent latent constructs (both the direct and indirect) of the research structural model.
### Table 5.14 Assessment of total effects

<table>
<thead>
<tr>
<th></th>
<th>Intention to adopt and use mICT</th>
<th>Perceived credibility of mICT</th>
<th>Perceived ease of use of mICT</th>
<th>Perceived usefulness of mICT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facilitating conditions</td>
<td>0.214***</td>
<td></td>
<td>0.305***</td>
<td>0.130***</td>
</tr>
<tr>
<td>Perceived credibility of mICT</td>
<td>-0.040</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived ease of use of mICT</td>
<td>0.561***</td>
<td></td>
<td></td>
<td>0.427***</td>
</tr>
<tr>
<td>Perceived high cost of technology</td>
<td>-0.013</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived usefulness of mICT</td>
<td>0.429***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived mICT self-efficacy</td>
<td>0.251***</td>
<td>0.436***</td>
<td>0.415***</td>
<td>0.339***</td>
</tr>
</tbody>
</table>

As can be seen, perceived ease of use of mICT and perceived usefulness of mICT were the major direct influences on the intention to adopt and use mICT. Facilitating conditions and perceived mICT self-efficacy were the major indirect influences on the intention to adopt and use mICT: facilitating conditions via its influence on perceived ease of use of mICT and perceived mICT self-efficacy via its influences on perceived ease of use of mICT and perceived usefulness of mICT. The effect of facilitating conditions via perceived ease of use of mICT was smaller than of perceived mICT self-efficacy. But it was about a half as strong as that via perceived usefulness of mICT. Perceived high cost of technology and perceived credibility of mICT played no role.

### 5.2.3.3. Coefficient of determination ($R^2$)

Coefficient of determination ($R^2$) is used to measure the amount of variance in a dependent variable explained by all of the independent variables which are linked to it. To evaluate if the model has the ability to explain the variance in the dependent variables, SmartPLS was used to calculate $R^2$ values for the dependent variables. Table 5.15 presents the percentages of variance that were explained by each of the dependent variables.
Table 5.15 $R^2$ values for the dependent constructs

<table>
<thead>
<tr>
<th>Variable</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention to adopt and use mICT</td>
<td>0.471</td>
</tr>
<tr>
<td>Perceived ease of use of mICT</td>
<td>0.432</td>
</tr>
<tr>
<td>Perceived usefulness of mICT</td>
<td>0.294</td>
</tr>
<tr>
<td>Perceived credibility of mICT</td>
<td>0.191</td>
</tr>
</tbody>
</table>

The above table shows that the model has the ability to explain the variance in the dependent variables. It can be seen that 43.2% of the variance in perceived ease of use of mICT was explained by perceived mICT self-efficacy and facilitating conditions. The research model also explained 47.1% of the variability in the intention to adopt and use mICT in the Libyan construction industry. Only 29.4% of the variance in perceived usefulness of mICT was explained by perceived ease of use of mICT and perceived mICT self-efficacy. Lastly perceived mICT self-efficacy explained 19.1% of the variance in perceived credibility of mICT.

5.2.3.4 Assess the $f^2$ effect size

As discussed in Section 4.7.2.4, assessment of $f^2$ effect size was used to evaluate the substantive impact of potentially omitting each independent construct on the linked dependent construct in the structural model. This assessment was done by omitting each independent construct in turn from the research model and calculating $f^2$ size effect in terms of the change in $R^2$ (value of $R^2$ including the independent construct and $R^2$ excluding the independent construct).
The results of $f^2$ effect size assessment are summarized in Table 5.16.

Table 5.16 $f^2$ size assessment

<table>
<thead>
<tr>
<th>Dependent variable: Intention to adopt and use mICT</th>
<th>Dependent variable: Perceived usefulness of mICT</th>
<th>Dependent variable: Perceived ease of use of mICT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indep. Const.</td>
<td>$R^2_{inc}$</td>
<td>$R^2_{exc}$</td>
</tr>
<tr>
<td>P.high cost</td>
<td>0.471</td>
<td>0.471</td>
</tr>
<tr>
<td>P.ease of use</td>
<td>0.471</td>
<td>0.401</td>
</tr>
<tr>
<td>P.Useful</td>
<td>0.471</td>
<td>0.369</td>
</tr>
<tr>
<td>P.self-effic.</td>
<td>0.471</td>
<td>0.471</td>
</tr>
<tr>
<td>P.credi.</td>
<td>0.471</td>
<td>0.470</td>
</tr>
<tr>
<td>Facil. cond.</td>
<td>0.471</td>
<td>0.471</td>
</tr>
</tbody>
</table>

As can be seen from Table 5.16, the $f^2$ effect size of the independent variable perceived high cost of technology on the dependent variable intention to adopt and use mICT is absolutely no effect ($f^2 = 0.000$) which means that perceived high cost of technology does not have any substantive impact on the intention to adopt and use mICT in the Libyan construction industry. Likewise for the variables perceived mICT self-efficacy ($f^2 = 0.000$), perceived credibility of mICT ($f^2 = 0.002$) and facilitating conditions ($f^2 = 0.000$). The effect size of perceived ease of use of mICT as an independent variable for the dependent variable intention to adopt and use mICT in Libyan construction industry is almost a medium effect ($f^2 = 0.132$), this was expected. The more ease of use of mICT the users find, the fewer barriers they will face in trying to adopt and use mICT. The effect size of the independent variable perceived usefulness of mICT on the dependent variable intention to adopt and use mICT is a medium effect ($f^2 = 0.193$), this result was also expected. The more useful users perceive mICT to be, the more they intend to adopt and use it.
In addition, the $f^2$ effect size of perceived ease of use of mICT and perceived mICT self-efficacy as independent variables for perceived usefulness of mICT are respectively medium ($f^2 = 0.159$) and small ($f^2 = 0.095$). This means that these variables have a substantive impact and that perceived mICT self-efficacy is a less important influence on perceived usefulness of mICT than perceived ease of use of mICT.

Finally, perceived mICT self-efficacy and facilitating conditions as independent variables for perceived ease of use of mICT variable had respectively medium ($f^2 = 0.174$) and small ($f^2 = 0.093$) effect sizes.

To conclude the results showed that perceived usefulness on mICT has the largest impact on intention to adopt and use mICT in the construction industry.

### 5.2.3.5. Predictive Relevance $Q^2$

Blindfolding was used to assess the predictive relevance of the structural model (see Section 4.7.2.5). Blindfolding was run using SmartPLS for one dependent latent variable after another (perceived ease of use of mICT, perceived usefulness of mICT and intention to adopt and use mICT). After calculating of the predictive relevance value $Q^2$ for each dependent construct, the effect size of each independent construct on each dependent latent variable path ($q^2$) was also calculated.

Table 5.17, summarises the outcomes of the blindfolding procedure and predictive relevance assessment of the dependent latent variables of the research model.
Table 5.17 Blindfolding and predictive relevance assessment

<table>
<thead>
<tr>
<th>Dependent latent variable</th>
<th>Independent variables</th>
<th>$Q^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention to adopt and use mICT</td>
<td>Perceived usefulness of mICT, Perceived ease of use of mICT, Perceived mICT self-efficacy, Perceived high cost of technology, Perceived credibility of mICT, Facilitating conditions</td>
<td>0.350</td>
</tr>
<tr>
<td>Perceived ease of use of mICT</td>
<td>Perceived mICT self-efficacy, Facilitating conditions</td>
<td>0.275</td>
</tr>
<tr>
<td>Perceived usefulness of mICT</td>
<td>Perceived ease of use of mICT, Perceived mICT self-efficacy</td>
<td>0.195</td>
</tr>
<tr>
<td>Perceived credibility of mICT</td>
<td>Perceived mICT self-efficacy</td>
<td>0.159</td>
</tr>
</tbody>
</table>

The above table indicates that the independent constructs (perceived usefulness of mICT, perceived ease of use of mICT, perceived mICT self-efficacy, perceived high cost of technology, perceived credibility of mICT and facilitating conditions) have a predictive relevance with a $Q^2$ value of equal 0.350 for the dependent construct intention to adopt and use mICT in Libyan construction industry. Table 5.16 also shows that the independent constructs perceived mICT self-efficacy and facilitating conditions have a predictive relevance with a value of $Q^2$ of 0.275 for the dependent perceived ease of use of mICT in Libyan construction industry. Likewise, the independent constructs perceived ease of use of mICT and perceived mICT self-efficacy have a predictive relevance with a $Q^2$ value of 0.195 for the dependent construct perceived usefulness of mICT. Lastly, the independent construct perceived mICT self-efficacy has a predictive relevance with a $Q^2$ value of 0.16 for the dependent construct perceived credibility of mICT.
mICT. All $Q^2$ values are considerably above zero, and thus suggest that the model has predictive relevance regarding the dependent latent constructs.

Table 5.18 presents the results of $q^2$ which were calculated according to the changes in $Q^2$ values as previously stated in Section 4.7.2.5.

Table 5.18 $q^2$ effect sizes on dependent latent variables

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>$(q^2)$ effect size assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention to adopt and use of mICT</td>
<td>Dependent variable:</td>
</tr>
<tr>
<td>$Q^2_{inc}$</td>
<td>$Q^2_{exc}$</td>
</tr>
<tr>
<td>$Q^2_{inc}$</td>
<td>$Q^2_{exc}$</td>
</tr>
<tr>
<td>Indep. Const.</td>
<td>P.high cost</td>
</tr>
<tr>
<td>P.ease of use</td>
<td>0.354</td>
</tr>
<tr>
<td>P. Useful</td>
<td>0.354</td>
</tr>
<tr>
<td>P.self-effic.</td>
<td>0.354</td>
</tr>
<tr>
<td>P. Credi.</td>
<td>0.354</td>
</tr>
<tr>
<td>Facilit. cond.</td>
<td>0.354</td>
</tr>
</tbody>
</table>

As described in Section 4.7.2.5, $q^2$ 0.02 is considered a small effect, 0.15 represents a medium effect and 0.35 represents a large effect. The effect size of the independent variable perceived high cost of technology on the dependent variable intention to adopt and use mICT is a small effect ($q^2 = 0.092$), the effect size of perceived ease of use of mICT as an independent variable for the dependent construct intention to adopt and use mICT in the construction industry is also a small effect ($q^2 = 0.097$).

Likewise, the effect size of independent construct perceived usefulness of mICT on dependent construct intention to adopt and use mICT is small effect ($q^2 = 0.117$) and the effect size of perceived mICT self-efficacy as an independent variable for the dependent variable intention to adopt and use mICT in the construction industry is a medium effect ($q^2 = 0.156$). The effect sizes of both perceived credibility of mICT and facilitating
conditions as independent variables for intention to adopt and use mICT were negligible ($q^2 = 0.004$ and $q^2 = 0.018$).

In addition, the effect size of the independent variables perceived ease of use of mICT and perceived mICT self-efficacy on the dependent variable perceived usefulness of mICT respectively represent small effect sizes ($q^2 = 0.098$ and $q^2 = 0.014$).

Lastly, perceived mICT self-efficacy and facilitating conditions as independent variables for the dependent construct perceived ease of use of mICT both had small effect sizes ($q^2 = 0.088$ and $q^2 = 0.048$) respectively.

5.2.3.6. Structural model testing summary

Table 5.19 summarizes the results of $R^2$, $f^2$, $Q^2$, $q^2$ with respect to all relationships in the research model, along with path coefficients.
### Table 5.19 Summary of structural model results

<table>
<thead>
<tr>
<th>Coefficient of determination (R² Value)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent construct</td>
<td>R²</td>
</tr>
<tr>
<td>Intention to adopt and use mICT</td>
<td>0.471</td>
</tr>
<tr>
<td>Perceived ease of use of mICT</td>
<td>0.432</td>
</tr>
<tr>
<td>Perceived usefulness of mICT</td>
<td>0.294</td>
</tr>
<tr>
<td>Perceived credibility of mICT</td>
<td>0.191</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blindfolding predictive relevance assessment Q²</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent latent variable</td>
<td>Independent constructs</td>
</tr>
<tr>
<td>Intention to adopt and use mICT</td>
<td>Perceived usefulness of mICT</td>
</tr>
<tr>
<td></td>
<td>Perceived ease of use of mICT</td>
</tr>
<tr>
<td></td>
<td>Perceived mICT self-efficacy</td>
</tr>
<tr>
<td></td>
<td>Perceived high cost of technology</td>
</tr>
<tr>
<td></td>
<td>Perceived credibility of mICT</td>
</tr>
<tr>
<td></td>
<td>Facilitating conditions</td>
</tr>
<tr>
<td>Perceived ease of use of mICT</td>
<td>Perceived mICT self-efficacy</td>
</tr>
<tr>
<td></td>
<td>Facilitating conditions</td>
</tr>
<tr>
<td>Perceived usefulness of mICT</td>
<td>Perceived ease of use of mICT</td>
</tr>
<tr>
<td></td>
<td>Perceived self-efficacy of mICT</td>
</tr>
<tr>
<td>Perceived credibility of mICT</td>
<td>Perceived self-efficacy of mICT</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Structural path coefficients, effect size f² and effect size q²</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent construct: intention to adopt and use of mICT</td>
<td>Dependent construct: perceived usefulness of mICT</td>
</tr>
<tr>
<td>Indep. Cons.</td>
<td>Path Coeff.</td>
</tr>
<tr>
<td>P. high cost of tech.</td>
<td>-0.012</td>
</tr>
<tr>
<td>Not signif.</td>
<td>No effect</td>
</tr>
<tr>
<td>0.000</td>
<td>0.092</td>
</tr>
<tr>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td>P. ease of use of mICT</td>
<td>0.378</td>
</tr>
<tr>
<td>Signif.</td>
<td>Medi. effect</td>
</tr>
<tr>
<td>0.378</td>
<td>0.097</td>
</tr>
<tr>
<td>0.000</td>
<td>0.092</td>
</tr>
<tr>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td>P. usefulness of mICT</td>
<td>0.429</td>
</tr>
<tr>
<td>Signif.</td>
<td>Medi. effect</td>
</tr>
<tr>
<td>0.429</td>
<td>0.117</td>
</tr>
<tr>
<td>0.000</td>
<td>0.092</td>
</tr>
<tr>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td>Perceived mICT self-efficacy</td>
<td>-0.034</td>
</tr>
<tr>
<td>-0.034</td>
<td>0.156</td>
</tr>
<tr>
<td>0.000</td>
<td>0.092</td>
</tr>
<tr>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td>Perceived credibility of mICT</td>
<td>-0.040</td>
</tr>
<tr>
<td>Not signif.</td>
<td>No effect</td>
</tr>
<tr>
<td>-0.040</td>
<td>0.004</td>
</tr>
<tr>
<td>0.000</td>
<td>0.092</td>
</tr>
<tr>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td>Facilitating conditions</td>
<td>0.042</td>
</tr>
<tr>
<td>Not signif.</td>
<td>No effect</td>
</tr>
<tr>
<td>0.042</td>
<td>0.018</td>
</tr>
<tr>
<td>0.000</td>
<td>0.092</td>
</tr>
<tr>
<td>0.012</td>
<td></td>
</tr>
</tbody>
</table>
5.2.4. Hypotheses testing

The research model has eleven hypotheses. These hypotheses were tested and the results are as follows:

- **Hypothesis H1**: *Perceived usefulness of mICT will positively affect the intention to adopt and use mICT in the construction industry.*

  Based on the analysis, *perceived usefulness of mICT* had a significant influence on the intention to adopt and use mICT in the Libyan construction industry. Consequently, this hypothesis was supported.

- **Hypothesis H2a**: *Perceived ease of use of mICT will positively affect the intention to adopt and use mICT in the construction industry.*

  The analysis established that *perceived ease of use of mICT* had a significant impact on the intention to adopt and use mICT in the Libyan construction industry. Therefore, this hypothesis was supported.

- **Hypothesis H2b**: *Perceived ease of use of mICT will positively affect the perceived usefulness of mICT in the construction industry.*

  Testing the model showed also that *perceived usefulness of mICT* was significantly affected by *perceived ease of use of mICT* in the Libyan construction industry. Therefore, this hypothesis was supported.

- **Hypothesis H3**: *Perceived high cost of technology will negatively affect the intention to adopt and use mICT in the construction industry.*

  *Perceived high cost of mICT technology* had no significant influence on the intention to adopt and use mICT in the Libyan construction industry. Therefore, this hypothesis was not supported.
• **Hypothesis H4:** Perceived credibility of mICT will positively affect the intention to adopt and use mICT in the construction industry.

Perceived credibility of mICT did not demonstrate a significant impact on the intention to adopt and use mICT in the Libyan construction industry. Therefore, this hypothesis was not supported.

• **Hypothesis H5a:** Perceived mICT self-efficacy will positively affect the intention to adopt and use mICT in the construction industry.

Perceived mICT self-efficacy had no significant effect on the intention to adopt and use mICT in the Libyan construction industry. Consequently, this hypothesis was not supported.

• **Hypothesis H5b:** Perceived mICT self-efficacy will positively affect the perceived ease of use of mICT in the construction industry.

Perceived ease of use of mICT was significantly impacted by perceived mICT self-efficacy in the Libyan construction industry. Therefore, this hypothesis was supported.

• **Hypothesis H5c:** Perceived mICT self-efficacy will positively affect the perceived usefulness of mICT in the construction industry.

Perceived mICT self-efficacy demonstrated a significant effect on perceived usefulness of mICT in the Libyan construction industry. Based on that, this hypothesis was supported.

• **Hypothesis H5d:** Perceived mICT self-efficacy will negatively affect the perceived credibility of mICT in the construction industry.

Perceived mICT self-efficacy did not demonstrate a negative effect on perceived credibility of mICT but a positive effect. Therefore, this hypothesis was not supported.

• **Hypothesis H6a:** Facilitating conditions will positively affect the intention to adopt mICT in the construction industry.

Facilitating conditions did not demonstrate a significant positive impact on the intention to adopt mICT in the Libyan construction industry. Therefore, this hypothesis was not supported.
and use mICT in the construction industry.

Facilitating conditions had no significant direct impact on the intention to adopt and use mICT in the Libyan construction industry. As a result, this hypothesis was not supported.

- **Hypothesis H6b**: Facilitating conditions will positively affect the perceived ease of use of mICT in the construction industry.

Perceived ease of use of mICT was significantly affected by the facilitating conditions in the Libyan construction industry. Hence, this hypothesis was supported.

### 5.3. Qualitative findings

The purpose of this section is to present the results of the analysis of the participant interview data which was collected in order to investigate what stakeholders think the benefits are that could be gained from adopting and using mICT in the construction industry, and also to determine the interviewees’ perspectives regarding the current and future use of mICT in the Libyan construction industry, in order to answer Research Questions 2 and Research Question 3:

**RQ2)**: *What are the benefits that could be gained from mICT adoption and use in the Libyan construction industry?*

**RQ3)**: *What are the current uses of mICT and the future prospects of using mICT in the Libyan construction industry?*

### 5.3.1. Background information

Twenty five semi-structured interviews were carried out. To assure the quality of conducting and recording the interviews, all interviews were conducted in quiet locations at the worksites of the participants’ companies. Table 5.21 presents the participants’ background information and duration of each interview.
Table 5.20 Background information about interviewees

<table>
<thead>
<tr>
<th>Interview No.</th>
<th>Gender</th>
<th>Interviewee’s occupation</th>
<th>Level of ICT background</th>
<th>Total work Experience (years)</th>
<th>Duration of interview (min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>Labourer</td>
<td>Intermediate</td>
<td>18</td>
<td>19.21</td>
</tr>
<tr>
<td>2</td>
<td>Male</td>
<td>Consultant</td>
<td>Advanced</td>
<td>27</td>
<td>21.09</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>Project manager</td>
<td>Advanced</td>
<td>8</td>
<td>25.14</td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>Engineer</td>
<td>Intermediate</td>
<td>17</td>
<td>18.32</td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>Project manager</td>
<td>Intermediate</td>
<td>10</td>
<td>17.28</td>
</tr>
<tr>
<td>6</td>
<td>Male</td>
<td>Project manager</td>
<td>Intermediate</td>
<td>20</td>
<td>20.13</td>
</tr>
<tr>
<td>7</td>
<td>Male</td>
<td>Project manager</td>
<td>Intermediate</td>
<td>25</td>
<td>19.01</td>
</tr>
<tr>
<td>8</td>
<td>Male</td>
<td>Project manager</td>
<td>Intermediate</td>
<td>30</td>
<td>18.09</td>
</tr>
<tr>
<td>9</td>
<td>Male</td>
<td>Labourer</td>
<td>Intermediate</td>
<td>19</td>
<td>18.44</td>
</tr>
<tr>
<td>10</td>
<td>Male</td>
<td>Client</td>
<td>Intermediate</td>
<td>25</td>
<td>22.19</td>
</tr>
<tr>
<td>11</td>
<td>Male</td>
<td>Project manager</td>
<td>Intermediate</td>
<td>12</td>
<td>19.32</td>
</tr>
<tr>
<td>12</td>
<td>Male</td>
<td>Labourer</td>
<td>Intermediate</td>
<td>13</td>
<td>25.16</td>
</tr>
<tr>
<td>13</td>
<td>Male</td>
<td>Project manager</td>
<td>Advanced</td>
<td>24</td>
<td>16.32</td>
</tr>
<tr>
<td>14</td>
<td>Male</td>
<td>Labourer</td>
<td>Intermediate</td>
<td>12</td>
<td>20.56</td>
</tr>
<tr>
<td>15</td>
<td>Male</td>
<td>Labourer</td>
<td>Intermediate</td>
<td>12</td>
<td>23.41</td>
</tr>
<tr>
<td>16</td>
<td>Male</td>
<td>Project manager</td>
<td>Intermediate</td>
<td>25</td>
<td>18.26</td>
</tr>
<tr>
<td>No</td>
<td>Sex</td>
<td>Position</td>
<td>Level</td>
<td>Age</td>
<td>Salary</td>
</tr>
<tr>
<td>----</td>
<td>-----</td>
<td>------------------</td>
<td>-----------</td>
<td>-----</td>
<td>--------</td>
</tr>
<tr>
<td>17</td>
<td>Male</td>
<td>Consultant</td>
<td>Intermediate</td>
<td>25</td>
<td>23.54</td>
</tr>
<tr>
<td>18</td>
<td>Male</td>
<td>Contractor</td>
<td>Intermediate</td>
<td>10</td>
<td>22.46</td>
</tr>
<tr>
<td>19</td>
<td>Male</td>
<td>Project manager</td>
<td>Intermediate</td>
<td>30</td>
<td>17.53</td>
</tr>
<tr>
<td>20</td>
<td>Male</td>
<td>Client</td>
<td>Intermediate</td>
<td>30</td>
<td>20.30</td>
</tr>
<tr>
<td>21</td>
<td>Male</td>
<td>Consultant</td>
<td>Intermediate</td>
<td>37</td>
<td>25.05</td>
</tr>
<tr>
<td>22</td>
<td>Male</td>
<td>Labourer</td>
<td>Intermediate</td>
<td>15</td>
<td>24.32</td>
</tr>
<tr>
<td>23</td>
<td>Male</td>
<td>Project manager</td>
<td>Intermediate</td>
<td>27</td>
<td>22.16</td>
</tr>
<tr>
<td>24</td>
<td>Male</td>
<td>Labourer</td>
<td>Intermediate</td>
<td>14</td>
<td>20.15</td>
</tr>
<tr>
<td>25</td>
<td>Male</td>
<td>Labourer</td>
<td>Intermediate</td>
<td>1</td>
<td>18.12</td>
</tr>
</tbody>
</table>

As can be seen from the above Table 5.21, all the participants who agreed to be interviewed were males, although females in Libya have been involved and employed in a large number of jobs which are suitable for female labour in the construction industry. While females agreed to participate in completing questionnaires as part of this research, they declined to be involved in interviews. Females in Libya often see their involvement in society as remaining socially acceptable as long as they do not seek public attention. Moreover, the Libyan culture also sees that women often willingly take a backseat to men and refrain from participating in public activities (Muftah, 2012).

Table 5.21 illustrates that most of the participants had an intermediate level of experience in using ICT. The table also shows that the participants occupied a range of different positions in their companies. This range was sought to obtain a diversity of
views and opinions from the interviewees regarding the adoption and use of mICT in the Libyan construction industry.

5.3.2. Qualitative findings concerning the benefits of mICT

The qualitative analysis of the comments and the responses from the participants about the benefits that could be gained from adopting and using mICT and in the Libyan construction industry is presented in this section. The interviewees’ comments and responses regarding the interview questions are reported in Appendix I. To address Research Question 2, which was “What are the benefits that could be gained from mICT adoption and use in the Libyan construction industry?”, the qualitative analysis started by extracting the participants’ comments from the interview transcripts and extracting the themes and synonyms which were related to the benefits of mICT against the participants’ responses (see Appendix H for an example), and finally, linking the synthesised responses to each interview question (see Appendix I).

Most of the interviewees’ views were consistent with respect to the benefits of mICT in the construction industry. All interviewees (25 interviewees) believed that mICT is very essential to the stakeholders in the Libyan construction industry. For example, Interviewee 1 stated “I reckon that mICT is very essential for progressing work and I can see more than 80% of the users in the construction projects are using this technology” (1:B2). Interviewee 2 corroborated that by saying “I think mICT is very essential in the Libyan construction industry due to the services that this technology is offering and the role that it is playing for processing work” (2: B2). Interviewee 3 also added “In my opinion, this technology is the best means and mediator that can be used to communicate in construction projects and it is very essential to use in the construction field” (3:B2).
Most of the respondents believed that mICT is an essential technology for users in the Libyan construction industry due to the massive benefits that could be gained. Benefits that were identified from the analysis are listed in Table 5.22:

Table 5.21 Benefits of mICT

<table>
<thead>
<tr>
<th>Benefits of mICT in the Libyan construction industry</th>
<th>No. of interviewees</th>
</tr>
</thead>
<tbody>
<tr>
<td>• mICT can be used in organising and arranging work</td>
<td>12</td>
</tr>
<tr>
<td>• mICT can be useful for completing work</td>
<td>4</td>
</tr>
<tr>
<td>• mICT can be useful in saving time, cost and effort</td>
<td>9</td>
</tr>
<tr>
<td>• mICT can be useful in communicating and interacting</td>
<td>2</td>
</tr>
<tr>
<td>• mICT can be beneficial in transferring of information</td>
<td>2</td>
</tr>
</tbody>
</table>

5.3.2.1. mICT can be used for organising and arranging work

Twelve interviewees said that mICT is very beneficial in organising and arranging work in the Libyan construction industry. Some of these interviewees see that mICT is useful in organising to supply materials at construction worksites. For example, Interviewee 3 stated “...it can be also useful for directing and leading suppliers and organising with them for example to supply materials at the right places at construction projects sites” (3:B1).

Other interviewees believed that mICT is useful for organising meetings. For example, Interviewee 4 stated “......it can be used in sending messages regarding organising for work meetings between clients and contractors” (4:B1). Interviewee 5 also mentioned this benefit by saying “......most of our mICT use in construction projects is to organise
work between the construction projects’ parties, sometimes through messages or making calls to arrange meetings or to supply materials, ...” (5:B1).

Interviewee 18 also stated another mICT benefit related to organising by saying “It is a technology that can be used in organising for specific work in the construction industry such as sharing information between the project managers and other workers or client and other stakeholders of projects at worksites” (18:B1).

Likewise, others said that mICT can be used for organising work in terms of solving problems. For example, Interviewee 14 stated “.....it is a technology that can be used in organising the work, for example sometimes workers get stuck on an issue at the project worksite, and mobile technology can be useful in organising to solve that problem by following up the procedures of finalizing that operation” (14:B1). Interviewee 22 added “It helps in organising to connect contractors with other partners of construction projects to solve any problems that could face the work, for example shortages in materials or workers absence” (22:B1).

5.3.2.2. mICT can be useful for completing work

Four interviewees considered that mICT technology is useful in the construction industry to assist to complete or finalise work. For example, Interviewee 4 stated “Certainly,..., it is useful and assists in completing work in the construction industry projects as planned and scheduled, for example, finishing designs, time are word tables (project Gantt charts), preparing quantity tables and, etc. ” (4:B3). Interviewee 5 also stated “.....it is necessary for completing the work of projects in the construction industry” (5:B2). Likewise, Interviewee 13 said “...it helps in completing and achieving the targets of the projects and finishing project operations as scheduled and also in closing up construction projects with high-quality specifications regarding time and
cost or materials” (13:B2). Similarly, Interviewee 25 said, “mICT is a technology that can be used to finish some work in the construction industry” (25:B1).

5.3.2.3. mICT can be useful for saving time, cost and effort

The participants believed that mobile technologies can facilitate a reduction in construction cost, time and effort. Seven interviewees said that mICT is beneficial in saving time, cost or effort. For example, Interviewee 5 stated “Based on my experience, mICT can be used in construction to organise the work between the stakeholders of the construction projects sometimes through sending messages or making calls to arrange meetings or to supply materials and potentially to reduce time and save money” (5:B1). Interviewee 10 also stated “……Yes, it is successful and saves project time and effort too, for example, eliminating the time of rewriting or retyping letters and saving travel time” (10:B3).

Interviewee 16 also believed that mICT is beneficial by stating “It is a technology that can be used in the construction industry for processing work and has some significant advantages for example, it can save time and effort” (16:B1). Likewise, Interviewee 17 said “As this technology can save effort, time and cost for our company’s work, we are thinking of adopting it in a massive way for the whole of our project work” (17:B5).

In addition, Interviewee 18 mentioned another benefit of mICT concerning time by stating “….it is very effective in saving time which is very important for the projects’ deadlines” (18:B2), he also linked other benefits by saying “besides saving time and effort, I can see mICT in Libya’s construction industry is very secure, easy to use and there is a quality infrastructure.” (18:C5).

Other mICT’s benefits relating to time and cost can also be identified from the interview data, such as, accelerating and speeding up the progress and performance of the activities in construction projects. Interviewee 11 said that “…..this technology can
accelerate and speed up the progress of projects by for example, updating project information, reviewing project timetables in order to avoid or prevent delays” (11:B2). Interviewee 23 mentioned that mICT could be beneficial in reducing paper work by stating “Certainly mICT technologies are successful due to their benefits regarding reducing paper work in order to save time and cost” (23:B3). Likewise, Interviewees 20 and 22 mentioned the same benefits regarding time, cost and effort.

5.3.2.4. mICT can be useful for communicating and interacting

The results show that mICT has a significant role as one of the most useful technologies for supporting communication and interaction between stakeholders in the construction field. For example, Interviewee 3 stated “In my opinion, this technology is one of the best means and mediators that can be used to communicate and interact in construction projects, either by making phone calls or by other communicating means like Viber, Skype, Emails or Yahoo messenger” (3:B2). Interviewee 7 added “…mICT can be used to communicate with international construction companies to get the latest innovations regarding designs and other operations such as clarifying quantities or specifications and calculating projects’ cash flow in order to develop and improve the construction industry in Libya” (7:B1).

5.3.2.5. mICT can be beneficial in transferring and storing information

Several other interviewees had a common view regarding the benefits of mICT in the Libyan construction industry and they believe that such technology complements other technologies in terms of transferring and storing information. For example, Interviewee 7 said “…mICT provides technologies that complement other technologies and can be used in storing information such as reports, maps, etc.” (7: B1). Interviewee 19 supported that by saying “It is a technology that makes the transferring of information much easier from worksites to other companies’ main offices” (19:B1).
Overall, most of the interviewees were consistent in stating that mICT is providing many benefits to the stakeholders in the Libyan construction industry. These benefits were summarised as mentioned at the beginning of this section (see Table 5.22).

5.3.3. Qualitative findings concerning the current uses and the future prospects of using mICT

This section presents the qualitative analysis of the comments and the responses that were provided by the interviewees regarding the current uses and the future prospects of using mICT in the Libyan construction industry. In particular, to address Research Question 3, which was “What are the current uses of mICT and the future prospects of using mICT in the Libyan construction industry?”, the qualitative analysis started by extracting the participants comments (which are listed in Appendix G) and highlighting the themes in the participants’ responses which are related to current use of mICT and to interviewees’ perspectives on the future use of these technologies (see Appendix H), and finally summarizing them together (see Appendix I).

5.3.3.1. Current uses of mICT in the Libyan construction industry

All interviewees (25) stated that they have mobile phones and have been using them for long time and they are also familiar with some other mICT technologies such as handheld computers (laptops) and Internet. The interviewees in this study emphasized some current uses of mICT in their construction companies as listed in Table 5.23.

The majority of the participants stated that some personal attempts have been made to integrate mICT (mobile phones, handheld computers) into their companies to improve the output of their projects and to enhance the level of performance. Moreover, each one of those interviewees went on to say that he was familiar with these technologies and had enough experience in using them.
### Table 5.22 Current mICT uses in the Libyan construction industry

<table>
<thead>
<tr>
<th>Type of mICT technology (currently used)</th>
<th>Technology uses</th>
<th>Purpose of use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mobile phones</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Contacting and interaction (phone calls, text messages, emails, Viber and Skype).</td>
<td>• Arranging for meetings&lt;br&gt;• Solving problems&lt;br&gt;• Following up the progress of projects&lt;br&gt;• Transferring information (reports and letters)</td>
<td></td>
</tr>
<tr>
<td>• Taking photos</td>
<td>• Tracking the movement and status of all materials, equipment, personnel, and other resources on-site to enable workers to instantly locate the resources they need and get them delivered for immediate use</td>
<td></td>
</tr>
<tr>
<td>• GPS</td>
<td>• Recording the exact path to get somewhere&lt;br&gt;• Using GPS to determine the route to a specific locations</td>
<td></td>
</tr>
<tr>
<td><strong>Handheld Computers</strong> (Laptops, Tablets)</td>
<td>• AUTO CAD programs</td>
<td>• For designing and drawing maps and designs</td>
</tr>
<tr>
<td></td>
<td>• Microsoft Word</td>
<td>• For reporting, preparing quantity tables and bids and writing letters</td>
</tr>
<tr>
<td></td>
<td>• Webcams&lt;br&gt;• CCTV cameras</td>
<td>• Monitoring, observing and controlling materials and workers movement</td>
</tr>
</tbody>
</table>

All interviewees stated that they have mobile phones and computers (laptops) and they added that their personal use of these technologies could also make them able to adopt and use them for work. For example, Interviewee 4 stated “*I have had a mobile phone since 2005*” (4:A5) and he added “…, as an engineer, mobile phone technology and laptops assist me to finish some work such as arranging meetings with clients or solving some problems either by making direct calls or sending text messages and I also use some programs such as AUTO CAD to help me in designing and drawing maps and sketches, etc.” (4:A6).
Interviewee 5 explained other uses of mICT in the Libyan construction industry regarding laptops by saying “In our company, our laptops are connected wirelessly to cameras (CCTV) for monitoring, observing, controlling materials and workers movement and work at sites. Moreover, we also use other technologies for transferring data such as Internet and mobile phones” (5:B4).

In addition, Interviewee 6 provided another mICT use by stating “I am a civil engineer and my long experience in using mobile phones, handheld computers and the Internet allows me to easily use them for executing some work for my company such as following up the progress of activities or taking photos for work sites or materials and equipment. Moreover, I am also using them for preparing bids, reports and letters or sometimes to check and update quantity tables, etc.” (6:A6). Interviewee 18 added “As a contractor, most of my use of these technologies is to organise meetings with clients or project managers by making calls and sending messages, in addition, my other use is for preparing tenders or contracts and other purposes related to the construction field” (18:A6).

Besides using mobile phones for making calls and sending text messages, interviewees have mentioned that they also use GPS as another facility of mobile phones when travelling for work. For example Interviewee 8 stated “I have used GPS which provides location and time information in all weather conditions and use it sometimes as a compass when moving for work to specific locations” (8:B4). And as they are using mobile phones for interacting and sharing knowledge, they are also using handheld computers (laptops) for the same purposes. For example, Interviewee 2 stated “As a consultant, I also use the available Internet networks on my laptop for contacting, discussing and offering advice to workers of the construction projects either via emails, Messenger or Skype and Viber” (2:A6). Interviewee 13 also clarified that by saying “As
a project manager and to keep up to date with project partners, I use Internet networks for sending emails or making calls to arrange and finish work” (13:A6).

As can be seen from the examples above, the qualitative analysis of the interview data indicated that the participants in this study emphasized mICT as an important characteristic of ICT. In addition, they have made attempts to involve mICT technology in their jobs to enhance their performance on the one hand and to increase the construction companies’ outcomes on another hand.

5.3.3.2. Future prospects of using mICT in the Libyan construction industry

Interviewees in this study were also asked their thoughts regarding the future prospects of using mICT in the Libyan construction industry. Interviewees emphasized some future perspectives of using mICT technologies as listed below in Table 5.24.

Table 5.23 Future prospects of using mICT

<table>
<thead>
<tr>
<th>Future prospects of using mICT technologies</th>
<th>Number of Interviewees</th>
</tr>
</thead>
<tbody>
<tr>
<td>• mICT technologies will be more successful and massively used and widely disseminated in all Libyan construction industry in the future</td>
<td>25</td>
</tr>
<tr>
<td>• The government should have strategies and developments in the future to support mICT use such as:</td>
<td></td>
</tr>
<tr>
<td>- Increasing the number of mobile service providers</td>
<td>3</td>
</tr>
<tr>
<td>- Establishing investment contracts with international mICT technology suppliers</td>
<td></td>
</tr>
<tr>
<td>- Adopting some training programs for stakeholders such as organising and processing work using mICT</td>
<td></td>
</tr>
<tr>
<td>- Import sophisticated innovations such as smart phones and wireless modems</td>
<td></td>
</tr>
</tbody>
</table>
The qualitative analysis of this study shows that Interviewees have addressed their perspectives regarding the current and future use of mICT technologies in the Libyan construction industry. All interviewees (25) believed that the adoption and using mICT in the Libyan construction industry might get more successful in future (see Appendix G for examples of interview transcripts). For example Interviewee 1 stated “… I expect mICT technologies in Libya’s construction industry will be more successful in the future if they are supported by the government” (1:C5). Interviewee 14 added “I think mICT technology in the Libyan construction industry will be widely disseminated to make work much easier in future than now (14:C5). Interviewee 19 said “I think mICT technologies will be used in future much more than now for transferring and receiving information between users in the Libyan construction industry” (19:C5).

Moreover, three participants believed that mICT technologies in the Libyan construction industry will be more successful in future if the government undertakes developments and provides strategies to support these technologies. For example, Interviewee 25 stated “I hope the government can put some strategies in place in future to support these technologies” (25:C5). Interviewee 21 clarified some of these policies by saying “This technology should receive some developments by the government in future such as increasing the number of mobile service providers or making investment contracts with international mICT technology suppliers” (21:C5). Interviewee 23 added “I hope mICT technologies in the Libyan construction industry will have some government developments such as adopting some training programs for stakeholders for example, how to organise and process work using mICT and moreover, the government can import sophisticated innovations such as smart phones and wireless modems to improve interactions in the construction domain much more in the future” (23:C5).
As previously stated, one of the purposes of the qualitative analysis which has been applied in this study was to investigate what the interviewees have thought and seen regarding the future prospects of using of mICT technologies in the Libyan construction industry. Interviewees’ thoughts concerning the future prospects of using of mICT were summarized in Table 5.24.

5.4. Summary

The results of the quantitative data analysis to test the research model and the qualitative analysis of the interview data were provided in this chapter. The quantitative analysis was started with the descriptive characteristics of the participants and their experience in using mICT in the Libyan construction industry. Most of the participants had experience using mICT. The evaluation of the measurement model was done and showed that was suitable for testing the structural model. Total effects of the research model were presented and showed that some of the proposed factors have a direct influence on the intention to adopt and use mICT such as perceived usefulness of mICT and perceived ease of use of mICT and others have indirect influence such as perceived mICT self-efficacy and facilitating conditions but the rest had no effect. The results were also showed that six hypotheses were supported but the rest were not.

The qualitative findings of the semi-structured interviews regarding the benefits and current uses and future prospects of using mICT in the Libyan construction industry were also presented in this chapter. The participants mentioned that they were interested in adopting and using mICT for their work and identified significant benefits such as saving time, cost and could also be used to perform lots work for their companies.

Chapter 6 presents a detailed discussion of both the quantitative and qualitative results concludes the research study.
Chapter 6. Discussion and Conclusion

6.1. Introduction
The quantitative and qualitative research results are discussed in this chapter. The research model and its constructs and their roles in influencing the intention to adopt and use mICT in the Libyan construction industry are discussed in Section 6.2. Section 6.3 discusses the progress towards answering the three main research questions. Limitations are discussed in Section 6.4 and the research implications for future research are discussed in Section 6.5. Recommendations for adopting and using mICT in the Libyan construction industry are presented in Section 6.6 and Section 6.7 concludes the thesis.

6.2. Research model discussion
The present study was designed to investigate and analyse the factors that could influence the intention to adopt and use mICT in the Libyan construction industry. It also considers the benefits that could be gained from adoption and use of mICT technologies and the current uses and future prospects regarding adopting and using mICT in the Libyan construction industry. This study introduced and tested a model to explain stakeholders’ intentions to adopt and use mICT in the Libyan construction industry. Figure 6.1 shows the relationships from the original research model (Figure 3.1) that were supported. The model was designed based on prior studies that have used technology acceptance models such as TAM (Davis, 1989), TPB (Ajzen, 1991), TAM2 (Venkatesh & Davis, 2000), UTAUT (Venkatesh et al., 2003), and especially the model by Luarn and Lin (2005) which represents the influence of factors that might impact the adoption and use of mICT and demonstrated an ability to explain and predict behavioural intention to use mICT. In addition to the broader technology acceptance
literature, the model also draws work on benefits of mICT for construction projects (Bowden et al., 2006; Son et al., 2012).

The supported relationships in the research model as found in this study are shown in Figure 6.1. Perceived usefulness of mICT is influenced by perceived ease of use of mICT and perceived mICT self-efficacy, and perceived usefulness of mICT influences the intention to adopt and use mICT. The results therefore suggest that, when participants in the Libyan construction industry believe that mICT is beneficial they are more likely to intend to adopt and use it. In addition, perceived ease of use of mICT also plays an important role. This construct was influenced by perceived mICT self-efficacy and facilitating conditions, and in turn had positive influences on perceived usefulness of mICT and the intention to adopt and use of mICT.

This study suggests that the theoretical research model has the ability to explain some of the intention to adopt and use mICT in the Libyan construction industry. The model explained 47.1% of the total variance in the participants’ intended adoption and use of mICT. This is consistent with prior studies such as Zarpou et al. (2010) which explained 38.3% of the variability in the intention to adopt mobile services. This means that independent variables considered in this study are important for understanding intention to adopt and use mICT in the construction industry. However, the explanatory power could possibly be increased by including the influence of other factors. Son et
al.’s. (2012) model which was proposed to investigate the factors that influence successful implementation of mobile computing devices in the construction industry explained 67% after extending TAM with other organisational, technical and social factors which have been considered important constructs in other technology acceptance models and theories. For example social influence was shown to have a significant impact on the decision to adopt mobile computing devices in construction (Son et al., 2012).

The following sections discuss the main role of each proposed construct in the research model of this study, in terms of intention to adopt and use mICT in the Libyan construction industry.

6.2.1. The role of perceived usefulness of mICT
Considerable research has been carried out to investigate whether users will accept and voluntarily use information systems with respect to numerous factors such as perceived usefulness, and perceived ease of use (e.g. Venkatesh et al., 2003; Luarn & Lin, 2005).

One of the research model’s primary constructs is perceived usefulness of mICT. The findings of this study revealed that perceived usefulness of mICT plays a significant role in influencing users’ intention to adopt and use mICT in the construction industry. This is consistent with other previous studies such as Son et al. (2012), Luarn and Lin (2005) and Sun, Cao, and Yu, (2010) who found that perceived usefulness had a significant effect on adoption intention and user acceptance of mobile technology. The results showed that the intention of users to adopt and use mICT in the Libyan construction industry is influenced by how useful they believe these technologies are.

6.2.2. The role of perceived ease of use of mICT
The research model of this study proposed that perceived ease of use of mICT influences the intention to adopt and use mICT in the Libyan construction industry
both directly and indirectly via perceived usefulness of mICT. The construct perceived ease of use of mICT was found to have a significant direct influence on the intention to adopt and use mICT, and also a significant direct effect on perceived usefulness of mICT. The direct relationship between perceived ease of use of mICT and the intention to adopt and use mICT is consistent with many studies such as Son et al. (2012), Luarn and Lin (2005) and Sun et al. (2010). Likewise, the relationship between perceived ease of use of mICT and perceived usefulness of mICT is consistent with the results of previous studies such as Luarn and Lin (2005), Yaghoubi and Bahmani (2010) and Son et al., (2012) which means that perceived usefulness of mobile technologies in the construction industry increases when users perceive that mICT technologies are easy to use and not much effort will be required to use them.

6.2.3. The role of perceived high cost of technology

The perceived high cost of the technology construct in the research model was hypothesized to directly influence intention to adopt and use mICT in the Libyan construction industry. But one of the unanticipated findings of this study was that the relationship between perceived high cost of technology and intention to adopt and use mICT was not as expected. Although participants were aware of the high the prices of mICT technologies, they also saw mICT as a beneficial technology to their jobs in construction projects rather than being a financial burden. These findings are inconsistent with the findings of Luarn and Lin (2005), Harindranath et al., (2008) and Brewer and Gajendran (2012) which supported the negative relationship between perceived financial cost and behavioral intention to use mobile technology. This difference may be because the majority of the participants see that mICT facilities and infrastructure in the public sector and government companies are financially supported
and funded by the government and they see also that mICT will be used to complete work in the construction industry even if there are financial barriers.

6.2.4. The role of perceived credibility of mICT

Surprisingly, the quantitative results did not support the expected and proposed direct relationship between *perceived credibility of mICT* and *intention to adopt and use mICT* in the Libyan construction industry. The result is inconsistent with Sun et al., (2010) who reported that their study supports Luarn and Lin’s (2005) and Wang, Wang, Lin and Tang’s (2003) findings which showed that perceived credibility significantly influences the behavioural intention to use mICT. The majority of participants in this study believed that mICT is very secure and did not have concerns about using it for work in the construction industry.

6.2.5. The role of perceived mICT self-efficacy

The results showed that *perceived mICT self-efficacy* indirectly influences the *intention to adopt and use mICT* in the Libyan construction industry via both *perceived ease of use of mICT* and *perceived usefulness of mICT*. These results are consistent with the findings of Wang et al. (2003) and Luarn and Lin (2005). The results also confirm the direct relationship between *perceived mICT self-efficacy* and *perceived credibility of mICT* which is consistent with Wang et al.’s (2003) findings. It was interesting to note that *perceived mICT self-efficacy* had a similar strength influence on both *perceived credibility of mICT* and *perceived ease of use of mICT* but less than on *perceived usefulness of mICT* (see Table 5.14 for assessment of total effects). This implies that if stakeholders feel confident about mICT skills they generally demonstrate a higher perception of credibility and ease of use of mICT and also suggests that users with high expertise might rate an mICT as more secure and easier to use than those with lower expertise.
6.2.6. Role of facilitating conditions

Consistent with previous studies such as Venkatesh et al. (2003) and Kripanont (2007), the findings of this study did not support the proposed direct relationship between facilitating conditions and intention to adopt and use mICT while this relationship was supported in the studies of Dwivedi (2005) and Ooi et al. (2011).

The lack of a direct relationship between facilitating conditions and intention to adopt and use mICT in this study could be attributed to the fact that participants see that they have the knowledge necessary to use mICT and access to the software, hardware and network facilities required to use mICT and participants didn’t mention any concerns regarding this issue.

On other hand, the results of this study did establish an indirect positive relationship between facilitating conditions and intention to adopt and use mICT via perceived ease of use of mICT. Therefore users should find mICT easier to use when they have an adequate technical support, good communications infrastructure for mICT technology and there are no compatibility problems related to the mobile technologies they would use. These results are consistent with Lu et al. (2014).

6.3. Answering the research questions

As stated in Chapter 1 and 3, the primary aim of the research was to investigate what factors could influence the intention to adopt and use mICT by stakeholders in the Libyan construction industry. The factors investigated include perceived usefulness of mICT, perceived ease of use of mICT, perceived high cost of technology, perceived mICT self-efficacy, perceived credibility of mICT and facilitating conditions. The research also considered what benefits could be gained from mICT adoption and use in the Libyan construction industry and what the current uses of mICT and the future
prospects regarding using mICT in the Libyan construction industry are. This section discusses the progress of the study towards answering the research questions.

The first research question of the thesis was:

*RQ1*: *What are the factors that could influence mICT adoption and use in the Libyan construction industry?*

As previously stated in the beginning of this thesis, Libya recently has been involved in a truly serious civilian war which destroyed much of the buildings and infrastructure; reconstructing and rebuilding the country is one of the major concerns and an important target the government is focusing on. Moreover, using new innovations such as mobile technologies to do this will be taken into consideration by the Libyan authorities. Investigating and analysing the factors that affect the *intention to adopt and use mICT* will help the authorities who are involved in the Libyan construction industry (for example Ministry of Housing and Utilities) to avoid the impediments which can negatively affect the adoption and usage of these technologies.

The answer to this research question is that *intention to adopt and use mICT* in the Libyan construction industry was found to be directly affected by *perceived usefulness of mICT* and *perceived ease of use of mICT* and indirectly affected by *perceived mICT self-efficacy and facilitating conditions*. This means that the more stakeholders perceive mICT useful as and easy to use the more likely are they intend to adopt and use mICT. Similarly for perceived mICT self-efficacy, the more stakeholders feel confident about their use of mICT the more likely they are to intend to adopt and use mICT.

Likewise for facilitating conditions, the more stakeholders have adequate technical support and no compatibility problems using mICT, the more likely are to find it easy to use and intend to adopt and use mICT.
It was proposed that high cost of technology would also influence intention to adopt and use mICT, but surprisingly the findings of this study are inconsistent with the previous research and this was found not to be the case.

The second research question of the thesis was:

RQ2): *What are the benefits that could be gained from mICT adoption and use in the Libyan construction industry?*

The second aim of this study was to determine what benefits could be gained from mICT adoption and use in the Libyan construction industry. The qualitative results showed that mICT technologies are seen to be very beneficial to the participants and they were positive about adopting and using them for work due to the benefits that they expected to gain. This study produced results that corroborate the findings of Bowden et al. (2006) and Leskinen (2008) in the matter of reduction in time and cost saving. Participants indicated that mICT technologies in the construction industry could provide a large set of benefits and also contributes in the development of construction field by: providing access to accurate and up to date information and improving the skills of workers.

The third research question of the thesis was:

RQ3): *What are the current uses of mICT and the future prospects of using mICT in the Libyan construction industry?*

On the question of what are the current uses of mICT and the future prospects regarding adopting and using mICT technologies all participants stated that they have mobile phones and laptops and they added that their personal use of these technologies makes them able to adopt and use them for the purpose of improving the output of their projects and enhancing the level of their performance.
Moreover, this study also set out with the aim of assessing the future prospects of using mICT in the Libyan construction industry. The participants believed that mICT technologies will be more successful and widely disseminated in all of the Libyan construction industry in the future. They also said that the government should have strategies and undertake developments in the future to support mICT use such as: increasing the number of mobile service providers, establishing investment contracts with international mICT technology suppliers, providing training programs for stakeholders.

Participants’ future perspectives regarding the future use of mICT could help the authorities to develop plans and procedures that could improve the performance and work in construction projects.

6.4. Research limitations

Although not many difficulties were faced in this study, and the research was done as planned, reached its aims and was successfully accomplished, there are a few limitations that need to be considered.

First, adding other variables to the model and testing it could help to understand further influences on intention to adopt and use mICT in the construction industry. For example, social influence has been shown to have a significant impact on the decision to adopt mobile computing devices in construction (Son et al., 2012) and may a useful addition to the model. Also another factors related to individual characteristics such as resistance to change have been shown to have a significant influence on the success of ICT implementation in construction industry (Henderson & Ruikar, 2010).

Secondly, the participants were most likely older and more educated than would be expected in the industry.
Thirdly, the interviewees in this study represented a narrow range of gender (sample excluded females) and this can be considered as a weakness because a sample with more diversity would have benefited the study results. This could not be avoided and researcher attributed that to the culture of the country.

6.5. The research implications

Findings of this study revealed various research implications relating to the adoption and use of mICT in the construction industry.

This study investigated and highlighted the factors that could influence the adoption and use of mICT in the Libyan construction industry, and it has shown how perceived usefulness of mICT, perceived ease of use of mICT, perceived mICT self-efficacy and facilitating conditions affect either directly or indirectly participants’ intention to adopt and use mICT.

Moreover, this study helps to understand the nature and extent of mICT factors influencing adoption and use mICT within the construction companies and highlighted the areas where mICT can be beneficial and successfully implemented.

The main contribution of this study to scholarly knowledge is the theoretical research model of adopting and using mICT in the construction field which was designed based on prior studies that have used TAM (Davis, 1989), TPB (Ajzen, 1991), TAM2 (Venkatesh & Davis, 2000), UTAUT (Venkatesh et al., 2003), and especially the model by Luarn and Lin (2005) which represents the influence of factors that might impact the adoption and use of mICT. The model included additional factors that hadn’t previously been tested in the construction domain, and this adds to understanding of enabling factors in this area in developing countries. Although some other studies have been conducted regarding the Libyan construction industry (e.g. Ngab, 2007), this study is
deemed to be the first study concerning the assessment of the *intention to adopt and use mICT* in the Libyan construction industry.

In addition, the study found that participants in the Libyan construction industry have a strong intention to adopt and use mICT as they perceive the usefulness and ease of use of these technologies. In other words this study has gone some way towards enhancing research understanding of what factors could affect the *intention to adopt and use mICT*.

Lastly, identifying benefits and perspectives of participants regarding future adoption of mICT could support authorities increasing their knowledge of the role that mICT could play in the construction industry and might also lead them to give priority attention to bolstering use of these technologies not only in construction industry but overall across Libya’s industry sectors.

**6.6. Practical implications for the Libyan construction industry**

Although this study has uncovered many areas that need additional study, it has presented a model which could be used as input to a practical guide for construction organisations and other industries in Libya or other countries that plan to adopt and use mICT. This study has also highlighted factors that might reduce the success of mICT adoption and use in the Libyan construction industry. Moreover, this study identified that mICT technologies are beneficial in some areas such as saving time, reducing cost and have other noticeable benefits for the stakeholders and projects; therefore it is important that the Libyan government should encourage construction stakeholders to adopt and use mICT technologies to improve project performance and outcomes. In particular, this study sees that mICT technologies should have government support and the government should also apply strategies to deploy these technologies in the Libyan construction industry such as increasing the number of mobile service providers,
establishing investment contracts with international mICT technology suppliers, adopting training programs for stakeholders and importing sophisticated innovations. The research conducted in this thesis has led to identification of some useful results for stakeholders in the Libyan construction industry if they adopt and use mICT.

In addition, the researcher sees that this research should open doors for the Libyan government in seeking ways to contribute in adopting and using mICT much more in the future and it would be one of the beneficiaries.

Modern communication networks that are supported by government investment would also allow the construction industry to use the latest innovations which would result in a reduction in duration and costs of construction projects.

The government should also provide gateways to disseminate an mICT technology culture among the construction stakeholders by for example conducting seminars or disseminating newsletters regarding this technology and expand mICT training programs to improve the skills of construction stakeholders to be able to adopt and use such these technologies.

Construction companies could also adopt plans in order to promote construction stakeholders perceptions of self-efficacy in mobile technology and to improve performance of projects by organizing training courses in various mobile technologies, thus increasing stakeholders’ familiarity with mobile computing technologies which in turn can positively influence the intention to adopt and use mobile technologies.

6.7. Recommendations for future research

The study has highlighted the influence of some factors on the intention to adopt and use mICT in the Libyan construction industry and the benefits that could be gained from
this adoption. It also presents some recommendations to researchers for future work to build upon this study. These recommendations are:

- Further research could be done using the research model of this study to investigate other variables that might influence the adoption of mICT either in Libya or in other countries. For example, social factor to examine wheather influences mICT in the Libyan construction industry.

- Several of the findings from previous research such as Wang et al. (2003), Luarn and Lin (2005), Dyerson and Barnes (2008) and Brewer and Gajendran (2012) on the influence of perceived credibility and perceived high cost of technology on the intention to adopt and use technologies were not replicated in this study. Therefore, it would be valuable for future research to address this lack of influence.

- If future research could involve female participants in interviews as qualitative data collection, new insights might be obtained such as more suggestions and recommendations and other views.

6.8. Scholarly contribution to knowledge

The study has made a contribution to scholarly knowledge by:

- Providing an inclusive model of mICT adoption and use in the construction industry. In particular, the research model of this study provides insight into the relationship between the proposed variables and the intention to adopt and use mICT and this has not been examined or tested before in the Libyan construction industry.

- The understanding of the factors that influence adoption and use mICT in the construction industry that has been developed through this study could provide an essential mechanism to encourage construction organisations to prepare for mICT adoption and use.
• Providing a theoretical foundation for researching the mICT context of the construction industry in the future.

6.9. The research conclusion

This study was the first study designed to systematically survey the intention of participants to adopt and use mobile technologies in the Libyan construction industry and specifically aimed to investigate the factors that might influence the intention of adopting and using mICT. Likewise, it set out to determine the benefits that could be gained from adopting and using mICT and to investigate participants’ perspectives regarding adopting and using mICT in the construction industry. The following conclusion can be drawn from this study.

This study has answered the research questions as initially proposed. Intention to adopt and use mICT in construction industry is directly affected by two important factors that are perceived usefulness of mICT and perceived ease of use of mICT and indirectly by other factors such as perceived mICT self-efficacy and facilitating conditions. Similarly, the study has shown that mICT is very beneficial to the stakeholders in the construction industry in numerous areas such as for reducing time, cost and effort and for interacting, monitoring, information exchanging and also for organising and completing work. In addition, the study has also identified the construction industry participants’ perspectives on what the future holds for mICT use in the construction sector, and the necessity for government support.
Appendix A: Information letter
An investigation of factors that influence the intention to adopt and use mobile communication and technology (mICT) in the Libyan construction industry.

Survey by Questionnaire
Form Seq. No. (   )
Libya Survey -2013

By: Jamal Mohamed Sheglabo
Australia Mobile: +61450499706
Email: jsheglabo2@yahoo.com
Dear Construction Client, Contractor, Project Manager or Worker

I am conducting research on the adoption and use of mobile communication and technology (mICT) in the Libyan construction industry as partial fulfilment of the requirements of a PhD degree in Information Technology with a focus on mobile technology (mICT), from Murdoch University in Australia. My supervisors are Dr Michael Dixon, and Dr Tanya McGill.

The purpose of this survey is to evaluate the perceptions of mICT by stakeholders and determine the factors that influence the intention to adopt and use mICT in the construction industry in Libya. The findings may help in understanding the constraints on or the barriers to using this technology, which may prove valuable for strategic planning and practice in the construction domain.

Completion and return of the questionnaire to the administrative staff or to the researcher by email or mail in a closed and stamped envelope will constitute consent to participate in this research. The questionnaire offers the option of taking part in a subsequent interview.

Be advised that participation is voluntary. Confidentiality will be assured in the analysis and reporting of data since the questionnaire is anonymous. There are no known risks in participating in the study. And please be assured that the investigator has no financial interest in the research.

It might take 25-30 minutes to complete the questionnaire. Participants will be able to receive an email about feedback and the outcomes of the research by the researcher.

If you have any question about this research please do not hesitate to contact Jamal Mohamed Sheglabo (Libya mobile: +218925414618, Australia mobile: +614 50499706, e-mail: jsheglabo2@yahoo.com), or my supervisors (Michael Dixon, e-mail M.Dixon@murdoch.edu.au, Tel: +61893606086, Associate Professor Tanya McGill, e-mail T.Mcgill@murdoch.edu.au, Tel: +6893602798).

With thanks your cooperation is highly appreciated.

Jamal Mohamed Sheglabo
Doctoral candidate
Tel: +61450499706
Email: jsheglabo2@yahoo.com
Dr. Michael Dixon  
School of Engineering and Information Technology  
Tel: +61893606086  
Email: m.dixon@murdoch.edu.au

Associate Professor Tanya McGill  
School of Engineering and Information Technology,  
Tel: +61 8 93602798  
Email: t.mcgill@murdoch.edu.au

This study has been approved by the Murdoch University Human Research Ethics Committee (Approval 2013 /036). If you have any reservation or complaint about the ethical conduct of this research, and wish to talk with an independent person, you may contact Murdoch University’s Research Ethics Office (Tel. +61 8 9360 6677 or e-mail ethics@murdoch.edu.au). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
An investigation of factors that influence the intention to adopt and use mobile communication and technology (mICT) in the Libyan construction industry.

بحث

الباحث: جمال محمد شفلابو

الهاتف (استراليا): +61450499706

البريد الإلكتروني: jsheglabo2@yahoo.com
عزيزي العميل – المقاول – مدير المشروع العامل

أنا أقوم بإجراء بحث بشأن بناء وتفتيح تقنية المعلومات المنقولة (mICT) في صناعة البناء والتشييد في ليبيا كجزء من المتطلبات الفنونية للدكتوراه في تقنية المعلومات بالتركيز على تقنية المعلومات والاتصالات المنقولة (mICT) من جامعة موردوخ في أستراليا. وتحت إشراف المشرفين الدكتور مايكل ديكسون، والدكتورة تانيا ماكجيل.

أعتبر الحصول على البيانات من أجل الدراسة أمرًا حاسمًا في تقييم تاورات ووجهات النظر فيما يخص استعمال تقنية المعلومات. وتحت اشراف المشرفين الدكتور مايكل ديكسون، والدكتورة تانيا ماكجيل.

الغرض من القيام بهذا البحث هو تقييم تسوسات ووجهات النظر فيما يخص استعمال تقنية المعلومات والاتصالات المنقولة من قبل أصحاب العملة في ذلك وقد تؤثر على نية استعمال هذه التقنية في صناعة البناء والتشييد في ليبيا. النتائج التي سوف يتم الحصول عليها ستساعد في فهم الفوائد والمخاطر التي قد تعبيق استخدام هذه التقنية. وأيضاً قد تكون مفيدة في البرمجة عن قيمة هذه التقنية في التخطيط الاستراتيجي والنازح العملية في مجال البناء.

استكمال وإتمام الاستطلاع الخاص بالدراسة وترجيعه إلى الباحث عن طريق البايبل أو البريد الإلكتروني يعتبر موافقة فعلية للمشاركة في هذا البحث. الاستطلاع يشتمل على عدة أسئلة، ولذا فإنك ربما تحتاج إلى بعض الوقت لقراءته. ويرجى التأكد من أنك لا تملك مالحة مالية في هذا البحث.

قد يستغرق الاستضافة حوالي 25-30 دقيقة لإتمامه. المشاركون بإمكانهم الحصول على نتائج هذا البحث من قبل الباحث عن طريق البريد الإلكتروني (البايبل) أو البريد الإلكتروني للمشرفين (مايكل ديكسون، البريد الإلكتروني: M.Dixon@murdoch.edu.au، هاتف: 53616126 602، أستاذ مشارك، و تانيا ماكجيل، البريد الإلكتروني: T.Mcgill@murdoch.edu.au، هاتف: 53615452 602).

إذا كان لديك أي سؤال حول هذا البحث من فضلك لا تتردد في الاتصال بالمشرفين جمال محمد شقلابو ( هاتف نقال: +61 450499706 + ليبيريا، أو +61 450499706 أستراليا، البريد الإلكتروني: M.Dixon@murdoch.edu.au). .

 تشكتكم ونود أن نتعاون معكم.
جمال محمد شقلابو
طلاب دكتوراه - جامعة موردوخ.
هاتف: +61 450499706
jsheglabo2@yahoo.com
بريد الإلكتروني: murdoch.edu.au

دكتور مايكل ديكسون.
دكتور مايكل ديكسون.
تمت الموافقة على هذه الدراسة من قبل جامعة موردوخ من قبل لجنة أخلاقيات الإنسان بجامعة موردوخ (الموافقة 136/5103). إذا كان لديك أي تحفظ أو شكوك حول السلوك الأخلاقي لهذا البحث، وترغب في التحدث مع شخص مستقل بالخصوص، يمكنك الاتصال بـ مكتب أخلاقيات البحوث بجامعة موردوخ (هاتف: +618936066777 أو على البريد الإلكتروني ethics@murdoch.edu.au). سيتم التعامل مع أي قضايا قمت برفعها بكل ثقة وسيتم التحقق الكامل فيها و، وسيتم إعلامك بكل النتائج التي تم التوصل إليها.
Appendix B: English version of the questionnaire
<table>
<thead>
<tr>
<th>ICT</th>
<th>Information and Communication Technology.</th>
</tr>
</thead>
<tbody>
<tr>
<td>mICT technology</td>
<td>A generic term used to refer to a variety of devices that allow people to access data and information from wherever they are e.g. handheld computers or cell phone connections to make phone calls as well as connecting to the Internet to enhance the performance of work activities.</td>
</tr>
<tr>
<td>Perceived mICT self-efficacy</td>
<td>A user's (client, project manager, contractor, consultant or worker) belief about his or her ability to use mICT in order to enhance the performance in construction industry.</td>
</tr>
<tr>
<td>Perceived credibility of mICT</td>
<td>The degree to which a user (client, project manager, contractor, consultant or worker) believes the use of mICT will have no security and privacy threats.</td>
</tr>
</tbody>
</table>

**Part A: Demographic and Background Participant Information**

This part of the questionnaire asks about your background. Please tick √ one of the given answers.

1. How old are you?
   - i 18-29
   - ii 30-39
   - iii 40-50+

2. What gender are you?
   - i Male
   - ii Female

3. What is your education level?
   - i Primary school
   - ii High School
   - iii Institute
   - iv University

4. What employment sector do you work in?
   - i Public Sector
   - ii Private Sector
   - iii Self-employment

5. Which of the following illustrates your skills and experience level of using mICT?
   - i Beginner
   - ii Intermediate
   - iii Advanced
Part B: Perceived usefulness of mICT.

This part of the questionnaire relates to how useful mICT would be for the construction industry. Please rate your agreement with each statement.

6. Using mICT would be useful for the construction industry.

   Strongly Disagree                  Strongly Agree
   1      2      3      4      5

7. Using mICT would help to get necessary information when it is needed.

   Strongly Disagree                  Strongly Agree
   1      2      3      4      5

8. Using mICT would reduce the time taken for construction activities.

   Strongly Disagree                  Strongly Agree
   1      2      3      4      5

9. Using mICT in my job would increase my productivity.

   Strongly Disagree                  Strongly Agree
   1      2      3      4      5

10. Using mICT would reduce the number of construction activity defects.

    Strongly Disagree                  Strongly Agree
    1      2      3      4      5

11. Using mICT would reduce the number of accidents at construction project sites.

    Strongly Disagree                  Strongly Agree
    1      2      3      4      5

12. Using mICT would reduce the capital cost and/or money wastage of construction projects.

    Strongly Disagree                  Strongly Agree
    1      2      3      4      5
13. Using mICT would reduce the operations and maintenance cost.

   Strongly Disagree  1  2  3  4  5  Strongly Agree

14. Using mICT would support construction processes and reduce paperwork.

   Strongly Disagree  1  2  3  4  5  Strongly Agree

15. Using mICT would make the interaction easier between workers at construction sites.

   Strongly Disagree  1  2  3  4  5  Strongly Agree

**Part C: Intention to adopt and use mICT.**

This part of the questionnaire relates to your intention to adopt and use mICT. Please rate your agreement with each statement.

16. I support the adoption and use of mICT at the construction industry projects.

   Strongly Disagree  1  2  3  4  5  Strongly Agree

17. I intend to increase my use of mICT to perform construction activities in the future.

   Strongly Disagree  1  2  3  4  5  Strongly Agree

18. Given that I had access to mICT, I predict that I would use it in construction industry projects.

   Strongly Disagree  1  2  3  4  5  Strongly Agree

19. Assuming that I have access to the mICT, I intend to use them to perform construction project activities.

   Strongly Disagree  1  2  3  4  5  Strongly Agree

20. I will recommend others to use mICT in performing construction activities.

   Strongly Disagree  1  2  3  4  5  Strongly Agree
**Part D: Perceived ease of use of mICT**

This part of the questionnaire relates to how easy to use you think mICT would be. Please rate your agreement with each statement.

21. Learning to use mICT to perform construction project activities would be easy.

   - Strongly Disagree
   - Strongly Agree
   - 1   2   3   4   5

22. I would find it is easy to remember how to perform tasks using mICT in the construction industry.

   - Strongly Disagree
   - Strongly Agree
   - 1   2   3   4   5

23. It would be easy to become skilful using mICT in construction projects.

   - Strongly Disagree
   - Strongly Agree
   - 1   2   3   4   5

24. My interaction with mICT for construction activities would be clear and understandable.

   - Strongly Disagree
   - Strongly Agree
   - 1   2   3   4   5

25. I would find it easy to get mICT to do what I want it to do.

   - Strongly Disagree
   - Strongly Agree
   - 1   2   3   4   5

**Part E. Perceived high cost of technology**

This part of the questionnaire relates to the expense of mICT. Please rate your agreement with each statement.

26. The cost of using the mICT in construction projects would be reasonable.

   - Strongly Disagree
   - Strongly Agree
   - 1   2   3   4   5

27. Using mICT in construction industry should be expensive overall.

   - Strongly Disagree
   - Strongly Agree
   - 1   2   3   4   5
28. The cost of using mICT would be a burden to the construction industry.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5</td>
<td></td>
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</tbody>
</table>

29. It would be often have difficulties in paying mobile technologies bills.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
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<tbody>
<tr>
<td>1 2 3 4 5</td>
<td></td>
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</table>

30. mICT would be used in the construction industry even though there are financial barriers.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
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<td>1 2 3 4 5</td>
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</table>

**Part F. Perceived credibility of mICT**

This part of the questionnaire relates to how mICT might impact privacy and security in the construction industry. Please rate your agreement with each statement.

31. Using mICT would not be divulged work information in construction industry.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5</td>
<td></td>
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</table>

32. I would find mICT secure for transferring sensitive information in the construction industry.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
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<tbody>
<tr>
<td>1 2 3 4 5</td>
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</table>

33. Overall, mICT is safe for transferring sensitive information.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
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<td>1 2 3 4 5</td>
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</table>

34. I would feel secure sending sensitive information using mICT.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
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<tbody>
<tr>
<td>1 2 3 4 5</td>
<td></td>
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</table>

35. mICT is a secure means through which to send sensitive information in the construction industry.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
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<tr>
<td>1 2 3 4 5</td>
<td></td>
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</table>

36. I would feel totally safe providing private information when using mICT.
Part G. Perceived mICT self-efficacy

This part of the questionnaire relates to your confidence in using mICT. Please rate your agreement with each statement.

37. I am able to use mICT without the help of others.

38. I could use mICT if someone showed me how to do it first.

39. I could use mICT if I had just built-in help facilities for assistance.

40. I have the knowledge and skills required to use mICT.

41. I can remain calm when facing mICT difficulties because I can rely on my coping abilities.
**Part H. Facilitating conditions**

This part of the questionnaire relates to support how for using mICT in the construction industry. Please rate your agreement with each statement.

42. I am given the necessary support and assistance to use mICT.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
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</table>

43. I have the financial and technological resources required to use mICT.

<table>
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<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
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</table>

44. I have access to the software, hardware and network technologies required to use mobile technologies.

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<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
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</table>

45. The mICT I would use is well integrated and provided in a stable service infrastructure.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
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</tbody>
</table>

46. My service provider/operator facilitates the use of mICT.

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<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
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</table>

47. There is no compatibility problems related to the mICT I would use.

<table>
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<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
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</table>

48. When I need help to use mICT, specialized instruction is available to help me.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
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</table>
If you have further information or comment about the subject of the questionnaire please feel free to indicate them below:

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This research consists of two data collection tools that are this questionnaire and follow up interviews of selected participants.

Would you like to participate in a 25 minute interview? The questions of the interview will be handed or submitted to you prior to the interview and arrangements will be carried out to conduct the interview.
1. ☐ No 2. ☐ Yes

If ‘Yes’, Please leave your contacts and the researcher will arrange for the interview.
Land phone: ...........................................................
Mobile: ...........................................................
Email: ...........................................................

Please return the questionnaire to the researcher by one of the two prior mentioned ways.
Thanks and your cooperation is highly appreciated.
Appendix C: The Arabic version of the questionnaire
الاستبيان

تقنية المعلومات الاتصالات

مصطلح عام يستخدم للإشارة إلى مجموعة متنوعة من الأجهزة التي تسمح للناس للوصول إلى البيانات والمعلومات. كما كانوا على سبيل المثال خلية الاتصال الهاتف لإجراء المكالمات الهاتفية وكذلك الاتصال عن طريق الإنترنت للتعزيز وتحسين أداء النشاط.

اعتقاد المستخدم (عميل، مدير مشروع، مستشار أو عامل) بأن له أو لها القدرة على استخدام خدمات تقنيات الموبيل من أجل تعزيز وتحسين أداء النشاط مشروع البناء.

هي الدرجة التي عندها المستخدم (عميل، مدير مشروع، مستشار أو عامل) يعتقد أن استخدام تقنية الموبيل لن تهدد الأمان والخصوصية.

الجزء الأول: البيانات الديموغرافية الأولية.

من فضلك اختر إجابة واحدة فقط لكل سؤال أدناه بوضع علامة صح غي المربع المناسب.

إلى أي الفئات العمرية تنتمي؟

أ. 18 - 29
ب. 30 - 39
ج. 40 - 55

ما جنسك؟

أ. ذكر
ب. أنثى
3. ما مستوى التعليم؟

أ. ابتدائي  
ب. ثانوي  
ج. معهد  
د. جامعي

4. ما نوع القطاع الذي تعمل به؟

أ. قطاع عام  
ب. قطاع خاص  
ج. يعمل لحساب نفسه

5. ما مستوى خبرتك في مجال استخدام تقنية المعلومات والاتصالات المنقولة؟

أ. مبتدئ  
ب. متوسط  
ج. متقدم

الجزء الثاني: فائدة تقنية المعلومات والاتصالات المنقولة

من فضلك اجب عن الآتي وذلك بوضع دائرة على الرقم الذي تراه مناسب

6. استخدام تقنية المعلومات والاتصالات المنقولة تكون مفيدة لصناعة البناء والتشييد.

موافق بشدة  غير موافق بشدة

5 4 3 2 1

7. استخدام تقنية المعلومات والاتصالات المنقولة من شأنها ان تساعد في الحصول على المعلومات اللازمة عند الحاجة إليها.

موافق بشدة  غير موافق بشدة

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8. استخدام تقنية المعلومات والاتصالات المنقولة من شأنها ان تساعد في تقليل الوقت اللازم لتنفيذ انشطة التشييد.

موافق بشدة  غير موافق بشدة

5 4 3 2 1
9. خدمات تقنية المعلومات والاتصالات المنقولة من شأنها أن تساعد في زيادة انتاجيتي في العمل.

لا موافق بشدة موافق بشدة

أ 5 
ب 4 
ج 3 
د 2 
ه 1

10. تقنية المعلومات والاتصالات المنقولة من شأنها أن تساعد في تقليل عدد الاحتكاء في نشاطات التشييد.

لا موافق بشدة موافق بشدة

أ 5 
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د 2 
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11. تقنية المعلومات والاتصالات المنقولة من شأنها أن تساعد في تقليل عدد الحوادث في مواقع مشاريع التشييد.

لا موافق بشدة موافق بشدة

أ 5 
ب 4 
ج 3 
د 2 
ه 1

12. تقنية المعلومات والاتصالات المنقولة من شأنها أن تساعد في تقليل رأس مال المشروع والفاقد المالي كذلك.

لا موافق بشدة موافق بشدة

أ 5 
ب 4 
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د 2 
ه 1

13. تقنية المعلومات والاتصالات المنقولة من شأنها أن تساعد في تقليل مبالغ العمليات والصيانة.

لا موافق بشدة موافق بشدة

أ 5 
ب 4 
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د 2 
ه 1

14. تقنية المعلومات والاتصالات المنقولة من شأنها أن تدعم إجراءات التشييد وتقلل الاعمال الورقية.

لا موافق بشدة موافق بشدة

أ 5 
ب 4 
ج 3 
د 2 
ه 1

15. تقنية المعلومات والاتصالات المنقولة من شأنها أن تجعل التواصل بين العاملين سهل في مواقع التشييد.

لا موافق بشدة موافق بشدة

أ 5 
ب 4 
ج 3 
د 2 
ه 1
الجزء الثالث: استدراك الرغبة في استخدام تقنية المعلومات والاتصالات المنقولة

من فضلك اجب عن الآتي وذلك بوضع دائرة على الرقم الذي تراه مناسب

16. أنا أؤيد وادعم استخدام تقنية المعلومات والاتصالات المنقولة في مشاريع صناعة البناء والتشييد.

17. أعتزم زيادة استخدامي لتقنية المعلومات والاتصالات المنقولة في المستقبل.

18. لو كان لدي امكانية الدخول والوصول لتقنية المعلومات والاتصالات المنقولة، أتوقع أنني سوف استخدامها.

19. على افتراض أن لدي امكانية الوصول والدخول لتقنية المعلومات والاتصالات المنقولة، حتما أعتزم وارغب في استخدامها.

20. سأوصي الآخرين باستخدام تقنية المعلومات والاتصالات المنقولة.
الجزء الرابع: سهولة استخدام تقنية المعلومات والاتصالات المنقولة.

من فضلك اجب عن الآتي وذلك بوضع دائرة على الرقم الذي تراه مناسب.

21. تعلم استخدام خدمات تقنية المعلومات والاتصالات المنقولة سهلة ويسيرة.

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22. من السهل على ان يذكر كيفية انجاز المهام باستخدام تقنية المعلومات والاتصالات المنقولة في صناعة البناء والتشييد.

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23. من السهل ان تصبح ماهرا عندما تستخدم تقنية المعلومات والاتصالات المنقولة.

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24. تفاعل مع تقنية المعلومات والاتصالات المنقولة واضح ومفهوم.

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25. اجد من السهل ان تقوم تقنية المعلومات والاتصالات المنقولة بكل مربع القيام به.

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الجزء الخامس: استدراك ارتفاع تكاليف استخدام التقنية.

من فضلك اجب عن الآتي وذلك بوضع دائرة على الرقم الذي تراه مناسب:

26. اجد ان استخدام تقنية المعلومات والاتصالات المنقولة مقبولة جدا ومبررة.

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27. استخدام تقنية المعلومات والاتصالات المنقولة يكون مكلفًا بصفة عامة.

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28. مستوى اسعار تقنية المعلومات والاتصالات المنقولة تشكل عينا على صناعة الإنشاءات.

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29. انه من الغالب ان تكون هناك صعوبات في دفع فواتير تقنية المعلومات والاتصالات المنقولة.

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30. يجب استخدام تقنية المعلومات والاتصالات المنقولة في صناعة البناء والتشييد بالرغم من ارتفاع تكاليفها واسعارها.

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من فضلك اجب عن الاتي وذلك بوضع دائرة على الرقم الذي تراه مناسب

31. استخدام تقنية المعلومات والاتصالات المنقولة لن يفشي اسرار العمل أو يعرض المعلومات الخاصة بالعمل

لكشف.

32. أنا تقنية المعلومات والاتصالات المنقولة امنة عند القيام بإجراء نقل معلومات حساسة

33. في العموم تقنية المعلومات والاتصالات المنقولة امنة لنقل المعلومات الحساسة

34. اشعر بامان عند ارسال معلومات حساسة عبر تقنية المعلومات والاتصالات المنقولة

35. تقنية المعلومات والاتصالات المنقولة وسائل امنة لنقل المعلومات الحساسة

36. اشعر بالامان التام عند تقديم معلوماتي الشخصية عبر تقنية المعلومات والاتصالات المنقولة
من فضلك اجب عن الآتي وذلك بوضع دائرة على الرقم الذي تراه مناسب

لا يوجد محتوى صورة في الصورة المقدمة.

### الجزء السابع: استدراك الكفاءة الذاتية

#### 37. أنا قادر على استخدام تقنية المعلومات والاتصالات المنقولة دون مساعدة الآخرين.

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#### 38. يمكنني استخدام تقنية المعلومات والاتصالات المنقولة إذا أظهر لي شخص ما كيفية استخدامها.

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#### 39. يمكنني استخدام تقنية المعلومات والاتصالات المنقولة إذا دربت على الوسائل المساعدة لذلك.

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#### 40. لدي المعرفة والمهارات اللازمة لاستخدام تقنية المعلومات والاتصالات المنقولة.

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#### 41. أكون هادئاً عندما تواجهني صعوبات في استخدام تقنية المعلومات والاتصالات المنقولة لاتني اعتمد على قدراتي في حلها.

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الالجزء الثامن: تيسير الوسائط.

من فضلك اجب عن الآتي وذلك بوضع دائرة على الرقم الذي تراه مناسب

42. أنا أمنح الدعم والمساعدة اللازمة لاستخدام تقنية المعلومات والاتصالات المنقولة.

لا يوجد مشاكل توافقيا أو تلائمية لها علاقة باستخدام تقنية المعلومات والاتصالات المنقولة.

44. لدي امكانية الوصول خدمات البرمجيات والاجهزة والشبكة اللازمة لاستخدام تقنية المعلومات والاتصالات المنقولة.

45. تقنية المعلومات والاتصالات المنقولة التي استخدمها ذات بنية تحتية جيدة ومتكاملة.

46. مقدم الخدمة ومشغلها يزودني ويمكنني من استخدام تقنية المعلومات والاتصالات المنقولة.

47. لا توجد مشاكل توافقيا أو تلائمية لها علاقة باستخدام تقنية المعلومات والاتصالات المنقولة.
عندما احتاج المساعدة لاستخدام خدمات تقنية المعلومات والاتصالات المنقولة توجد نشرات متخصصة لمساعديني.

مواقف بشدة

غير مواقف بشدة

5 4 3 2 1

اذا كان لديك المزيد من المعلومات أو تعليق حول موضوع الاستبيان فلا تتردد في اضافتها وبيانها ادناه.

هل ترغب في اجراء مقابلة معك لمدة 25 دقيقة. مع العلم بان الاستبيان ستقدم لك مسبقا قبل اجراء المقابلة؟

نعم لا

اذا كانت اجابتك بنعم نأمل منك ترك وسيلة الاتصال الخاصة بك في الاسفل وسيقوم الباحث بوضع الترتيبات لمقابلتك.

الهاتف الأرضي

الهاتف النقال

البريد الالكتروني (الإيميل)

نثمن لك مساهمتك في انجاز هذه الدراسة من خلال الإجابة على جميع استمالة الاستبيان.

الرجاء اعادة الاستبانة للباحث بواحدى الطرق المشار إليها.
Appendix D: Interview’s information letter
Project title: An investigation of factors that influence the intention to adopt and use mobile communication and technology (mICT) in the Libyan construction industry.

Dear Construction Client, Contractor, Project Manager or Worker

My name is Jamal Mohamed Sheglabo. I am a PhD student at Murdoch University in Western Australia. My supervisors are Dr Michael Dixon, and Dr Tanya McGill. Currently I am studying the adoption and use of mobile communication and technology (mICT) in the Libyan construction industry as partial fulfilment of the requirements of a PhD degree in Information Technology with a focus on mobile technology. The findings may help in understanding the constraints on, or the barriers to, using this technology, which may prove valuable for strategic planning and practice in the construction domain.

You can further assist the study by agreeing to be interviewed. The study involves an optional interview taking approximately 25-30 minutes. Be assured that the interview is for research purposes and is not part of the subject’s assessment in the company. The contents of the interview involve background information and your attitudes towards mICT. Participation in the interview is entirely voluntary and you can decide not to take part even if you indicated agreement on the questionnaire. All information given during the interview is confidential, and no names and other information that might identify individuals will be obtained. And please be assured that the investigator has no financial interest in the research. Participants will be able to receive an email about feedback and the outcomes of the research by the researcher.

If you have any question about this research please do not hesitate to contact Jamal Mohamed Sheglabo (Libya mobile: +218925414618, Australia mobile: +61 4 50499706, e-mail: jsheglabo2@yahoo.com), or my supervisors (Dr. Michael Dixon, e-mail M.Dixon@murdoch.edu.au, Tel: +61 8 93606086, Associate Professor Tanya McGill, e-mail T.Mcgill@murdoch.edu.au, Tel: +61 8 93602798).

Thanks and your cooperation is highly appreciated

Jamal Mohamed Sheglabo
Doctoral candidate
This study has been approved by the Murdoch University Human Research Ethics Committee (Approval 2013/036). If you have any reservation or complaint about the ethical conduct of this research, and wish to talk with an independent person, you may contact Murdoch University’s Research Ethics Office (Tel. +61 8 9360 6677) or e-mail ethics@murdoch.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
Appendix E: Interview guide
Interview Guide

Part A: Demographic and Background Information

1. How old are you?
2. What is your gender?
3. What education level do you have?
4. What is your total work experience in the field of construction?
5. Do you use mobile technology? How long have you been using it?
6. How would you describe your (Computer, Internet, mICT) experience?

Part B: mICT in construction industry in Libya

1. What do you understand by mICT in the construction industry?
2. To what extent you think that using mICT is essential in the Libyan construction industry?
3. In your opinion do you think adoption and use of mICT will be successful in construction projects?
4. Would you name mICT either you have used or know about?
5. How would you describe the intention to adopt and use mICT in the company you are working for?

Part C: Security and Privacy concerns to use mICT.

1. Do you think using mICT in Libya’s construction industry is secure?
2. Would you have any concerns about your privacy while you are using the mICT?
3. Can you describe what aspects of mICT concerns are having the most influence on mICT users in construction projects?
4. In your opinion what action should be done to protect your privacy?
5. Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction?
Appendix F: Consent form
Participant Consent Form

I have read the participant information sheet, which explains the nature of the research and the possible risks. The information has been explained to me and all my questions have been satisfactorily answered. I have been given a copy of the information sheet to keep.

I am happy to be interviewed and for the interview to be audio / video recorded as part of this research. I understand that I do not have to answer particular questions if I do not want to and that I can withdraw at any time without needing to give a reason and without consequences to myself.

I agree that research data from the results of the study may be published provided my name or any identifying data is not used. I have also been informed that I may not receive any direct benefits from participating in this study.

I understand that all information provided by me is treated as confidential and will not be released by the researcher to a third party unless required to do so by law.

Participant’s name: ____________________________
Signature of Participant: ________________________
Date: .........../....../......

I confirm that I have provided the Information Letter concerning this study to the above participant; I have explained the study and have answered all questions asked of me.
Signature of researcher: ________________________
Date: .........../....../......
Appendix G: Interview transcripts
Interview no. 1

Part A: Demographic and Background information

Q1: How old are you? (1:A1)
Ans: 48 years.

Q2: What is your gender? (1:A2)
Ans: Male.

Q3: What education level do you have? (1:A3)
Ans: Institute.

Q4: What is your total work experience in the field of construction? (1:A4)
Ans: 18 years as a worker and contractor.

Q5: Do you use a mobile? How long have you been using it? (1:A5)
Ans: Yes I do have one and I can easily deal with it because I have been using it 11 years.

Q6: How would you describe your experience in computer, Internet and mICT? (1:A6).
Ans: My experience in mobile phone, computer and Internet is intermediate. I am using these technologies for more than ten years in lots works in my job as a contractor, for example for making some calls, sending messages, storing information etc.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (1:B1)
Ans: My understanding by mICT in construction as: a mediator or appliance for communicating between the first party of projects and the second party and between the engineers who are supervising the projects in construction industry.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (1:B2)
Ans: I reckon that mICT is very essential for progressing works and I can see more than 80% of the users in the construction projects are using this technology.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (1:B3)
Ans: This is what I wish and to be enough to give a propulsion and support to the construction projects.
Q4: Would you name ICT technologies either you have used or just know about it? (1:B4)

Ans: Internet and mobile technologies.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (1:B5)

Ans: Due to the ease of using this technology, we have a strong intention to adopt and use mICT by a percentage of 100%. And I couldn’t see any reasons that might obstacle using this technology in construction industry even cost.

Part C: Security and Privacy concerns to use mICT

Q1: Would you think using mICT in Libya’s construction industry are secure? (1:C1)

Ans: Yes, I think it is very secure.

Q2: Do you have any concerns about your privacy while you are using the mICT? (1:C2)

Ans: No, I don’t have any concerns while I am using mICT.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (1:C3)

Ans: As I understand and answered before, there are no any concerns in using mICT in construction projects.

Q4. In your opinion what action should be done to protect your privacy? (1:C4)

Ans: mICT is a secure and no need to take any action to protect the privacy, but if there will be any concerns, there are a lot of action can be done e.g. specific code or password, etc.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (1:C5)

Ans: I would like to say, I hope the technologies of mICT will be developed in Libya and I expect mICT in the Libya’s construction industry will be more successful future if they were supported by the government.

End of 1st Interview
Interview no. 2

Part A: Demographic and Background information

Q1: How old are you? (2:A1)
Ans: 50 years.
Q2: What is your gender? (2:A2)
Ans: Male.
Q3: What education level do you have? (2:A3)
Ans: University: Bachelor in civil engineering
Q4: What is your total work experience in the field of construction? (2:A4)
Ans: 27 years as a consultant.
Q5: Do you use a mobile? How long have you been using it? (2:A5)
Ans: Yes I do have one and I have been using it since 2000.
Q6: How would you describe your experience in computer, Internet and mICT? (2:A6)
Ans: - As a consultant, I also use available Internet networks on my laptop for contacting either via emails, Messenger or Skype and Viber to discuss or offer advice to workers of the construction projects.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (2:B1)
Ans: My understanding by mICT in construction as: a mediator or appliance for communicating to enhance the role of the administration in general specially the administration of projects and there are some programs regarding to the construction are installed in the mobiles that can be used in running of construction works and we can gain many benefits from using it which is off course depending on the experience and how easy you can interact with it.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (2:B2)
Ans: I think mICT is very essential in Libyan construction industry due to the technologies that this technology is offering and the role that it is playing for processing work.
Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (2:B3)

Ans: *Certainly, it will be very successful.*

Q4: Would you name ICT technologies either you have used or just know about it? (2:B4)

Ans: *I’ve used some other communicating and information technologies.*

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (2:B5)

Ans: *I have a strong intention to adopt and use mICT in all activities of our company projects.*

**Part C: Security and Privacy concerns to use mICT**

Q1: Would you think using mICT in Libya’s construction industry are secure? (2:C1)

Ans: *Definitely, it is secure.*

Q2: Do you have any concerns about your privacy while you are using the mICT? (2:C2)

Ans: *No, but if there are, they are very few and they will be disappeared by more developing of the technology.*

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (2:C3)

Ans: *Some little disconnections of networks and some little concerns regarding to the privacy divulge.*

Q4. In your opinion what action should be done to protect your privacy? (2:C4)

Ans: *One of the actions is developing the work and action of networks in Libya and enact some laws to protect the privacy of mobiles technology technologies users.*

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (2:C5)

Ans: *No, thanks*

End of 2nd Interview
Interview no. 3

Part A: Demographic and Background information

Q1: How old are you? (3:A1)

Ans: 32 years.

Q2: What is your gender? (3:A2)

Ans: Male.

Q3: What education level do you have? (3:A3)

Ans: University: Bachelor in civil engineering.

Q4: What is your total work experience in the field of construction? (3:A4)

Ans: 8 years as a project manager.

Q5: Do you use a mobile? How long have you been using it? (3:A5)

Ans: Yes I do have one and I have been using it since 2003.

Q6: How would you describe your experience in computer, Internet and mICT? (3:A6)

Ans: I am a project manager and have an advanced experience in computer, mobile phones and Internet and using these technologies since the year 2003 for many purposes like searching websites, contacting, drawings and other works.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (3:B1)

Ans: My understanding by mICT in construction as: mICT is a technology for communicating with projects’ parties to arrange meetings or presentations, it can also be useful in directing suppliers and organising with them for example to supply materials at the right places at construction projects sites.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (3:B2)

Ans: I think and in my opinion, this technology is one of the best means and mediators that can be used to communicate and interact in construction projects, either by making phone calls or by other communicating means like Viber, Skype, Emails or Yahoo messenger.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (3:B3)
Ans: Yes.

Q4: Would you name ICT technologies either you have used or just know about it? (3:B4)

Ans: I have used websites specifically the ones which are for construction works and the communicating means like Skype and Viber yahoo messengers.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (3:B5)

Ans: As this technology is very helpful and essential in construction industry, we have strong intention to adopt and use it in most of company’s work.

Part C: Security and Privacy concerns to use mICT

Q1: Would you think using mICT in Libya’s construction industry are secure? (3:C1)

Ans: Yes I think it is secure to some extent.

Q2: Do you have any concerns about your privacy while you are using the mICT? (3:C2)

Ans: No, I don’t have any concerns about my privacy.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (3:C3)

Ans: I can’t see any aspect to protect privacy.

Q4. In your opinion what action should be done to protect your privacy? (3:C4)

Ans: No need, but if there are any concerns of using mICT, there should be some programs to avoid and reduce those concerns.

Q5. Lastly and in the end of this interview, do you have any other information you want to Add for the future of mICT in Libya’s construction? (3:C5)

Ans: No, thanks.

End of 3rd Interview
Interview no. 4

Part A: Demographic and Background Information

Q1: How old are you? (4:A1)
Ans: 43 years.
Q2: What is your gender? (4:A2)
Ans: Male.
Q3: What education level do you have? (4:A3)
Ans: University: Bachelor in civil engineering
Q4: What is your total work experience in the field of construction? (4:A4)
Ans: 17 years as an engineer.
Q5: Do you use a mobile? How long have you been using it? (4:A5)
Ans: Yes, I have had a mobile phone since 2005.
Q6: How would you describe your experience in computer, Internet and mICT? (4:A6)
Ans: - as an engineer, mobile phone technology and laptops assist me to finish some work such as arranging meetings with clients or solving some problems either by making direct calls or sending text messages and I also use some programs such as AUTO CAD to help me in designing and drawing maps and sketches, etc.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (4:B1)
Ans: My understanding by mICT in construction as: this technology is easily can be used to lead labours at worksites and to inform them where the workers can damp and supply materials in the worksites and it can be used in sending messages regarding organising for work meetings between clients and contractors.
Q2: To what extent you think that using mICT is essential in Libyan construction industry? (4:B2)
Ans: Definitely, it is very essential and mICT is the most important technology for using to communicate in construction industry in general.
Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (4:B3)

Ans: Certainly, it is successful and it is useful and assists in completing work in the construction industry projects as planned and scheduled for example, finishing designs, time tables (project Gantt charts), preparing quantity tables and, etc.

Q4: Would you name ICT technologies either you have used or just know about it? (4:B4)

Ans: Most of ICT technologies e.g. Internet, mobile, etc.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (4:B5)

Ans: We have a strong intention to adopt and use mICT for processing the work in the company.

**Part C: Security and Privacy concerns to use mICT**

Q1: Would you think using mICT in Libya’s construction industry are secure? (4:C1)

Ans: Yes I think it is very secure up to now.

Q2: Do you have any concerns about your privacy while you are using the mICT? (4:C2)

Ans: No, I don’t have any concerns.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (4:C3)

Ans: I can’t see any concerns in using mICT in construction projects.

Q4. In your opinion what action should be done to protect your privacy? (4:C4)

Ans: In case if that to be exist, the government should apply some regulations and protection laws to protect users’ privacies.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (4:C5)

Ans: No, thanks

End of 4th Interview
Interview no. 5

Part A: Demographic and Background information

Q1: How old are you? (5:A1)
Ans: 31 years.

Q2: What is your gender? (5:A2)
Ans: Male.

Q3: What education level do you have? (5:A3)
Ans: University.

Q4: What is your total work experience in the field of construction? (5:A4)
Ans: 10 years as a project manager.

Q5: Do you use a mobile? How long have you been using it? (5:A5)
Ans: Yes I do have one and I have been using it since 7 years.

Q6: How would you describe your experience in computer, Internet and mICT? (5:A6)
Ans: - My experience as a project manager in using those technologies is intermediate.
I am mostly using mobile phone for calling and texting and laptops for reporting and some engineering programs.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (5:B1)
Ans: Based on my experience, most of our mICT use in construction projects is to organise work between the construction projects’ parties, sometimes through messages or making calls to arrange meetings or to supply materials potentially to reduce time and save money.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (5:B2)
Ans: It is very essential and necessary for completing the work in Libyan construction industry.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (5:B3)
Ans: Certainly, yes.
Q4: Would you name ICT technologies either you have used or just know about it? (5:B4)

*Ans:* In our company, our laptops are connected wirelessly to cameras (CCTV) for monitoring, observing, controlling materials and workers movement and work at sites. Moreover, for transferring data we are using other technologies such as Internet and mobile phones.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (5:B5)

*Ans:* We have extremely intention to adopt and use mICT in the company due to the previous reasons I have stated.

**Part C: Security and Privacy concerns to use mICT**

Q1: Would you think using mICT in Libya’s construction industry are secure? (5:C1)

*Ans:* Ye, it is secure and I can’t see any problems in using mICT.

Q2: Do you have any concerns about your privacy while you are using the mICT? (5:C2)

*Ans:* No, I don’t have any concerns to use mICT in construction field.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (5:C3)

*Ans:* As I know, no specific aspect could affect the users of mICT in Libyan construction industry.

Q4. In your opinion what action should be done to protect your privacy? (5:C4)

*Ans:* mICT is a secure and I can see anything should be done to protect my privacy.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (5:C5)

*Ans:* No, thanks

End of 5th Interview
Interview no. 6

Part A: Demographic and Background information
Q1: How old are you? (6:A1)
Ans: 48 years.
Q2: What is your gender? (6:A2)
Ans: Male.
Q3: What education level do you have? (6:A3)
Ans: University. Bachelor of civil engineering
Q4: What is your total work experience in the field of construction? (6:A4)
Ans: 20 years as a project manager and supervision engineer.
Q5: Do you use a mobile? How long have you been using it? (6:A5)
Ans: Yes I do have one and I have been using it since 2004.
Q6: How would you describe your experience in computer, Internet and mICT? (6:A6)
Ans: - I am a civil engineer and my experience in using mobile phones, handheld computers and the Internet allows me to easily use them for executing some work for my company such as following up on the progress of activities or taking photos of work sites or materials and equipment. Moreover, I am using them for writing bids, reports and letters or sometimes to check and update quantity tables etc.

Part B: mICT in construction industry in Libya
Q1: What do you understand by mICT in the construction industry? (6:B1)
Ans: My understanding by mICT in construction as a technology uses to send messages for work and it can be also used to send reports from worksites to the main office of the company.
Q2: To what extent you think that using mICT is essential in Libyan construction industry? (6:B2)
Ans: I can see mICT technology technologies in Libyan construction industry is very essential for the work.
Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (6:B3)

Ans: It is very successful.

Q4: Would you name ICT technologies either you have used or just know about it? (6:B4)

Ans: Most of my knowledge is about Internet.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (6:B5)

Ans: We have the intention to adopt and use mICT in the company where I am working for.

Part C: Security and Privacy concerns to use mICT.

Q1: Would you think using mICT in Libya’s construction industry are secure? (6:C1)

Ans: Yes, it is secure and I can’t see any problems up to now.

Q2: Do you have any concerns about your privacy while you are using the mICT? (6:C2)

Ans: No, I don’t have any concerns while I am using mICT.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (6:C3)

Ans: I can’t see any aspect of concerns that can influence mICT users.

Q4. In your opinion what action should be done to protect your privacy? (6:C4)

Ans: For my privacy I can’t see any action should have to do.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (6:C5)

Ans: Yes, I would like to thank the researcher and good luck to him.

End of 6th Interview
Interview no. 7

**Part A: Demographic and Background information**

Q1: How old are you? (7:A1)

*Ans: 56 years.*

Q2: What is your gender? (7:A2)

*Ans: Male.*

Q3: What education level do you have? (7:A3)

*Ans: University. BSc. in civil engineering*

Q4: What is your total work experience in the field of construction? (7:A4)

*Ans: 25 years as a project manager and supervision engineer.*

Q5: Do you use a mobile? How long have you been using it? (7:A5)

*Ans: Certainly yes, and I have been using it since 1999.*

Q6: How would you describe your experience in computer, Internet and mICT? (7:A6)

*Ans: - My experience in computer is intermediate and the same for both Internet and mICT and as an engineer most of my using of computer on drawings and searching for construction websites and contacting.*

**Part B: mICT in construction industry in Libya**

Q1: What do you understand by mICT in the construction industry? (7:B1)

*Ans: My understanding mICT are technologies that complement other technologies and can be used in storing information such as reports, maps, etc. mICT is also used to reduce paper and saving money, mICT can be used to communicate with the international construction companies to get the latest innovations regarding designs and other operations such as clarifying quantities or specifications and calculating projects’ cash flow in order to develop the construction industry in Libya.*

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (7:B2)

*Ans: It is very essential for Libyan construction industry due to the important role that it plays for communications. Facilities of mICT can be widely used in construction industry for example, AUTO CAD and others applications.*
Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (7:B3)

*Ans: Definitely, It is very successful and in my opinion it helps in developing the construction industry in Libya.*

Q4: Would you name ICT technologies either you have used or just know about it? (7:B4)

*Ans: Internet either websites or Skype and computers.*

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (7:B5)

*Ans: Most of construction companies were founded on the communications technologies and the company which I am working for is one of those companies. Therefore, our company has a strong intention to adopt and use mICT as one of the essential technologies for construction works.*

**Part C: Security and Privacy concerns to use mICT.**

Q1: Would you think using mICT in Libya’s construction industry are secure? (7:C1)

*Ans: As I know it a secure technology.*

Q2: Do you have any concerns about your privacy while you are using the mICT? (7:C2)

*Ans: No, I don’t have any concerns.*

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (7:C3)

*Ans: I can’t see any aspect of concerns that can influence mICT users.*

Q4. In your opinion what action should be done to protect your privacy? (7:C4)

*Ans: As I see there will be no need to take any action, but it is that necessary, I can use my own password or any other code.*

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (7:C5)

*Ans: No, thanks.*

End of 7th Interview
Interview no. 8

Part A: Demographic and Background information

Q1: How old are you? (8:A1)
Ans: 49 years.

Q2: What is your gender? (8:A2)
Ans: Male.

Q3: What education level do you have? (8:A3)
Ans: University. BSc. in civil engineering

Q4: What is your total work experience in the field of construction? (8:A4)
Ans: 30 years as a site project manager.

Q5: Do you use a mobile? How long have you been using it? (8:A5)
Ans: Yes of course, I do have one and I have been using it nearly 20 years.

Q6: How would you describe your experience in computer, Internet and mICT? (8:A6)
Ans: - My experience in using computer mostly regarding typing reports and preparing some table for example, projects’ time tables, quantities’ tables and I am also using Internet for Emails and contacting with my company’s client and workers. Overall, my experience is intermediate for such these technologies.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (8:B1)
Ans: My understanding by mICT in construction is using all technologies and facilities that are available in mobile for construction work.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (8:B2)
Ans: It is essential not only for Libyan construction industry but for the entire world.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (8:B3)
Ans: Yes of course it is successful.

Q4: Would you name ICT technologies either you have used or just know about it? (8:B4)
Ans: I have used GPS which provides location and time information in all weather conditions and use it as a compass when moving for work to specific locations.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (8:B5)

Ans: Yes, the company is doing its best to use it and has a strong intention to adopt it in most of its construction works.

Part C: Security and Privacy concerns to use mICT

Q1: Would you think using mICT in Libya’s construction industry are secure? (8:C1)

Ans: Up to right now, I can’t see it as unsecure technology.

Q2: Do you have any concerns about your privacy while you are using the mICT? (8:C2)

Ans: No, I don’t have any concerns while I am using mICT.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (8:C3)

Ans: I cannot see any kind or aspect of concerns.

Q4. In your opinion what action should be done to protect your privacy? (8:C4)

Ans: I am trying to use an internet security programs in my mobile and also for my computer.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (8:C5)

Ans: No, thanks.

End of 8th Interview
Interview no. 9

**Part A: Demographic and Background information**

Q1: How old are you? (9:A1)

Ans: 42 years.

Q2: What is your gender? (9:A2)

Ans: Male.

Q3: What education level do you have? (9:A3)

Ans: University. BSc. in civil engineering.

Q4: What is your total work experience in the field of construction? (9:A4)

Ans: 19 years as engineer (worker).

Q5: Do you use a mobile? How long have you been using it? (9:A5)

Ans: Yes I do, since 2004.

Q6: How would you describe your experience in computer, Internet and mICT? (9:A6)

Ans: - Computer, mobile phone or Internet being considered main mains for contacting and completing work in construction industry. Personally, I am using for more than nine years ago and I can find myself intermediately familiar of using such those technologies.

**Part B: mICT in construction industry in Libya**

Q1: What do you understand by mICT in the construction industry? (9:B1)

Ans: It is a technology that can be used for some works on construction industry for example; Internet uses and it can also be used for organising some works. Using this technology depends on how the user is able and can to interact with it.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (9:B2)

Ans: I can see mICT technology technologies in Libyan construction industry as a very essential technology.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (9:B3)

Ans: It is successful to some extent.
Q4: Would you name ICT technologies either you have used or just know about it? (9:B4)

Ans: Mostly Internet, computer and mobile phone.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (9:B5)

Ans: We have partly intention to adopt and use mICT in some works for the company.

Part C: Security and Privacy concerns to use mICT

Q1: Would you think using mICT in Libya’s construction industry are secure? (9:C1)

Ans: No it is not secure.

Q2: Do you have any concerns about your privacy while you are using the mICT? (9:C2)

Ans: Yes I do have some concerns regarding divulge.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (9:C3)

Ans: In my opinion, the most concern is about hacking the work information.

Q4. In your opinion what action should be done to protect your privacy? (9:C4)

Ans: there should be some security programs to protect the users’ privacy.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (9:C5)

Ans: No thanks, but I just want to thank you for your coming and doing this research.

End of 9th Interview
Interview no. 10

Part A: Demographic and Background information

Q1: How old are you? (10:A1)

Ans: 52 years.

Q2: What is your gender? (10:A2)

Ans: Male.

Q3: What education level do you have? (10:A3)

Ans: University. BSc. in civil engineering

Q4: What is your total work experience in the field of construction? (10:A4)

Ans: 25 years as a project manager, supervision engineer and lastly a client.

Q5: Do you use a mobile? How long have you been using it? (10:A5)

Ans: Yes I do, since 2005.

Q6: How would you describe your experience in computer, Internet and mICT? (10:A6)

Ans: As a civil engineer most of my work is drawing and following up projects’ progress and my intermediate experience in these technologies assists me to complete most of the work in our company.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (10:B1)

Ans: My understanding to this technology, it is a mean for communicating between the project managers of the projects and the managers of the top management.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (10:B2)

Ans: It is very essential and important to process the work in construction industry.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (10:B3)

Ans: Yes it is successful and saves project time and effort too for example, eliminating the time of rewriting or retyping or eliminating the travel time.

Q4: Would you name ICT technologies either you have used or just know about it? (10:B4)

Ans: Mostly Internet, computer and mobile phones.
Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (10:B5)

Ans: Due to the importance of mICT technology, the company is planning to adopt and use this technology in most of the construction works.

Part C: Security and Privacy concerns to use mICT

Q1: Would you think using mICT in Libya’s construction industry are secure? (10:C1)

Ans: I think it is not very secure, but it is good.

Q2: Do you have any concerns about your privacy while you are using the mICT? (10:C2)

Ans: No, I do not have any concerns.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (10:C3)

Ans: I can’t see any aspect of concerns.

Q4. In your opinion what action should be done to protect your privacy? (10:C4)

Ans: In my opinion there is no need to take any action, but if it is necessary, there should be a code between the parts or stakeholders of the projects to avoid the suffusion of the privacy or work information.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (10:C5)

Ans: Yes, I hope this research will be a good advice or recommendation to the users of mICT in construction industry to adopt and use it in such way to enhance the work in construction field.

End of 10th Interview
Interview no. 11

Part A: Demographic and Background information

Q1: How old are you? (11:A1)
Ans: 48 years.

Q2: What is your gender? (11:A2)
Ans: Male.

Q3: What education level do you have? (11:A3)
Ans: University. Civil engineer

Q4: What is your total work experience in the field of construction? (11:A4)
Ans: 12 years as a project manager and supervision engineer.

Q5: Do you use a mobile? How long have you been using it? (11:A5)
Ans: Yes I do, I have using it around 10 years.

Q6: How would you describe your experience in computer, Internet and mICT? (11:A6)
Ans: - I have at least ten years using such technologies and currently using them for my job and my experience is intermediate which only for sending messages, writing reports and exchange information with other projects’ stakeholders.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (11:B1)
Ans: It is a technology to connect the stakeholders of projects together and it is a mean has an essential role to success the projects.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (11:B2)
Ans: Yes, it is very essential and this technology can accelerate and speed up the progress of projects by for example updating projects’ information, reviewing project timetables to avoid or prevent delays.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (11:B3)
Ans: Definitely, yes.
Q4: Would you name ICT technologies either you have used or just know about it? (11:B4)

Ans: Mobile phones, computers and Internet.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (11:B5)

Ans: yes, we have a strong intention to adopt and use it due to the essential benefits that can be provided by this technology regarding the work in construction domain.

**Part C: Security and Privacy concerns to use mICT**

Q1: Would you think using mICT in Libya’s construction industry are secure? (11:C1)

Ans: I think it is secure.

Q2: Do you have any concerns about your privacy while you are using the mICT? (11:C2)

Ans: No, I do not have any concerns, if so there must be some solutions.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (11:C3)

Ans: I can’t see any aspect of concerns.

Q4. In your opinion what action should be done to protect your privacy? (11:C4)

Ans: In my opinion it is secure, but there must be some codes of security systems to protect the privacy.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (11:C5)

Ans: No, thanks.

End of 11th Interview
Interview no. 12

Part A: Demographic and Background information

Q1: How old are you? (12:A1)
Ans: 36 years.

Q2: What is your gender? (12:A2)
Ans: Male.

Q3: What education level do you have? (12:A3)
Ans: University. BSc. of civil engineering

Q4: What is your total work experience in the field of construction? (12:A4)
Ans: 13 years as engineer (worker).

Q5: Do you use a mobile? How long have you been using it? (12:A5)
Ans: Yes I do, I have using it for my work since the year of 2000.

Q6: How would you describe your experience in computer, Internet and mICT? (12:A6)
Ans: My experience in computer and Internet is intermediate and the same as for mICT, moreover, computer and Internet are very important for finalizing my job in construction projects, for example, for sending information, drawing maps, monitoring work sites by using CCTV cameras and other purposes too.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (12:B1)
Ans: It is very important technologies that have providing the required information for processing work in construction industry and it is the easiest way to contact all the stakeholders of projects.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (12:B2)
Ans: I reckon that mICT service has a very essential role in Libyan construction industry.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (12:B3)
Ans: Definitely yes, mICT are very effective in most of operations of the construction projects.
Q4: Would you name ICT technologies either you have used or just know about it? (12:B4)

Ans: I am using Internet in searching of websites and contacts for example Skype and YahooMessenger, I am also using mobile phones and computer for finishing work.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (12:B5)

Ans: Yes, we have a strong intention to adopt and use mICT service and we will use it more than as it should be if it is available with no disconnections.

**Part C: Security and Privacy concerns to use mICT**

Q1: Would you think using mICT in Libya’s construction industry are secure? (12:C1)

Ans: I think it is secure because I can see any secret information we fear to diffuse.

Q2: Do you have any concerns about your privacy while you are using the mICT? (12:C2)

Ans: No, I do not have any concerns.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (12:C3)

Ans: Based on my experience and knowledge that I have as a user of mICT, I can’t describe any aspect of concerns that can affect me to use mICT.

Q4: In your opinion what action should be done to protect your privacy? (12:C4)

Ans: In my opinion there is no need to take any action, but if it must be there should be a specific programs of protection for example password or security code.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (12:C5)

Ans: Yes, there should be a particular organising in Libya between the constructions companies and mobile technologies providers for adopting and using mICT technology in such a way to enhance their technologies.

End of 12th Interview
Interview no. 13

Part A: Demographic and Background information

Q1: How old are you? (13:A1)
Ans: 53 years.

Q2: What is your gender? (13:A2)
Ans: Male.

Q3: What education level do you have? (13:A3)
Ans: University. BSc. of civil engineering

Q4: What is your total work experience in the field of construction? (13:A4)
Ans: 24 years as a project manager.

Q5: Do you use a mobile? How long have you been using it? (13:A5)
Ans: Yes I do have one, around 16 years.

Q6: How would you describe your experience in computer, Internet and mICT? (13:A6)
Ans: As a project manager to keep to up to date with project partners, I use Internet networks for sending emails or making calls to arrange and finish some work.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (13:B1)
Ans: It is a technology to connect all the worksite workers together with the top management.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (13:B2)
Ans: I think and in my opinion it is very essential and it helps in completing and achieving the targets of the projects and finishing project operations as scheduled and also in closing up construction projects with high quality specifications regarding time and cost or materials.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (13:B3)
Ans: Yes, due to the important role that this technology plays in construction industry.
Q4: Would you name ICT technologies either you have used or just know about it? (13:B4)

Ans: I am using Internet for websites of construction companies and other contacting technologies for example sky be, yahoo messenger and ...etc.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (13:B5)

Ans: yes, we have a strong intention to adopt and use mICT due to the ease of using it.

**Part C: Security and Privacy concerns to use mICT**

Q1: Would you think using mICT in Libya’s construction industry are secure? (13:C1)

Ans: Partly is secure, I meant it is not 100%.

Q2: Do you have any concerns about your privacy while you are using the mICT? (13:C2)

Ans: yes, I do have some concerns regarding to divulge.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (13:C3)

Ans: As I said, only divulge of the privacy of mICT users.

Q4: In your opinion what action should be done to protect your privacy? (13:C4)

Ans: There should be security systems.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (13:C5)

Ans: No, thanks.

End of 13\textsuperscript{th} Interview
Interview no. 14

**Part A: Demographic and Background information**

Q1: How old are you? (14:A1)

*Ans: 35 years.*

Q2: What is your gender? (14:A2)

*Ans: Male.*

Q3: What education level do you have? (14:A3)

*Ans: University.*

Q4: What is your total work experience in the field of construction? (14:A4)

*Ans: 12 years as supervision engineer.*

Q5: Do you use a mobile? How long have you been using it? (14:A5)

*Ans: Yes I do, about 9 years.*

Q6: How would you describe your experience in computer, Internet and mICT? (14:A6)

*Ans: Overall, I have an intermediate experience in using these technologies. Most of my use is concerning making phone calls or sending text messages for organising some work or meetings. Moreover, I am using Internet for searching websites or sending emails or reports.*

**Part B: mICT in construction industry in Libya**

Q1: What do you understand by mICT in the construction industry? (14:B1)

*Ans: My understanding by mICT it is a technology that can be used in organising the work, for example sometimes workers got some stuck on an issue at the worksite, mobile technology can be useful in organising to solve that problem by following up the procedures of finalizing that operation.*

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (14:B2)

*Ans: I think mICT service is very essential in the Libyan construction industry work.*

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (14:B3)

*Ans: Yes, mICT will be very successful due to its importance.*
Q4: Would you name ICT technologies either you have used or just know about it? (14:B4)

Ans: Mostly, using mobile phones, computers and Internet.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (14:B5)

Ans: yes, we have good intention to adopt and use mICT.

Part C: Security and Privacy concerns to use mICT

Q1: Would you think using mICT in Libya’s construction industry are secure? (14:C1)

Ans: I it is relatively secure.

Q2: Do you have any concerns about your privacy while you are using the mICT? (14:C2)

Ans: Yes, I do have some concerns.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (14:C3)

Ans: In my opinion taping is the most aspect.

Q4: In your opinion what action should be done to protect your privacy? (14:C4)

Ans: There should be some protection programs for example a specific codes or encryption for some information.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (14:C5)

Ans: Yes, I think mICT technology in the Libyan construction industry will be widely disseminated to make work much easier in future than now.

End of 14th Interview
Interview no. 15

**Part A: Demographic and Background information**

Q1: How old are you? (15:A1)

*Ans*: 37 years.

Q2: What is your gender? (15:A2)

*Ans*: Male.

Q3: What education level do you have? (15:A3)

*Ans*: University. Construction engineering

Q4: What is your total work experience in the field of construction? (15:A4)

*Ans*: 12 years as manager (worker).

Q5: Do you use a mobile? How long have you been using it? (15:A5)

*Ans*: Yes I do, since 9 years.

Q6: How would you describe your experience in computer, Internet and mICT? (15:A6)

*Ans*: I can say my experience is intermediate in all of them. In addition, work in construction is normally depending on information exchange and I can find mICT either mobile phones, computer or Internet are very suitable for our work overall.

**Part B: mICT in construction industry in Libya**

Q1: What do you understand by mICT in the construction industry? (15:B1)

*Ans*: It is an assistance channel for any construction project.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (15:B2)

*Ans*: I think it is very essential and necessary.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (15:B3)

*Ans*: Yes, due to its importance.

Q4: Would you name ICT technologies either you have used or just know about it? (15:B4)

*Ans*: I am using mobile phone, computers and Internet.
Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (15:B5)

Ans: yes, we have a strong intention to adopt and use mICT because it is very important for our company’s work.

Part C: Security and Privacy concerns to use mICT

Q1: Would you think using mICT in Libya’s construction industry are secure? (15:C1)

Ans: For our work yes it is a secure and we have not seen any problem while using it.

Q2: Do you have any concerns about your privacy while you are using the mICT technologies? (15:C2)

Ans: No.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (15:C3)

Ans: I can’t see any aspect regarding user’s privacy while using mICT.

Q4: In your opinion what action should be done to protect your privacy? (15:C4)

Ans: There shouldn’t be any.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (15:C5)

Ans: Yes, I hope there will be much care for this technology due to the necessity and the demand of this technology to perform the construction industry work.

End of 15th Interview
Interview no. 16

Part A: Demographic and Background information
Q1: How old are you? (16:A1)
Ans: 60 years.
Q2: What is your gender? (16:A2)
Ans: Male.
Q3: What education level do you have? (16:A3)
Ans: University.
Q4: What is your total work experience in the field of construction? (16:A4)
Ans: 25 years as a project manager.
Q5: Do you use a mobile? How long have you been using it? (16:A5)
Ans: Yes I do have one since 2005.
Q6: How would you describe your experience in computer, Internet and mICT? (16:A6)
Ans: I have an intermediate level of experience in using mICT. For example I am using some computer programs e.g. AUTO CAD for drawings and using the available networks for searching some websites regarding construction materials manufacturing. For mICT, this technology has a magnificent role in the success most of projects.

Part B: mICT in construction industry in Libya
Q1: What do you understand by mICT in the construction industry? (16:B1)
Ans: It is a technology that can be used in the construction industry for processing work and has significant advantages such as it can save time and effort.
Q2: To what extent you think that using mICT is essential in Libyan construction industry? (16:B2)
Ans: I think it is very essential and I expect will have more use in future for construction field in Libya.
Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (16:B3)

Ans: Certainly, that is by experience action of the past, we found much difference in the progress of the construction projects while we were not used this technology and when we using it.

Q4: Would you name ICT technologies either you have used or just know about it? (16:B4)

Ans: Mobile phones, computers and Internet.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (16:B5)

Ans: Sure, and we are already using it now.

Part C: Security and Privacy concerns to use mICT

Q1: Would you think using mICT in Libya’s construction industry are secure? (16:C1)

Ans: yes.

Q2: Do you have any concerns about your privacy while you are using the mICT? (16:C2)

Ans: No.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (16:C3)

Ans: I can’t see any aspect.

Q4: In your opinion what action should be done to protect your privacy? (16:C4)

Ans: There shouldn’t be any.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (16:C5)

Ans: Yes, I certainly advise all construction companies in Libya to use this technology due to the benefits that could be gained from adopting and using of this technologies.

End of 16th Interview
Interview no. 17

Part A: Demographic and Background Information

Q1: How old are you? (17:A1)

Ans: 48 years.

Q2: What is your gender? (17:A2)

Ans: Male.

Q3: What education level do you have? (17:A3)

Ans: University.

Q4: What is your total work experience in the field of construction? (17:A4)

Ans: about 25 years as a consultant.

Q5: Do you use a mobile? How long have you been using it? (17:A5)

Ans: Yes I do, since the beginning of adopting it in Libya.

Q6: How would you describe your experience in computer, Internet and mICT? (17:A6)

Ans: My experience is intermediate in all of them and as a consultant, most of my work is regarding offering advices and technical opinions which need sometimes to call clients or engineers or sending them letters or make some adjustments for maps or drawings.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (17:B1)

Ans: It is a technology that has generally an important role in construction industry.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (17:B2)

Ans: In the extreme.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (17:B3)

Ans: Certainly, if it has been adopted in right way.

Q4: Would you name ICT technologies either you have used or just know about it? (17:B4)

Ans: Yes, I do use mICT, Internet and computers (Laptops).
Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (17:B5)

Ans: As this technology can save effort, time and cost for our company’s work, we are thinking of adopting it in a massive way for the whole of our project work.

Part C: Security and Privacy concerns to use mICT

Q1: Would you think using mICT in Libya’s construction industry are secure? (17:C1)

Ans: yes, to some extent.

Q2: Do you have any concerns about your privacy while you are using the mICT? (17:C2)

Ans: No. I don’t have any.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (17:C3)

Ans: I can’t see any aspect.

Q4: In your opinion what action should be done to protect your privacy? (17:C4)

Ans: In my opinion it is secure, but the providers should make or put some protection system to protect the privacy of the users not only in construction but for all over sectors.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (17:C5)

Ans: Yes, I hope the government will try to adopt this technology and circulate it in all construction companies and make consultant bureaus to provide some consultancies to the users regarding using mICT.

End of 17th Interview
Interview no. 18

**Part A: Demographic and Background information**

Q1: How old are you? (18:A1)

*Ans: 36 years.*

Q2: What is your gender? (18:A2)

*Ans: Male.*

Q3: What education level do you have? (18:A3)

*Ans: University.*

Q4: What is your total work experience in the field of construction? (18:A4)

*Ans: More than 10 years as a contractor.*

Q5: Do you use a mobile? How long have you been using it? (18:A5)

*Ans: Yes I do, since the year of 2004.*

Q6: How would you describe your experience in computer, Internet and mICT? (18:A6)

*Ans: As a contractor, most of my use of these technologies is for making calls and sending messages to organise meetings with clients or project managers. In addition, my other use is for preparing tenders or contracts and other purposes related to the construction field.*

**Part B: mICT in construction industry in Libya**

Q1: What do you understand by mICT in the construction industry? (18:B1)

*Ans: It is a technology that can be used in organising for specific work in the construction industry for such as sharing information between the project manager and other workers at worksites and sometimes with the client and other stakeholders of projects.*

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (18:B2)

*Ans: It is very essential and it is very effective in saving time which is very important for the projects’ deadlines.*

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (18:B3)

*Ans: Certainly, due to the previous reasons.*
Q4: Would you name ICT technologies either you have used or just know about it? (18:B4)

*Ans*: Yes, most of my knowledge is about computers and other communications like mobile and Internet.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (18:B5)

*Ans*: Yes we have a strong intention to use it because we are very much in need to use it.

**Part C: Security and Privacy concerns to use mICT**

Q1: Would you think using mICT in Libya’s construction industry are secure? (18:C1)

*Ans*: Yes.

Q2: Do you have any concerns about your privacy while you are using the mICT? (18:C2)

*Ans*: For the work no. But regarding my privacy there is some of concerns.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (18:C3)

*Ans*: I can’t see any aspect.

Q4: In your opinion what action should be done to protect your privacy? (18:C4)

*Ans*: I couldn’t see any action that should be done specially in Libyan construction industry.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (18:C5)

*Ans*: Yes, and besides saving time and effort, I can see mICT in Libya’s construction industry is very secure, easy to use and there is a quality infrastructure.

End of 18th Interview
Interview no. 19

Part A: Demographic and Background information
Q1: How old are you? (19:A1)
Ans: 62 years.
Q2: What is your gender? (19:A2)
Ans: Male.
Q3: What education level do you have? (19:A3)
Ans: University.
Q4: What is your total work experience in the field of construction? (19:A4)
Ans: More than 30 years in construction supervision.
Q5: Do you use a mobile? How long have you been using it? (19:A5)
Ans: Yes I do, more than 10 years.
Q6: How would you describe your experience in computer, Internet and mICT? (19:A6)
Ans: My experience is intermediate in all of them. Moreover, and as supervision engineer, my career is to follow up workers in construction projects and this job needs to use some technologies such as mobile phones, computers and Internet websites.

Part B: mICT in construction industry in Libya
Q1: What do you understand by mICT in the construction industry? (19:B1)
Ans.: It is a technology that makes the transferring of information much easier from the worksites to their companies’ main offices.
Q2: To what extent you think that using mICT is essential in Libyan construction industry? (19:B2)
Ans.: It is very essential and it will have much more uses for future.
Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (19:B3)
Ans: Certainly, it is that.
Q4: Would you name ICT technologies either you have used or just know about it? (19:B4)

Ans: Yes, I am using computers for reports and drawings, Internet for searching of construction work websites and mobile phones to following up works and consulting with other construction stakeholders.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (19:B5)

Ans: yes, in present time, the facilities we have got is not enough but we might apply this technology in future.

Part C: Security and Privacy concerns to use mICT

Q1: Would you think using mICT in Libya’s construction industry are secure? (19:C1)

Ans: yes, I think it is secure to use in construction industry.

Q2: Do you have any concerns about your privacy while you are using the mICT? (19:C2)

Ans: No.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (19:C3)

Ans: I can’t see any aspect of concerns.

Q4: In your opinion what action should be done to protect your privacy? (19:C4)

Ans: If there are any concerns about the privacy of any users, there must be specific issues to protect their privacies.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (19:C5)

Ans: Yes, I think mICT technologies will be used in future much more than now for transferring and receiving information among users in the Libyan construction industry.

End of 19th Interview
Interview no. 20

Part A: Demographic and Background information

Q1: How old are you? (20:A1)
Ans: 53 years.

Q2: What is your gender? (20:A2)
Ans.: Male.

Q3: What education level do you have? (20:A3)
Ans.: University.

Q4: What is your total work experience in the field of construction? (20:A4)
Ans: More than 30 years as client of Construction Company.

Q5: Do you use a mobile? How long have you been using it? (20:A5)
Ans: Yes I do, more than 15 years.

Q6: How would you describe your experience in computer, Internet and mICT? (20:A6)
Ans: My experience is intermediate in all of them. I am mostly using mobile phones for making calls and computers for reports and Internet for searching for websites in construction field and others.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (20:B1)
Ans: It is a technology to make calls, organising work and to store work data in construction industry.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (20:B2)
Ans.: I can see it is very essential in all fields of life specifically in the construction, we consider it a part of work between variance work organisations.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (20:B3)
Ans: Sure, it will save time and cost.
Q4: Would you name ICT technologies either you have used or just know about it? (20:B4)

Ans.: Yes, I am using mobile phones, Internet and intranet and others such as computers.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (20:B5)

Ans.: We are already using it and we are providing mobiles for most of the employees of our company and we are paying the bills for using mICT.

**Part C: Security and Privacy concerns to use mICT**

Q1: Would you think using mICT in Libya’s construction industry are secure? (20:C1)

Ans: Certainly yes.

Q2: Do you have any concerns about your privacy while you are using the mICT? (20:C2)

Ans: No I don’t think so.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (20:C3)

Ans: I can’t see any aspect of concerns.

Q4: In your opinion what action should be done to protect your privacy? (20:C4)

Ans: I think Libyan government already has applied some laws to protect the privacy of mICT users not only in construction industry but at most of sectors of the country.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (20:C5)

Ans: Yes, as I see your research is good and will help in publishing and disseminating this technology in the Libyan construction industry due to the importance and the magnificent role that this technology plays.

End of 20th Interview
Interview no. 21

**Part A: Demographic and Background information**

Q1: How old are you? (21:A1)
Ans.: 68 years.

Q2: What is your gender? (21:A2)
Ans: Male.

Q3: What education level do you have? (21:A3)
Ans.: University.

Q4: What is your total work experience in the field of construction? (21:A4)
Ans: More than 37 years as a consultant.

Q5: Do you use a mobile? How long have you been using it? (21:A5)
Ans: Yes I do, about 15 years.

Q6: How would you describe your experience in computer, Internet and mICT? (21:A6)
Ans.: - My experience in using computer is for writing some advices to clients and drawing maps using AUTO CAD program and also preparing project’ time and quantities ables. For mobile phone, I am using it for about fifteen years for making call regarding organising meeting or sending messages. As a consultant I am also use Internet to complete some work for my company. Generally my experience in mICT is intermediate.

**Part B: mICT in construction industry in Libya**

Q1: What do you understand by mICT in the construction industry? (21:B1)
Ans: It is a technology to make the contacting much easier between the parts of any construction project and has a big role in organising works.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (21:B2)
Ans: I can see it is very essential in the Libyan construction industry but in present time still not using it very much and I hope in future we will increase our usage in most of construction works.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (21:B3)
Ans: Sure, there is no doubt, certainly it is successful.

Q4: Would you name ICT technologies either you have used or just know about it? (21:B4)

Ans: Yes, I am using some contact technologies like mobile phone and Internet applications such as Skype and I am using also computers for completing some works for my company.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (21:B5)

Ans: Now we are already using it and we mostly depend on this technology in running the company’s works.

Part C: Security and Privacy concerns to use mICT

Q1: Would you think using mICT in Libya’s construction industry are secure? (21:C1)

Ans: Yes, to some extent and we still have some fear of using it regarding divulge.

Q2: Do you have any concerns about your privacy while you are using the mICT? (21:C2)

Ans: Now, there is no any.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (21:C3)

Ans: I can’t see any aspect of concerns, but if so only about divulge.

Q4: In your opinion what action should be done to protect your privacy? (21:C4)

Ans: I think there shouldn’t be taken any action only if divulge have thought that can be happened.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (21:C5)

Ans: This technology should have some developments by the government in future such as increasing the number of mobile service providers or investment contracts with international mICT technology suppliers.

End of 21th Interview
Interview no. 22

Part A: Demographic and Background information

Q1: How old are you? (22:A1)
Ans: 40 years.

Q2: What is your gender? (22:A2)
Ans: Male.

Q3: What education level do you have? (22:A3)
Ans: University.

Q4: What is your total work experience in the field of construction? (22:A4)
Ans: More than 15 years as engineer (worker).

Q5: Do you use a mobile? How long have you been using it? (22:A5)
Ans: Yes I do, about 8 years (2005).

Q6: How would you describe your experience in computer, Internet and mICT? (22:A6)
Ans.: In computer is mostly for writing reports, reviewing time table and preparing materials quantities tables and for mobile phone, I am using them for making some calls and texting messages. For Internet I am using this service for contacting and transferring information through Emails or other applications. My total experience was intermediate in all of them.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (22:B1)
Ans: It helps in organising to connect contractors with other parts of construction projects to solve any problems that could face the work, for example shortages in materials or workers absence(turnover).

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (22:B2)
Ans: I can see it is very essential in the Libyan construction industry.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (22:B3)
Ans: Sure, it will be very successful.
Q4: Would you name ICT technologies either you have used or just know about it? (22:B4)

Ans: Yes, I am using some technologies of mICT such as computer, mobile phones and some facilities of Internet.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (22:B5)

Ans: As this technology is being developing, we have a strong intention to use it for most of our works.

Part C: Security and Privacy concerns to use mICT

Q1: Would you think using mICT in Libya’s construction industry are secure? (22:C1)

Ans: No.

Q2: Do you have any concerns about your privacy while you are using the mICT? (22:C2)

Ans: Sometimes I feel uncomfortable while I am using my mobile due to some concerns of divulge.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (22:C3)

Ans.: In my opinion, fearing of spread of work secrets and divulge is the most aspect of concerns.

Q4: In your opinion what action should be done to protect your privacy? (22:C4)

Ans: I hope there will be some protection systems or codes to protect the privacy of mICT technologies users.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (22:C5)

Ans: Yes, mICT is a technology that should strongly be advised to use in construction industry due to its benefits for saving cost and time.

End of 22th Interview
Interview no. 23

Part A: Demographic and Background information

Q1: How old are you? (23:A1)
Ans: 50 years.

Q2: What is your gender? (23:A2)
Ans: Male.

Q3: What education level do you have? (23:A3)
Ans: University.

Q4: What is your total work experience in the field of construction? (23:A4)
Ans: Approx. 27 years as project manager engineer (private sector).

Q5: Do you use a mobile? How long have you been using it? (23:A5)
Ans.: Yes I do, since it has been entered to Libya.

Q6: How would you describe your experience in computer, Internet and mICT? (23:A6)
Ans: In all these technologies my experience is intermediate, I am using them generally for making calls, transferring and store information, monitoring work at worksites and etc.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (23:B1)
Ans: mICT in general can be used, but in some specific works like surveying of areas sometimes you will find some difficulties to do that.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (23:B2)
Ans: It is excessively essential in most of the Libyan construction industry works.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (23:B3)
Ans: Certainly mICT technologies are successful due to their benefits in saving time and cost and reducing paper work in order to save time and cost.

Q4: Would you name ICT technologies either you have used or just know about it? (23:B4)
Ans: Yes, I am using some mICT for finishing my work such as computers, Internt
facilities and mobile phones too.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (23:B5)

Ans: We have a strong intention to use this technology.

Part C: Security and Privacy concerns to use mICT

Q1: Would you think using mICT in Libya’s construction industry are secure? (23:C1)

Ans: Yes, it is secure because the data or information we are using is not top secret.

Q2: Do you have any concerns about your privacy while you are using the mICT? (23:C2)

Ans: No, I do not have any concerns.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (23:C3)

Ans: I can’t see any aspect

Q4: In your opinion what action should be done to protect your privacy? (23:C4)

Ans: There is no need to take any action.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (23:C5)

Ans: I hope mICT in the Libyan construction industry will have some government developments such as adopting some training programs for stakeholders such as organising and processing work using mICT and import sophisticated innovations such as smart phones and wireless modems to improve interactions in the construction domain much more in the future.

End of 23th Interview
Interview no. 24

Part A: Demographic and Background information

Q1: How old are you? (24:A1)
Ans: 47 years.
Q2: What is your gender? (24:A2)
Ans: Male.
Q3: What education level do you have? (24:A3)
Ans: University.
Q4: What is your total work experience in the field of construction? (24:A4)
Ans.: 14 years as engineer (worker).
Q5: Do you use a mobile? How long have you been using it? (24:A5)
Ans.: Yes I do, since 1998.
Q6: How would you describe your experience in computer, Internet and mICT? (24:A6)
Ans: My total experience which is about fourteen years in construction sector gives me a good chance to use some mICT such as computer, mobile phones and Internet and intermediately can deal with them for finishing work for my company.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (24:B1)
Ans: mICT is a technology that is using to exchange information and for organising for example, meetings and etc.
Q2: To what extent you think that using mICT is essential in Libyan construction industry? (24:B2)
Ans: It is very essential due to the technologies that they are providing.
Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (24:B3)
Ans: Certainly, because it has lots contributions in developing of the construction field.
Q4: Would you name ICT technologies either you have used or just know about it? (24:B4)
Ans: Yes, I am using most of available technologies in Libya such as computers, mobile phones and Internet facilities.
Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (24:B5)

Ans.: Sure have a strong intention to adopt and use it.

Part C: Security and Privacy concerns to use mICT

Q1: Would you think using mICT in Libya’s construction industry are secure? (24:C1)

Ans: Yes, it is secure because there is no secret data in construction and our work.

Q2: Do you have any concerns about your privacy while you are using the mICT? (24:C2)

Ans: No.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (24:C3)

Ans: I cannot see any aspect.

Q4: In your opinion what action should be done to protect your privacy? (24:C4)

Ans: If it is exist, we can use some security programs to protect our work.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (24:C5)

Ans: mICT is very important technology to use at worksites and offices too and it can be used to help to boom the Libyan construction field.

End of 24th Interview
Interview no. 25

Part A: Demographic and Background information

Q1: How old are you? (25:A1)
Ans: 25 years.

Q2: What is your gender? (25:A2)
Ans: Male.

Q3: What education level do you have? (25:A3)
Ans: University.

Q4: What is your total work experience in the field of construction? (25:A4)
Ans: one year as engineer (worker).

Q5: Do you use a mobile? How long have you been using it? (25:A5)
Ans: Yes I do, more than 10 years.

Q6: How would you describe your experience in computer, Internet and mICT? (25:A6)
Ans: - Generally, I have an intermediate level of experience in using all of them. As an engineer and have more than ten years working for my company, my job required to be familiar with such these technologies to finish some works in construction industry.

Part B: mICT in construction industry in Libya

Q1: What do you understand by mICT in the construction industry? (25:B1)
Ans: mICT is a technology that can be used to finish some work in the construction industry.

Q2: To what extent you think that using mICT is essential in Libyan construction industry? (25:B2)
Ans: Of course, It is very essential.

Q3: In your opinion do you think adoption and use mICT will be successful in construction projects? (25:B3)
Ans: Yes it will be very successful due to the importance role in assisting in finishing works.

Q4: Would you name ICT technologies either you have used or just know about it? (25:B4)
Ans: Besides using computer and mobile phone, I am using some other Internet facilities such as Skype or Yahoo Messenger for exchanging information with clients.
other workers.

Q5: How would you describe the intention to adopt and use mICT in the company you are working for? (25:B5)

Ans.: Sure, we are using it to fulfil many works like design and supervision.

**Part C: Security and Privacy concerns to use mICT**

Q1: Would you think using mICT in Libya’s construction industry are secure? (25:C1)

Ans: Yes, up to now it is secure.

Q2: Do you have any concerns about your privacy while you are using the mICT? (25:C2)

Ans: Not exactly.

Q3. Can you describe what aspect of mICT concerns is having the most influence on mICT users in construction projects? (25:C3)

Ans.: I cannot see any aspect, but if there is some only about divulge.

Q4: In your opinion what action should be done to protect your privacy? (25:C4)

Ans: If it should be, there must be protection codes or programs.

Q5: Lastly and in the end of this interview, do you have any other information you want to add for the future of mICT in Libya’s construction? (25:C5)

Ans: I hope the government can put some strategies in place in future to support these technologies.

End of 25th Interview
Appendix H: Themes selection process
### Themes selection process

<table>
<thead>
<tr>
<th>Themes</th>
<th>Interviewees’ Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benefits:</strong>&lt;br&gt;Useful for <strong>organising</strong> and <strong>arranging</strong> work.</td>
<td>It can be <strong>useful</strong> for directing items’ suppliers and organising with them for example to supply materials at right places in construction projects sites. (3:B1) It can be used in sending messages regarding <strong>organising</strong> for uses to work’s meetings between clients and contractors. (4:B1) <strong>mICT</strong> <strong>organise</strong> the work between the stakeholders of the construction projects through sending messages or making calls for example, to <strong>arrange</strong> meetings or to supply materials. (5:B1) It is a technology that can be used in <strong>organising</strong> for specific work in the construction industry such as sharing information between the project managers and other workers at worksites and sometimes with the client and other stakeholders of projects. (18:B1)</td>
</tr>
<tr>
<td><strong>Useful for</strong> <strong>completing</strong> work.</td>
<td>It helps in organising to connect contractors with other partners of construction projects to solve any problems that could face the work, for example shortages in materials or workers absence. (22:B1) It is useful and it assists in <strong>completing works</strong> in the construction industry projects as planned and scheduled, for example, finishing designs, time tables (project Gantt charts), preparing quantities tables and, etc. (4:B3) It helps in <strong>completing</strong> and achieving the targets of the projects finishing project operations as it had been scheduled and also in closing up the construction projects with high quality specifications regarding time and cost or materials. (13:B2). <strong>mICT</strong> is a technology that can be used to <strong>finish</strong> some works in construction industry” (25:B1). Based on my experience, <strong>mICT</strong> can be used in construction to <strong>organise</strong> the work between the stakeholders of the construction projects sometimes through sending messages or making calls to <strong>arrange</strong> meetings or to supply materials potentially to <strong>reduce</strong> time and <strong>save money</strong>. (5:B1)</td>
</tr>
<tr>
<td><strong>Useful for</strong> <strong>save time,</strong> <strong>cost</strong> and <strong>effort = speed up</strong></td>
<td></td>
</tr>
</tbody>
</table>
Yes it is successful and saves the project time and effort too. (10:B3).

This technology can accelerate and speed up the progress of projects by for example updating projects’ information, reviewing projects’ timetables using time now technique to avoid or prevent delays. (11:B2).

It is a technology that can be used in the construction industry for running works and has significant advantages it can saves time and effort. (16:B1)

Besides saving time and effort, I can see mICT are very secure, easy to use and have quality infrastructure in Libya’s construction industry. (18:C5).

Certainly, they are successful due to their benefits regarding reducing paper work too in order to save time and cost. (23:B3).

In my opinion, this technology is one of the best means that can be used to communicate and interact in construction projects, either by making phone calls or by other communicating means like Viber, Skype, Emails or Yahoo messenger. (3:B2).

mICT can be used to communicate with the international construction companies to get the latest innovations regarding designs and other operations such as clarifying quantities or specifications and calculating projects’ cash flow in order to develop the construction industry in Libya. (7:B1)

mICT in the construction are technologies have existed to complement other technologies and to be used in storing information such as reports, maps and other works that can be executed by mICT. (7:B1).

It is a technology to make the transferring of information much easier from the work sites to companies’ main offices. (19:B1)
<table>
<thead>
<tr>
<th>Current use</th>
<th>We are already using it and we are providing mobiles for most of the employees of our company and we are paying the bills for using mICT.(20:B5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Already using it = phone calls, text messages.</td>
<td>As an engineer had an intermediate experience, using mobile phone technology and laptop assist me to finish some works such as arranging meetings with clients or solving some problems either by making direct calls or sending text messages and I am also using some computer (laptop) programs such as AUTOCAD help me in designing and drawing maps and sketches etc. (4:A6)</td>
</tr>
<tr>
<td>Computer = AUTOCAD.</td>
<td>In our company, our laptops are connected to cameras (CCTV) for monitoring works at sites. Moreover, we use them for transferring data we are using other technologies such as Internet and mobile phones. (5:B4)</td>
</tr>
<tr>
<td>Designing, reports, tenders, tables, bids, and Monitoring</td>
<td>I am a civil engineer and my intermediate level of experience in using mobile phones, computer and Internet made me easily using them for executing some works for my company such as following up some activities’ progress or taking photos of work sites or materials and equipments. Moreover, I am using them for writing bids, reports and letters or sometimes to check and update quantities tables etc. (6:A6).</td>
</tr>
<tr>
<td>Internet= Websites, software</td>
<td>As a contractor has an intermediate level of experience, most of my using of these technologies is in making calls, sending messages to organise for meetings with clients or project managers. In addition, my other using of computer is for preparing tenders or contracts and other purposes related construction field. (18:A6).</td>
</tr>
</tbody>
</table>
| Mobile phones = calls, taking photos and messages | Future prospects
|                  | We have a strong intention to adopt and use mICT because it is very important for our company’s work.(15:B5) |
|                  | Due to the importance of mICT technology, the company is planning to adopt and use this technology in most of the construction works.(10:B5) |
|                  | I hope there will be much care for this technology due to the necessity and the demand of this technology to perform the construction industry works.(15:C5) |
|                  | I expect mICT in the Libya’s construction industry will be more successful in future if they were supported by the government. (1:C5) |

<table>
<thead>
<tr>
<th>Future prospects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful ,</td>
</tr>
<tr>
<td>Planning to adopt it, care,</td>
</tr>
<tr>
<td>supported, government , Policies</td>
</tr>
<tr>
<td>Increase , Mobile providers, Investment,</td>
</tr>
</tbody>
</table>
I hope the government can put some policies in place in future to support these technologies” (25:C5)

This technology should have some developments by the government in future such as increasing the number of mobile service providers or investment contracts with international mICT technologies suppliers. (21:C5)

I hope mICT in the Libyan construction industry will have some government developments such as adopting some training programs for stakeholders and import sophisticated innovations to improve the construction domain much more in future. (23:C5)
Appendix I: Participants’ response summary
### Participants’ response summary

<table>
<thead>
<tr>
<th>Key words of interview question (As in interview guide)</th>
<th>Response summary (Number of interviewees)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>mICT, computer and Internet Background</strong></td>
<td>All interviewees have mICT, handheld computers (laptop) and Internet experience. (25) <strong>Most participants have average experience</strong></td>
</tr>
<tr>
<td><strong>Is mICT essential to the Libyan construction industry users?</strong></td>
<td><strong>It is essential. (25)</strong></td>
</tr>
<tr>
<td>What do interviewees understand by mICT in the construction (benefits)?</td>
<td><strong>Beneficial in organizing work. (12)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Assist in completing work. (4)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Saves time, cost and effort of projects (e.g. reduces paper work , accelerate and speed up progress) (7)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Beneficial in transferring and storing information. (6)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Useful for communicating and interacting. (2)</strong></td>
</tr>
<tr>
<td><strong>How would stakeholders describe the intention to adopt and use mICT in the company they are working for?</strong></td>
<td>All Interviewees mentioned that have a strong intention to adopt and use mICT. <strong>We have a strong intention. (23)</strong> <strong>We have partly Intention. (1)</strong></td>
</tr>
<tr>
<td><strong>mICT, computer and Internet Background and current use.</strong></td>
<td>Are currently using: <strong>Mobile phones. (25)</strong> <strong>Handheld Computers. (25)</strong></td>
</tr>
<tr>
<td>Have different levels of experience.</td>
<td><strong>Advanced level from 12 to 16 years. (3)</strong> <strong>Intermediate level from 7 to 20 years. (22)</strong></td>
</tr>
<tr>
<td><strong>How would you describe the intention to adopt and use mICT in the company you are working for?</strong></td>
<td>Interviewees mentioned this technology should be adopted and used. (25)</td>
</tr>
<tr>
<td><strong>Is adoption and use mICT will be more successful in construction industry (Future prospects)?</strong></td>
<td>Interviewees see that mICT will be more successful if it’s adopted and used in construction industry. (25)</td>
</tr>
</tbody>
</table>
Do you have any other information you want to add for the future of mICT in Libya’s construction? (Future prospects).

<table>
<thead>
<tr>
<th>Interviewees have mentioned no comments (10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interviewees mentioned other future prospects of using mICT in Libyan construction industry (10)</td>
</tr>
<tr>
<td>• mICT technologies will be more successful and widely disseminated in all Libyan construction industry in the future.</td>
</tr>
<tr>
<td>• mICT technologies should have some government strategies and developments in the future such as:</td>
</tr>
</tbody>
</table>

*Increasing the number of mobile service providers - Establish investment contracts with international mICT technology suppliers - Import sophisticated innovations such as smart phones and wireless modems - Adopting some training programs for stakeholders such as organising and processing work using mICT.*
Appendix J: List of measurement items
### List of measurement items

<table>
<thead>
<tr>
<th>Item name</th>
<th>Item label</th>
<th>Item description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P.Usefulness1</td>
<td>Perceived usefulness of mICT 1</td>
<td>Using mICT would be useful for the construction industry.</td>
</tr>
<tr>
<td>P.Usefulness2</td>
<td>Perceived usefulness of mICT 2</td>
<td>Using mICT would help to get necessary information when it is needed.</td>
</tr>
<tr>
<td>P.Usefulness3</td>
<td>Perceived usefulness of mICT 3</td>
<td>Using mICT would reduce the time taken for construction activities.</td>
</tr>
<tr>
<td>P.Usefulness4</td>
<td>Perceived usefulness of mICT 4</td>
<td>Using mICT in my job would increase my productivity.</td>
</tr>
<tr>
<td>P.Usefulness5</td>
<td>Perceived usefulness of mICT 5</td>
<td>Using mICT would reduce the number of construction activities defects.</td>
</tr>
<tr>
<td>P.Usefulness6</td>
<td>Perceived usefulness of mICT 6</td>
<td>Using mICT would reduce the number of accidents at construction projects sites.</td>
</tr>
<tr>
<td>P.Usefulness7</td>
<td>Perceived usefulness of mICT 7</td>
<td>Using mICT would reduce the capital cost and/or money wastage of construction projects.</td>
</tr>
<tr>
<td>P.Usefulness8</td>
<td>Perceived usefulness of mICT 8</td>
<td>Using mICT would reduce the operations and maintenance cost.</td>
</tr>
<tr>
<td>P.Usefulness9</td>
<td>Perceived usefulness of mICT 9</td>
<td>Using mICT would support construction processes and reduce paperwork.</td>
</tr>
<tr>
<td>P.Usefulness10</td>
<td>Perceived usefulness of mICT 10</td>
<td>Using mICT would make the interaction easier between workers at construction sites.</td>
</tr>
<tr>
<td>Intention 1</td>
<td>Intention to adopt and use mICT 1</td>
<td>I support the use of mICT in construction industry projects.</td>
</tr>
<tr>
<td>Intention 2</td>
<td>Intention to adopt and use mICT 2</td>
<td>I intend to increase my use of mICT to perform construction activities in the future.</td>
</tr>
<tr>
<td>Intention 3</td>
<td>Intention to adopt and use mICT 3</td>
<td>Given that I had access to mICT, I predict that I would use it in construction projects.</td>
</tr>
<tr>
<td>Intention 4</td>
<td>Intention to adopt and use mICT 4</td>
<td>Assuming that I have access to mICT technologies, I intend to use them to perform construction activities.</td>
</tr>
<tr>
<td>Intention 5</td>
<td>Intention to adopt and use mICT 5</td>
<td>I will recommend others to use mICT in performing construction activities</td>
</tr>
<tr>
<td>P.ease 1</td>
<td>Perceived ease of use of mICT</td>
<td>Learning to use mICT to perform construction project activities would be easy.</td>
</tr>
<tr>
<td>P.ease 2</td>
<td>Perceived ease of use of mICT 2</td>
<td>I would find it is easy to remember how to perform tasks using mICT in the construction industry.</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>P.ease 3</td>
<td>Perceived ease of use of mICT 3</td>
<td>It would be easy to become skillful mICT in construction projects.</td>
</tr>
<tr>
<td>P.ease 4</td>
<td>Perceived ease of use of mICT 4</td>
<td>My interaction with mICT for construction activities would be clear and understandable.</td>
</tr>
<tr>
<td>P.ease 5</td>
<td>Perceived ease of use of mICT 5</td>
<td>I would find it easy to get mICT to do what I want it to do.</td>
</tr>
<tr>
<td>P.H.Cost 1</td>
<td>Perceived high cost of technology 1</td>
<td>The cost of using mICT in construction projects would to be reasonable.</td>
</tr>
<tr>
<td>P.H.Cost 2</td>
<td>Perceived high cost of technology 2</td>
<td>Using mICT in construction industry would be expensive overall.</td>
</tr>
<tr>
<td>P.H.Cost 3</td>
<td>Perceived high cost of technology 3</td>
<td>The cost of using mICT would be a burden to the construction industry.</td>
</tr>
<tr>
<td>P.H.Cost 4</td>
<td>Perceived high cost of technology 4</td>
<td>It would be often have difficulties in paying mobile technologies bills.</td>
</tr>
<tr>
<td>P.H.Cost 5</td>
<td>Perceived high cost of technology 5</td>
<td>mICT would be using in construction industry even though there are financial barriers.</td>
</tr>
<tr>
<td>P.Creedibility1</td>
<td>Perceived credibility of mICT 1</td>
<td>Using mICT would not divulge work information in construction industry.</td>
</tr>
<tr>
<td>P.Creedibility2</td>
<td>Perceived credibility of mICT 2</td>
<td>I would find the mICT secure for transferring the sensitive information in construction industry.</td>
</tr>
<tr>
<td>P.Creedibility3</td>
<td>Perceived credibility of mICT 3</td>
<td>Overall, mICT is safe for transferring sensitive information.</td>
</tr>
<tr>
<td>P.Creedibility4</td>
<td>Perceived credibility of mICT 4</td>
<td>I would feel secure sending sensitive information using Mict.</td>
</tr>
<tr>
<td>P.Creedibility5</td>
<td>Perceived credibility of mICT 5</td>
<td>mICT is a secure means through which to send sensitive information in construction industry.</td>
</tr>
<tr>
<td>P.Creedibility6</td>
<td>Perceived credibility of mICT 6</td>
<td>I would feel totally safe providing private information when using mICT.</td>
</tr>
<tr>
<td>P.S.efficacy1</td>
<td>Perceived mICT self-efficacy 1</td>
<td>I am able to use mICT without the help of others.</td>
</tr>
<tr>
<td>P.S.efficacy2</td>
<td>Perceived mICT self-efficacy 2</td>
<td>I could use mICT if someone showed me how to do it first.</td>
</tr>
<tr>
<td>P.S.efficacy3</td>
<td>Perceived mICT self-efficacy 3</td>
<td>I could use mICT if I had just built-in help facilities for assistance.</td>
</tr>
<tr>
<td>P.S.efficacy4</td>
<td>Perceived mICT self-efficacy 4</td>
<td>I have the knowledge and skills required to use mICT.</td>
</tr>
<tr>
<td>P.S.efficacy5</td>
<td>Perceived mICT self-efficacy 5</td>
<td>I can remain calm when facing mICT difficulties because I can rely on my coping abilities.</td>
</tr>
<tr>
<td>F.Condition1</td>
<td>Facilitating condition 1</td>
<td>I am given the necessary support and assistance to use mICT.</td>
</tr>
<tr>
<td>F.Condition2</td>
<td>Facilitating condition 2</td>
<td>I have the financial and technological resources required to use mICT.</td>
</tr>
<tr>
<td>F.Condition3</td>
<td>Facilitating condition 3</td>
<td>I have access to the software, hardware and network technologies required to use mobile technologies.</td>
</tr>
<tr>
<td>F.Condition4</td>
<td>Facilitating conditions 4</td>
<td>The mICT I would use are well integrated and provided in a stable service infrastructure.</td>
</tr>
<tr>
<td>F.Condition5</td>
<td>Facilitating conditions 5</td>
<td>My service provider/operator facilitates the use of mICT.</td>
</tr>
<tr>
<td>F.Condition6</td>
<td>Facilitating conditions 6</td>
<td>There is no compatibility problems related to the mICT I would use.</td>
</tr>
<tr>
<td>F.Condition7</td>
<td>Facilitating conditions 7</td>
<td>When I need help to use mICT, specialized instruction is available to help me.</td>
</tr>
</tbody>
</table>
References


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