The New Role of the Client in Adopting Innovation in Construction Projects

دور المالك الجديد في تبني الابتكار في مشاريع البناء و التشييد

by

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Abstract

The rate of innovation adoption in the construction industry has been witnessed to have risen due to an increased awareness in clients about the perceived benefits of innovation. Two important innovation examples that have been adopted by many construction clients in recent years were explored, which are: Building Information Modeling (BIM) and Prefabrication. The construction client`s role in the traditional procurement method, which is considered the dominant procurement method in the construction industry, has been witnessed to have changed towards driving construction industry stakeholders to adopt innovation in construction projects.

The new role of the construction client is that of innovation co-creator in which the client plays the pivotal role of diminishing the barriers which exist under the traditional procurement method's hierarchy and inducing the construction project stakeholders to work closely and collaboratively to co-create innovation. The literature investigated the diffusion of innovation in the construction industry which revealed seven factors which have been influencing the change in the client's role towards a new role of co-creating innovation in construction projects. These factors were used to derive the research hypotheses.

The quantitative research approach was implemented in this research to examine the defined hypotheses through a survey which was collected from 107 professionals presenting different organizations working in the United Arab Emirates construction industry. The data analysis results revealed that there are six factors which influence the change in the construction client's role towards the adoption of innovation in construction projects in the United Arab Emirates, which are: performance improvement, environmental sustainability, client characteristics, organizational culture, client experience and competence, and government regulations.

The research concluded that the aforementioned six factors are influencing change in the construction client's role under the traditional procurement method towards the new role of co-creating innovation in construction projects in the United Arab Emirates.

Key words: Client`s Role, Innovation co-creation, UAE.

ملخص البحث

شهد معدل اعتماد الابتكار في صناعة البناء والتشييد ارتفاعا بسبب زيادة الوعي لدى الملاك بشأن الفوائد المتصورة للابتكار. تم استكشاف نموذجين هامين للابتكار تم اعتمادهما من قبل العديد من ملاك صناعة البناء والتشييد في السنوات الأخيرة وهما: نمذجة معلومات البناء والتصنيع المسبق. وقد شهد دور المالك في طريقة الشراء التقليدية والتي تعتبر طريقة الشراء الأكثر شيوعا في صناعة البناء والتشييد تغيرا نحو دفع جميع الأطراف ذو العلاقة نحو اعتماد الابتكار في مشاريع البناء والتشييد.

يتجسد الدور الجديد للمالك في كونه المشارك في تبني الابتكار حيث يقوم المالك بدور محوري في ازالة الحواجز القائمة بين أطراف صناعة التشييد والبناء في إطار التسلسل الهرمي لطريقة الشراء التقليدية وتحفيز أطراف المشروع على العمل بشكل وثيق وتعاوني من أجل المشاركة في تبني الابتكار. تم مراجعة الدراسات السابقة لدراسة انتشار الابتكار في صناعة البناء والتشييد والتي كشفت عن سبعة عوامل أثرت على التغير في دور المالك نحو الدور الجديد في المشاركة في تبني الابتكار في مشاريع البناء والتشييد حيث استخدمت هذه العوامل لاستنتاج فرضيات البحث.

تم تطبيق منهج البحث الكمي في هذا البحث لدراسة الفرضيات المعرفة من خلال استطلاع تم توزيعه وجمعه من قبل 107 مختص يمثلون شركات مختلفة تعمل في مجال صناعة البناء والتشييد في دولة الإمارات العربية المتحدة. كشفت نتائج تحليل البيانات أن هنالك ستة عوامل تؤثر على التغير في دورالمالك نحو تبني الابتكار في مشاريع البناء والتشييد في دولة الإمارات العربية المتحدة وهي: تحسين الأداء, الاستدامة البيئية, مميزات المالك, الثقافة المؤسسية, خبرة و كفاءة المالك ، واللوائح الحكومية.

واستخلص البحث أن العوامل الستة المذكورة أعلاه تؤثر على التغير في دور المالك في إطار طريقة الشراء التقليدية نحو الدور الجديد المتمثل في المشاركة في تبني الابتكار في مشاريع البناء و التشييد في دولة الإمارات العربية المتحدة.

الكلمات الدالة: دور المالك، تبني الابتكار المشترك، الإمارات العربية المتحدة.

Dedication

To my beloved parents for their unlimited support, encouragement, motivation whom whatever I will do, I will never ever compensate them.

To my beloved wife Bodour for her continuous support, assistance and motivation and to my sons Farouq and Omar who were missing my care during my study.

To my beloved brothers and sister for their continuous encouragement and motivation.

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Tareq Al-Tayeh

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Tareq Al-Tayeh

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List of Abbreviation

A/E: Architect/Engineer.

BIM: Building Information Modelling.

D: Dimensional.

DBB: Design-Bid-Build.

DOI: Diffusion of Innovation.

FP: Foundational Premise.

GCC: Gulf Cooperation Council.

GDP: Gross Domestic Product.

H: Hypothesis.

IBS: Industrial Building System.

LEED: Leadership in Energy and Environmental Design.

PMI: Project Management Institute.

S-D: Service-Dominant.

SPSS: Statistical Package for Social Sciences.

UAE: United Arab Emirates.

UK: United Kingdom.

USA: United States of America.

1. Chapter One- Introduction

1.1. Overview of the Construction Industry

Hughes and Murdoch (2001) defined the construction industry as: "The erection, repair and demolition of things as diverse as houses, offices, shops, dams, bridges, motorways, home extensions, chimneys, factories and airports". Another definition for the construction industry was suggested by Segerstedt and Olofsson (2010): "The erection, maintenance, and repair of immobile structures, the demolition of existing structures, and land development". They affirmed that the construction industry is distinguished from other industries due to its unique products, temporary organization and site production. The construction industry was also defined by Hemstrom et al. (2011) as: "A project-based activity involving numerous individuals from different companies working together at a construction site towards completing one product".

Aritua et al. (2009) highlighted the main feature of the construction industry as being project-based, and defined the project as "A temporary organization, usually existing for a short duration, which will deliver one or more outputs in accordance with a specific business case". The project was defined by The Project Management Institute as "A temporary endeavor undertaken to create a unique product, service, or result." (PMI 2013).

The construction industry plays a major role in the global economy. Osei (2013) highlighted the significant role of the construction industry in the socio-economic development of any country and its potential for stimulating growth in other sectors and generating substantial employment as the construction industry provides a country with essential facilities and infrastructure such as hospitals, schools, townships, offices, houses, urban infrastructure, highways, roads, ports, railways, airports, a power system, and telecommunications. Morledge and Smith (2013), Ofori (2015), Olanrewaju and Abdul-Aziz (2015), and Muhammad (2015) confirmed the significant contribution of the construction industry to national social and economic development and highlighted that the construction industry is essential for national development in providing the necessary facilities and infrastructure which stimulates economic growth in other sectors.

Within construction projects, the client is centrally located within the construction supply chain and employs the services of consultants and contractors in addition to sourcing the funds for the construction projects and being the most active stakeholder and serving as a main connector or hub within the stakeholder`s network (Chinyio & Olomolaiye 2010). The construction client was defined by Davies and Jokiniemi (2011) as "A person or organization which commissions a building or construction". Another definition was added by Kilinc et al. (2015) who referred to the construction client as "A person or organization, who at a particular point in time, has the power to initiate and commission design and construction activity with the intention of improving the performance of an organization`s social or business objectives".

The importance of the client in the construction industry has attracted many researchers who have confirmed that the client is the main hub for the construction project network and plays a major role in the construction process. Brandon & Lu (2008) shed light on the construction client`s importance and affirmed that the client plays a significant role in the construction industry. Chinyio and Olomolaiye (2010) pointed out that the construction client is the most important stakeholder in the construction project as they initiate the project, finance it, and determine the project`s scope and objectives. Siva and London (2011) also confirmed the importance of the construction client as they have the spending power and are the reason why the industry exists, while all the other construction project stakeholders are working to satisfy the requirements of the client.

1.2. The Construction Industry in the United Arab Emirates

The United Arab Emirates (UAE) is located on the Arabian Peninsula between latitudes 22.0˚ and 26.5˚ north and between 51.0˚ and 56.5˚ east. The UAE is situated between Oman to the southeast and Saudi Arabia to the south and west as shown in **Figure.1**. The total UAE land area is about 83,600 square kilometers and is comprised of seven emirates: Abu Dhabi (the capital), Dubai, Sharjah, Umm Al-Quwain, Ajman, Ras Al Khaima and Fujairah. The total population of the UAE is 8.3 million (2010). The country has an arid climate with two main seasons, winter and summer. Winter is between November and March with an average temperature of 26˚C during the day time and 15˚C during the night time. Summer occurs from April through September and tends to be very hot with the

temperature rising to about 50˚C and high humidity levels hitting over 90% (UAE Ministry of Energy 2012).

Since the UAE was established in 1971, its economy has grown 200-fold. In 2012 the UAE had the second biggest economy in the Arab world after Saudi Arabia. It accounts for more than a quarter of the gross domestic product (GDP) of the Gulf Cooperation Council (GCC), and nearly 14 per cent of the combined GDP of the countries in the Middle East/ North Africa region. The energy sector is the foundation of the UAE's wealth as it has the world's seventh-largest proven reserves of both crude oil and natural gas which is a key source of revenue to finance other industries to maintain the economy's diversification. Many another important sectors actively contribute to the UAE's economic prosperity, namely: tourism, transport & logistics, construction, real estate, manufacturing, wholesale & retail trade, mining & quarrying, banking, agriculture and utilities (UAE National Media Council 2013).

Figure.1: United Arab Emirates Map
Adopted from 3rd National Communication 2012, p.1

Zaneldin (2006) pointed out that the United Arab Emirates is investing billions of dollars every year to develop the country's infrastructure which provides the required housing, schools, hospitals, shopping malls, telecommunications, electricity and water, hotels and

recreational facilitates. He also highlighted that the majority of the construction projects were being constructed in the Emirates of Abu Dhabi and Dubai. Ren et al. (2008) referred to the significant growth in the UAE's economic and social development and highlighted many remarkable projects in the emirate of Dubai such as: The Palm, the Dubai International Airport Extension, Dubai Marina and Souk Al Nakheel. El-Sayegh (2008) confirmed the exceptional boom in the UAE construction industry which reached its optimum in the year 2007 and pointed out that the UAE government has started to take measures for reducing the country's dependency on oil by diversifying its economy into the commercial, tourism and industrial sectors which triggered a growth in the UAE construction industry which was represented in many new mega-construction projects.

Randeree and Chaudhry (2012) confirmed the importance of the construction industry in the UAE economy to provide the required facilities for other sectors and stated that the construction industry had witnessed a significant boom which recorded a value of 221 billion USD in the year 2007, which ranked the highest in the Gulf region. Al-Malkawi and Pillai (2013) affirmed that the late 2007 global financial crisis left marks on the UAE construction industry while the construction industry has been showing a recovery from the crisis's impacts since 2011. Mehta (2014) confirmed the significant boom in the UAE construction industry during the years 2004-2007 which was driven by infrastructure and real estate where the construction industry and real estate were the most important non-oil sectors in the UAE. They affirmed that the UAE construction industry had been sharply affected in the year 2008 due to the world economic crisis in the year 2007 while the industry had shown signs of recovery since the year 2011.

The Annual Economic Report 2015 which was issued by the United Arab Emirates Ministry of Economy stated that the total Gross Domestic Product (GDP) for the United Arab Emirates amounted to 1.46 trillion dirhams in 2014 with a growth rate of 3.2%. The report pointed out that the construction sector contributes 9% of total GDP and ranked first among all sectors in the UAE economy in terms of employment distribution where employment in the construction industry recorded 19.5% of total employment (UAE Ministry of Economy 2015).

Bueno (2015) confirmed the impact of the 2008 financial crisis on the UAE construction industry while he affirmed that the UAE is back in growth mode with significant schemes and vision. He referred to many remarkable new construction projects undertaken in the UAE such as Saadiyat Island, the Louvre Abu Dhabi, Zayed National and Guggenheim museums, Abu Dhabi Wild Life Park, Dubai Metro, Jumeirah Tram, Dubai Creek, Dubai Design District, Sheikh Mohammed Bin Rahsed City, Diera Island and Dubai Healthcare City, in addition to the projects which will be constructed for the Dubai EXPO 2020.

Mehran (2016) agreed that the UAE construction industry has witnessed a recovery from the global financial crisis of 2007. The industry contributed about 60 percent of the property boom in the GCC countries in the year 2011. Also there is currently an expansion in the construction industry after Dubai won the EXPO 2020 which gave Dubai and the UAE a significant economic boost. The construction industry is now under huge pressure to develop the facilities and infrastructure required to host the EXPO.

1.3. Overview of the Adoption of Innovation in the Construction Industry

Innovation is defined by Blayse and Manley (2004) as "The actual use of a nontrivial change and improvement in a process, product or system that is novel to the institution developing the change". Asad et al. (2005) added another definition of innovation from the construction industry perspective: "A new idea that is implemented in a construction project with the intention of deriving additional benefits although there might have been associated risks and uncertainties, the new idea may refer to new design, technology, material component or construction method deployed in a project". Hartmann (2006) mentioned that the construction industry has been witnessing a major change towards adopting innovation which has been a strategic decision undertaken by many construction clients to improve industry performance. Yitmen (2007) highlighted that new market conditions, new technologies and increasing end-user expectations are imposing radical reviews for the industry which is under huge pressure to improve its performance and that could be achieved through adopting innovative solutions to cope with the construction industry's challenges.

Akintola et al. (2012) confirmed the importance of innovation in the construction industry and affirmed that innovation is necessary as a source of competitive advantage to cope

with construction's increasing complexity and sophistication which keeps pressure on the industry to embrace innovation. They affirmed that construction clients are now acting as a catalyst to foster innovation adoption by applying pressure on the supply chain members to improve the industry's overall performance.

Within the UAE context, the innovation concept has been widely promoted and adopted in all sectors. The UAE Government has taken significant steps and developed strategies to motivate and promote the adoption of innovation. The UAE National Innovation Strategy Report, issued by the UAE Ministry Of Cabinet Affairs (2015), defined innovation as "The aspiration of individuals, private institutions and government to achieve development by generating creative ideas and introducing new products, services and operations that improve the overall quality of life. Innovation is key to promoting economic growth, increasing competiveness and providing new job opportunities". The report highlighted that the UAE's Government emphasizes the importance of innovation in meeting the country`s aspiration of development across all sectors through the UAE Vision 2021 (UAE Ministry Of Cabinet Affairs 2015).

From the construction perspective, there have been many innovations adopted in the construction industry in the UAE in line with the National Strategy for Innovation and following the global trend of adopting innovation in the construction industry. A remarkable example of innovation is MASDAR City which is one of the leading organizations in the Middle East in the development of energy and resource efficient low-carbon construction in the Emirate of Abu Dhabi in the United Arab Emirates. Madichie (2011) and Elchalakani (2014) mentioned that MASDAR City is the world's first zero-carbon, zero-waste city fully powered by renewable energy and its role is promoting innovation in emerging markets. Madakam and Ramaswamy (2016) confirmed the innovations in MASDAR city and mentioned that MASDAR city is a new 'smart' city which is intent on being the first zero-carbon city in the world.

Another innovation example in the UAE construction industry is the adoption of Building Information Modelling (BIM) which is one of the latest innovations adopted in the construction industry worldwide (Eadie et al. 2013; Ogwueleka 2015). Mehran (2016) highlighted that Dubai Municipality mandated BIM implementation in the UAE in May

2014 which will be used in buildings over 40 stories high or more than a total area of 300,000 ft² as well as in Government projects. The UAE is aiming to deploy the latest technologies and innovations to improve people`s lives and to develop its economy in compliance with the country`s National Innovation Strategy. Dubai is in line to build the world`s first fully functional 3D printed building which will establish the UAE's position as a global centre of 3D printing in construction and design (Construction Business News 2016).

Many construction projects in UAE have been named among the most innovative and least wasteful in the world, namely: Legoland Castle Kingdom in Dubai, NAS Arena Indoor Futsal and Volleyball Stadium in Dubai, Midfield Terminal Complex in Abu Dhabi, Al Habtoor City Theatre and Dubai Opera. The UAE construction industry is expected to experience more innovations in adopting Building Information Modelling, 3D printing and prefabrication (Gulf News 2016).

1.4. Statement of the Problem

The research problem was defined by Kothari (2004) as "Some difficulty which a researcher experiences in the context of either a theoretical or practical situation and wants to obtain a solution for the same". This affirmed the significant importance of establishing the research problem which will formulate the general topic into a specific research problem and thus constitute the first step in the scientific research.

The construction client`s role has been witnessed to be significantly changing from being dependent on the services of other professional entities such as architects and other consultants towards the new role of driving the adoption of innovation in the construction industry through specifying novel requirements and exerting pressure on the project`s stakeholders to adopt innovation in order to improve their projects` performance (Hartmann et al. 2008; Kulatunga et al 2011; Xue et al. 2014). Kilinc et al. (2015) confirmed the change in the construction client`s role towards the new role of driving the adoption of innovation in the construction industry and stated: "Clients undertake an important role in terms of both creating and promoting the right project conditions for realization of innovation".

Hale et al. (2009), Babatunde et al. (2010), and Chinyio and Olomolaiye (2010) investigated the construction client`s role under the traditional procurement method which had been defined as the dominant procurement method in the construction industry and concluded that the construction client will appoint an architect to act on his behalf to prepare the project design, select the contractor and supervise the construction process with a very minimal role for the client in the construction process, they also shed light on the characteristic of the traditional procurement method in the distinction between the project`s stakeholders.

Based on the above findings, the construction client`s role under the traditional procurement method could not drive effectively the project`s stakeholders to adopt innovation due to this procurement method characteristic of making distinctions between the project`s stakeholders which hurdles the adoption of innovation; therefore the research problem is that the construction client`s role in the traditional procurement method is undermining the adoption of innovation in the construction industry.

1.5. Research Aims and Objectives

Kothari (2004) affirmed the importance of defining the research aims and objectives and stressed on its benefits in enabling and directing the researcher to set up the research questions through application of scientific procedures. Saunders et al. (2016) defined the research aim as "A brief statement of the purpose of the research" and the research objectives as "Clear, specific statements that identify what the researchers wish to accomplish as a result of doing the research".

Wilson (2014) distinguished the differences between the research problem and its aims, objectives and questions. He mentioned that the research problem is more specific than the research topic and added the following definitions: "The research aim is what you want to achieve; research objectives describes how you are going to achieve the research aim; and research questions are the tools that help to answer the research problem". He defined the sequence of establishing these research components to be: problem-aim-objectives-questions as illustrated in **Figure.2**.

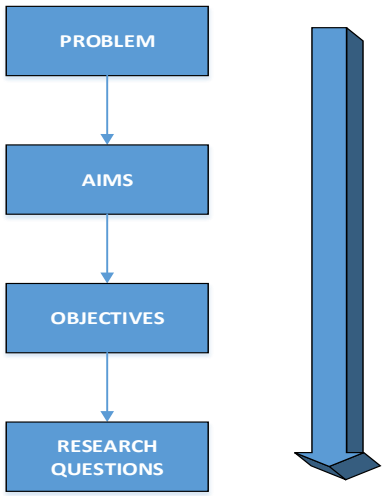

Figure.2: Relationship between problem, aims, objectives and questions
Adopted from Wilson (2014), p.55

Following the research defined problem in section 1.4 "the construction client`s role in the traditional procurement method is undermining the adoption of innovation in the construction industry"; the construction client`s role in the traditional procurement method has been confirmed by many researchers to be changing towards driving innovation adoption in the construction industry (Hartmann et al. 2008; Kulatunga et al. 2011; Xue et al. 2014; Kilinc et al. 2015). Accordingly, the researcher established the aim of this research to be **investigating the factors which are influencing the change in the construction client`s role under the traditional procurement method towards driving innovation adoption in the construction industry**. In order to achieve the defined research aim, the researcher established the followings objectives:

1. Formulate a critical understanding of the construction client`s role under the traditional procurement method.
2. Explore the factors which are influencing the change in the construction client`s role under the traditional procurement method towards the new role of driving innovation adoption in the construction industry.
3. Investigate the new construction client`s role in innovation adoption.

1.6. Research Questions

Blaikie (2004) affirmed the significant importance of establishing the research questions which will direct the research process towards achieving the defined research aim and objectives and pointed out that the research questions are in three types: “What” questions which seek descriptive answers, “Why” questions which seek understanding or explanation, and “How” questions which seek appropriate interventions about change.

Saunders et al. (2016) stressed the importance of turning the defined research problem into clearly defined research questions before proceeding in the research process, whereas they considered the research questions as the center of the research which will influence the choice of the literature review and the overall research design.

The definition of the research questions was based on the flow chart proposed by Wilson (2014) which located the research question generation step as the last step after the definition of the objectives. To achieve the research objectives, the following research questions were formulated for further guidance:

RQ.1: What is the role of the construction client under the traditional procurement method?

RQ.2: What are the factors which influence the change in the clients` role towards adopting innovation in construction projects?

RQ.3: What is the new role of the construction client in driving innovation adoption?

The following **Table.1** “Research Map” illustrates the utilized structured mapping based on the works of Wilson (2014) for deriving the research problem, aim, objectives and questions. That is followed by establishing hypotheses where applicable for the defined research questions which will be tested to accept or reject those hypotheses where each research question is supported by an underlying theory which underpins the defined objective.

Problem Statement	Research Aim	Research Objectives	Research Questions	Supporting Research Hypotheses	Underlying Theories
The construction client`s role in the traditional procurement method is undermining the adoption of innovation in the construction industry	Investigating the factors which are influencing the change in the construction client`s role under the traditional procurement method towards driving innovation adoption in the construction industry	Formulate a critical understanding of the construction client`s role under the traditional procurement method	RQ.1: What is the role of the construction client under the traditional procurement method?	Not Applicable	Construction Client`s Role in Traditional Procurement
		Explore the factors which are influencing the change in the construction client`s role under the traditional procurement method towards the new role of driving innovation adoption in the construction industry	RQ.2: What are the factors which influence the change in the clients` role towards adopting innovation in construction projects?	H1 H2 H3 H4 H5 H6 H7	Diffusion of Innovation Theory (DOI)
		Investigate the new construction client`s role in innovation adoption	RQ.3: What is the new role of the construction client in driving innovation adoption?	Not Applicable	Co-Creation Theory

Table.1: Research Map

1.7. Research Scope

In order to define the scope of this research, the researcher conducted a literature review in the context of this research problem, aims and objectives. The researcher decided to limit this research to investigate the change in the construction client`s role under the traditional procurement method in addition to limiting the research to the construction industry in the United Arab Emirates.

The research scope will also include exploring two examples of the adopted innovations in the construction industry to realize the change in the construction client`s role towards driving adoption of innovation; the first innovation example is the Building Information Modelling (BIM) which was defined by Brandon and Lu (2008) and Bryde et al. (2013) as a major innovative tool which has been found to assist the construction industry in improving its performance, the second example is the Prefabrication which has been defined by Chiang et al. (2006), Tam et al. (2007), and Kamar et al. (2011) to be a significant innovative method which had been initiated to assist the construction industry worldwide to improve its performance.

1.8. Research Structure

The structure of this research will be composed of seven chapters starting with the introduction chapter and will end with the referencing and appendices chapter.

Chapter One is the Introduction Chapter which provides an overview of the construction industry, snapshots of the construction industry in the UAE, an overview of adoption of innovation in the construction industry, a statement of the problem, and the research aim, objectives, questions and scope.

Chapter Two is the Literature Review which includes an extensive review of the literature in the context of the research problem, aim, and objectives. It includes construction client overview, construction client`s role in the traditional procurement method, the change in the construction client role towards adoption of innovation, two examples for adoption of innovation in the construction industry and investigating factors which are influencing the change in the client`s role towards driving innovation.

Chapter Three is the Theoretical Framework, it includes the theoretical framework which will evolve from the conducted literature review which will illustrate all the literature findings, the theoretical framework will be the basis to derive the research hypotheses which will be tested and then contrasted with the literature review findings.

Chapter Four is the Research Methodology which will review the available research methods and select the most appropriate method in line with the research aim and objectives. That will be followed by selecting the appropriate data collection method and design the data collection instrument accordingly including deciding on the data sampling method and data collection administration.

Chapter Five is the Data Collection & Analysis which includes the data collection and analysis to test the derived hypotheses which will then be contrasted in the discussion section with the literature review findings.

Chapter Six is the Conclusions & Recommendation chapter which presents the conclusions of this research which are extrapolated from the earlier literature review and the analysis of the collected data in addition to recommendations for the construction industry professionals and future studies.

Chapter Seven is the References & Appendices which includes the references section which lists all the references used in the research, in addition to the appendices section which presents the research data collection instrument and the analysis tests` results.

2. Chapter Two- Literature Review

2.1. Construction Client's Overview

This section will discuss and investigate the construction clients from different angles. The section will include a definition of the construction client, exploring the construction client's importance and an identification of the different types of construction clients.

2.1.1. Construction Client Definition

Hughes and Murdoch (2001) defined the construction client as "The person or firm responsible for commissioning and paying for the design and construction of the building". They added that the client is the customer for the construction industry and usually referred to as the Employer in building contracts. Brandon and Lu (2008) agreed with the aforementioned definition and added that the construction client can be a representative of the owner or act with delegated authority of the owner.

The "Procurement in the construction industry" report which was published by the Chartered Institute Of Building in 2010 defined the client as: "The sponsor of the whole construction process who provides the most important perspective on project performance and whose needs must be met by the project team; the term client implies that it is one person or one organization to whom all other parties could refer" (The Charter Institute of Building 2010). They added: "All the construction projects must begin with a client, this is the party who has instigated the project, will have thoughts about why the facility should be built, will have organized the funding and be convinced that it is a worthwhile investment". Hemstrom et al. (2011) defined the construction client as "A legal entity or person that carries out or assigns others to carry out construction, demolition or land work, he starts the building project and has the overall responsibility to lead the project from an original idea to a finished building, unless the client chooses to delegate the responsibility to some other actor".

Another definition of the construction client was added by Ryd (2014) and Nina (2014) which is "The entity that at its own expense initiates building, construction, or infrastructure projects; the construction client is also the entity that interprets and translates the organization's needs, expectations and wishes to set requirements and conditions

within building and construction projects". Kilinc et al. (2015) referred to the construction client as "A person or organization, who at a particular point in time, has the power to initiate and commission design and construction activity with the intention of improving the performance of an organization`s social or business objectives". They added that the client contributes in the project process and takes over the completed facility and evaluates its performance to establish the lessons learnt for future projects.

2.1.2. Construction Client`s Importance

Hughes and Murdoch (2001) confirmed the construction client's importance and mentioned that the client has the ultimate authority in the construction process. Brandon and Lu (2008) affirmed the construction client's importance and significant role in the construction industry and described him as the "Giant" who would drive the construction industry. They stated: "In construction, it is the client who chooses the process, procurement form and requirements, which to a large extent determines the boundaries for other actors in the sector".

Chinyio and Olomolaiye (2010) also investigated the importance of the construction client; they mentioned that the construction client is centrally located and employs the consultants and contractors and funds the project; the client is the most active stakeholder and being the hub within the construction project stakeholders' network. They stated: "The client is the initiator of all construction projects, his or her requirements are often crucial to the project success, as they finance the project and determines the project`s objectives and scope".

Qi et al. (2010) affirmed the construction client's importance and stated: "The client is one of the most important stakeholders in the construction industry; one of the major characteristics of construction is that the client normally triggers the design and production of construction facilities". Segerstedt and Olofsson (2010) pointed out the importance of the client's role in the construction industry and identified the client as "The most significant actor" in the construction industry.

Vennstrom and Eriksson (2010) confirmed the importance of the client in the construction industry and referred to the client as the key position whom selects the procurement and

construction methods of the construction process. The client importance was also highlighted by Siva and London (2011) who stated that "Clients are the primary reason why the industry exists and therefore it is the ultimate goal of the industry to satisfy the requirements of clients", they referred to the client`s role as the construction project's initiators and financers who are the driving force in the construction industry. Therefore construction projects could be looked at as a response to the client's business needs

The importance of construction clients was also discussed by Love et al. (2012) who stated: "Clients are frequently active participants in the procurement process and often influence the behaviour of various actors such as contractors, subcontractors, designers, engineers, and suppliers who form the project team by demanding sustainable products and technologies". Ryd (2014) investigated the construction client's importance in the sustainable built environment and concluded that the "Client is an influential co-creator of the sustainable built environment of the future".

2.1.3. Construction Client Types

Kometa et al. (1995) studied the types of the construction clients and classified them based on the frequency of their construction operation; they categorized the construction clients as experienced clients and inexperienced clients where the experienced client whom are building on a regular or continuous basis in more than once every five years, while the inexperienced clients build only once or less every five years.

Hartmann et al. (2008) also classified the construction clients from the building frequency perspective in regard to the number of undertaken projects within a certain time period. The first category is the occasional clients where the construction project is a unique or very infrequent activity for them, and the second category is the professional clients who undertake construction projects regularly. They also classified the construction clients from the ownership perspectives and classified the construction clients under two categories; the first is the public construction client who provide public goods and services for a nonprofit basis, and the second is the private construction clients who are not owned by the government and deliver goods and services in order to make a profit.

Brandon and Lu (2008) agreed with categorizing the construction clients as public-sector and private-sector; they added another differentiation between the paying client and the end-user client. They also highlighted that the clients could be categorized based on their experience between one-off clients and repeat-business clients. They highlighted that the type of client plays a major impact on their contribution to innovation.

Chinyio and Olomolaiye (2010) classified the construction clients into two types according to the ownership of the construction projects as private clients and public clients; they also distinguished between the known client who will be running the construction phase and the virtual client who is the end user who will use the project at completion and defined this as "The entity that will put the facility into use". They affirmed that the end user`s requirements are extremely important in the owner investment strategy since they are paying the revenue for the project; they categorized the end users into four categories which are: residential, industrial, agricultural, and government property.

Morledge and Smith (2013) investigated the client types and summarized them into three categories: category one is based on the client's experience which includes experienced and occasional clients; category two which includes single clients or corporate client; and finally category three which includes public clients and private clients.

2.2. Construction Client`s Role in the Traditional Procurement Method

This section will explore the definition and the adoption of the traditional procurement method in the construction industry and will investigate the construction client's role in this procurement method.

2.2.1. Traditional Procurement Method Definition

Construction procurement in general was defined by Chinyio and Olomolaiye (2010) as "An organizational structure that defines and describes the roles of stakeholders, the relationship between them - both formal and informal, their individual responsibilities, the sequence of activities and timing of events required to provide a facility, as well as the practices and techniques of management that are used". Mathonsi and Thwala (2012) also defined construction procurement as: "The process which creates, manages, and fulfills construction contracts". Another definition was added by Naoum and Egbu (2015) who

defined the construction procurement as: “A mechanism for linking and coordinating members of the building team through the building process in a unique system structure, both functionally and contractually; functionally via roles, authority and power; contractually via responsibilities and risks”. Babatunde et al. (2010) defined construction procurement as: “The management of the total process involved in construction project delivery”.

Many construction procurement methods are available but this research focuses on the traditional construction procurement method. Ibbs et al. (2003) described the traditional procurement method as: “The project is separated into a design phase and construction phase, with two well defined phases; construction will start once the design is completed, while the drawings become the basis for the bidding documents because the owner is more certain about the finished product”.

Hale et al. (2009) defined the traditional procurement method as: “A project delivery method in which the owner enters into a contract with an architect/engineer (A/E) firm that provides design services based on the requirements provided by the owner, the A/E deliverables includes plans and specifications for the construction of the project, these documents are subsequently used by the owner as the basis to make a separate contract with a construction company”. Babatunde et al. (2010) defined the traditional procurement method as: “The architect and engineers prepare designs, in collaboration with the quantity surveyor who advises on the cost implications of design deliverables; the tender process afterwards produces the contractor for the execution of the work; on the award, the successful contractor executes the work as designed under the supervision of the consultants”. Chinyio and Olomolaiye (2010) agreed with the earlier definitions and stressed that the traditional procurement method has the unique characteristic of separating the responsibility between the project design and construction teams.

2.2.2. Review for the Adoption of the Traditional Procurement Method

There has been a consensus between the different researchers that the traditional procurement method has been the most dominant construction procurement method used in the construction industry worldwide. Ibbs et al. (2003) affirmed in their research that the traditional procurement method is the most accepted construction procurement method in

the United States. The procurement fact sheet issued by Constructing Excellence (2004) stated that the traditional procurement method was the most commonly used method for construction procurement; the report affirmed its suitability for all types of clients including the inexperienced ones and referred to it as a suitable procurement method for complex projects and projects where functionality is a prime objective due to its time predictability and cost certainty.

Ojo et al. (2006) confirmed that the use of the traditional procurement method is increasing in developing countries and it is representing the primary construction procurement method for the government as well as the largest employers and to some of the private clients. Chinyio and Olomolaiye (2010) have also confirmed that the traditional procurement method is the most dominant method in the construction industry. The report published by The Chartered Institute of Building (2010) confirmed that the traditional procurement method is the most used procurement method in the construction industry for the longest time therefore it has become the most understood. The report highlighted that the greatest strength of this method is the simplicity of defining responsibilities where the designer is responsible for the design and the contractor is responsible for the construction (The Chartered Institute of Building 2010).

DADA (2012) concluded in their research concerning the construction procurement methods in Nigeria that the traditional procurement method is the dominant procurement method in many countries including Nigeria. Mathonsi and Thwala (2012) investigated the traditional procurement method and highlighted that the reason behind the name is due to this procurement method being in existence for a long time and its being the only choice available for most construction clients for many years. They also highlighted the emergence of new nontraditional procurement systems such as: integrated procurement systems similar to the design and build method; management oriented systems such as construction management and management contracting, while they affirmed that the traditional procurement method is the most used method. Yu and Shen (2013) also found that the traditional construction procurement method is the most used method in buildings procurement in Hong Kong.

Morledge and Smith (2013) referred to the traditional procurement method as the most commonly adapted procurement method in the UK especially for inexperienced and occasional clients. They highlighted that this method has been seen as the least risky approach to clients as there is substantially a high certainty of design, cost, and duration assuming this method is implemented properly; they also added that this method attracts the clients who have a limited budget or limited borrowing power as this method allows the construction cost to be determined with reasonable certainty before construction starts. Akintan and Morledge (2013) confirmed that the traditional procurement method became the main method for construction procurement in the UK after the industrial revolution of the nineteenth century and it remains currently the dominant procurement method in the UK.

The traditional procurement method has been also the dominant construction procurement method in the United Arab Emirates construction industry similar to other countries worldwide. Ren et al. (2008) confirmed that the traditional construction procurement method is the most adopted procurement method in the Emirate of Dubai in the United Arab Emirates. Morledge and Smith (2013) found that most of the construction projects in the GCC including the UAE were procured through the traditional procurement method. Khalifa et al. (2015) investigated the adoption of the new construction procurement methods in the United Arab Emirates such as the partnering approach of public-private partnership procurement strategy; they concluded that the adoption of all the newly introduced construction procurement methods is very limited and affirmed that despite the recent boom in the United Arab Emirates construction industry the traditional method is still dominating the local construction market.

2.2.3. Construction Client`s Role in the Traditional Procurement Method

Hughes and Murdoch (2001) defined the role as "The relationship between a participant and an operation", they highlighted that the role will define the contribution that each participant makes to a project and how they interact with the construction process. Other definition was by added by Brandon and Lu (2008) as "The relationship with the supply chain and the various stakeholders who have interests in the final constructed output". The role had been also defined in the Oxford Dictionaries (2016) as "The function assumed or

part played by a person or thing in a particular situation". The role was also discussed by Chinyio and Olomolaiye (2010) who affirmed that the selected construction procurement method would dictate the role of the client in the construction project temporary organization; they referred to the procurement method as "An organizational structure that defines and describes the roles of stakeholders".

Murdoch and Hughes (2008) investigated the client`s role in the traditional procurement method and studied its organizational structure, they mentioned that the traditional procurement method is a very common method and it's also known as "General Contracting". The process starts with the architect who collects the client`s/employer`s requirements and translates it into a design brief which after approval will be developed through the design stages. The architect will coordinate with other specialists for the structural and services design, after then the quantity surveyor - the "Author of the Bill of Quantities" - will develop the bill of quantities which will itemize and quantify as far as possible every aspect of the work. After that, the contractors are invited for bidding for the works specified in the documents, based on that the contractual relationship will be between the client, the architect, the specialist designers, and the quantity surveyor. The organization structure of the traditional procurement method is illustrated below in **Figure.3.**

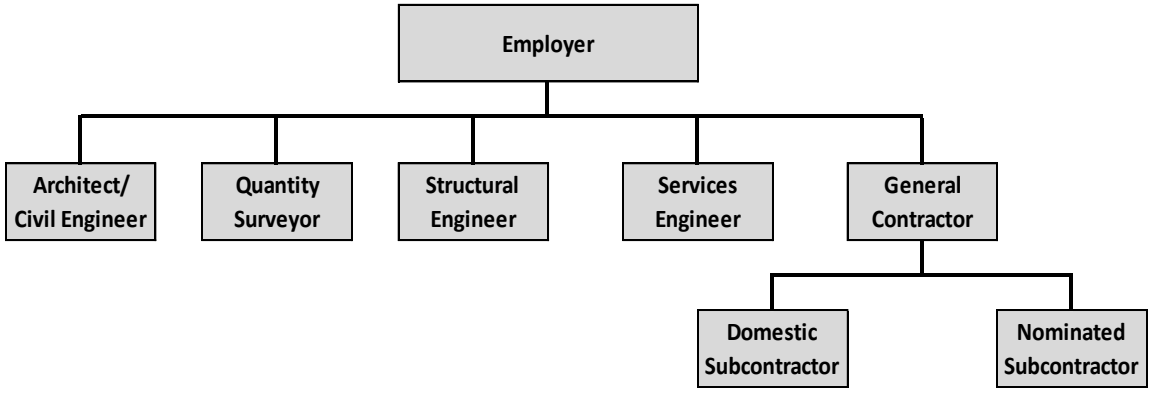

Figure.3: Contractual Relationships in General Contracting
Adopted from: Murdoch and Hughes (2008), p.28

Morledge and Smith (2013) studied also the client`s role in the traditional procurement method and mentioned that the client will award the project design to an architect who may

subcontract the other design specialties to other professional firms or the client may directly contract the different design specialties to different professional firms. The client will proceed in the tendering stage upon design completion with the help of the architect to select the contractor who will be tied up contractually directly with the client where there is a limited power between the contractor and the architect during the execution phase. All the contractor`s subcontractors and suppliers are lying under the contractor's responsibility and the contractor is liable for managing and coordinating these entities. They illustrated the traditional procurement method below in **Figure.4** and highlighted the sequential feature of this procurement method which totally separates the three stages of design, tendering and construction.

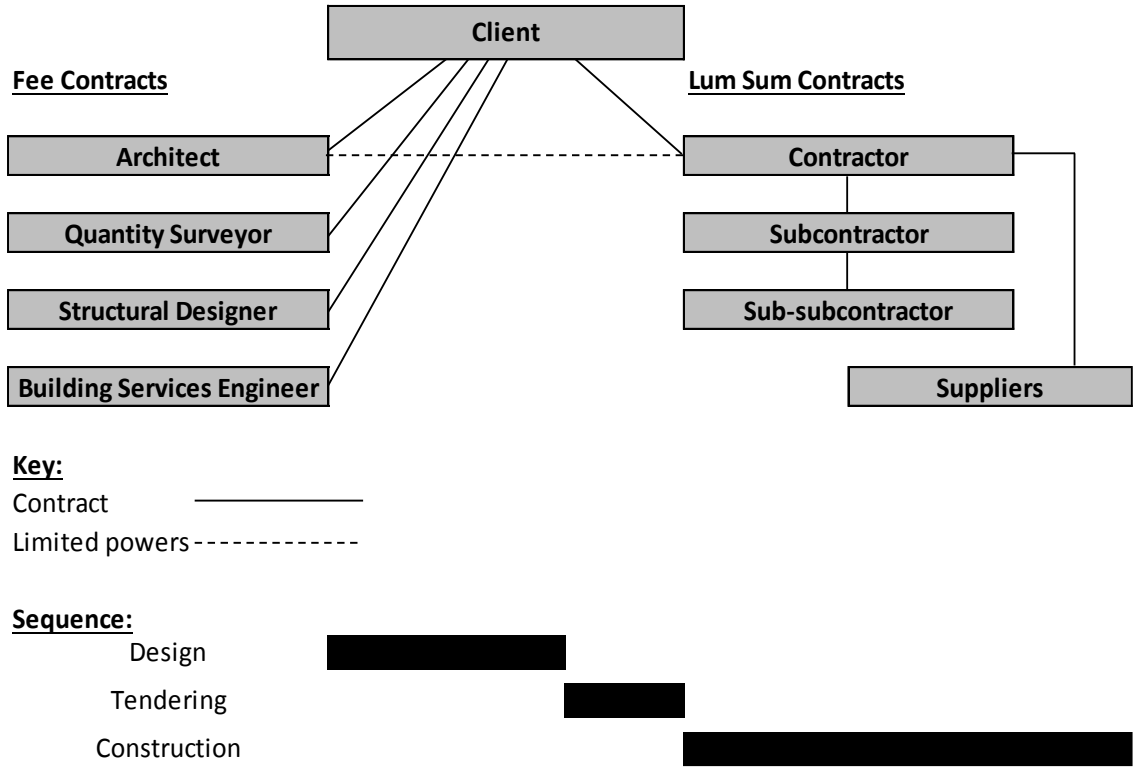

Figure.4: Organizational Structure for a traditional design-bid-build approach
Adopted from: Morledge and Smith (2013), p.128

Alharthi et al. (2014) investigated the organization structure of the traditional construction procurement method; the client will procure professional consultancy services to design and specify the works which will be the basis for inviting the contractors for the bidding process; the selected contractor will be contractually linked with the client based on the

supplied construction documents where a functional relationship will link the contractor with the consultant during the project execution and maintenance period as illustrated in **Figure.5**. They also linked the client and the nominated subcontractors contractually and kept the relationship with the main contractor as a functional and coordination relationship without a contractual liability in-between.

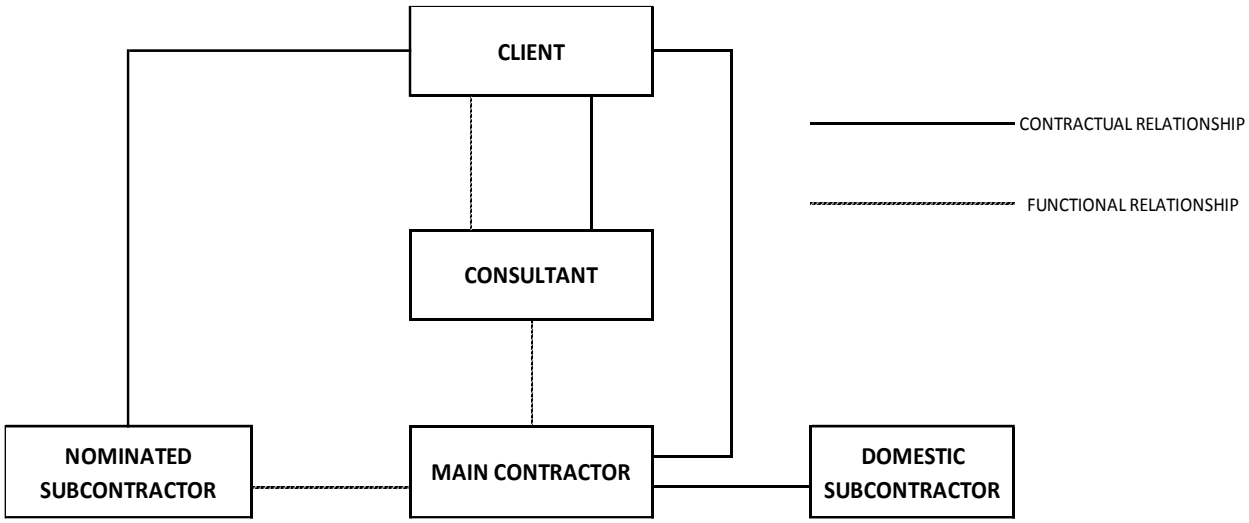

Figure.5: Relationship between parties in a traditional procurement system
Adopted from Alharthi et al. (2014)

Walker and Hampson (2003) referred to the traditional procurement method as a discrete method where each phase is separated; they mentioned that the process begins with the client who provides his brief to the architect, the architect will develop the project design with the help of the other engineers and then tenderers are invited for bidding where the contractor is selected and the construction work commences. The procurement fact sheet report issued by Constructing Excellence (2004) explained the roles and responsibilities of the project team in the traditional procurement method as "The client develops the business case for the project, provides a brief and budget and appoints a team of consultants to prepare a design, plus tender documents. The client appoints the building contractor to construct the works to the design, by the contract completion date and for the agreed price…. the consultants administer the contract on behalf of the client and advise on aspects associated with design, progress and stage payment which must be paid by the client".

Ojo et al. (2006) studied the traditional procurement method and mentioned that the architect will take the client brief and develop it with the help of other engineering specialties into a complete design which will then be translated into a bill of quantities by the quantity surveyor, after the completion of design and the bill of quantities contractors are invited to tender for the construction and the wining contractor will execute the project under the guidance of the architect. Male (2007) agreed on the client`s role in the traditional procurement method and shed light on the architect's role being the first point of contact for the client as they are involved from the early inception stage of receiving the client brief all the way forward through the whole project stages of design, tendering and construction.

Aritua et al. (2009) investigated the client`s role in the traditional procurement method and explained that the client`s requirements will be established with the help of advisors and these requirements will be translated into a project brief which will be the basis for the architect to proceed in the design process. Once the design is completed the tendering stage will be undertaken to select the contractor with the help of the architect who will also supervise the construction process. Therefore there is clear separation between the design and construction phases. Babatunde et al. (2010) agreed with the earlier findings and confirmed that the client`s role will be awarding the design to the architect who will produce the project design, manage the tendering and construction process while the client will have a separate contractual relationship with the architect and the contractor.

Mathonsi and Thwala (2012) agreed with the earlier organization charts for the traditional procurement method and affirmed that the client will contract the design to a consultant to carry out the project`s design and upon design completion the client will appoint the contractor based on tendering which may be open tendering, selective tendering or negotiated tendering; they clarified that the client will get into two separate contractual obligations with the design consultant and the contractor.

2.3. The Change in the Construction Client`s Role Towards Adoption of Innovation

This section will explore the definition of innovation, types of innovation, innovation process overview, benefits of adoption of innovation in the construction industry and the new construction client`s role in adoption of innovation.

2.3.1. Definition of Innovation

The definition of innovation has attracted many researchers. Mitropoulos and Tatum (2000) defined innovation as "An idea, practice, or material artifact perceived to be new by the relevant unit of adoption". Hartmann et al. (2008) defined innovation as "A new product, service, process or market which is developed and exploited in organizations".

Another definition for innovation was added by Kulatunga et al., (2011) who defined innovation as "The effective generation and implementation of a new idea which enhances overall organizational performance". They highlighted that innovation could include introducing and implementing of new processes, products, or management approaches which will increase the project's efficiency. Klinic et al. (2015) defined also the innovation and its phases as "A sequential three phases` process that involves idea generation, idea development, and the diffusion of developed concepts that includes six critical tasks namely, internal sourcing, cross unit sourcing, external sourcing, selection, development, and companywide spread of the idea".

Yitmen (2007) has defined innovation in construction as: "Application of technology that is new to an organization and that significantly improves the design and construction by decreasing the cost, increasing the performance, and improving the business process". The Chartered Institute of Building has carried out a research namely "Innovation in construction: ideas are the currency of the future" (2007) and defined innovation as: "The successful exploitation of new ideas" and followed by another definition as "The successful introduction of new technologies or procedures into industry" (The Chartered Institute of Building 2007).

Another definition of innovation from the construction perspective was added by Kissi et al. (2010) as "The generation or adoption of ideas, design concepts or delivery processes, new to the adopting organization which when implemented will yield a reduction in cost

and/or time associated with project delivery and improve the quality of the final output with a high level of client satisfaction". Xue et al. (2014) conducted an extensive review in the construction industry innovation literature; they summarized the various definitions of construction innovation below in **Table.2**

Author	Definition of Construction Innovation
Tatum (1987)	First use of a technology within a construction firm
Freeman (1989)	Any improvement in a process, product, or system that is novel to the institution developing the change has been defined as an innovation
Slaughter (1993)	Anything new that is actually used
Slaughter (1998)	Innovation as the actual use of non-trivial change and improvement in a process, product, or system that is novel to the institution developing the change
Toole (1998)	Application of technology that is new to an organization and that significantly improves the design and construction of a living space by decreasing installed cost, increasing installed performance, and/or improving businesses process
Mottawa (1999)	The process through which new ideas turn into new components of constructed products that have economic, functional, or technological value
Seaden (2001)	The implementation of significantly new processes, products or management approaches in order to increase efficiency of an organization
Dulaimi (2005)	The generation, development, and implementation of ideas that are new to an organization and that have practical or commercial benefits

Table.2: Overview of Definition of Construction Innovation
Adopted from Xue et al. (2014), p. 113

2.3.2. Types of Innovation

There are many typologies in the literature regarding classifying types of innovation. Tangkar and Arditi (2000) defined two classifications for innovation: the first is incremental innovation which involves a smooth continuous process leading to steady improvements in the products or process; while the second category is the radical innovation which involves the establishment of totally new products or processes.

Manley and McFallan (2003) added another typology for the classification of innovation. They classified innovation as organizational and technical; they then highlighted that organizational innovation involves managerial and business practice improvements while technical innovation involves application of engineering and scientific concepts. Asad, et al. (2005) agreed with classifying innovation as organizational and technical; they

mentioned that organizational innovation is related to introducing a change in the organizational structure while technical innovation is related to product or process innovation.

Another piece of research has tried to encompass the above two categories of classification. Damanpour and Wischnevsky (2006) defined three typologies for the classification of innovation types: the first is product and process innovation; the second is technical and administrative innovation; and the third is radical and incremental innovation. Brandon and Lu (2008) considered all the types of innovation and summarized them into two groups: radical which will be a response to a crisis or pressure from the external environment; and incremental where the innovation will be implemented step by step. They also added another typology which classified innovation between product innovation which focuses on reducing the cost to obtain a greater volume of output for the same given input, and process innovation which describes a new knowledge which allows the production of a superior quality output from the same given resource. They defined three stages which innovation will pass through, which are: idea generation, adoption, and implementation.

Blayse and Manley (2004) have investigated innovation types in the context of the construction industry and they found it to take many forms, classifying innovation in the following five categories: incremental innovation which is small and based on existing knowledge and experience; radical innovation which will be a breakthrough in science or technology; modular innovation which will be a change in the component concept only; architectural innovation which deals with a change in links to other components or system; and system innovation which stands for integrated multiple innovation. They also referred to the Oslo manual which categorized innovation as either technical innovation which involves product or process innovation or organizational innovation which involves changes to the organization's structure and the introducing of new management techniques.

2.3.3. Innovation Process Overview

Tangkar and Arditi (2000) discussed in their research the innovation process which has a transformation process from invention to adoption. They defined the innovation process as a flow that passes through six phases, which are: need, creation, invention, innovation,

diffusion, and adoption. Damanpour and Wischnevsky (2006) discussed the entire innovation process and defined it as: "The entire process from the decision to begin research on a recognized or potential problem, to development, commercialization, diffusion, the decision to adopt, implementation, and consequences". They distinguished the generation and adoption processes of the innovation and stated "The generation of innovation results in an outcome- a product, service, or technology that is at least new to an organizational population. A second organization adopts this innovation by acquiring it from or by imitating the organization that has produced it. As such, adoption basically means that the innovation is developed elsewhere, not in the adopting organization".

Hartmann et al. (2008) have also investigated the innovation process and distinguished it into two phases: generation and adoption. They highlighted the importance of distinguishing between these two phases and confirmed that the generation phase will develop the new ideas or processes but they will not come to light unless they have been adopted as intended. Desmarchelier and Fang (2016) agreed with dividing the innovation process into the two phases of diffusion and adoption and affirmed that diffusion has to occur for the parties to visualize the newly generated ideas and decide on the adoption step. They stated: "The decision to adopt an innovation must be associated from the reception of information about the innovation, and the former must be understood in light of a range of assessment heuristics".

The defined two phases of the innovation process have been investigated by many researchers in order to understand the differentiation between these phases. Mitropoulos and Tatum (2000) defined the diffusion phase as "The process by which a new technology becomes accepted and used by its potential user" and defined the adoption phase as "The process by which an individual or organization identifies and implements a new technology". Manely and McFallan (2003) affirmed the importance of the two phases claimed that both are interconnected to ensure the effective implementation of innovation, and stated "The diffusion of innovations through adoption behaviour is essential to the maximization of benefits flowing from original innovation".

Damanpour and Wischnevsky (2006) defined the generation phase as "A creative process in which new and existing ideas are combined in a novel way to produce an invention or a

configuration that was previously unknown", and they defined the adoption phase as "A problem-solving process in which an existing idea is adapted to address the recognized needs and identified problems within an organization". Panuwatwanich et al. (2009) and Delre et al. (2010) highlighted the importance of the diffusion phase in the innovation process and referred to it as it determines the speed of the idea propagating through the targeted society. They emphasized that the success of the innovation process would rely at the first instance on how effective the innovation is spread to the targeted audience as the adoption decision would not occur unless the innovation has been diffused effectively.

Frattini et al. (2014) defined diffusion as "The process through which an innovation is communicated through certain channels and adopted over time among the members of a social system". They mentioned that the innovation will be diffused through information dissemination and will then be adopted. They also highlighted that the clients who initially adopt an innovation will create pressure for potential later adopters to follow.

The diffusion of innovation phase was also defined by Abdul Hameed et al. (2012) as "A process by which an innovation is communicated through certain channels over a period of time among members of a social system", and the adoption of innovation phase as "A process that results in the introduction and use of a product, process, or practice that is new to the adopting organization". They affirmed the importance of the adoption phase where the innovation decision will be taken based on the received diffusion of the innovative solutions.

2.3.4. Benefits of Adoption of Innovation in the Construction Industry

Many researchers have investigated and defined the benefits of adopting innovation in the construction industry. Blayse and Manley (2004) affirmed the significant benefits of adoption of innovation in the construction industry, they stated that "The higher the levels of innovation in the construction industry, the greater the likelihood that it will increase its contribution to economic growth". They confirmed that the construction industry supply chain members must innovate to compete and enhance the construction industry's performance. Hartmann (2006) agreed that innovation adoption adds significant benefits to the construction industry and affirmed that innovation has been recognized as a crucial strategic change in the construction industry.

Damanpour and Wischnevsky (2006) referred to innovation as an essential concept to firms` growth and presented a source of competitive advantages. They affirmed that innovation has become essential to enable firms to grow and survive in the context of current global competition, rapid technological advances and resources scarcity. Yitmen (2007) agreed with the importance of innovation adoption in the construction industry and mentioned that the construction industry has been continuously criticized due to its low performance compared with other industries, and this drawback has created the important need of introducing innovation to reshape the industry and improve its performance.

The research conducted by Dale (2007) shed light on the negative environmental impacts which the construction industry is responsible for due to its operations. Surprisingly the report stated that the construction industry is contributing to greenhouse gas emissions more than traffic. The construction industry poses serious threats to environmental sustainability so the industry has urgent obligations to seek innovative solutions within the built environment to reduce and mitigate its negative environmental impacts through investigating innovative new green approaches. The report confirmed that adopting innovative green approaches would definitely reduce the negative impacts of the construction industry and improve significantly its environmental performance.

Gambatese and Hallowell (2011) defined many benefits which innovation can add to the construction industry such as decreases in costs, shortening of schedules, improving of quality, increasing safety, establishing competitive advantages, and increasing market share, in addition to helping the organization survive in the market. They stated that "Innovation is essential for continued organizational success and the advancement of the industry". Ryd (2014) shed light on the negative environmental impacts of the construction industry such as urbanization, energy inefficiency, climate and demographic changes. He highlighted the benefits of innovation in improving the built environment's sustainability which had been a main concern in the construction industry. Therefore the construction clients are driving the industry's different participants to adopt innovative sustainable approaches to reduce negative environmental impacts.

Kilinc et al. (2015) listed in their research the many benefits of adoption of innovation: improved image of the firm, improved revenue and profits, market growth, customer

satisfaction, cost reduction and value added, improvements in quality, increase in technical capability, increase in organizational effectiveness, and intellectual capital. They added: "The construction industry is thus being challenged to bring about successful innovation to create new levels of value for the client".

2.3.5. The new Construction Client`s Role in Adoption of Innovation

There has been consensus among many researchers regarding the change of the construction client`s role towards the new role of driving the construction industry to adopt innovation in projects (Blayse & Manley 2004; Asad et al. 2005; Ivory 2005; Hartamnn et al. 2006; Brandon & Lu 2008; Hartmann et al. 2008; Kulatunga et al. 2011; Xue et al. 2014; Kilinc et al. 2015). The literature confirmed that the construction clients had recognized the many benefits of adopting innovation in construction projects and they had started 'thinking outside the box' and looking towards innovation as the solution to cope with the construction industry's traditional drawbacks and to improve its performance. The construction client's new role is driving all the construction participants such as architects, contractors and their subcontractors, and manufacturers to adopt innovation in the construction industry.

Blayse and Manley (2004) discussed in their research the innovation in the construction industry which had been recognized as an essential requirement to enable the industry to improve its performance and maintain its competitiveness. They affirmed the importance of the client in driving innovation and referred to the client as the "Key industry participant in terms of driving innovation and they have enormous capacity to exert influence on firms and individuals involved in construction in a way that fosters innovation". They also stated that "Clients have a profound role to play in providing an organizational context in favour of innovation and innovation diffusion".

Asad et al. (2005) confirmed that construction clients are undertaking a new role in driving the various industry parties to adopt innovation. They stated that the "Client can act as a catalyst to foster innovation by exerting pressure on the supply chain partners to improve the overall performance by helping them to devise strategies to cope with unforeseen changes by demanding high standards of work and by identifying specific novel requirements for a project". Ivory (2005) agreed on the change in the construction client`s

role towards adopting innovation in the construction industry and stressed the importance of the client`s role in driving the industry to adopt innovation. He affirmed that clients are playing the role of innovation supporters and act as champions of innovation to facilitate the adoption of innovation in their projects.

Hartamnn et al. (2006) explored the new construction client`s role in driving the construction industry to adopt innovation and stated: "Construction clients are able to stimulate innovation not only by determining the building specifications and determining higher building and process performance, but also by establishing and controlling the mechanisms that account for the extent of collaboration and communication of project participants". Hartmann et al. (2008) affirmed the importance of the construction client in adopting innovation in the industry; they stated that "Clients are in a prominent position to exert direct or indirect influence on the potential of construction projects to generate innovative solutions". They added that client innovation adoption behaviour is extremely important in the adoption of innovation in construction projects while the potential of innovation adoption will wane without having a supportive client.

Kulatunga et al. (2011) investigated the change in the client`s role from being focused towards the traditional objectives of completing the construction projects within the allocated budget, on schedule, and achieving the preset quality metrics to being the innovation driver in the construction industry. They confirmed the change in the construction client`s role towards driving the adoption of innovation in the industry through exerting pressure on the different parties to adopt innovation in their projects. Xue et al. (2014) agreed on the new construction client`s role in driving innovation adoption in construction projects and mentioned that construction clients are exerting pressure on the industry to improve product quality, reduce costs, and shorten the construction period which all are stimulating innovation solutions to enable the construction actors to comply with the client's demands.

Based on the aforementioned findings, it has been evidenced in the literature that the construction client`s role has been changing toward driving the adoption of innovation in the construction industry which has been arising as an essential requirement to enable the industry to cope with its traditional drawbacks and improve its performance which will

result in delivering significantly improved projects which will meet the client's requirements and will improve the construction project's overall performance.

2.4. Examples for Adoption of Innovation in the Construction Projects

This section will discuss the adoption of Building Information Modelling and Prefabrication which have both been selected as examples of innovation in the construction industry and have been adopted by clients in construction projects as innovative tools to improve their projects` performance.

2.4.1. Building Information Modelling "BIM"

2.4.1.1. Definition of Building Information Modelling

The topic of Building Information Modelling has attracted many researchers. Sebastian (2011) defined BIM as "A digital representation of physical and functional characteristics of a facility and serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward". Eadie et al. (2013) defined Building Information Modelling as "The process of generating, storing, managing, exchanging, and sharing building information in an interoperable and reusable way, it requires the development and use of a computer-generated model to stimulate the planning, design, construction and operational phases of a project".

Masood et al. (2014) also added another detailed definition for BIM from the functional perspective which is "A computer generated model to integrate the planning, design, construction and operation of a facility. BIM portrays the geometry, graphic information and spatial relationships, quantities and characteristics of building elements, materials inventories, cost estimates and schedule of performance". Another definition was added by Ogwueleka (2015) who defined BIM as "A digital representation of physical and functional characteristics of a facility, it is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle".

Bryde et al. (2013) also studied the multidimensional capacity of BIM. They mentioned that level 3D keeps all the project and asset information, data and documentation in electronic form; level 4D is for the scheduling of information; and level 5D is for estimating information. In conclusion, the basic model will be in 3D and could be

advanced by adding more data to upgrade to 4D and 5D to use it for scheduling and estimating purposes. Masood et al. (2014) agreed with the levels 3D, 4D & 5D while they had also added new levels which are: 6D which includes the subcontractors' and vendor's data required for the procurement and 7D which includes operation and maintenance management, and lastly 8D which includes risk assessment.

2.4.1.2. Building Information Modelling and Innovation

Building Information Modelling (BIM) has been applied as an innovative tool to cope with the complexity of the construction process which includes many parties and involves large quantities of drawings and documents. This complexity can result in details being overlooked and issues not being properly managed which results in miscommunication among the project`s team members. Brandon and Lu (2008) introduced building information modelling (BIM) as an innovative tool which will form a platform for storing and managing the building's information during all stages of the project`s life cycle. They stated that "Innovation can be secured through BIM".

The construction clients had started driving the adopting of BIM in their projects to overcome the traditional problems of sharing and updating documentation and improve the performance of their projects (Eadie et al. 2013). Porwal and Hewage (2013) agreed with defining Building Information Modelling as one of the important innovative tools in the construction industry and affirmed that its adoption shall be driven by the clients and that the adoption process would require changes in work practices and participants` roles.

Zahrizan et al. (2013) found in their study that many construction clients are gradually enforcing BIM in their projects which have resulted in many construction companies investing in BIM technology to fulfill their clients` needs. Masood et al. (2014) referred to BIM as an innovative tool which improves the quality of design and construction and reduces reworking during construction stages in addition to supporting facility management during the total building life cycle. Bryde et al. (2013) confirmed that the proliferation of Building Information Management has been a major innovation in the last decade in construction information and communication technology and is being currently used as the new project management tool to manage the design, construction and maintenance of buildings during the building lifecycle.

Aladag et al. (2016) affirmed that BIM technology is a major innovative tool which has created a significant shift in the construction industry and is now considered one of the most essential tools that assists the construction industry in increasing and maintaining its competitiveness through assisting the different stakeholders in dealing with complex construction projects through the different phases of design, bidding, construction and maintenance. It also reflects many other benefits on the construction projects such as change control, fewer reworks, energy efficiency, improved health and safety, risk and quality management. Aladag et al. (2016) investigated the various uses of BIM in the construction industry and mentioned that BIM could be used for several purposes such as: design and construction integration, risk assessment, cost estimation, scheduling, communication and coordination, documentation, value engineering, quality and safety, sustainability, project management and facility management.

2.4.1.3. Adoption of BIM in the Construction Industry

Bryde et al. (2013) looked through case studies of BIM adoption in the construction industry and found that it has been utilized on high-profile large-scale construction projects such as the London 2012 6,000-seater Olympic Velodrome and the 48-floor Leadenhall building which will have a height of 225m and will be one of the tallest buildings in London. They also noticed that BIM has been used on smaller-scale projects such as modular stairs in the new bus station at Slough, and they also confirmed that the UK Government has stated that from the year 2014 onward all awarded contracts will require different members to use fully collaborative BIM level 3D. They also affirmed that the public and private sectors in the USA are also promoting the use of BIM in their construction projects.

Ogwueleka (2015) mentioned that the United States of America was the first country to adopt BIM in the construction industry in the mid-year of 2000; they highlighted that there has been a global call from the projects owners to use BIM and green technologies to improve the quality of the construction industry. They affirmed that the implementation of BIM technology in the construction industry is driven by the increasing number of projects owners demand and those projects' increasing complexity which has led to the BIM revolution as an innovative tool to cope with the industry challenges.

Aladag et al. (2016) reviewed the adoption of BIM in the construction industry; they mentioned that the UK Government announced in May 2011 that they will require fully collaborative 3D BIM as a minimum requirement by the year 2016. They mentioned that BIM adoption has recently emerged in the Turkish construction industry as a necessity to cope with the strict sustainability regulations which were established in 2007, while the construction industry stakeholders have realized that BIM adoption will assist them in complying with the new sustainability regulations and will improve their projects' performance.

Macauley et al. (2016) explored the adoption of BIM in the construction industry worldwide and found that BIM adoption has been employed in many countries and it has been promoted by most of the governments who started mandating BIM adoption in the mega projects as the first stage of adoption; they mentioned that many countries in the European Union have started adopting BIM in their construction projects such as UK, France, Italy, Germany, Spain, Finland, Denmark, Norway, Netherlands, and the Czech Republic. That is in addition to other countries such as USA, Brazil, Chile, Canada, Singapore, China, Australia, and New Zealand. Within the Middle East the report confirmed that UAE has been the leading Middle East country in adopting BIM where Dubai Municipality since 2014 has mandated BIM in construction projects over 40 storeys tall or with an area more than 27,871 m², and a new circular update was issued in 2015 to mandate BIM for all government projects which exceed 20 floors.

Mehran (2016) mentioned that BIM has been an innovative tool which is reshaping the construction industry. She also mentioned that the UAE construction industry is moving towards adopting the BIM technology. Dubai Municipality has been the first authority to mandate BIM implementation in the UAE in May 2014 which will be used in buildings over 40 storeys or more than 300,000 ft² as well as government projects. BIM has already been adopted in landmark projects in the UAE such as the Louvre Museum, Guggenheim and Midfield Terminal in Abu Dhabi. Mehran also highlighted that BIM will be mandatory in public-sector projects in the UK by 2016.

2.4.1.4. Benefits of Adoption Building Information Modelling

Linderoth (2010) defined six benefits of using BIM in the early conceptual stage: quick visualization, better decision taking during the project management process, quick and accurate update of changes, reducing the man-hours which are required to establish reliable space programs, improved communication between all the project team members, better scope control and ensuring a higher confidence level in scope completeness. Sebastian (2011) added that BIM will improve significantly the communication between the design office, the construction site, and the offsite fabrication; the model will allow the sharing of all the information and details for every item and that would be shared among all team members which will result in improved communication and a significant reduction of problems and errors.

Bryde et al. (2013) investigated the perceived benefits of adopting BIM in the construction industry; they mentioned that the benefits of BIM are not only limited to the geometric modelling of the building's performance but it would definitely assist in managing construction projects and that would reflect in cost reduction through the building's whole lifecycle in addition to the significant time saving. They mentioned that BIM replaces the traditional paper-based tools and keeps everything in a virtual environment which allows all the project members such as owners, designers, contractors and facility management to use it through the building's whole lifecycle in a more efficient and effective way compared to the traditional methods.

Eadie et al. (2013) listed some of the benefits of adopting BIM in the construction industry such as: lessening the construction project's environmental impact, better cost and time performance, and significant improvements in the construction operation's safety and quality. They also added that adopting BIM will reduce the wastage of materials and will improve the design and construction processes throughout the phases of design, preconstruction, construction and facility management by providing an overall life cycle tool which can manage and control the project from inception till handing it over to the operation team/end users where the BIM will include all the project's historical information since the inception stage, as built drawings, operation and maintenance manuals, materials logs and details.

Zahrizan et al. (2013) affirmed the problem of managing the construction documents and argued that any problem in the project's information could significantly hinder the productivity of the construction projects; they stated that "Information is perhaps the most important construction material"; they affirmed the necessity of managing the construction project's information through utilization of BIM as a platform which would support collaboration and communication between the different construction team members. Ogwueleka (2015) had discussed the perceived benefits of BIM and concluded many benefits such as effective information sharing, accuracy in procuring the materials at the right time, effective design and technical review of projects, efficiency in quality, cost and time management.

Aladag et al. (2016) discussed the benefits of adopting BIM from the sustainability perspective and concluded that BIM contributes to facilitating and complying with green building design in terms of energy and daylight analysis, stimulating energy performance of projects, reducing carbon footprint of projects, reducing waste, computation of the quality of materials and LEED documentation. Mehran (2016) highlighted the benefits of BIM which spans over the construction project lifecycle in the different phases of preconstruction, construction and post construction; BIM would be used in the 3D model to transmit and use the building`s information, the time could be incorporated in the time model 4D and the cost could be incorporated in the cost model 5D.

2.4.2. Prefabrication

2.4.2.1. Definition of Prefabrication

Chaing et al. (2006) defined prefabrication as "A manufacturing and pre-assembly process generally taking place at a specialized factory, in which various materials are joined to form a component part for final installation"; they added that the prefabrication term is also interchangeably with the terms offsite manufacturing and industrialized building system (IBS). Another definition for the industrial building system was added by Abdul Kadir et al. (2006) which is "Industrial building system includes the industrial process by which components of a building are conceived, planned, fabricated, and erected on site". They added that the offsite prefabricated system is about transferring the building operation from

the site to the factory where the prefabrication allows the building components to be built at the factory at a convenient time and delivered to the construction site on time.

Jaillon and Poon (2009) agreed with the aforementioned definitions and added: "the manufacturing process may be undertaken in a factory environment or under open sky in the site". They also gave examples from the prefabricated building system which are: prefabricated slabs, vertical structural elements, facades, partitions, stairs, and sanitary units. Egb (2010) confirmed that there are many terms used interchangeably in the literature to describe prefabricated construction, namely: manufactured construction, off-site construction, off-site manufacturing, industrial building system, and modern methods of construction. He defined them all as having the same meaning as they all had the intention of "moving some of the effort that goes into construction offsite into the controlled environment of a manufacturing facility".

Kamar et al. (2011) agreed with the above definitions and mentioned that the term prefabrication is used interchangeably with other terms like offsite construction, industrialized building system, offsite manufacturing, modern method of construction, industrialized building and industrialized construction which all are different terms but having the same meaning; they defined it as "A construction technique in which components are manufactured in a controlled environment (on or offsite), transported, positioned and installed into a structure with minimal additional site works".

2.4.2.2. Prefabrication & Innovation

Chiang et al. (2006) affirmed that many clients had already started promoting the adoption of prefabrication as an innovative approach which derives from the manufacturing sector and improves the construction industry's performance. They stated: "Prefabrication is promoted as a manufacturing approach to construction not to decrease construction cost, but to increase quality and efficiency, and to reduce construction waste". They focused on the importance of the client's crucial role of championing prefabrication in the industry as an innovative solution to improve performance.

Prefabrication as a newly introduced construction method will be facing difficulties at the first stage due to being a new method to some construction industry members who might

oppose change at the outset. Abdul Kadir et al. (2006) discussed in their research that some contractors prefer the traditional construction system which they have been dealing with for decades compared to the new emerging prefabrication method.

Tam et al. (2007) affirmed the urgent need of adopting innovative solutions such as prefabrication construction methods to enable countries to achieve the required developments while maintaining the environment for future generations. They criticized the traditional construction methods for negatively impacting the environment and being responsible for around 40% of the total waste intake. Brandon & Lu (2008) referred to prefabrication as one of the new technologies which is presenting innovation in the construction industry and helping in overcoming the industry`s inherent problems through advancing the level of quality, efficiency, performance and safety.

Kamar et al. (2011) confirmed that prefabrication is one of the major innovations in the construction industry, they referred to it as "An innovative process of building construction using the concept of mass-production of industrialized systems, produced at a factory or onsite within a controlled environment; it includes the logistical and assembly aspects of it, done in proper coordination with thorough planning and integration". Onyeizu et al. (2011) referred to the prefabrication method as one of the important innovations in the construction industry, the adoption of which will benefit the construction industry through faster delivery times, better productivity and the reduced the need for unskilled workers. Bari et al. (2012) looked at the prefabrication method as an innovative solution to deal with the drawbacks of conventional construction methods and to assist the industry in achieving its targets while minimizing its negative impacts.

2.4.2.3. Adoption of Prefabrication in the Construction Industry

Azman et al. (2012) discussed the application of the prefabrication concept in the Malaysian construction industry, where they found that the first attempt was in 1964 by Housing and Local Government. While the industry players preferred to use conventional methods, the Construction Industry Development Board in Malaysia had started educating the construction industry in the prefabrication concept to increase their awareness through programs since 1998. This has led to incremental improvement in the construction

prefabrication which has been recorded in an increasing trend since the first quarter of 2010.

Jin et al. (2013) affirmed that the prefabrication in the construction industry had been used as an innovative tool to improve the industry competitiveness and to reduce the negative environmental impacts, they quoted on example of the 80 floors high Rotating Tower in Dubai in the United Arab Emirates which was designed by Architect David Fisher; this tower will be the first factory-built skyscraper, the building's central core will be constructed on site which contains the buildings vertical transport system and services, while the remainder of the structure is prefabricated in a factory in Italy.

Tam et al. (2007) found in his research that the adoption of the prefabrication concept is widely accepted in Hong Kong construction where the most common prefabrication application recorded is in facades and stairs. Jaillon and Poon (2008) agreed with the prefabrication methods been implemented in Hong Kong and mentioned that the government is encouraging the adoption of the prefabrication approach to reduce the negative impact of conventional construction methods. The Hong Kong government introduced incentive schemes to promote adoption of prefabrication in the construction industry through granting exceptions on the gross floor area and site coverage calculations under the Building Ordinance. Segerstedt and Olofsson (2010) studied the adoption of prefabrication in the construction industry and found that it had been successfully adopted in Japan and mentioned also that 74% of the detached single houses in Sweden are manufactured in offsite factories.

Villaitramani and Hirani (2014) investigated the adoption of prefabrication in India; they found that prefabrication came to effect in India in the early 1950s as an innovative solution to the housing crisis resulting from the influx of refugees from western Pakistan. The Indian prefabrication industry were the pioneers in producing various civil and architectural projects throughout India. However the prefabrication sector has recently been more developed due to technological advancement and the help of Building Modelling Information technology. They confirmed the importance of prefabrication in the Indian construction industry due to the challenge of the current difficulties of slum inhabitants. Fabrication is looked at as an innovative tool to provide housing as there are

fewer logistical difficulties, the costs are less and less time is needed to enhance the standard of living of slum residents.

Azman et al. (2012) have also mentioned that the UK government learned the prefabrication system from Japan through the large car manufacturer Toyota which built Toyota Homes in 1975. The UK government has spent up to 10 million pounds on prefabrication researches and is trying to get construction industry members to adopt prefabrication in their projects. They mentioned that prefabrication is now well known in Australia, the USA and other European countries.

2.4.2.4. Benefits of Adoption the Prefabrication

Tam et al. (2007) highlighted the many advantages of adopting prefabrication in the construction industry which are: freezing the design at an early stage so that the changed orders will be very minimal, improving the product`s quality, reducing the overall cost and timeframe, reducing significantly the environmental impacts through the reduction in generated waste, and better integration and coordination between the design and construction efforts. Kadir et al. (2006) added another benefit which was the significant labour saving compared to the traditional onsite operations; they claimed that the saving could reach up to 50% in the total required man hours and that would result in shorter project times and cost savings.

Poon (2007) referred to prefabrication as an innovative method that will significantly reduce waste and assist the industry to improve its environmental performance which has been widely criticized due to being responsible for generating huge amounts of waste in addition to natural resources depletion and greenhouse gas emissions. Jaillon and Poon (2008) mentioned that many countries are starting to adopt prefabrication to improve productivity and quality, to reduce manpower, reduce construction time, and improve the environmental performance of the construction industry in terms of reduction of waste, dust, and noise.

Jaillon and Poon (2009) referred to the report “Construct for excellence” issued by the Construction Industry Review Committee in 2001 in Hong Kong which recommended adoption of prefabrication in the construction industry to enhance quality and reduce waste

generation on construction sites, they also affirmed that adopting prefabrication is one of the main features of green buildings due to the perceived significant environmental benefits. Al-Hajj and Hamani (2011) confirmed the significant benefit of prefabrication in minimizing generated waste; they mentioned that the United Arab Emirates is considered one of the biggest waste producers where 75% of the nation's waste is generated by construction activities; they recommended the use of prefabrication in the construction industry to reduce waste and improve the industry's environmental performance.

Bari et al. (2012) had explored in their research the benefits of the prefabrication method and concluded that there are many benefits, which are: fewer workers needed, improvement of quality, increased productivity, overcoming the negative environmental impacts associated with conventional construction methods, better supervision and quality control, overall cost savings, reduced construction time, increased design and construction integration, improved environmental performance due to minimizing waste generation to 52% compared to the traditional onsite construction methods, and reduction of natural resources depletion. Azman et al. (2012) listed the many benefits of the construction prefabrication method, namely: minimal waste, a cleaner environment, reduction of site labour, better quality control, faster project completion, neater and safer construction sites, and lower total construction costs.

Pecur et al. (2014) mentioned many advantages for adopting prefabrication in the construction industry such as: safer construction operations; quicker and cheaper building achieving sustainable construction by significant reduction of waste and natural resources depletion; a decrease in construction time and cost; and improving operational safety. Villaitramani and Hirani (2014) agreed with the earlier benefits and highlighted the reduction in the number of labours required which would result in a significant reduction of site accidents which makes the industry safer in addition to increasing the project's efficiency. They also confirmed the achievement of better quality which will result in more durable products due to the strict quality control mechanisms adopted in the factory environment. They also added that the construction process will run unaffected by adverse climate conditions.

2.5. Factors Influencing the Change in the Construction Client's Role

Kulatunga (2010) confirmed that clients are having a leading role in stimulating innovation in the construction industry and their role is documented to be changing to promote adoption of innovation in their construction project through championing innovation adoption; he stated that "The client of a construction project is the initiator of most of the projects by identifying novel requirements to be delivered by the construction sector, the client is the base around which other parties communicate, collaborate, make important and innovative decisions, and implement the project". This was agreed earlier by Hartmann, et al. (2008), they mentioned that client behaviour is changing towards taking a new role of driving adopting innovation and confirmed that there are several factors which are influencing the change in the construction client role towards driving adopting innovation. Panuwatwanich et al. (2009), Delre et al. (2010), Abdul Hameed et al. (2012), and Frattini et al. (2014) recommended that the exploration of the adoption influencing factors will come to light in the diffusion of innovation phase which is a predecessor to the innovation adoption phase, they confirmed that the diffusion phase will propagate the new innovations through the communication channels and play the role of convincing the individual to adopt these innovations over time.

Lyytinen and Damsgaard (2001) confirmed that the most popular theory in the context of diffusion of innovation is the diffusion of innovation theory (DOI) which was established by (Rogers 1995) and was popular in the information technology industry, they pointed out that the diffusion of innovation theory was drawn on rational theories of organizational life adopted from economics, sociology and communication theories which explain the individual adoption decisions or intentions to adopt innovation". Mustonen-Ollila and Lyytinen (2003) shed light on the benefits of the theory of diffusion of innovation (DOI) in identifying the potential factors which would influence the adoption of innovation and stated "We adopt the (DOI) theory (Rogers, 1995) as a theoretical basis to identify and analyze factors that affect information system process innovation adoption".

Haider and Kreps (2004) defined the diffusion of innovation as "Diffusion is the process through which an innovation, defined as an idea perceived as new, spreads via certain

communication channels over time among the members of a particular social system", they added that the diffusion of innovation theory (DOI) discusses how the new innovation is transmitted through various social channels and explains the individual behavioral change which could be evaluated through measuring the rate of adoption of innovation". Greenhalgh et al. (2004) added other definition for the diffusion of innovation as "The spread of ideas among individuals, largely by imitation", they confirmed that the diffusion of innovation process will lead to communicate and spread the new intervention through the social channels and will influence the individual adoption decision.

Wang et al. (2012) explained that the diffusion of innovation theory (DOI) which was established by (Rogers 1995) is a broad social psychological theory which describes the pattern of innovation adoption by discussing the mechanism of innovation diffusion and predicting the adoption rate where the theory is explaining the innovation decision process and explaining the rate of adopting a new innovation. They defined the diffusion of innovation based on (Rogers 1995) as "the process by which an innovation is communicated through certain channels over time among the members of a social system" and commented that. Mollaoglu et al. (2015) added that the diffusion of innovation theory helps to examine how the innovation would be communicated over a period of time and through the social system to reach the adoption phase.

Based on the above studies; investigating the factors which are influencing the change in the client role towards driving adopting innovation is underpinned by the diffusion of innovation theory (DOI) which was established by (Rogers 1995) as a theoretical basis to identify and analyze the factors which are influencing the change in the client behavior towards the decision of adopting innovation in construction projects; the following sections will investigate the construction innovation literature and extract the factors which have been influencing the construction client to change his role towards driving adoption of innovation in the construction projects.

1. Market demand & competition:

Market pull which includes customer demand and competitive pressures was recognized by Mitropoulos & Tatum (2000) as an important factor for driving innovation, and they

mentioned that market competitive pressures are driving construction clients to adopt new innovative approaches to differentiate themselves from their competitors and to gain a cost advantage; they argued that market pull force is the primary factor which is influencing the construction clients to change their role in their projects and drive the different parties to adopt innovation. Bossink (2004) concluded in his research that the innovation-demanding market is an important factor which is driving the clients to exert pressure on the construction parties to innovate to meet the market demand. The competition factor was also agreed on by Blayse and Manley (2004) who mentioned that the construction clients must innovate to compete in the market and the innovation will improve the operations and the financial results of their projects.

Dulaimi et al. (2005) stated: "Companies achieve competitive advantages through acts of innovation by differentiating their products and/or services and making this strategy as an alternative to cost competition". Asad et al. (2005) confirmed the benefits of the competitive advantages and stated "It is widely accepted that promotion of innovation and innovative thinking is a pre-requisite to any competitive advantage".

Hartmann (2006), Yitmen (2007), Thorpe et al. (2008), and Brandon and Lu (2008) affirmed that market competition is a major incentive which is driving construction clients to adopt innovation and agreed that innovation is a pre-requisite to achieve a competitive advantage. Hartmann et al. (2008) investigated the relationship between construction innovation and competition and confirmed that competition is reshaping the client's role towards adopting innovation; they found that adoption of innovation in the private sector is based on the associated economic benefits at the first instance which drives the strategic decision of the construction client to undertake innovative approaches. They stated that "The adoption behaviour of private clients in construction mainly depends on the contribution of the constructed facility to the competitive positioning of the organization". They argued that the competition factor is related only to the private construction clients who are running their business for profit generation while this factor should not be relevant to the public-sector clients whose innovation behaviour is governed by different interests and motivations.

Arif and Egbu (2010) highlighted that market competition has been enforcing the industry to improve its efficiency and to become more cost effective. Kissi et al. (2010) agreed with the importance of market competition in driving innovation and stated: "Innovation provides an avenue by which organizations can differentiate their products or services". Kulatunga (2010) defined market demand as a main driver for the clients to adopt innovation in their projects, enabling them to compete in the market. He highlighted that the increasing demand for new types of projects has arisen due to changing lifestyles and to urbanization which is redirecting the construction clients to drive the construction supply chain to be more innovative enabling them to cope with the market demand.

Xue et al. (2014) investigated the relationship between market demand and innovation, they concluded that there is increasing demand in the market for innovative projects which stimulate the clients to adopt innovative solutions to meet the customer needs and be more competitive in the market; they added that innovation would improve the company image and defined it as an important factor which is motivating the adoption of innovation. Kilinc et al. (2015) agreed with the market demand as an important factor which is influencing the clients to change their behaviour and adopt innovative solutions to enable them to cope with the increasing demand in the market and being more competitive; they highlighted that the clients are operating in the market according to the customer needs which shall be well addressed by the clients in their construction projects.

2. Client`s experience & competence:

Blayse and Manley (2004) agreed that the technical competence of the client is one of the most important factors that drive them to adopt innovation in their projects due to being a precondition for their innovation behaviour in the construction projects; they added that the client`s organizational resources are a key factor for successful innovation adoption, and they also highlighted that the client`s experience is an important factor which stimulates innovation in the construction industry among the different parties and stated: "The more demanding and experienced the client, the more likely it is to stimulate innovation in the projects it commissions". Bossink (2004) affirmed that the firm`s technological capability is a main driving factor for adopting innovation in the construction industry and stated: "Technological capabilities of organization in the industry push the implementation of the

new solutions by these organizations in their construction projects". Ivory (2004) claimed that the construction clients' technical knowledge is mandatory to enable them having the confidence to commit to innovation; they also pointed out that the client competence is a key ingredient to drive innovation in construction projects.

Ivory (2005) agreed with the importance of the construction client`s technical competency in the process of adoption of innovation, he mentioned that the client`s ability to promote innovation is restricted by the client's competence to understand the technical issues related to innovation enabling the client to judge confidently on the associated risks of innovation. He added that the innovation process will not happen in isolation as it needs the contribution of all the team members, therefore the positive client contribution in the design and in the innovation process relies on his technical competence which is looked at as a main factor influencing and enabling the construction clients adopting innovation in their projects.

Hatmann et al. (2006) confirmed that the clients' experience and competence is one of the main factors enhancing the clients contribution in innovation and encouraging them to change their role towards driving adoption of innovation in their projects, as their experience and competence will enable them to deal with innovation complexity and ensure the successful adoption especially for the clients who are investing in the research and development in their organizations. They stated that "The complexity of an innovation will be lower for an experienced and competent client who is also better able to judge the relative advantage of the new idea". Yitmen (2007) confirmed the importance of the client's technical competence and stated "The innovation potential of the firms depends on their ability to acquire existing knowledge, to create new knowledge and to make use of it for the realization of new construction solutions; knowledge plays a critical role in creating and sustaining competitive advantages of construction firms".

Hartmann et al. (2008) agreed with defining the client`s experience as a main factor which is changing the client behaviour towards adopting innovation; they stated that "Clients who continuously carry out projects have gained a certain level of technical competence and experience which allows them to understand the principal mode of functioning, the advantages and the disadvantages of an innovation solution". They added that the years of

experience which the client has developed from previous projects are found to be a reason for the client adopting innovation in a competent way and that is the case of professional clients being able to exploit the innovation benefits much more than occasional clients. Brandon and Lu (2008) confirmed that the client experience in the construction industry impacts significantly in the innovation process where the more the client is experienced in the construction industry the more likely he will contribute to the innovation process.

Kulatunga (2010) defined the client`s technical competency as one of the major factors that is encouraging the active participation of the client in adopting innovative solutions where the technical competent client would perceive and react more actively with the new innovative approaches due to better understanding of technical matters. Love et al. (2012) confirmed that the construction client's experience is a significant factor which influences their innovation behaviour; they mentioned that client experience varies significantly and stated "More experienced and technically competent clients actively participate in driving innovation throughout the construction process". They affirmed that the more experienced clients could control and manage the construction project team members and were more likely to embrace innovation. On the contrary, the clients with limited knowledge avoid adopting innovation due to their limited experience.

Loosemore and Richard (2015) investigated the relationship between the construction client's experience and their innovation behaviour and concluded that the more experienced clients are driving innovation in their projects due to being experienced clients and having a clear vision for their needs. They stated that "Dominant clients actively engage with driving innovation in the industry to procure assets critical to its core business", and added that the client's education is an important factor in driving innovation as it enables the client to deal with the risks which are associated with innovation. Jones et al. (2016) affirmed that the construction client`s type plays a key role in the promotion of adopting innovation and confirmed that the experienced clients who are building more frequently are more likely to be demanding and stimulating innovation in their projects.

3. Client`s characteristics:

In the literature, the client`s characteristics are seen as one of the main factors which drives the client towards adopting innovation in their projects. Bossink (2004) found that the client`s characteristics such as championing and leadership had positive impacts on the client`s adoption of innovation and enhancing the client's new role in initiating and releasing innovative ideas. Hartmann et al. (2006) confirmed the importance of the client's characteristics in the innovation process and claimed that the client's communication characteristics will increase the client`s awareness of innovation and will lead to change his behaviour towards the adoption of innovation. Hartmann (2006) and Hartmann et al. (2008) highlighted that the client`s characteristics will enable the building of long-term relationships with the construction industry supply chain members such as the designers and contractors and found this to be promoting the client to adopt innovation behaviour which would evolve through long business relationships which build trust and confidence between the different construction parties.

Kulatunga (2010) investigated the relationship between the client`s personal characteristics and their behaviour in the adoption of innovation; he found that the client`s personal characteristics are reshaping client behaviour into adopting and undertaking innovative approaches in their projects; he mentioned many of these characteristics such as: value judgment on innovation, vision towards innovation, self-motivation, flexibility and receptiveness to change, receptiveness to risks, ability to be a team player, communication skills, ability to establish relationships with supply chain members. These personal characteristics were found to reshape client behaviour towards championing innovation adoption in the construction industry.

Gambatese and Hallowell (2011) affirmed that the personnel characteristics of the construction client have a crucial impact on the innovation process; they defined many characteristics which have a strong positive relationship to the adoption of innovation, namely: commitment, willingness and ability to manage conflicts, and championing characteristics; they affirmed that these characteristics will increase the construction client`s participation in driving innovation in construction projects. Xue et al. (2014) agreed with the importance of the client`s characteristics in the innovation process, such as

communication and cooperation, which enable the sharing of information and knowledge between the different parties and will positively influence innovation outcomes. Loosemore and Richard (2015) confirmed that there had been consensus among the researchers that innovation will not happen unless there is leadership by the construction client who could use their purchasing power to demand and drive innovation in the construction industry.

4. Government`s regulations:

The government`s regulations have been defined as an important factor which drives the construction clients to adopt innovative ideas in the construction industry to meet the requirements of these regulations; Blayse and Manley (2004) mentioned that the government`s regulations and policies have a strong influence over reshaping the characteristics of the construction industry, and mentioned that many governments are establishing performance approach requirements and defined this to be promoting significantly innovation behaviour where the clients have to adopt innovative approaches to cope with these requirements and ensure the compliance of their projects.

Bossink (2004) confirmed that government regulations are defined as an effective driver of innovation which is driving the construction parties towards the adoption of innovation; he referred to the performance-based regulations which are forcing the construction industry members to innovate to comply with these specifications. Hartmann (2006) agreed with these findings and confirmed that the government regulations are an important factor that is driving the construction clients to change their behaviour towards undertaking innovative approaches to meet the new regulations requirements.

Hemstrom et al. (2011) agreed with defining governmental regulation as a driving factor for innovation; they claimed that regulations and standards such as building codes will influence the adoption of innovation and formulate the direction of new changes. Love et al. (2012) found that the governments' and regulatory bodies' regulations, codes and standards represent a main factor which significantly keeps pressure on the construction clients to adopt innovation. They gave an example of the performance regulations which specify the final regulatory goals that consequently encourage and facilitate innovation.

Thorpe et al. (2008) referred also to the government sustainability regulations as an example of the government regulations which enforce adopting innovation in the construction industry to improve the industry's environmental performance. Qi et al. (2010) investigated in their research the construction industry's negative environmental impacts and stated that "The significant impacts of construction activities on the environment have triggered a serious alarm and the governments worldwide have introduced various policies and regulations for controlling them". They defined the enforcement of these laws and regulations as a major factor which is driving the construction clients to keep pressure on the construction project team to adopt innovative solutions to improve their projects' environmental performance, and added: "The enforcement of these laws is expected to stop the environmental deterioration whilst maintaining economic growth".

Jones et al. (2016) highlighted that many regulations have been initiated to reduce and control the construction industry's negative environmental impacts. These regulations have been motivating and enforcing the construction clients to adopt innovative techniques to cope with these regulations. They stated that "A shift to more resource-efficient construction will require the adoption of novel techniques and behaviours by a traditionally conservative industry".

Another example of government regulation is the new regulations adopted by many governments to mandate implementing building information modelling (BIM) in the construction industry. This has been defined as an innovative tool enabling the construction industry to cope with project complexity and improve performance (Brandon & Lu 2008; Eadie et al. 2013; Hewage 2013; Aladag et al. 2016).

Many researchers investigated the new government regulations in adopting building information technology in the construction industry. Ogwueleka (2015) affirmed that the United States of America had started adopting BIM since the year 2000; Aladag et al. (2016) mentioned that the United Kingdom had announced in May 2011 that the government projects will require 3D BIM as minimum requirement by the year 2016 and also affirmed that the BIM adoption is increasing in the Turkish construction industry. Mcauley et al. (2016) confirmed that many countries worldwide had started mandating

BIM, namely France, Italy, Germany, Spain, Finland, Denmark, Norway, Netherlands, Czech Republic, Brazil, Chile, Canada, Singapore, China, Austria, and New Zealand and affirmed that the United Arab Emirates has been the leading country in the Middle East in BIM adoption.

5. Environmental sustainability:

Jaillon and Poon (2008) discussed the significant negative environmental impacts of the construction industry and affirmed the urgent need of adopting the sustainable construction principles to deal with the negative environmental impacts of the construction industry such as: the use of landfill and virgin lands which often leads to a loss of biodiversity and soil, depletion of non-renewable resources, air and water pollution, water and energy consumption, waste generation, and generation of noise by construction activities.

Qi et al. (2010) discussed in their report the significant negative environmental impacts of the construction industry which have been quoted as a major contributor to environmental pollution such as air, noise, solid waste, and water pollution; they mentioned that the construction industry's sustainability has been defined as a major factor which is driving the construction stakeholders towards adopting innovative environmental strategies to reduce the construction industry's negative environmental impacts and improve its sustainability; they defined green construction as "a way of innovation mainly focused on improving the efficiency of resources usage and protecting the environment".

Hemstrom et al. (2011) affirmed that the construction industry stands for about 40% of the total primary energy use and carbon dioxide emissions. They looked at sustainability as a factor which is driving the industry to adopt innovative solutions, and stated that "It is argued that decisions to adopt innovation must take place during the initial design and engineering stage as the specifications and requirements and contracts with contractors are based on these decisions".

Love et al. (2012) emphasized the significant negative impacts of the construction industry on the environment such as natural resources depletion, waste generation, CO2 emissions, and being a major factor behind global warming. They confirmed that adopting the sustainability concept in the construction industry is becoming a mandatory requirement to

mitigate its negative environmental impacts, and referred to innovation as the tool required to adopt sustainability in the construction industry. They stated that "Sustainability is inextricably linked to innovation because it requires radical changes in the way goods and services are produced, distributed, and used while sustaining economic growth". They concluded that sustainability is a main factor which drives the construction industry to adopt innovation enabling the industry to improve its environmental performance.

Xue et al. (2014) agreed with the earlier findings and affirmed that environmental pressures are driving clients towards adopting innovative approaches and techniques to deal with the traditional construction methods and techniques and reduce the industry environmental impacts. Kinlinc et al. (2015) mentioned in their research that there are new pressures on the construction industry to improve the environmental performance of the construction projects through undertaking sustainable construction which is a factor that is driving the clients to adopt innovative solutions in the construction projects design and construction methods to cope with the increasing environmental negative impacts and improve the construction industry sustainability.

6. Organizational culture:

Mitropoulos and Tatum (2000) referred to the organizational culture as an important factor which facilitates and promotes the adoption of innovation; they affirmed that the organizational culture which values innovation will secure the mechanisms, incentives and resources for the identifying and implementing of innovation. Dulaimi et al. (2003) agreed with the importance of the organization's culture in providing the appropriate climate which motivates and fosters the adoption of innovation, and added that inter-organizational coordination is a major factor to ensure the adoption of innovation due to the construction project being carried out by several parties.

Dulaimi et al. (2005) stressed organizational culture as a factor which plays a crucial role in enhancing and supporting the adoption of innovation as it forms the proper climate that fosters innovation culture. They agreed that a supportive organizational climate - which includes rewards for creativity, tolerance of risk, failure and mistakes, and commitment of

necessary resources - would promote the adoption of innovation and redirect the firm towards undertaking innovation in their projects.

Hartmann (2006) claimed that introducing innovation relies on the firm`s physical and mental resources which are allocated for the innovative activities, and affirmed that the organizational culture has a critical role in motivating firms to adopt innovation and stated: "Organizational culture seems to play a critical role in developing and maintaining involvement in and dedication to innovation". He investigated the importance of the organizational culture in adopting innovation and claimed that it encompasses many parameters such as motivation, trust, communication, recognition, and a no-blame culture where all these form a supporting environment which promotes and facilitate firms' behaviour towards the adoption of innovation.

Rutten et al. (2009) confirmed the impact of the organizational culture on the innovation process and added that its importance is not limited within the same organization but will expand to inter-organizational cooperation between the different firms; they highlighted that the inter-organizational cooperation is a significant factor in construction innovation as it will enable better communication between the different construction project`s parties and their organizations will cooperate and work together to implement innovation. Kissi et al. (2010) agreed on organizational culture as a main factor which will ensure the availability of the innovation climate which will enhance the championing of innovation which will ensure the adoption of innovation. They claimed that innovation championing behaviour would reflect a significant positive impact on project performance. Gambatese and Hallowell (2011) agreed with the importance of inter-organizational cooperation between the different firms and established that the compatibility of organizations is essential for successful co-innovation.

7. Performance improvement:

Asad et al. (2005) highlighted that innovation in the construction industry will lead to improvement in offered services and products and that will improve significantly the organization's profitability. They discussed in their research the reflected benefits of innovation in the construction industry and concluded that innovation has been recently

considered as the fourth performance dimension in addition to the traditional three dimensions of cost, time, and quality; therefore the clients have been exerting huge pressures on construction firms to adopt innovation to improve the performance of their projects. Hartmann et al. (2006) referred to innovation as enhancing the construction industry's performance, gaining higher profits and attaining competitive advantages; they added that construction clients are adopting innovation solutions to improve their projects' performance.

Manely et al. (2009) defined innovation in the construction industry as improving the competitive advantages of nations, industries and firms. They claimed that innovation is a key to improve the performance of the industry and that it has resulting social and economic benefits. Yitmen (2007) confirmed that the end-user's demands for cost effectiveness is representing an important incentive which drives the construction firms to adopt innovation solutions to improve cost-related issues in their project including the initial construction cost and the long-term operational cost.

Kissi et al. (2010) affirmed that the innovation is resulting in significant improvements to the performance of the construction industry; they stated that "Innovation in the construction industry has mainly been driven by developing solutions to problems encountered on site; others have been motivated by the aspiration to improve performance". They highlighted that profit maximization has been defined as an important driving force for innovation.

The life cycle cost was addressed by Hemstrom et al. (2011) as one of the major benefits of adopting innovation in the construction industry and acting as a factor which triggers the construction clients to adopt innovation in their projects; they referred to innovation as an economic instrument when they consider the reduction in the construction project life cycle cost by reducing the building energy use maintenance cost. Xue et al. (2014) affirmed the significant benefits for innovation in improving construction industry performance as it would reduce project duration and cost, improve quality, and improve the industry's environmental performance; therefore is it a crucial factor which is influencing the construction clients changing their behaviour towards driving the adoption of innovation in their projects to improve their performance.

2.6. Summary

The extensive literature review affirmed the noticeable change in the construction client`s role from the role undertaken in the traditional procurement method where the client and the other stakeholders such as consultants and contractors are in distinct roles, towards the new role of driving adoption of innovation.

The literature review defined innovation and gave insight into the innovation process and its benefits to the construction industry which has been increasingly realized by the construction clients who are looking to innovation as the solution which will solve the inherent problems in the construction industry and improve its performance. That was followed by discussing the adoption of building information modelling and prefabrication as two examples for the adoption of innovation in the construction industry to explore the perceived benefits of adopting innovation in the construction industry.

The client role has been witnessed to be significantly changing towards driving the construction projects' stakeholders to adopt innovation in construction projects and to improve their performance; the literature defined the following seven factors which had been found to be influencing the change of the construction client` role towards driving the adoption of innovation in the construction industry, which are: market demand & competition, client`s experience & competence, client`s characteristics, government`s regulations, sustainability, organizational culture and performance improvement.

3. Chapter Three- Theoretical Framework

This chapter will articulate the theoretical framework in line with the extensive literature review findings and in connection with the research defined problem, aims and objectives. The theoretical framework emerged from the extensive literature review and underpinned by the earlier co-creation literature based on the service-dominant theory which was established by (Vargo & Lusch 2004a); the following sections will explore the emergence of the service-dominant logic and investigate the value co-creation notion which will be followed by synchronizing this theory in the context of construction client value co-creation. That will be followed by developing a theoretical framework to illustrate the research findings. Therefore this research theoretical framework is built on the "Client Co-creation Theory" based on the interpretation of the service-dominant theory emerged from the works of (Vargo & Lusch 2004a).

3.1. Overview of the Service-Dominant Logic

The "service dominant (S-D) logic" was established by Vargo and Lusch (2004a) which illuminated the evolution of the marketing shift from the tradition of goods-dominant marketing towards the new dominant logic of service-dominant in which intangibility, exchange processes and relationships are central to the new logic of the service dominant view. The new service-dominant logic includes eight foundational premises (FPs) as follow: "FP1-The application of specialized skills and knowledge is the fundamental unit of exchange, FP2- Indirect exchange masks the fundamental unit of exchange, FP3- Goods are distribution mechanisms for service provision, FP4- Knowledge is the fundamental source of competitive advantage, FP5- All economics are services economics, FP6- The customer is always a co-producer, FP7- The enterprise can only make value propositions, FP8- A service centered view is customer oriented and relational".

Vargo et al. (2008) defined service as "The application of competence (knowledge and skills) by one entity for the benefit of another" and confirmed that value and value creation are at the heart of services and are essential to understand the service system dynamics. They distinguished the difference between the traditional view of goods-dominant logic and the new alternative view of service-dominant logic, where in the goods-dominant logic the value is created by the firm and distributed in the market through exchange of goods

and money while in the service dominant logic the roles of producers and consumers are not separated and where value is always co-created jointly and mutually through an interaction between the providers and customers by integration of resources and competences.

Cova and Salle (2008) mentioned that the service-dominant theory which was originated by (Vargo & Lusch 2004a) moved the marketing orientation from "market to" philosophy, where customers are promoted to, targeted, and captured, to a "market with" philosophy where the customer and supply-chain partners are collaborating together in the entire marketing process, this being a major shift from the traditional goods-dominant logic.

Spohrer and Maglio (2008) agreed that the service sector is growing in the global economy and the world`s economy is shifting from agriculture and manufacturing to services especially in the services which include a higher degree of innovations. They mentioned that services in general require clients and providers to work together to transfer the resources, competencies and capabilities by the providers to provide a service which complies with the client's requirements. They defined services as "An activity or series of activities provided as a solution to customer problems". Payne et al. (2008) confirmed the changing trend in marketing from the traditional way in which the suppliers produce goods and services and the customers just purchase those goods and services, to the new trend which is the customer engaging in dialogue with the suppliers during each stage of the product design and delivery. This dialogue is an interactive process of learning together which will result in supplier and customer having the opportunity to create a value process which will ensure compliance with the customer's needs and improve the firm`s business.

3.2. Overview of Co-Creation

The principle of co-creation emerged from the foundational premises number 6 in the earlier service-dominant logic established by Vargo and Lusch (2004). They defined the role of the customer in the new service-dominant logic as "The customer is a co-producer of the service; marketing is a process of doing things in interaction with the customer; the customer is primarily an operant resource, only functioning occasionally as an operand resource".

The co-creation concept was further reviewed and explained thoroughly in Vargo and Lusch (2008) who discussed the co-creation concept in line with the foundation premises 6 in their earlier service-dominant logic; they mentioned that the co-creation was trapped in the earlier traditional good-dominant logic and is currently widely adopted in the new service-dominant logic which is primarily regarding value creation rather than production logic and value co-creation is critical to the service-dominant logic; they changed the foundational premises 6 to be "The customer is always a co-creator of value". Vargo et al. (2008) affirmed that value is co-created through the shared efforts of firms, employees, customers, stockholders, government agencies and other related entities and it is always determined by the customer.

Payne, et al. (2008) studied the sixth foundational premise in the service dominant theory developed by Vargo and Lusch (2004a &2006) and defined value co-creation as "A process that involves the supplier creating superior value propositions with customers determining value when a good or service is consumed"; they discussed the emergence of value co-creation in the business and stated that "Central to service dominant (S-D) logic is the proposition that the customer becomes a co-creator of value, this emphasizes the development of the customer-supplier relationship through interaction and dialog".

Cova and Salle (2008) agreed that co-creation emerged from the service-dominant logic in which the value is co-created by a customer and a supplier which is significantly changing the customer role from a consumer for the offered services to a co-creator of value. Spohrer and Maglio (2008) confirmed that service science is the basis of the emergence of value co creation, and highlighted that the client plays a key role in the co-creation of value where the clients shall perform some activities to ensure that they are getting the most value from the offered services. Witell et al. (2011) confirmed that the value in use is a central theme for the service-dominant logic as the customer is always a co-creator of value; they defined co-creation as "Activities in which customers actively participate in the early phases of the development process by contributing information about their own needs and/or suggesting ideas for future services that they would value being able to use"; they added that the potential of customers as active contributors in the development of new

products or services has been long recognized where the customer could lead, involve, and interact in the value co-creation.

Gronroos and Voima (2012) emphasized the important role of the customer which has been recognized through the service-dominant logic which emphasized that the customer is not a value creator but a value co-creator and stated "Customers are always co-creators of value"; they mentioned that the service-dominant logic stimulates that the service shall be ultimately experienced by the customer who will be engaged in the value co-creation process along with the service providers and confirmed that the interaction between the customer and service provider is the basis of value co-creation and in case there are no interactions the value co-creation is impossible. They referred to the customer and service provider as value co-creators and defined co-creation as "A process that includes actions by both the service provider and customer and possibly other actors".

Galvagno and Dalli (2014) mentioned that co-creation is one constitutive element of the service-dominant theory established by (Vargo & Lusch 2004) which suggested that the companies should not focus on products but should just consider their offering in terms of the services they can offer the customers. They defined co-creation as "The joint, collaborative, concurrent, peer-like process of producing new value, both materially and symbolically", and also mentioned that the co-creation concept is changing the roles of customers and suppliers to interact and collaborate to reach the maximum value which is contrary to the traditional system in which the price system was mediating the supply chain relationship. Co-creation will merge the efforts, resources and competencies of the customer and suppliers to generate value through interaction where value will provide benefits for both the customer and the supplier.

3.3. Client Co-Creation in Construction

Based on the co-creation concept which was discussed in the foundation premises number 6 in the service dominant logic which was established by (Vargo & Lusch 2004) who stated that "The customer is always a co-creator of value", value is co-created through the shared efforts of firms, employees, customers, stockholders, government agencies and other related entities and it is always determined by the customer through the value co-creation process which was defined by Vargo and Lusch (2004 &2006) as "A process that

involves the supplier creating superior value propositions with customers determining value when a good or service is consumed". Payne, et al. (2008) agreed that value is exploited through the dialogue between the customer and the suppliers during each stage of the product design and delivery.

The new customer role in value co-creation based on the service-dominant theory was also confirmed by Cova and Salle (2008), Spohrer and Maglio (2008), and Gronroos and Voima (2012) who pointed out that the customer role is radically changing from the traditional role of being trapped with the offered goods by suppliers under the earlier good-dominant logic towards the new role of being the co-creator of value under the service-dominant logic in which the customer is getting closer and interacts more actively with the service providers during the product development process which ensures that the product development process is incorporating the customer requirements and ultimately will add value to both customer and service providers.

The value co-creation process between the customer and the other service providers will enable the co-creation of innovation. This is one of the main benefits generated through the co-creation process. This was confirmed by Kristensson et al. (2008) who stressed that customer involvement in the production process is based on the notion of value co-creation which will enable the customer to introduce innovative ideas for forthcoming products which will enhance the product`s end value due to the customer tailoring the service or product in compliance with his requirements. They pointed out that the customer's role in the value co-creation process shall start from the beginning of the innovation process.

In the context of the construction industry; Cox and Piroozfar (2011) confirmed that the value co-creation concept is still new but is noticeably transmitting the construction design from being undertaken distinctly inside the designer firm to be undertaken through a dynamic interaction between the client and the design firm to add value. They also highlighted that the co-creation concept is changing radically the construction client`s role from the traditional role of just presenting the requirements through the project brief while the other stakeholders are undertaking all the subsequent processes distinctly, to the new construction client's role of being a value co-creator through inducing interaction with the different stakeholders such as designers, suppliers, main contractor, subcontractors and

manufacturers to work together from the early stages throughout all the construction project phases and thus generating innovation as the co-created value.

Morledge and Smith (2013) distinguished the difference between the construction industry and other industries and noted that the purchasers of construction projects are usually referred to as "Clients" rather than "Customers" as they are purchasing services rather than products and the construction industry is primarily a service industry; they added another difference which is the temporary nature of construction projects which dictate a temporary relationship between the client and the contractor for a specific project which will dissolve once the project is completed, therefore the link between the client and the contractor is frequently fractured unlike in other industries which have continuous demands which enable constructing and refining a stable supply chain relationships. They also confirmed that construction is a service-based industry where the client is not sold a product but a bespoke project.

Aapaoja et al. (2013) confirmed that the construction industry is a service-based industry where the value is co-created by the clients and the different stakeholders through the value co-creation process led by the client, and they emphasized that stakeholder involvement during the construction project's early stages is of paramount importance for value creation in the industry. Ryd (2014) affirmed that the construction client's new role as co-creator shall be undertaken in the early stages of the construction project design which will influence positively the project`s outcomes.

Liu et al. (2014) confirmed that the traditional construction procurement method is having the clients and the other stakeholders such as designers and contractors in distinct roles, which is hindering any value creation due to fragmenting the different stakeholders. However, adoption of the concept of value co-creation allows the construction client and the other stakeholders to work collaboratively from the early construction project stage and is thus referred to as a key to enhance project success. They also emphasized that value co-creation is significantly fostering and enhancing adoption of innovation through the new client-contractor relationship which overcomes the traditional fragmented nature of the construction industry in addition to the change in the role of construction parties from the

traditional passive role of building based on the architect design to a more active role in which all the project stakeholders collaborate throughout all the construction process.

Smyth et al. (2016) confirmed that the notion of value co-creation is an emergent concept in the construction which emanated from the service-dominant logic established by Vargo and Lusch (2004; 2008) and affirmed that the value co-creation notion will enhance innovation adoption in the construction industry through integrating the construction client who is referred to as a co-creator with the other supply chain members to interact and work collaboratively in developing solutions to the client's new value propositions and solve the client`s problems through adopting innovative solutions. Fuentes and Smyth (2016) emphasized that value co-creation would reach its peak intensity in the design phase of the construction project where value co-creation in co-design would ensure that the client value propositions are attended through co-design with the participation of the different stakeholders which will ensure that the client`s propositions are transferred from design to operation.

3.4. Theoretical Framework and its Components

This section will conceptualize the literature review findings and connect it with the diffusion of innovation theory which was established by Rogers (1995) and the co-creation theory which emerged from the service dominant logic based on the works of Vargo and Lusch (2004) which are both underpinning this research. The theoretical framework will illustrate the change in the construction client`s role in line with the underpinning theories of diffusion of innovation and co-creation, that will be followed by deriving the research hypotheses which will be tested through the collected data analysis.

The theoretical framework illustrated in **Figure.6** starts in explaining the role of the construction client in the traditional procurement method based on the works of Murdoch and Hughes (2008), Morledge and Smith (2013), and Alharthi et al. (2014) who agreed that the traditional procurement method has distinct roles for the different organizational members who are: the client, various consultants (architect, structural engineers, service engineer, quantity surveyors), contractors and their suppliers, and subcontractors. Therefore the traditional procurement method is found to create distinct roles for the different stakeholders.

The second part of the theoretical framework is illustrating the literature review's defined influencing factors which are underpinned by the diffusion of innovation theory (Rogers 1995), these factors have been found to influence the change in the construction client role under the traditional procurement method towards the new role of driving adoption of innovation in the construction industry (Blayse & Manley 2004; Asad et al. 2005; Ivory 2005; Hartamnn et al. 2006; Brandon & Lu 2008; Hartmann et al. 2008; Kulatunga et al. 2011; Xue et al. 2014; Kilinc et al. 2015).

The literature defined the following influencing factors: the first factor is market demand and competition which has been a significant factor which incentivizes the client to drive adoption of innovation in their projects (Hartmann 2006; Yitmen 2007; Thorpe et al. 2008; Brandon & Lu 2008); the second factor is the client's experience and competence which represents the client's ability to participate and promote the adoption of innovation in the construction industry (Ivory 2005; Hartmann et al. 2008; Kulatunga 2010; Loosemore & Richard 2015; Jones et al. 2016); the third defined factor is the client's characteristics such as championing, leadership, communication, vision, motivation, flexibility, and commitment, which are all found to be reshaping the client's behaviour into undertaking and adopting innovation (Hartmann et al. 2006; Kulatunga 2010; Gambatese & Hallowell 2011; Xue et al. 2014; Loosemore & Richard 2015).

The fourth factor is government regulations which are found to be driving construction clients to adopt innovation to comply with government policies (Blayse & Manely 2004; Bossink 2004; Thorpe et al. 2008; Hemstrom et al. 2011; Love et al. 2012; Jones et al. 2016). The fifth factor is environmental sustainability, knowledge and awareness of which has been growing among construction clients who are trying to comply with the sustainability requirements through adopting innovative approaches (Jaillon & Pon 2008; Qi et al. 2010; Hemstrom et al. 2011; Love et al. 2012; Xue et al. 2014; Kinlinc et al. 2015).

The sixth defined factor was the organizational culture which was found to promote and facilitate adoption of innovation through providing the appropriate climate which will foster innovation adoption behaviour (Mitropoulos & Tatum 2000; Dulaimi et al. 2003; Dulaimi et al. 2005; Hartmann 2006; Rutten et al. 2009; Kissi et al. 2010; Gambatese &

Hallowell 2011). The seventh factor is construction industry performance. Many researchers had affirmed that innovation has been considered as the new performance parameter in addition to the traditional parameters of cost, time and quality due to innovation improving the industry's overall performance (Asad et al. 2005; Hartmann et al. 2006; Yitmen 2007; Manely et al. 2009; Kissi et al. 2010; Hemstrom et al. 2011; Xue et al. 2014).

These factors have been found to apply a strong influence on the construction client role under the traditional procurement method and change it from being separated from the roles of the other stakeholder towards the new role of being innovation co-creator based on the co-creation notion established by Vargo and Lusch (2004). The new construction client`s role of being innovative co-creator which is illustrated in the last part of the theoretical framework is stimulating interaction between all the construction project's stakeholders such as consultants, contractors, subcontractors and suppliers to work closely and collaboratively towards adoption of innovation as the co-created value through the shared efforts by all the construction projects stakeholders (Cox & Piroozfar 2011; Apaaoja et al. 2013; Ryd 2014; Liu et al. 2014; Smyth et al. 2016).

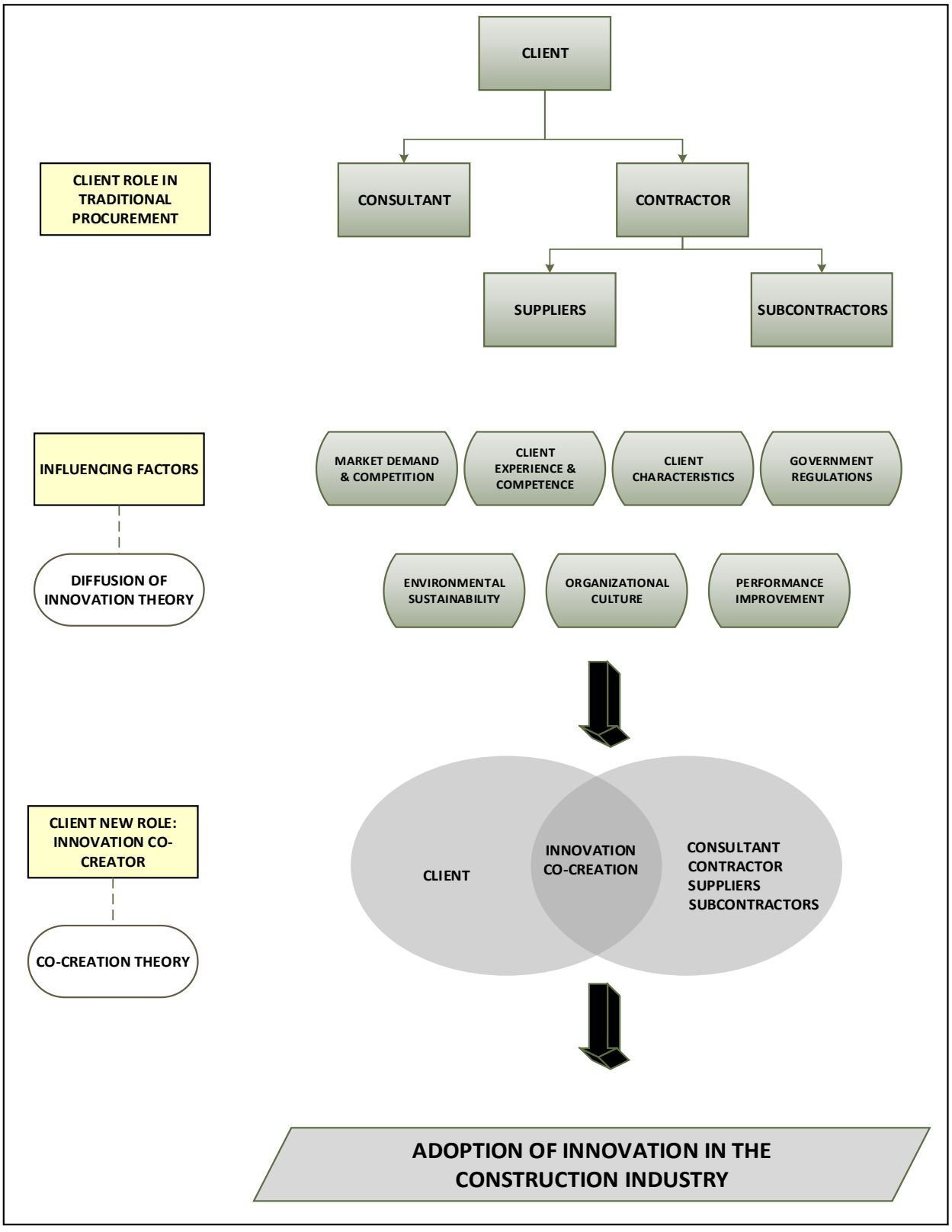

Figure.6: Theoretical Framework

3.5. Research Hypotheses

Kothari (2004) mentioned that the hypothesis will be constructed after the extensive literature review and defined the hypothesis as a "tentative assumption made in order to draw out and test its logical or empirical consequences". He affirmed that the hypothesis development is having a significant role in the research as it represents a focal point of the research as it will affect the testing conducted during the data analysis which will result in either accepting or rejecting the hypothesis. He also stated: "The role of the hypothesis is to guide the researcher by delimiting the area of research and to keep him on the right track. It sharpens his thinking and focuses attention on the more important facets of the problem; it also indicates the type of data required and the methods of data analysis to be used". Sukamolson (2010) defined the hypothesis as "A tentative explanation that accounts for a set of facts and can be tested by further investigation".

Wilson (2014) studied the hypothesis and defined it as "The hypothesis is concerned with the relationship between two variables and the hypothesis will predict the relationship between the variables and through testing may or may not support the theory"; they clarified that there are two types of hypothesis variables: independent variables which are seen as a cause and a dependent variable which is seen as the effect or outcome which is often referred to as a cause-and-effect relationship. They stated: "if you opt for a deductive approach, normally you would conduct a literature review in order to identify an appropriate theory and construct a hypothesis." Saunders et al. (2016) added another definition for the hypothesis: "A testable statement that there is an association, difference or relationship between two or more variables" and added that the researcher may use existing literature review theories to develop hypotheses and these hypotheses will be tested and confirmed where the testing may confirm, in whole or part, or be disproven, which leads to further development of the theory which could then be tested by a further researcher.

Kothari (2004) pointed out that the drawn hypothesis from the literature review findings will be built based on the relationship between the two variables, a dependent variable and independent variable; the dependent variable will be responsible for the effect and the

independent is responsible for the cause and added that the hypothesized relationship will be tested for verifying or rejecting the established hypothesis.

Based on the above, the researcher has established the seven hypotheses below which are illustrated in **Figure.7,** these hypotheses were derived from the theoretical framework (**Figure.6**) which emerged from the extensive literature review. The seven influencing factors were defined in the literature to be the cause for the change in the construction client`s role towards being innovation co-creator therefore they are defined as the independent variables which are influencing the change in the construction client`s role as the dependent variable, the hypotheses will be further tested during the collected data analysis process which will result in accepting or rejecting the established hypothesis:

H1: Market demand is encouraging the change in the construction client`s role towards driving adoption of innovation.

H2: There is a positive significant relationship between the construction client experience and competence with the change in the client`s role toward adoption of innovation.

H3: There is a positive significant relationship between the construction client`s characteristics with the change in the client`s role toward adoption of innovation.

H4: Government regulations are stimulating the change in the construction client`s role towards adoption of innovation.

H5: There is a positive significant relationship between environmental sustainability and the change in the construction client`s role in co-creating innovation among the project stakeholders.

H6: There is a positive significant relationship between the construction client organizational culture and the new role of the construction in co-creating innovation.

H7: The construction performance improvement is found to be promoting the change in the construction client`s role towards innovation co-creation.

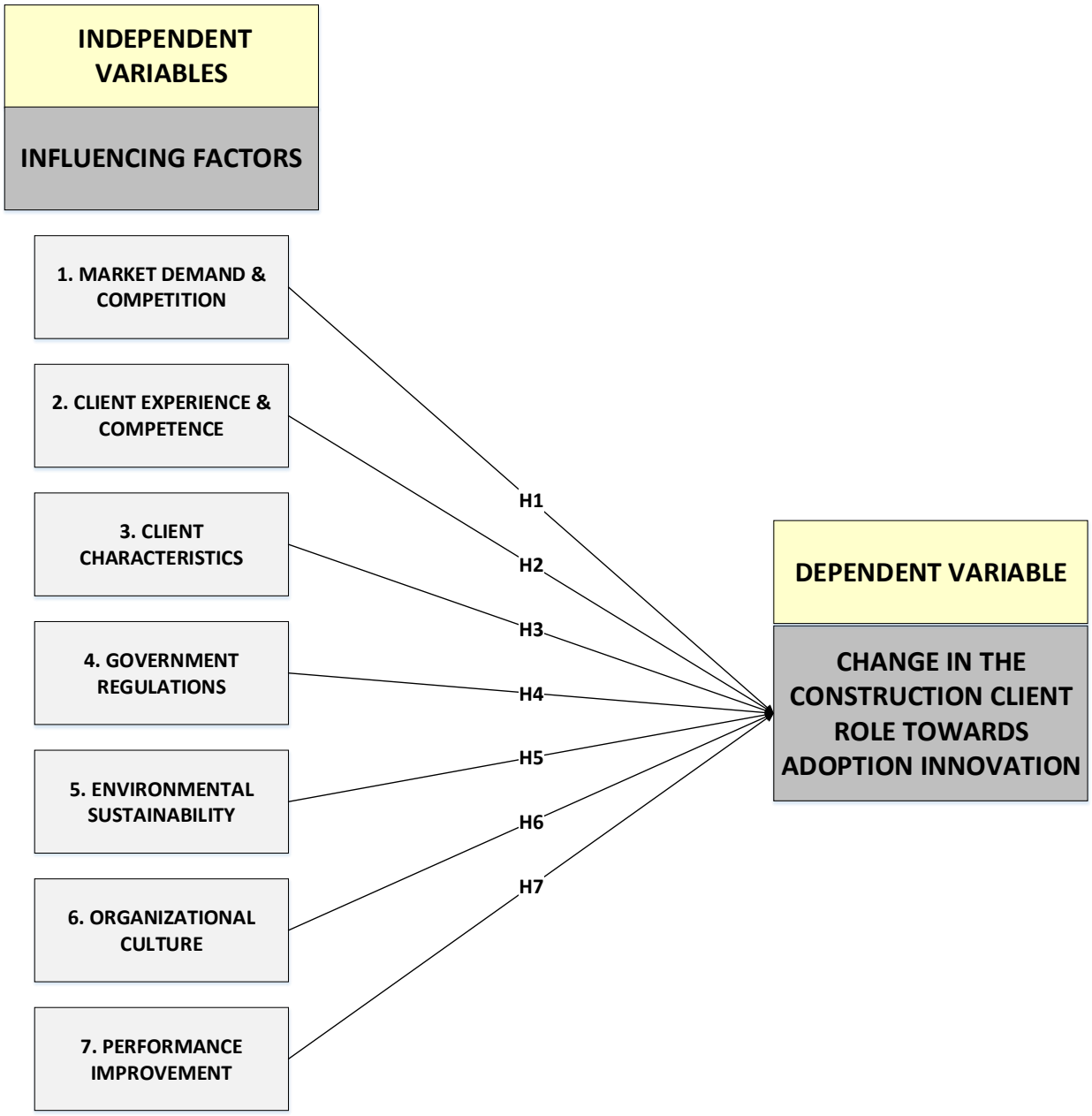

Figure.7: Research Hypotheses Diagram

4. Chapter Four- Research Methodology

4.1. Introduction

This chapter will outline the research methodology through investigating the different research methods and selecting the most appropriate method for this particular research in compliance with the research's defined problems, aims and objectives; the different research methods will be studied and contrasted to conclude with the most appropriate method which will be used to collect and analyze the data of the conducted extensive literature review.

Amaratunga et al. (2002) defined the research methodology as "The procedural framework within which the research is conducted" and confirmed that there are different schools of thought in methodology in which the philosophers and methodologists have been in long epistemological debate regarding the best research methodology; the debate has been between the positivists who use quantitative and experimental methods to test hypothetical-deductive generalizations and the interpretivists who uses qualitative and naturalistic approaches to understand human experience in a context-specific field.

Eldabi et al. (2002) defined the term epistemology as "Beliefs about the way in which knowledge is construed" and highlighted the two epistemological approaches: positivist, which encompasses quantitative approaches; and interpretivist, which encompasses qualitative approaches. They also agreed that there is not yet any perfect research methodology and there is no universally agreed research method due to the wide argument about the meaning of science while the well-developed methodology could offer an understanding of the products and processes of scientific enquiry. This was confirmed by Wilson (2014) who defined epistemology as "The nature of knowledge, which means how we conceive our surroundings".

Holt and Goulding (2014) added another definition of research methods: "The means by which the research act is performed and they are the procedures and techniques for gathering and analyzing data". Zhang et al. (2016) studied the different available research methods and found three methods being widely used which are: qualitative, quantitative, and mixed research methods; they studied the three methods and found that qualitative

research tends to apply a more holistic and natural approach to the resolution of a problem while quantitative research applies measurement to phenomena that can be represented in term of quantity, they also found mixed methodology being able to answer the increasingly complex and multifaceted research questions using both qualitative and quantitative methods.

Kothari (2004) defined nine steps for conducting scientific structured research which are: defining the research problem, defining the aim and objectives which will generate the research questions, an extensive literature review, hypothesis development, preparing the research design, determining the research sample, collecting the data, analyzing the data, generalization and interpretation, and report preparation as illustrated in **Figure.8.**

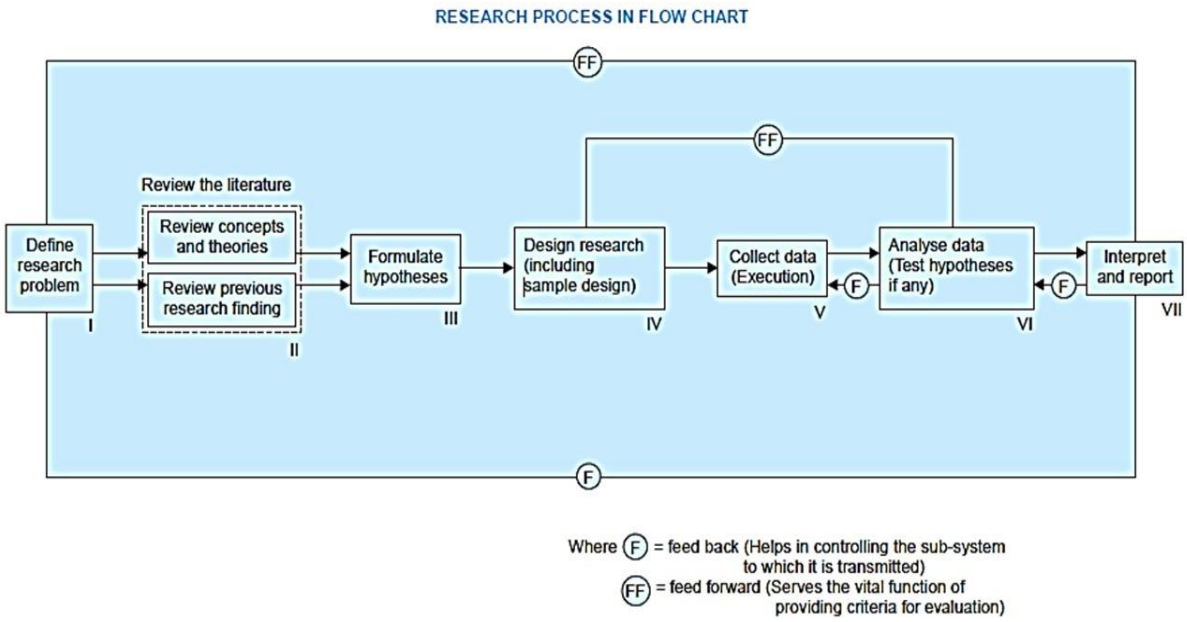

Figure.8: Research Process in Flow Chart
Adopted from Kothari (2004), p.11

Based on the research process flowchart developed by Kothari (2004), this research is designed as per the following sequential steps:

1. Definition of the research problem.
2. Establishing the research aim and objectives.
3. Establishing the research questions.

4. Extensive literature review.
5. Articulate the theoretical framework.
6. Develop the research hypothesis.
7. Select the appropriate research method.
8. Select the data collection method.
9. Design the research instrument.
10. Select a research sample.
11. Data collection.
12. Data analysis and hypothesis testing.
13. Discussion and interpretation of findings.
14. Conclusion.

4.2. Overview of the Research Methods

4.2.1. Qualitative Method

Malterud (2001) stated "Qualitative research methods involve the systematic collection, organization, and interpretation of textual material derived from talk or observation, it is used in the exploration of the meaning of social phenomenon as experienced by individuals themselves in their natural context". Amaratunga et al. (2002) added "the qualitative research is conducted through intense and prolonged contact with the field or life situation and all these data are qualitative as they refer to issues relating to people, objects and situations". They pointed out four major constraints against the use of the qualitative method which are: volume of data, complexity of analysis, details of classification record, and flexibility and momentum of analysis.

Eldabi et al. (2002) pointed out that the interpretivist approach aims at understanding a phenomenon from the point of view of the participants who are directly involved with the phenomenon under study. Therefore this approach encompasses the qualitative approach which emphasizes getting closer to the subject of study to investigate and understand social behaviour, and it is not concerned with the measurement and quantification of the phenomenon but targeting an understanding of the phenomenon's natural setting through face-to-face contact and observations. Kothari (2004) referred to the qualitative approach as "subjective assessment of attitudes, opinions and behaviour" and clarified that it

produces results either in non-quantitative form or in a form which is not subjected to complex quantitative analysis and having much techniques such as: focus group interviews, projective techniques and in-depth interviews.

Cassell et al. (2006) confirmed that qualitative research methods have a long history and tradition and infuse all the different management fields. They also pointed out that qualitative research contributed noticeably in the research field and suggested that qualitative techniques could enable rich insights into the issues which are of interest to both management practitioners and researchers. They agreed that qualitative methods can be employed more easily for researchers who are targeting access to the subjective experiences of organizational life, but they criticized those methods due to the credibility difficulties in qualitative research which may discourage researchers from conducting qualitative researches and stated: "There is clearly a perception that credibility is associated with quantification and scientific status".

Sukamolson (2010) referred to the qualitative method as being subjective and using non-numerical data and encompassing many methods such as interviews, case studies, ethnographic research, and discourse analysis. Malina et al. (2011) mentioned that the qualitative research encourages rich description and strategic comparison across cases which overcomes the inherent abstraction in quantitative methods and permits theory generalization (Wilson 2014).

Lock and Seele (2015) distinguished the qualitative research method by the meaning and context of what is said, done or intended by people. It focuses on the interpretation of facts or their meaning and highlighted that the main characteristic is the small sample size and the variety of qualitative inquiry methods which have been adopted, such as case studies, the focus groups, observations, and discourse analysis. Saunders et al. (2016) confirmed that the qualitative research is often associated with an interpretive philosophy where the researcher needs to sense the subjective and socially constructed meanings expressed about the phenomenon being studied.

4.2.2. Quantitative Method

Eldabi et al. (2002) highlighted that the positivist epistemology tries to understand a social setting by identifying individual components of a phenomenon and then explains the phenomenon in terms of constructs and relationships between constructs. Therefore this approach encompasses a more quantitative approach which relies on the measurement and analysis of statistical data to determine the relationships between one set of data to another.

Amaratunga et al. (2002) distinguished the quantitative method by its ability to test hypotheses and theories which could be generalizable. They highlighted the many strengths of quantitative methods such as: comparison and replication, independence of the observer from the subject, the subject is measured objectively rather than subjectively, reliability and validity are determined objectively, strength in measuring descriptive aspects, and testing hypotheses. While they also pointed out the weakness of the quantitative method which is mainly represented in the method's failure to ascertain deep underlying meanings and explanations in addition to being a snapshot of a situation rather than a deep investigation.

Muijs (2004) defined the quantitative research as "Explaining phenomena by collecting numerical data that are analyzed using mathematically based methods in particular statistics". Sukamolson (2010) defined quantitative research as "The numerical representation and manipulation of observations for the purpose of describing and explaining the phenomena that those observations reflect". He added another definition: "A type of research that is explaining phenomena by collecting numerical data that are analyzed using mathematically based methods in particular statistics"; he defined seven benefits of quantitative research which are: it provides estimates of populations at large; it indicates the extensiveness of attitudes held by people; it provide results which can be condensed to be statistics; it allows for statistical comparison between various groups; it has precision as it is definitive and standardized; it measures level of occurrence; it can answer questions such as "How many?" and "How often?". He also stressed the importance of objectivity in the research and recommended that the researcher shall be as detached from the research as possible and apply the methods which maximize objectivity and minimize the involvement of the researcher in the research.

Quantitative research assists the reader through de-emphasizing individual judgments and stressing the use of established procedures which lead to results that are generalizable to populations (Malina et al. 2011). Lock and Seele (2015) affirmed that the quantitative research method is distinguished by bigger sample size where the relationships between the different variables are measured and tested statistically and the quantitative research stream is more attributed towards the positivist notion thus making the quantitative research aiming to provide an objective method for studying phenomenon of scientific interest. He mentioned three examples of quantitative inquiry methods which are large scale surveys, experiments and quantitative content analysis. Saunders et al. (2016) affirmed that quantitative research is associated with the positivist approach especially when used with predetermined and highly structured data collection techniques, and stated: "As a positivist you would also try to remain neutral and detached from your research and data in order not to influence your findings".

4.2.3. Mixed Method

Amaratunga et al. (2002) affirmed the emergence of the new mixed method which integrates both the qualitative and quantitative methods and highlighted that this new method has been promoted by many researchers.

Harrison and Reilly (2011) mentioned that the mixed method research approach developed in the 1980s and defined it as "The type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches for the broad purpose of breadth and depth of understanding and corroboration"; they also highlighted that many names had been given for the mixed method such as "blended research, integrative, multi-method, multiple methods, triangulated studies, ethnographic residual analysis and mixed research" while they affirmed that mixed methods research has become the most popular term for mixing qualitative and quantitative data in a single study, while they criticized it due to not being aligned with a single system or philosophy while it is most often driven by the research question.

Malina et al. (2011) suggested that the mix of qualitative and quantitative methods through the mixed research method will be useful to obtain new and profound empirical insights. While the qualitative method is necessary to understand social phenomena, the quantitative

method requires valid conceptual grounding. Holt and Goulding (2014) confirmed the emergence of mixed method research which encompasses both the qualitative and quantitative approaches and pointed out that the reason behind the adoption of this method is the wide gulf between the researchers. In contrast, researchers who see the downsides to both methods decided to adopt a mixed method approach.

Holt and Goulding (2014) referred to the qualitative and quantitative methods as the two available traditional research methods, while they confirmed that debate between researchers concerning the selection of qualitative or quantitative methods has resulted in the emergence of the mixed method approach being the third methodological movement which integrates the two methods on the assumption that they complement each other.

4.3. Selected Research Method/Strategy

Amaratunga et al. (2002) highlighted that the two research methods have different strengths and weaknesses, and that there is no ideal solution but only a series of compromises and stated "research, like diplomacy, is the art of the possible". They recommended that each research methodology shall have its own specific approach to collect and analyze data and therefore each methodology would have its advantages and disadvantages. Many researchers had confirmed the famous methodological debate going on for the last few decades concerning the usefulness, quality and suitability of the different research methods, i.e. the conflict between the positivists who recommend the quantitative approach and the interpretivists who recommend the qualitative approach. They highlighted that this debate has been referred to in the literature as the "Paradigm war" (Sukamolson 2010; Holt & Goulding 2014; Lock & Seele 2015).

Many recommendations have been offered by researchers for the selection of a suitable research method. Sukamolson (2010) highlighted that the ultimate goal of any qualitative research is to understand a certain phenomenon while the ultimate goal of any quantitative research is to generalize the truth found in the sample to the population and designed six questions which are best answered using quantitative as opposed to qualitative methods which are: Do we want a quantitative answer, do we need to study the numerical change, do we need to conduct audience segmentation, do we need to quantify opinions, do we need to explain some phenomena and do we need to test hypotheses. Malina et al. (2011)

recommended the qualitative method to answer the research questions that address "how" and "why" while recommended the quantitative method to answer the research questions "how often" and "how many".

Tavakol and Sandars (2014) studied the differences between the qualitative and quantitative methods and concluded the following recommendations which could be used as a checklist enabling the researchers selecting the most appropriate research method:

1. Quantitative research has a positivist paradigm in which the research is viewed as an objective reality but qualitative research has a naturalistic paradigm in which the research is viewed as a socially constructed subjective reality.
2. Qualitative research provides an opportunity to develop models and theories while quantitative research provides an opportunity to test the theories deductively.
3. Qualitative approach is suggested to explore the knowledge about a phenomenon of interest especially if the available knowledge is little.
4. The accuracy of the quantitative research relies on the validity and reliability of the measurement tools while the trustworthiness of the qualitative research relies on the researcher as a tool.
5. Quantitative researchers rely on numerical values obtained from statistical procedures whereas the qualitative researchers rely on the experts actual voices.

In the context of this research, the literature review findings proved that there is substantial knowledge available in the context of the research's problems, aims, and objectives which led to establish hypotheses derived from the extensive literature review. Therefore the researcher opted to adopt the quantitative method due to its objective characteristics (which ensures that the researcher will be detached from the research) and also its ability in determining relationships between variables in the established hypothesis based on the works of Eldabi et al. (2002), Amaratunga et al. (2002), Sukamolson (2010), Tavakol and Sandars (2014), Lock and Seele (2015), and Saunder et al. (2016) who had a consensus regarding the positivist epistemology approach of the quantitative method represented in its characteristics of objectivity and its strong ability to test the hypotheses deductively using statistical and mathematical methods.

4.4. Data Collection Method and Instrument

4.4.1. Selected Data Collection Method

There have been many data collection methods available for both qualitative and quantitative research. Amaratunga et al. (2002) pointed out that many research tactics could be used for the qualitative and quantitative researchers and listed down all these tactics and their compliance with each of the two research methods below in **Table.3**.

Research approaches	**Positivistic (quantitative)**	**Phenomenological (qualitative)**
Action research		Strictly interpretivist
Case studies	Have scope to be either	Have scope to be either
Ethnographic		Strictly interpretivist
Field experiments	Have scope to be either	Have scope to be either
Focus groups		Mostly interpretivist
Forecasting research	Strictly positivistic with some room for interpretation	
Futures research	Have scope to be either	Have scope to be either
Game or role playing		Strictly interpretivist
In-depth surveys		Mostly interpretivist
Laboratory experiments	Strictly positivistic with some room for interpretation	
Large-scale surveys	Strictly positivistic with some room for interpretation	
Participant observer		Strictly interpretivist
Scenario research		Mostly interpretivist
Simulation and stochastic modelling	Strictly positivistic with some room for interpretation	

Table.3: Research Tactics and Philosophical Bases
Adopted from Amaratunga et al. (2002), P.27

Muijis (2004) mentioned that there are two main types of quantitative data collection methods, the first is the experimental data collection method which is also called "the scientific method" due to its popularity in the scientific researches where it originated from, and the second is the non-experimental data collection "survey method" which is very common in the social sciences. He affirmed that the most popular quantitative data collection method in social science is the survey method. The popularity of the survey method in quantitative researches was also agreed by Kothari (2004), Sukamolson (2010), and Wilson (2014).

Tavakol and Sandars (2014) recommended that the data collection process should match the research design and purpose and mentioned many data collection methods such as focus groups and interviews which are commonly used in qualitative methods, and they affirmed that the survey using the self-administered questionnaire is the most widely used data collection method in quantitative research methods. Creswell (2014) defined the survey and the experiment as the main quantitative data collection methods and highlighted that the survey provides quantitative numeric descriptions of trends, attitudes or opinions of a sample generalized to a population, while the experiment will identify a sample and generalize it to the population.

Lock and Seele (2015) added another data collection method which is the content analysis method which enables the researcher to analyze the existing materials and extrapolate meanings and findings; they mentioned that the content analysis could be conducted in the qualitative and quantitative modes. Saunders et al. (2016) confirmed that the main two quantitative data collection methods are the experiments and the survey; they stated that the survey strategy is usually associated with the deductive quantitative research approach and is a popular and common strategy in business and management research and is the most frequently used to answer "what", "who", "where", "how much", and "how many" questions.

In the context of the quantitative research method adopted in this research, the selection of the data collection method is drawn from the earlier works of Amaratunga et al. (2002), Muijis (2004), Sukamolson (2010), Wilson (2014), Creswell (2014), and Saunders et al. (2016) who had a consensus that the most popular data collection methods in quantitative

researches are the experimental method which is appropriate for quantitative scientific researches and the survey method "non-experiment" which is appropriate and being the most popular research method in social quantitative researches. Based on these findings and due to this research being non-scientific, the researcher opted to adopt the survey data collection method in line with the research's defined problems, aims and objectives.

4.4.2. Selected Data Collection Instrument and Administration

Passmore et al. (2002) mentioned three administration methods for the survey method: telephone interview, in-person interview, and self-administered questionnaire. They highlighted that self-administered questionnaires are distributed by mail or email and are less expensive to administer than the types and could provide more privacy and anonymity to the respondents, although this method requires a bigger survey population due to the number of incomplete or ignored questionnaires.

Muijis (2004) mentioned that the survey research method appears in various administration methods which all use standard questionnaire forms such as telephone interviews, face-to-face interviews, pencil-and-paper questionnaires conducted by post, and self-administered online questionnaires.

Sukamolson (2010) defined three types of survey research administration which are: in-person interviews, telephone interviews, and self-administered questionnaires. He recommended the self-administered questionnaire as one of the most efficient quantitative research data gathering instruments as it allows the researcher to collect detailed information from respondents who might not be easily accessible. He highlighted the advantages of the questionnaire survey which are: it is inexpensive, it does not require much of the interviewer's time, and it allows the respondents to maintain their anonymity.

Tavakol and Sandars (2014) confirmed that the self-administered questionnaire is one of the most frequently used and popular methods for collecting data in quantitative research methods and referred to it as an honest instrument due to its anonymity. They highlighted that the questionnaire is administered through web-surveying programs for disseminating and collecting and this minimizes errors. Rowley (2014) highlighted that the self-completion questionnaire or self-administered questionnaire refers to the respondent being

able to complete the questionnaire without any direct interaction with the researcher either in person or remotely and could be distributed and collected by post, e-mail or by hand.

Wilson (2014) affirmed that the self-administered questionnaire enables the respondent to complete it without the assistance of the interviewer, and recommended the self-administered questionnaire instrument due to its being a cost-effective instrument which enables collecting accurate and reliable data. Saunders et al. (2016) added that the survey strategy using questionnaires is popular as it allows data collection from a sizeable population in an economical way and the data collected through the survey strategy can be used to test the relationship between variables.

The researcher opted to adopt a web-based self-administered questionnaire instrument to be used for the data collection which will be analyzed to verify the defined hypotheses which emerged from the literature review findings; the instrument selection was based on the works Passmore et al. (2002), Muijis (2004), Sukamolson (2010), Tavakol and Sandars (2014), Rowley (2014), Wilson (2014), and Saunders et al. (2016) who established a consensus that the self-administered questionnaire is the most popular data collection instrument for survey research for the following reasons:

1. It uses online technology which enables data collection from a sizable sample of respondents in dispersed locations without any accessibility issues.
2. Web-based tools will minimize the errors and ensure accurate and reliable collected data.
3. Being self-administered the questionnaire will enable the respondents answer the questionnaire themselves without the need for communication between the researcher and the respondent which will save substantial time and enable the researcher to gather a massive volume of data compared to the other instruments which needs direct communication between the researcher and each respondent.
4. It is not an expensive method due to the non-requirement of communicating with each respondent
5. Allows collecting detailed and large amount of data as the respondents can respond conveniently due to having adequate time and not being limited to interview timing.

6. The respondents are assured of anonymity which will ensure objectivity.
7. The researcher is completely detached from the data collection process due to the respondents filling in the questionnaire themselves without the presence of the researcher which ensures no researcher bias in the data collection.
8. The large number of responses makes the data more dependable and reliable.

4.4.3. Data Collection Instrument Design

4.4.3.1. Introduction to Questionnaire Design

Couper et al. (2001) affirmed that the design of the self-administered questionnaire is extremely important to obtain unbiased answers from the respondents as the respondents are responding to the questionnaire themselves without the presence of the interviewer which requires a well-designed instrument which provides guidance for the respondent on how to answer each question. Krosnick and Presser (2010) mentioned the two types of questionnaire questions which are closed questions which can be used only if the answer choices are comprehensive and open questions which provide more reliable and valid measurement than closed questions.

Rowley (2014) categorized the questions into open questions which invite respondents to provide data or offer short comments, and closed questions which are accompanied by a number of options from which to select. He stated "The questions in the questionnaire are designed to generate data that is intended to answer your research questions". Wilson (2014) mentioned the two types of questions which are closed questions and open questions and confirmed the importance of the questionnaire design and recommended considering the following factors to get the most effective questionnaire: the questionnaire's purpose, ensuring reliability and validity, ensuring that the questions will help in achieving the research objectives, and the questionnaire's design in terms of theme, layout, length, questions order, coding and covering letter.

Tavakol and Sandars (2014) studied the questionnaire components and highlighted that there are two types of questions; the first type is the closed-ended questions which limit the respondent to select one of the provided options while the second type is the open-ended question which gives opportunity to the respondent to freely answer with more depth; they

pointed out that the analysis of the closed-ended questions is much easier compared to the open-ended type and recommended to avoid long questionnaire as the respondent may get bored and discard many questions which will affect the questionnaire reliability.

Passmore et al. (2002) mentioned the many scales used in questionnaires and noted their strengths and weaknesses: Likert scales, rating scales, pictorial scales, visual analog scales, ranks lists and semantic differential scales. They mentioned that the Likert scale is the traditional scale, employing a statement followed by responses ranging from strongly disagree to strongly agree. This scale is commonly used in surveys and will be familiar to most respondents. The number of scale points for responses can vary although the recommended number is five. Krosnick and Presser (2010) mentioned that Likert scaling is traditionally used in questionnaires and most often uses the 5-point scale.

Croasmun and Ostrom (2011) noted that this scale was developed by Rensis Likert in 1932. They highlighted the debate regarding the number of scale points while they affirmed that the majority preferred 5 points. Hartley (2013) confirmed that Likert scales are regularly used, employing either 5 or 7 scale points.

Rowley (2014) defined the Likert scale questions as "questions where respondents are asked to indicate how strongly they agree or disagree with series of statements". Vaske et al. (2016) mentioned that Likert introduced the summated rating scale in the year 1932 and described that the respondents indicate their level of agreement or disagreement to each statement which is relevant to the topic and pointed out four characteristic of the summated rating scale: first it must contain many survey questions which will be combined by summing or averaging; second each item in the scale shall reflect the concept behind it; third there are no right or wrong answers; and finally, each item in the scale is a statement and respondents rate each statement.

Based on the above findings, the researcher opted to adopt closed-ended questions which limit the respondents to select one of the provided answers which will enable easier analysis by avoiding scattered answers and keeping the respondent motivated in completing the questionnaire in short time and thus achieving more reliability.

4.4.3.2. Survey Questionnaire

The framework for the survey questionnaire was developed from earlier studies conducted by Damanpour and Schneider (2008) and Yitmen (2011). The questions in the first section "General information" were modified from the study of Damanpou and Schneider (2008) which are designed to define the participants' demographic characteristics and had multiple choice answers whereas the second and third sections "Construction client role" & "Factors influencing the change in the construction client role" were modified from the study of Yitmen (2011) which was designed to deal with the analytical side of the questionnaire to test the research hypotheses. The questions in both the second and third sections were designed using the Likert 5 points scale starting from "1.Strongly Disagree", "2.Disagree", "3.Undecided", "4.Agree", and "5.Strongly Agree" (Likert, 1932; Rowley, 2014; Wilson, 2014; & Saunders et al., 2016).

The questionnaire was prepared in the English language as many of the participants were non-Arabs and the Arab participants had a good command of the English language. The questionnaire is starting with a covering letter aiming to brief the respondents about the aim and objectives of the research and to motivate them to participate according to the recommendations of Wilson (2014) and Saunders et al. (2016). The questionnaire comprised 35 questions distributed over the three sections, namely: general information "Questions 1-5", the construction client role "Questions 6-14", and factors influencing the change in the construction client role "Questions 15-35".

The questionnaire was designed to explore the participants' demographic characteristics and to test the seven hypothesized relationships between each of the defined seven influencing factors as a uni-dimensional independent variables and the change in the construction client role as a uni-dimensional dependent variable as illustrated in the research hypothesis diagram **(Figure.7)**. The full questionnaire is demonstrated in the following **Table.4**.

According to the recommendation of Wilson (2014) and Saunders et al. (2016), the survey participants will be briefed on the survey aims and objectives which will be stated in the questionnaire introduction, the researcher will guarantee the participants' and their organizations' confidentiality and confirm that the research is for academic use only. The

"self-administered" questionnaire will be uploaded on the website "www.esurveycreator.com" and the survey link will be sent to the participants via separate emails enabling each participant to answer the questionnaire where all the answers will be uploaded anonymously on the survey website and the researcher could access it later to collect the data.

Survey Question	Variable/construct measured	Item/sub-construct	Description
Section.1: General Information			
Question 1	Education: Bachelor, masters or doctorate	Education	Bachelor=1, master=2, doctorate=3
Question 2	Total years of experience: 0-5, 5-10, 10-15, 15-20, above 20	Experience	(0-5=1), (5-10=2), (10-15=3), (15-20=4), (above 20=5)
Question 3	Managerial level: First level. middle level, senior level	Managerial. Level	First level=1, middle level=2, senior level=3
Question 4	Organization type: Client, consultant, contractor/subcontractor, supplier	Organization. Type	Client=1, consultant=2, contractor/subcontractor=3, supplier=4
Question 5	Organization`s employees no: 0-250, 250-500, 500-1,000, above 1,000	Employee.no	(0-250)=1, (250-500)=2, (500-1,000)=3, (above 1,000)=4
Section.2: Construction Client Role			
Question 6	Change in The Construction Client Role Towards Adoption of innovation	Client.Role.1	The traditional procurement method "Design-Bid-Build" is separating the design team from the construction team.
Question 7		Client.Role.2	The traditional procurement method "Design-Bid-Build" is not facilitating project team communication to adopt innovation in the construction industry.
Question 8		Client.Role.3	The construction client role in the traditional procurement method "Design-Bid-Build" is undermining the adoption of innovation in the construction industry.
Question 9		Client.Role.4	The construction client role is changing towards driving adoption of innovation in the construction industry.
Question 10		Client.Role.5	The construction client is undertaking construction team leadership to stimulate adoption of innovation.
Question 12		Client.Role.7	Construction client role is changing to that of innovation co-creator.
Question 13		Client.Role.8	Construction client is encouraging communication between the project stakeholders to co-create innovation.
Question 14		Client.Role.9	Client's new role of co-creation is enhancing innovation adoption in the construction industry.
Section.3: Factors Influencing The Change in the Construction Client Role			
Question 15	Market Demand & Competition	Market.1	Market demand & competition is stimulating construction clients to innovate.
Question 16		Market.2	Market demand & competition is positively changing the construction client's behaviour towards innovation.
Question 17		Market.3	There is no relation between market demand and the construction client's willingness to adopt innovation.

Survey Question	Variable/construct measured	Item/sub-construct	Description
Question 18	Client Experience & Competence	Experience.1	The construction client experience & competence level is promoting its participation in innovation.
Question 19		Experience.2	The construction client's experience & competence increases its capacity in adopting innovation.
Question 20		Experience.3	There is no relationship between the construction client's experience & competence and its behaviour in innovation.
Question 21	Client Characteristics	Characteristics.1	The construction client's characteristics are a major factor which enables the client to stimulate innovation.
Question 22		Characteristics.2	The construction client's characteristics are not related to the capacity of the client to innovate.
Question 23		Characteristics.3	The construction client's participation in the innovation process is relying on its characteristics.
Question 24	Government Regulations	Regulation.1	Government regulations are pushing the construction client to adopt innovation.
Question 25		Regulation.2	Government regulations are changing the construction client's role towards adopting innovation.
Question 26		Regulation.3	There is no significant relationship between government regulations and the construction client's behaviour in innovation.
Question 27	Environmental Sustainability	Sustainability.1	Environmental compliance is driving construction clients to adopt innovation in the construction industry.
Question 28		Sustainability.2	Environmental awareness is increasing the construction client's participation in innovation.
Question 29		Sustainability.3	The construction client is stimulating innovation to improve the construction industry's environmental sustainability.
Question 30	Organizational Culture	Culture.1	Organizational culture is an essential factor which motivates the construction client to adopt innovation.
Question 31		Culture.2	There is no relationship between the organizational culture and the construction client's attitude to adopting innovation.
Question 32		Culture.3	The supportive organizational culture is promoting the construction clients to adopt innovation.
Question 33	Performance Improvement	Performnace.1	Construction clients are increasingly adopting innovation to improve their projects` performance.
Question 34		Performnace.2	Innovation adoption is enhancing the construction projects` performance.
Question 35		Performnace.3	There is no relationship between construction project performance and construction client behaviour in innovation.

Table.4: Survey Instrument

4.4.3.3. Sampling Method

Tavakol and Sandars (2014) defined the survey sample as "A sample refers to those participants chosen for a research study and this should be representative of the target population". They affirmed that the sample size determination is a primary step of any research process as it represents the population which they defined as "The entire set of

study participants to which the results of the study are to be generalized". Rowley (2014) defined the research sample as "The people from whom responses are collected, are a sample drawn from a wider population, and are chosen to represent the wider population".

Blaikie (2004) mentioned two types of sampling: probability sampling which is the basis of the inferential analysis as it enables the results obtained from a sample to draw conclusions about a population; the second is the non-probability sampling which does not give every population element a chance of selection. They affirmed that inferential statistics is only possible when probability sampling is used and referred to two main methods of probability sampling; the first is the simple random sampling which involves a selection process that gives every possible sample of a particular size the same chance of selection, the second is systematic sampling which avoids having to number the whole population, although they criticized this method as it could introduce unnecessary bias.

Kothari (2004) has also defined the same two categories: the first is probability sampling where each sampled element has a known probability of being included in the sample and the second is non-probability sampling where the samples do not allow the researcher to determine its probability. Saunders et al. (2016) agreed with the above classification for the sampling methods; they highlighted that the probability sampling method is used once the researcher wants the sample to represent the targeted population and is available in five techniques: simple random, systematic random, stratified random, cluster, and multi-stage.

Simple random sampling had been widely recommended by many researchers. Cochran (1977) defined it as "A method of selecting n units out of the N such that every one of the distinct sample has an equal chance of being drawn" and recommended it due to its being the best method to introduce the sampling theory. Pfeffermann (1993) agreed with recommending the simple random method and confirmed its ability to present the targeted population.

Muijis (2004) affirmed that the most well-known method is simple random sampling as everyone in the population has exactly the same chance of being included in the sample because the sample is drawn randomly from the population which makes it the most unbiased method. Draugalis and Plaza (2009) recommended probability random sampling

as a sufficient method of survey sampling while they criticized the non-probability sampling methods due to its limitation of generalizing the results. The simple random sample was defined by Wilson (2014) as "Every member of the population has an equal probability of inclusion in your sample"; he recommended the probability or random sampling due to having the greatest freedom from bias. He mentioned many types of probability sampling techniques which are: "simple random sampling, systematic sampling, stratified random sampling, cluster sampling and multi-stage sampling". Saunders et al. (2016) affirmed that simple random sampling (random sampling) is the best once the researcher has defined the target population and preferably if the sampling is done in an electronic format. They highlighted also that probability sampling is often associated with survey and experiment research strategies.

Based on the earlier recommendations by Cochran (1977), Pfeffermann (1993), Muijis (2004), Draugalis and Plaza (2009), Wilson (2014), and Saunders et al. (2016), the researcher opted to adopt the simple random sampling technique as the most appropriate sampling technique for the following reasons: it is the most widely used sampling technique; it enables everyone in the population to have the same chance of being included in the sampling process; being a random method characterizes it is the most unbiased method and recommended for survey research.

4.4.3.4. Sampling Size

There has been consensus between researchers about the importance of determining the appropriate sample size to ensure that the selected sample is representing the targeted population (Tavakol & Sandars 2014; Blaikie 2004; Kothari 2004; Wilson 2014; Saunders et al. 2016).

Wilson (2004) confirmed that the sampling size shall be determined based on the selected targeted population number and defined the population as "A clearly defined group of research subjects that is being sampled". The researcher opted for 250 companies as a suitable number in line with the research time frame. The targeted companies are working in the construction field in the UAE in the following categories: clients, consultants, contractors, subcontractors and suppliers in line with the defined theoretical framework (**Figure.6**) and the research survey instrument.

Bartlett et al. (2001) reviewed the available literature on the sampling methods and developed a table for determining the minimum returned sample size for a given population size for continuous and categorical data based on the earlier works of Cochran (1977) and Krejcie and Morgan (1970) which is illustrated below in **Table.5.**

	Sample Size					
	Continuous data Margin of error= .03			Categorical data Margin of error= .05		
Population Size	alpha= .10 t= 1.65	alpha= .05 t= 1.96	alpha= .01 t= 2.58	p=.50 t=1.65	p=.50 t= 1.96	P=.50 t= 2.58
100	46	55	68	74	80	87
200	59	75	102	116	132	154
300	65	85	123	143	169	207
400	69	92	137	162	196	250
500	72	96	147	176	218	286
600	73	100	155	187	235	316
700	75	102	161	196	249	341
800	76	104	166	203	260	363
900	76	105	170	209	270	382
1,000	77	106	173	213	278	399
1,500	79	110	183	230	306	461
2,000	83	112	189	239	323	499
4,000	83	119	198	254	351	570
6,000	83	119	209	259	362	598
8,000	83	119	209	262	367	613
10,000	83	119	209	264	370	623

Table.5: Table for Determining Minimum Returned Sample Size for a Given Population Size for Continuous and Categorical Data
Adopted from Bartlett et al. (2001), p.48

Bartlett et al. (2001) explained the use of **Table.5** by firstly determining whether the research data is continuous data where the margin of error is considered to be .03 or the data is categorical data where the margin error is considered to be 0.5. The second step is to determine the value of "alpha" for the continuous data which is the level of acceptable risk the researcher is willing to accept that the true margin of error exceeds the acceptable margin of error and recommended the alpha level of .05 as acceptable for most of the research. The categorical data are categorized by the maximum possible proportion (p) which is considered to be .50 for all the categories. The third step is to determine the value

of (t) which is the value of selected alpha level in each tail and they recommended the use of t= 1.96 for an alpha level of .05 which is suitable for most research.

The difference between the continuous and the categorical data was also distinguished by Pasta (2009) who referred to the continuous data once the continuous variables are referred to as quantitative, metric or interval scales while they refer to the categorical if the data falls within ranges of selections. Blaikie (2004) also distinguished the difference between the continuous and categorical data where the continuous data are having an unlimited number of possible values between the whole numbers such as number of children in a family or a person`s height. He mentioned that the categorical data could come in two types: the first type involves assigning numbers to categories that identify different types of object, event or people which is referred to as nominal while the second type involves numbers that are used to establish a sequence of objects, events or people and are referred to as ordinal.

Based on the works of Pasta (2009) and Blaikie (2004), all the data in this research instrument is categorical data as it limits the respondents to answer within predefined categories for the demographic questions and within the predefined Likert 5-points scale for the other questions. Therefore by using **Table.5** above the selection of the sampling size shall be within the categorical data section. The researcher also considered the alpha level of .05 which is correspondent to a t value of 1.96 based on the recommendation of Bartlett, et al. (2001); therefore the sample selection shall fall within the fifth column (categorical, p=.50, t=1.96), going down to select the corresponding sample size to the predefined population size of 250; the sample size shall be the average of (200 population= 132 sample) & (300 population= 169 sample) which equals **151 sample**.

Draugalis and Plaza (2009) recommended using the following sampling table **(Table.6)** which was issued by Krejcie and Morgan (1970) and designed based on a margin of error p of 0.05.

Population Size	Sample Size
10	10
25	24
50	44
75	63
100	80
130	97
200	132
250	152
300	169
400	196
500	217
600	234
700	248
800	260
900	269
1,000	278
1,500	306
2,000	322
3,000	341
4,000	351
5,000	357
7,000	364
9,000	368
10,000	370
15,000	375
20,000	377
30,000	379
40,000	380
50,000	381
75,000	381

Table.6: Sample required from a Given Population to be Representative.
Adopted from Draugalis and Plaza (2009), p.2

Based on **Table.6** above, this research targeted a population of 250 which would require a sample size of **152.**

Wilson (2014) affirmed the importance of determining the sample size and referred to the following formula which was established by Yamane (1967) and affirmed that the sample size calculation is typically associated with probability sampling and recommended the use of confidence level at 95% and population parameter (P=.5) which equals to +/-5% precision level:

$$n = \frac{N}{1+N\,(e)^{2}}$$

Where:

n=sample size.

N=population size.

e=precision (sampling error).

By implementing the above formula to this research targeted population, the sample size shall be the following:

$$n = \frac{250}{1+250\,(.05)^{2}} = \textbf{154}\ \text{sample}$$

In conclusion, the targeted population of this research of 250 will need a sample size of **151** according to Bartlett, et al. (2001), a sample size of **152** according to Draugalis and Plaza (2009) and sample size of **154** according to Wilson (2014). Therefore the researcher opted to select the maximum calculated sample size of **154** to ensure that the sample is representing the targeted population based on the recommendations of Blaikie (2004), Kothari (2004), Tavakol and Sandars (2014), Wilson (2014), and Saunders et al. (2016).

4.4.4. Data Quality

Amaratunga et al. (2002) confirmed the importance of the data validity and reliability in quantitative research; Kimberlin and Winterstein (2008) agreed with the importance of data validity and reliability and stated "Key indicators of the quality of a measuring instrument are the reliability and validity of the measures". The following sections are discussing the reviewed literature about data reliability and validity:

4.4.4.1. Data Reliability

Schmitt (1996) affirmed that Cronbach`s alpha coefficient had become routine practice for measuring internal consistency or reliability and mentioned that majority of the researchers used it. Amaratunga et al. (2002) defined reliability as "The extent to which a test or procedure produces similar results under constant conditions on all occasions". They highlighted that reliability is aiming to minimize the errors and biases in a study and the object is to ensure that if other researchers followed later exactly the same procedures they

will get the same results and conclusions. They added that reliability deals with the data collection process to ensure consistency of results. Another definition of reliability was added by Drost (2011) who defined it as "Consistency of measurement over time or stability of measurement over a variety of conditions".

Passmore et al. (2002) recommended Cronbach`s alpha as an adequate measure of internal consistency. Yurdugul (2008) added that the coefficient alpha which was developed by Cronbach (1951) is the mostly common used index for estimating the reliability of measurement instruments in most research. Kimberlin and Winterstein (2008) mentioned that the coefficient of the internal consistency provides an estimate of the reliability measurement which is based on the assumption that the items that are measuring the same construct should correlate, they affirmed that the most widely used method for the estimate of the internal consistency reliability is Cronbach`s alpha which is the average of inter-correlations of items and the number of items in the scale.

Gorrell et al. (2011) recommended using Cronbach`s alpha to test the data reliability and stated "Cronbach`s coefficient alpha statistic (Cronbach 1951) is often used as an indicator of the reliability of a questionnaire, demonstrating that subjects show the same response pattern over the duration of the questionnaire and, where results span several sessions, over time (test-retest reliability), alpha indicates the extent of the correlation between items". Drost (2011) affirmed that the most popular method for testing internal consistency is coefficient alpha which was popularized by Cronbach (1951) and is referred to as Cronbach`s Alpha.

Croasmun and Ostrom (2011) defined the internal consistency reliability as "The extent to which items in an instrument are consistent among themselves and with the overall instrument", and highlighted that Cronbach`s alpha estimates internal consistency reliability. Bonett and Wright (2014) confirmed that Cronbach`s alpha reliability which was established by Cronbach in 1951 is one of the most usable measures of reliability in the social and organizational sciences and it measure internal consistency reliability. Vaske et al. (2016) explained that Cronbach's alpha (often symbolized by the lower-case Greek letter α) is commonly used to examine the internal consistency or reliability of summated rating scales. They highlighted that the Likert-type scale is based on the summated rating,

therefore if one encounters a lower alpha value; it is advised to try excluding items from the sum which would improve the alpha value.

There has been a wide debate between researchers regarding the definition of the minimum acceptable Cronbach alpha level. Schmitt (1996) recommended the value of 0.7 as a minimum acceptable level which was agreed by Passmore et al. (2002) and Saunders et al. (2016). Suliman (2001) considered Cronbach`s alpha value of 0.6 as minimal acceptability level, Thanasegaran (2009) reviewed the previous literature regarding the acceptable level of Cronbach alpha and found that Nunnally and Berstein (1994) defined the minimum level to be 0.7 while Malhotra (2004) confirmed that the minimum acceptance level shall be more than 0.6. Vaske et al. (2016) confirmed that there has been a convention that an alpha of .65–.80 is often considered "adequate" for a scale used in human dimensions research based on the works of Green et al. (1977), Spector (1992), and Vaske (2008).

Based on the above studies; the researcher decided to test the collected data reliability by using the Cronbach`s alpha coefficient with a minimum acceptance alpha value of 0.65.

4.4.4.2. Data Validity

Amaratunga et al. (2002) defined validity as "One of the concepts used to determine how well an answer is provided by the research". Passmore et al. (2002) defined validity as "The extent to which the concepts of interest are comprehensively represented by items in the questionnaire" and advised the following aspects in developing the questionnaire to ensure the questionnaire's validity: clear aim, the relevance of the target population, clear concepts that the questionnaire aims to measure, the methods used for item selection and reduction, and the interpretability of the items that all are well understood by all the respondents.

Kimberlin and Winterstein (2008) defined validity as "The extent to which an instrument measures what it purports to measure, validity requires that an instrument is reliable but an instrument can be reliable without being valid", and added "Validity is the extent to which the interpretations of the results of a test are warranted, which depend on the test`s intended use i.e. measurement of the underlying construct".

Drost (2011) stressed the importance of validity and referred to it as "The meaningfulness of research components"; Hartley (2013) pointed out that large samples increase the validity of the findings; Tavakol and Sandars (2014) highlighted the difference between the instrument reliability and validity and stated that "An instrument cannot be valid unless it is reliable" and added that the instrument reliability doesn't rely on its validity.

Kothari (2004) recommended piloting the survey instrument as "preliminary survey" to few respondents to reveal any issues or ambiguities to address it before proceeding in the main survey to ensure the data validity, Muijs (2004) stressed on the importance of the survey piloting and stated "The single most effective strategy to minimize problems and improve the instrument validity is to make sure you pilot your instruments", Rowley (2014) advised to pilot the survey instrument to colleagues and few members of the targeted population which will give a sense whether the questions are well understood and easy to complete while the problems which emerge from the pilot study shall be addressed in the final survey instrument before proceeding in the main survey to ensure the instrument validity, the survey piloting importance was also confirmed by Saunders et al. (2016) as the best method to ensure the instrument validity and recommended piloting the survey for minimum 10 respondents to address any issues in the survey validity before conducting the main survey.

According to the above findings, the researcher will ensure the data validity through addressing the validity concept through proper definition of the survey questions in addition to piloting the survey to 10 respondents, the feedback from piloting the survey will shed light on the areas that need to be improved which will be incorporated and considered in the main survey to ensure the instrument validity.

5. Chapter Five- Data Collection and Analysis

5.1. Data Collection

The data was collected through a self-administered questionnaire survey which was distributed to different professionals working in different organizations who are working in the construction field in the United Arab Emirates, namely: clients, consultants, contractors, subcontractors and suppliers. That was in line with the articulated theoretical framework components **(Figure.6)** which illustrates the different stakeholders who are related to the change in the construction client's role towards being an innovation co-creator. The targeted sample size was 154 according to the discussion in section **4.4.3.4** which was selected to present the targeted population of 250 organizations working in the construction field. The distributed web-survey is illustrated in **Appendix.1**.

According to the recommendations of Kothari (2004), Muijs (2004), Rowley (2014), and Saunders et al. (2016) the questionnaire was piloted to ensure the instrument's validity. The questionnaire was piloted to 10 respondents who were requested to answer it completely and provide their feedback in terms of the questions' quality. The pilot survey comments were considered and the questionnaire was refined and a revised questionnaire was issued to conduct the main survey. The survey link was sent to the respondents via email. 151 responses were returned over a period of 8 days although only 107 responses were answered completely. The researcher discarded the incomplete responses based on the recommendations of Rowley (2014) and therefore the data of the completed 107 responses were used for the analysis which equals a response rate of 69% which is considered to be high according to Nulty (2008), Baruch and Holtom (2008), and (Saunders et al. 2016) who had a consensus that a response rate of 50% is considered as acceptable for an individual scholar research survey.

5.2. Data Type

Wilson (2014) stressed the importance of defining the type of the collected data which is the first main step in the process of selecting the appropriate data analysis testing and classified the data in four main types: the first type is the nominal data which cannot be measured numerically and includes values that could be classified into categories such as gender and race; the second type is the ordinal data which is similar to the nominal data but

can be ranked-ordered e.g. the Likert scale; the third is interval data, when the distance between the numbers are equal across the range e.g. a temperature scale; and the fourth is the ratio data similar to interval data where each data has a fixed zero point e.g. income, weight, and height.

Tavakol and Sandras (2014), and Rowley (2014) emphasized the importance of understanding the nature of the variable`s data in order to perform the quantitative analysis and agreed on classifying the data in four groups: nominal, ordinal, interval and ratio measurement; Saunders et al. (2016) confirmed these four categories and stated "Understanding the difference between types of data is extremely important when analyzing your data quantitatively".

There has been a wide debate between the researchers regarding the classification of the variables data which are measured on the Likert scale. Bryman and Bell (2011) suggested that the Likert scale items are often treated as interval data for analysis while Rowley (2014) and Saunders et al. (2016) defined the Likert scale items as ordinal data. The debate between the researchers regarding determining the Likert scale data type lies in it being an essential determination which drives the selection of the appropriate data analysis testing where the parametric analysis is applicable in case the data is interval or ratio in addition to the sample being normally distributed while the second type of analysis which is non-parametric testing is used for the other data types and used once the normal distribution cannot be determined (Wilson 2014; Rowley 2014; Saunders et. al 2016).

Boone Jr and Boone (2012) investigated the Likert-type scale and distinguished the difference between the Likert individual items data "strongly approve, approve, undecided, disapprove, strongly disapprove" which is considered as ordinal data and the Likert scale data which is created by calculating the sum from four or more Likert-type items which is analyzed at interval measurement scale. They highlighted that the researcher shall decide whether he is performing the tests on the individual Likert item data or on the sum of four or more Likert items which develop the Likert scale data and advised on the tests shown in the following **Table.7** for each type.

	Likert-Type Data	Likert Scale Data
Central Tendency	Medina or Mode	Mean
Variability	Frequency	Standard deviation
Associations	Kendall tau B or C	Pearson`s r
Other Statistics	Chi-square	ANOVA, t-test, regression

Table.7: Suggested Data Analysis Procedures for Likert-Type and Likert Scale Data Adopted from Boone Jr and Boone (2012), p.3

Murray (2013) confirmed the interval feature of the Likert scale data which needs to be analyzed through the parametric analysis testing and stated "Norman (2010) suggests that Likert data can be analyzed using parametric tests without fear of coming to the wrong conclusion". Subedi (2016) agreed with determining the Likert scale data as interval data and concluded in his research that according to Pell (2005) the parametric tests can be conducted on the summed score of Likert scale data.

5.3. Variables` Measurement

Definition of variables measurement and their operational relationships is an essential step in the quantitative data analysis which drives the tests' selection and is an extremely important input which leads to selecting the right options in the quantitative statistical analysis process and therefore ensuring the accuracy of the tests results (Blaikie 2004; Muijs 2004; Wilson 2014; Saunders et al. 2016).

Blaikie (2004) confirmed that the quantitative analysis is comprised of variables where these variables normally start as concepts which are coming from either the research questions or hypotheses and defined the variable as "Any characteristics of objects, events or people that can vary". Bernard (2006), Wilson (2014) and Saunders et al. (2016) confirmed the importance of defining the survey variables and emphasized the importance of defining the variables type which significantly influences the choice of the data analysis testing and classified the variables in three types: univariate which includes one variable data which is not related to any other variable; bivariate which is comprised from two variables data where the relationship between the two variables is tested; and multivariate which is comprised from three or more variables data where the relationships between the

different variables are tested. The majority of descriptive statistics methods are based on univariate data while the inferential statistics are based on bivariate or multivariate data.

Kothari (2004) explained that the variables are also classified based on their dimensionality which is considered in two categories; the first is the uni-dimensional scale which measures only one characteristic of the respondent or object while the multi-dimensional scale allows the researcher to measure an item in more than one dimension at the same time whereas all the related variables in the different dimensions comprise the multi-dimensional variable. Blaikie (2004) agreed with the earlier classification and mentioned that the uni-dimensionality is determined once all the variables are measuring the same thing while in the multi-dimensional scale the variable will include other variables.

Bernard (2006) highlighted that the uni-dimensional variable means that the variable is measuring only its items while the multi-dimensional variable will include other variables which comprise the overall main multi-dimensional variable which measures the relationship between the different variables. Ziegler and Hagemann (2015) agreed with the earlier definitions and referred to the uni-dimensional variable as a "local independence" and thus is a uni-dimensional variable as it includes its items only and doesn't include other variables under it while the multi-dimensional variable could be referred to as "regional" as it is comprised from different variables which give it the multi-dimensionality feature.

The third variables' classification criteria is based on the variables dependency relationship according to Blaikie (2004), Wilson (2014), and Saunders et al. (2016), who emphasized that the survey method is based on testing the relationship between the variables which were drawn from the literature review through statistical analysis and defined the variables according to their dependency on four types of variables: a dependent variable that changes in response due to the change in other variables; an independent variable that causes changes in a dependent variable; a mediating variable that transmits the effect of an independent variable to a dependent variable; and a moderating variable that affects the relationship between an independent variable and dependent variable. However the third classification is only applicable for the bivariate and multivariate variables which have a relationship in between.

In the context of this research and as per the literature reviewed in sections 5.1 and in this section, the first 5 variables in section.1 in the survey instrument "General information" are measuring the sample characteristics which are: (Varibale.1-Education, measured by: bachelor=1, master=2, doctorate=3), (Variable.2-Years of Experience, measured by: 0-5=1, 5-10=2, 10-15=3, 15-20=4, above20=5), (Varibale.3-Manegerial level, measured by: first level=1, middle level=2, senior level=3), (Variable.4-Organization type, measured by: client=1, consultant=2, contractor/subcontractor=3, supplier=4), and (Variable.5-Employees number, measured by: 0-250=1, 250-500=2, 500-1,000=3, above 1,000=4). The variables "1 & 4" are comprised from nominal data while variables "2 & 5" comprised from interval data while variable "3" are comprised from ordinal data. Each of these 5 variables is univariate as it doesn't relate to other variables therefore it doesn't have any dependency feature in between in addition to being classified on a one-dimensional scale as it measure on level only.

The research hypothesis model illustrated in **Figure.7** developed 7 hypotheses between the seven influencing factors and the change in the client role towards adopting innovation. The section.2 in the survey instrument "Construction client Role" includes the variable "Change in the Client Role towards Adoption of innovation" which is comprised from 9 items "client role.1, client role.2, client role.3, client role.4, client role.5, client role.6, client role.6, client role.7, client role.8, and client role.9). These 9 items were measured using Likert`s five-point scale ranging from 1=strongly disagree to 5=strongly agree. As this variable is comprised from the summated data of the Likert five-point scale it is considered as interval data. The change in client role towards adopting innovation was found through the literature review to be influenced by each factor of the defined sevens factor on a one-dimensional level therefore it is considered as a uni-dimensional bivariate dependent variable.

The section.3 in the survey instrument "Factors influencing the change in the construction client role" includes the seven factors which were defined in the literature review to be influencing the change in the construction client role towards adopting innovation. Each factor is dealt with as a variable and comprised from 3 items as described below:

1. Market demand & competition "items market.1, market.2 & market.3".

2. Client experience & competence “items: experience.1, experience.2 & experience.3”.

3. Client characteristics “items: characteristics.1, characteristics.2 & characteristics.3”.

4. Government regulations “items: regulation.1, regulation.2 & regulation.3”.

5. Sustainability environment “items: sustainability.1, sustainability.2 & sustainability.3”.

6. Organizational culture “items: culture.1, culture.2 & culture.3”.

7. Performance improvement “items: performance.1, performance.2, and performance.3”.

The 21 items of the 7 variables were measured using Likert`s five-point scale ranging from 1=strongly disagree to 5=strongly agree, therefore the data is considered interval due to the summated Likert items data. Based on the literature review these variables were the reason behind the change in the client role while each variable is having a single relationship with the dependent factor on a one-dimensional level, therefore these 7 variables are considered as uni-dimensional bivariate independent variables.

It is worth noting that this section aimed to define in detail the different variable types and constructs to enable selecting the most appropriate analysis methods for the collected data; the aforementioned discussion in regard to the proposed relationships between the variables was drawn from the literature review findings and was used as the basis to develop the proposed hypothesis. The following sections will deal with analyzing the collected data and analyze it to establish or reject the hypothesized relationships between these factors.

5.4. Methods of Analysis

Rowley (2014) categorized two main categories of quantitative data analysis: the first category is the descriptive analysis which enables generating a profile for the survey sample while the second category is the analytical analysis “inferential statistics” which tests the hypothesis through analytical statistical techniques which enable an understanding of the relationship between the variables. Tavakol and Saundras (2014) agreed on the aforementioned two categories and stated “Quantitative researchers use numerical values and statistical procedures (both descriptive and inferential statics) in order to organize and

interpret numeric data". The classification of descriptive analysis and inferential analysis was also confirmed by Blaikie (2004), Wilson (2014), and Saunders et al. (2016).

5.4.1. Descriptive Analysis

Tavakol and Sandras (2014) affirmed that the descriptive analysis is widely used to describe the demographic characteristics of the survey sample and it includes frequency distribution, central tendency and standard deviation. Wilson (2014) agreed with the feature of descriptive analysis of describing the survey sample by presenting the sample's central tendency in terms of mean, median, mode and standard deviation and defined these parameters as "The mean is the arithmetical average of frequency distribution, the median is the middle number in a set of numbers/average, the mode is the value that occurs most often in the data set, and standard deviation is the spread of the data around the mean value".

Rowley (2014) pointed out that the descriptive analysis is also known as univariate analysis which deals with one variable at a time to demonstrate the respondents' characteristics and includes: totals, percentages, averages (means, modes, medians) and standard deviations for measuring the spread. Saunders et al. (2016) emphasized the importance of starting with descriptive analysis to enable the reader's understanding of the data and recommended also to describe the central tendency in terms of mode, median and standard deviation.

5.4.2. Inferential Analysis

Blaikie (2004) described inferential analysis as "…used to generalize the results obtained from a random (probability) sample back to the population from which the sample was drawn". Wilson (2014) mentioned that inferential statistics is using statistical methods to make interferences in relation to a wider population and is divided into parametric tests which should be applied only in case the data are interval or ratio, the sample is randomly drawn from the population, and the sample is from a population that is normally distributed. It is very important to choose the appropriate statistical test while the non-parametric methods are used once the normal distribution cannot be determined.

Subedi (2016) agreed with classifying the inferential statistics into parametric and non-parametric. Saunders et al. (2016) confirmed also the parametric and non-parametric classification and defined the inferential statistics as "The process of significance or hypothesis testing which tests the likelihood of the relationship between the variables". Zhang et al. (2016) highlighted that the use of inferential statistics is an important technique in quantitative methodology which enables the researchers to investigate in depth the relationships between the variables and provide the most useful and powerful tools in data analysis.

There are many tests available for conducting inferential statistical analysis. Rowley (2014) added another classification which depends on the number of the tested variables. The first type is the bivariate analysis which is related to testing the relationship between two variables and the second type is multivariate which deals with the relationship between more than two variables. He also mentioned several bivariate analysis tests which are: contingency table and x^2 to test the frequency of ordinal variables; correlation test which examines the relationship between two variables where the most commonly used correlation tests are Pearson`s r for the interval/continuous variables and Spearman` ρ for the ordinal variables; and regression test which goes one step further than correlation and shows the relationship between the two variables which calculates and predicts the value of one variable given the value of the other which is measured by a statistic called R^2.

Blaikie (2004) categorized the inferential tests into two categories: the first category includes the parametric tests which are when the distribution on a variable in a population approximates a normal distribution while the second category is the non-parametric tests which are used once the distribution of a variable in a population is not normally distributed. Wilson (2014) mentioned many tests which are associated with inferential statistics which are divided between the parametric (P) and non-parametric (NP) as illustrated in the following **Table.8**.

Method	Purpose	Example of application
Hypothesis testing	Estimation	H0-There is no difference in the mean exam marks between male and female managers. H1- There is a difference in the mean exam marks between male and female managers.
Confidence intervals	Estimation	Calculating a 95% confidence interval for the proportion of small firms in London that do business with Europe
Time series analysis	Forecasting	One-month moving averages of retail sales data
Pearson`s product moment correlation coefficient (P)	Measuring association	Correlating gender with height.
Spearman`s rank correlation coefficient (NP)	Measuring association	Comparing two managers` ranked assessment of ten employees.
Chi-squared test (NP)	Measuring association	Do some manufacturers produce more faulty goods than others?
Student`s t-test	Measuring association	Comparing the sample means of ages of female finance and marketing managers (independent t-test).
Simple regression (P)	Assessing the strength of relationship between variables	Strength of relationship between advertising spending and sales.
Multiple regression (P)	Assessing the strength of relationship between variables	Strength of relationship between advertising spending and training spending on sales.

Table.8: Examples of inferential statistics.
Adopted from Wilson (2014), p. 255

5.4.3. Analysis Methods Selection

The data analysis will include descriptive analysis which provides a profile for the survey sample in addition to the inferential analysis for testing the developed hypotheses based on the works of Blaikie (2004), Rowley (2014), and Wilson (2014).

The first part will be the descriptive statistical analysis which will be conducted for the five variables which are categorized under the first part of the survey instrument "Section.1. General Information" which were concluded in section 5.3 to be univariate variables operating in one dimension which are: "Education, Total years of experience, Managerial level, Organization type & Organization`s employees number", the descriptive analysis will be conducted for these 5 variables to demonstrate the survey sample characteristics such as frequency and the central tendency in terms of mean, median, mode and standard deviation based on the recommendations of Rowley (2014), Wilson (2014), and Sauders et al. (2016).

The second part will include the inferential analysis tests to examine the developed research hypothesis, the determination of the collected data and the variables type is a

mandatory perquisite to the selection of the appropriate inferential analysis method based on the works of Bernard (2006), Wilson (2014), and Saunders et al. (2016). The discussion in sections 5.2 & 5.3 concluded that all the hypothesis' dependent and independent variables are measured by the summated Likert five-points scale thus all the variables are comprised from interval data where the hypothesis model comprises from seven uni-dimensional bivariate independent variables against one uni-dimensional bivariate dependent variable.

The first step in selecting the inferential analysis is to determine the type of the tests whether to be parametric or non-parametric and that will be followed by selecting the appropriate tests based on the defined variables measures and its operational relationships according to Blaikie (2004), Muijs (2004), Rowley (2014), Wilson (2014), and Saunders et al. (2016). Due to the hypothesis variables being comprised from interval data, the most appropriate inferential analysis will be the parametric tests category according to Pell (2005), Norman (2010), Boone Jr and Boone (2012), Murray (2013), and Subedi (2016). Based on **Table.8** which was adopted from Wilson (2014), the most appropriate parametric inferential tests will be the Pearson`s product moment correlation coefficient and the Simple regression due to being inferential parametric tests which measure the association between the defined variables in addition to measuring the defined relationships` strength.

Artusi et al. (2002), Hauke and Kossowski (2011), Mukaka (2012), Sedgwick (2012), and Rowley (2014) agreed on defining the Pearson`s correlation coefficient as the most popular test for calculating the correlation coefficient for the parametric variables being normally distributed. Wilson (2014) highlighted that the correlation test is measuring only the association between the variables but doesn't measure the strength of the relationship, therefore he recommended to conduct the regression analysis test after the correlation test to assess the strength of the relationship established through the correlation test; this was confirmed by Blaikie (2004), Wilson (2014), Rowley (2014), and Saunders et al. (2016) who agreed that the regression analysis test is recommended to confirm the significant relationships found through the correlation test and to measure the strength of the relationships between the dependent and independent variables by calculating the coefficient of determination R^2 .

In conclusion, the analysis will start by conducting the descriptive analysis to present the sample profile which will be followed by Cronbach`s alpha reliability test to confirm the data reliability which was recommend by Schmitt (1996), Passmore et al. (2002), and Gorrell et al. (2011) as the most popular method for testing internal consistency. The reliable data will be used to conduct the Pearson`s correlation coefficient test to define the significance of the relationships between the defined variables and each established relationship will be further examined through the regression analysis to confirm the relationship's significance in addition to calculating the coefficient of determination R^2 to measure the strength of the significant relationships. The process of selecting the data analysis testing is illustrated in the following **Figure. 9** "Data analysis selection process".

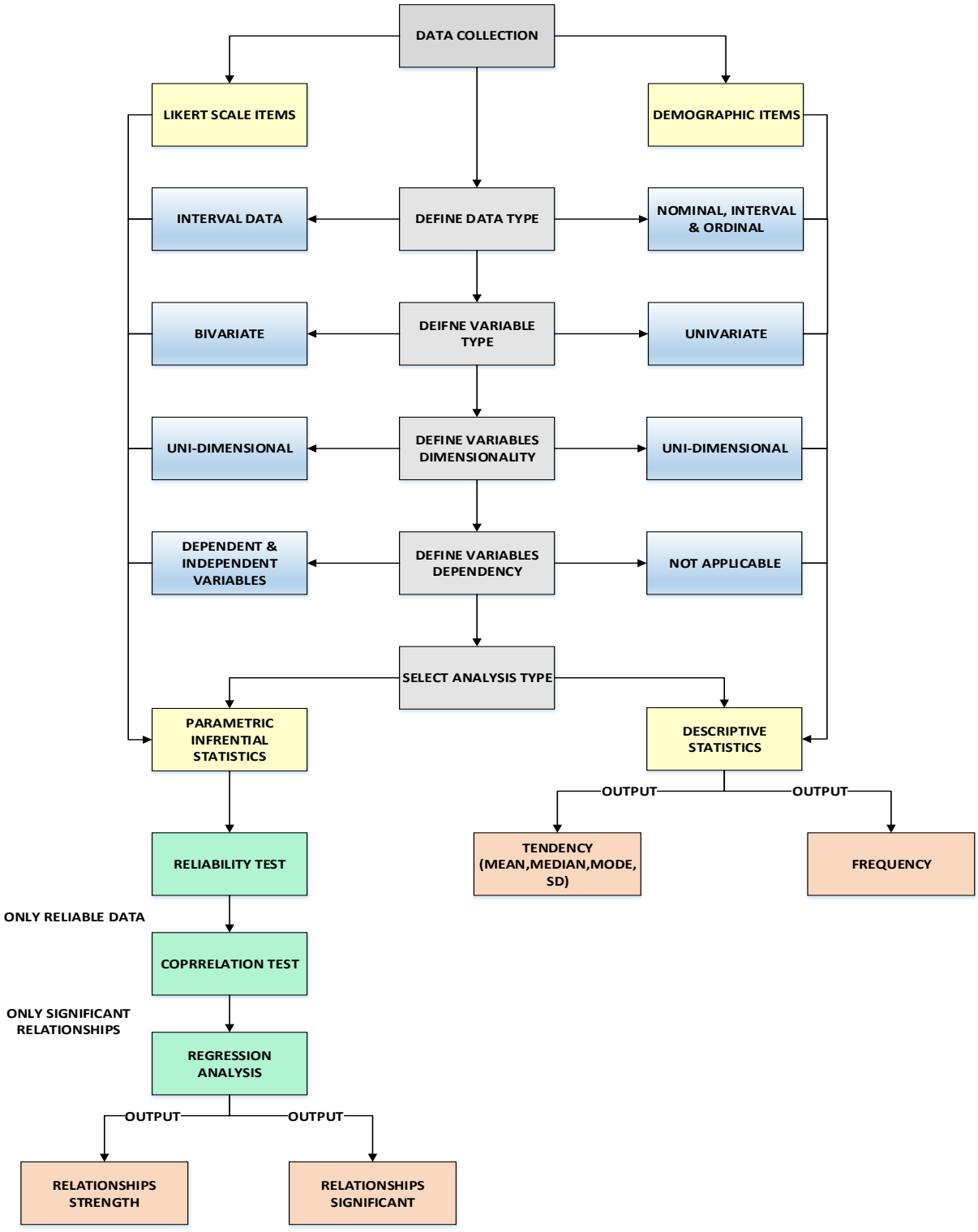

FIGURE.9: Data analysis selection process

5.5. Analysis and Results

According to Rowley (2014), there are three main groups of quantitative data analysis software, which are: web survey software such as Survey Monkey; office software such as Excel; and the statistical package for the social sciences (SPSS). He recommended the use of SPSS and stated "SPSS is a more specialist package that is a core tool for academic research and is a must for any quantitative researcher studying at doctoral level or beyond".

The researcher opted to use the Statistical Package for the Social Sciences software (SPSS) version.21 to analyze the collected data. Many resources were reviewed to investigate the SPSS software capacity and to understand the right procedures for using the SPSS software for analyzing the data such as Muijs (2004), Field (2009), IBM (2012) and Saunders et al. (2016).

The researcher discarded all the incomplete questionnaires and used only the completed 107 questionnaires; this was followed by checking and cleaning the data from any omissions or mistakes. The items were coded according to the variables codes defined in the survey instrument **(Table.4)**. After that the data was entered into the SPSS software; the negatively worded items in the survey instrument were re-coded on the SPSS by clicking on ('Transform>'Recode into same variables') and then selecting the negatively worded questions and defining the old values and new values as (1=5, 2=4, 3=3, 4=2, 5=1). The recoded items are: Market.3: There is no relation between market demand and the construction client willing for innovation; Experience.3: There is no relationship between the construction client's experience & competence and its behaviour in innovation; Character.2: The construction client characteristics are not related to the capacity of the client to innovate; Regulation.3: There is no significant relationship between government regulations and the construction client's behaviour in innovation; Org.Culture.2: There is no relationship between the organizational culture and the construction client's attitude in adopting innovation; and Performance.3: There is no relationship between the construction project performance and the construction client's behaviour in innovation.

5.5.1. Descriptive Analysis

In order to present the survey sample profile, the SPSS was used to calculate the frequencies for the respondents' demographic characteristics by clicking on ('Analyze'>'Descriptive Statistics'>'Frequencies'), then clicking on the "statistics" box and selecting the (mean, mode, median & standard deviation); that was followed by selecting the five items which comprise the 5 univariate variables of "Section.1 General information" in the survey which are (Education, Experience, Managerial level, Organization type and Organization employees` number).

Table.9 below presents the frequency of each demographic item, 65 respondents (61%) were bachelor`s degree holders in addition to 41 respondents (38%) who held a master`s degree while only one respondent (1%) held a doctorate. The experience of the survey respondents was distributed between the respondents who had 5 years and above with only one respondent (1%) located in the 0-5 years category; 19 respondents (18%) had 5-10 years, 35 respondents (33%) had 10-15 years, 28 respondents (26%) had 15-20 years and 24 respondents (22%) had over 20 years.

Demographic Characteristic	**Education**	**Experience**	**Managerial Level**	**Organization Type**	**Employee No**
Bachelor	**65**				
Masters	41				
Doctorate	1				
0-5 years		1			
5-10 years		19			
10-15 years		**35**			
15-20 years		28			
Above 20 years		24			
First level			14		
Middle level			37		
Senior level			5**6**		
Client				27	
Consultant				22	
Contractor/subcontractor				**47**	
Supplier				11	
0-250 employees					29
250-500 employees					15
500-1,000 employees					18
Above 1,000 employees					**45**
Total	**107**	**107**	**107**	**107**	**107**

Table.9: Demographic Characteristic Frequencies

The respondents who were working at a senior level were 56 in total (52%) while the first and middle levels recorded 14 respondents (13%) and 37 respondents (35%) respectively. The organization`s type item showed that the majority of the organizations were contractors/subcontractors which recorded a total of 47 organizations (44%) while the client and consultant organizations had a count of 27 clients' organizations (25%) and 22 consultants' organizations (21%), the suppliers' organizations recorded the lowest frequency of 11 organizations (10%). In terms of the organization's number of employees, the maximum number was for the category "Above 1,000 employees" in 45 organizations (42%) followed by the category "0-250" which recorded 29 organizations (27%) whereas the second and third categories "250-500" & "500-1,000" recorded 15 organizations (14%) and 18 organizations (17%) respectively.

It could be concluded that the selected sample had demographic characteristics which were distributed among the different categories and that could be interpreted as a good sampling which presented the input from the construction professionals from different perspectives, which augments the quality of the collected data.

The figures in **Table.10** represents the sample descriptive statistics in terms of "mean, median, mode, and standard deviation" which were defined by Wilson (2014) as "The mean is the arithmetical average of frequency distribution, the median is the middle number in a set of numbers/average, the mode is the value that occurs most often in the data set, standard deviation is the spread of the data around the mean value".

The results showed that the mean of the education value is "1.4" which is approximately located between bachelor and masters; the median and mode have the same value of "1" which is the bachelor with a standard deviation value of ".511". The mean of the experience is "3.51" which is located between the two categories "10-15" & "15-20", while the median and mode recorded the same value "3" which equals "10-15 years" with a standard deviation of "1.058". The managerial level mean is "2.39" which comes between middle and senior level while the median and mode recorded the same value of "3" which is the senior level category with a standard deviation of ".711".

The organization type mean is "2.39" which is located between "consultant" and "contractor/subcontractor" while the median and mode recorded the same value of "3" which is the "contractor/subcontractor" with a standard deviation of ".979". The mean of the employees number is "2.74" which is located between the two categories "25-500" & "500-1,000"; the median is "3" which is the category "500-1,000 employee"; while the mode recorded a different value of "4" which is the category "above 1,000 employees" with standard deviation of "1.261".

Descriptive Statistics	Education	Experience	Managerial Level	Organization Type	Employee No
Mean	1.4	3.51	2.39	2.39	2.74
Median	1.00	3.00	3.00	3.00	3.00
Mode	1	3	3	3	4
Std. Deviation	.511	1.058	.711	.979	1.261

Table.10: Descriptive Statistics

5.5.2. Inferential Statistics

5.5.2.1. Reliability Test

The researcher conducted Cronbach`s alpha coefficient test to measure the data reliability based on the recommendations of Schmitt (1996), Passmore et al. (2002), Gorrell et al. (2011), and Bonett and Wright (2014) who had consensus that Cronbach`s alpha coefficient which was developed by Cronbach in 1951 and is symbolized by lower-case Greek letter α is the most popular method for testing internal consistency and is the most commonly used index for estimating data reliability in most research. Croasmun and Ostrom (2011) defined the internal consistency reliability as "The extent to which items in an instrument are consistent among themselves and with the overall instrument". As mentioned in section 4.4.4 there had been wide debate between the researchers regarding the minimum acceptable alpha value which has been defined as 0.65 for this research based on the works of Suliman (2001), Malhotra (2004), Green et al. (1977), Spector (1992), Vaske (2008), and Vaske et al. (2016).

Vaske et al. (2016) confirmed that Cronbach`s alpha measures the extent to which the item responses correlate with each other which will inform how the data are internally consistent and referred to Cronbach`s alpha computing formula below:

$$\alpha = \frac{N}{N-1}\left(\frac{\sigma_X^2 - \sum_{i=1}^{N}\sigma_{Y_i}^2}{\sigma_X^2}\right)$$

Where:

N= the number of survey items in the scale.

σ x²= the variance of the observed total score.

σ y²= the variance of item I for person y.

The reliability test was done for all of the defined seven dependent and independent variable items on SPSS by clicking on ('Analyze'>'Scale'>'Reliability Analysis'). After that each variable item was selected and that was followed by clicking on the option of statics shown on the same screen and selecting the box (Scale if item deleted) which listed the value of alpha in front of each item in case the item is deleted which may be required to improve the alpha value in case the alpha for the total variable items is less than the approved threshold (Field 2006).

The first run of the reliability test showed reliable data for the variables (Client experience & competence α=0.721, government regulations α= 0.713, environmental sustainability α= 0.812, client role α= 0.664) while the other variables alpha recorded lower than the approved threshold of 0.65. The second iteration of the test was done to improve the alpha value by deleting certain items (defined through the option 'scale if deleted') which seemed to be inconsistent with the other scale items; the maximum possible alpha for the "Market demand" variable showed a value of α= 0.536 which is below the acceptable threshold, therefore the total "Market demand" variable items were deleted due to inconsistency.

The "Client characteristics" variable showed a value of α= 0.579 at the first run, the second run after deleting the second item of the variable "Character.2. The construction client characteristics are not related to the capacity of the client to innovate" improved significantly the alpha value up to 0.744. The "Organizational culture" variable showed a value of α= 0.540 at the first run which was improved in the second run to be α= 0.782 after deleting the second item "Org.Culture.2. There is no relationship between the

organizational culture and the construction client attitude in adopting innovation". The alpha value for the "Performance improvement" variable was improved from α= 0.336 up to α= 0.676 after the deletion of the third item "Performance.3. There is no relationship between the construction project performance and the construction client behaviour in innovation". Therefore the second test iteration resulted in accepting the variables (Client characteristic, organizational culture & performance) after deleting certain items which improved the alpha value to be higher than the acceptable threshold of 0.65.

In order to improve the scale reliability to ensure the data's internal consistency, the researcher deleted the items "Market.1, Market.2, Market.3, Character.2, Org.Culture.2, & Performace.3" which improved the overall value of α from 0.880 to 0.881 as shown below in **Table. 11** which presents the Cronbach`s alpha values.

Variable	Reliability Coefficient	Items	New value after deletion	Items
Market demand	0.536	3	-	-
Client experience & competence	0.721	3	NA	3
Client characteristic	0.579	3	0.744	2
Government regulations	0.713	3	NA	3
Environmental sustainability	0.812	3	NA	3
Organizational culture	0.540	3	0.782	2
Performance improvement	0.336	3	0.676	2
Client Role	0.664	9	NA	9
Total items	**0.88**	**30**	**0.881**	**24**

Table.11: Cronbach`s alpha values

The six rejected items were dropped from the scale to ensure internal consistency and the items` homogeneity whereas the related variables` summation were re-computed for the reliable items which will be examined in the next correlation test.

5.5.2.2. Pearson`s Correlation Test

Referring to the discussion in section **5.3.3,** the Pearson product moment correlation test will be conducted to examine the correlation between the dependent and independent variables in line with the defined hypothesis model **(Figure.7)** which emerged from the literature review. It is worth noting that this test will be conducted only for the variables summated from the reliable data based on the output of the reliability test in section

5.4.2.1. Wilson (2014) defined the Pearson product moment correlation (r) as "A parametric technique that measures the strength of association between two variables or bivariate data, the measurement will be represented between -1 and 1 where the value of 1 represents a perfect positive correlation and -1 represents a perfect negative correlation and where the value 0 means that there is no relationship between the two variables and they are independent", and presented the Pearson`s product moment correlation coefficient formula as mentioned below:

$$r = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sqrt{\left(\sum X^2 - \frac{(\sum X)^2}{N}\right)}\sqrt{\left(\sum Y^2 - \frac{(\sum Y)^2}{N}\right)}}$$

Where:

N= the number of data pairs.

y= the dependent variable.

x= the independent variable.

√= square root.

∑= the sum of.

Tavakol and Sandars (2014) agreed to use the Pearson correlation coefficient for calculating the association between two variables and explained the test method on the SPSS software by clicking on ('Analyze'>'Correlate'>'Bivariate'), and then moving the variables into the box and running the test to generate the correlation table. The test output will be the Pearson correlation coefficient (r) and the correlation significance level (p).

Chan (2003) confirmed that Pearson`s correlation test will describe the linear relationship between two variables and interpreted the output of the Pearson`s correlation coefficient test "r" by mentioning that the value of r lies between 1 and -1, whereas the value near 0 means that there is no correlation, while the values near +/-1 means a very strong correlation. He added that the negative sign means that the two variables are inversely related while the positive sign means a positive relation and illustrated the "r" value interpretation the following **Table.12**. He also added that the (*p*) value shows the probability of the relationship and thus explains the statistical significance.

Correlation Coefficient Value	Strength of linear relationship
At least 0.8	Very strong
0.6 up to 0.8	Moderately strong
0.3 to 0.5	Fair
Less than 0.3	Poor

Table.12: Strength of linear relationship
Adopted from Chan (2003), pp.614

The interpretation of the Pearson`s correlation coefficient (r) was confirmed by Sedgwick (2012), Mukka (2012), and Saunders et al. (2016). The statistical significance level, which is the second output of the Pearson`s correlation test, has been studied by many researchers. Rice (1989) stated that the significance level is accepted at two levels: the first is significant at the 5% level which means a 95% confidence level and the second is significant at 1% which means a 99% confidence level.

Ranstam (2008) and Aarts et al. (2012) highlighted that the confidence level (*p* value) provides evidence for the statistical significance and helps in interpretation of the research findings where there had been consensus on two confidence intervals; the first interval is with minimum acceptable significance threshold *(p)* less than 5% (tow-tailed) which means a confidence level of 95% whereas the second interval for the *(p)* less than 1% (tow-tailed) which gives a higher confidence level of 99%. Saunders, et al. (2016) agreed with the aforementioned interpretation for the significance level by mentioning that if the probability ($P < 0.05$ or lower) then there is statistically significant relationship while if the probability (*P*) is higher than 0.05 then it is concluded the relationship is not statistically significant.

The variables which were found to be unreliable through the previous reliability test were re-summated after excluding certain items in order to improve the internal data consistency α according to the minimum acceptable threshold of 0.65. The variable (Market demand) was totally dropped as all the trials of deleting some of its items had failed to improve the reliability up to the approved threshold. The variables (Client characteristic, organizational culture & performance improvement) were found to be reliable after deleting certain items, therefore the computing of these variables was redone based on summating the reliable

items only. The original reliable variables and the other variables which became reliable after the deletion of certain items were used to conduct the correlation test.

The SPSS software was used to run the Pearson`s correlation test by clicking on ('Analyze'>Correlate>'Bivariate'). The reliable variables were selected in addition to choosing the options of Pearson correlation coefficient and tow tailed significance test. The test results are illustrated below in **Table.13**.

Independent Variables	**Dependent Variable** Change in the client role towards adoption of innovation		
	Pearson Correlation (r)	Significance (2-tailed) (*P*)	N
Client experience & competence	.358**	.000	107
Client Characteristics	.457**	.000	107
Government regulations	.238*	.014	107
Environmental sustainability	.497**	.000	107
Organizational culture	.436**	.000	107
Performance improvement	.632**	.000	107

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Table.13: Pearson`s Correlation Coefficient Test Results

Based on the results above, there are significant relationships between all the above independent variables and the dependent variable where all the relationships are found to be significant at 0.01 significance level, which means a high confidence level of 99% (Ranstam 2008; Aarts et al. 2012). The Pearson`s correlation coefficient (r) for all the relationships recorded a positive value between 0 and 1 which means positive relationships between the independent variables and the dependent variable where the (r) values were ranging between .238 which is considered poor up to .632 which is considered moderately strong, based on the works of Chan (2003) and Wilson (2014).

The relationship between the six independent variables and the dependent variable recorded a different Pearson correlation coefficient (r) based on the strength of the defined significant relationships. The highest value was for the "Performance improvement" variable which recorded an (r) value of .632 which is considered as a moderately strong significant relationship. "Environmental sustainability", "Client characteristics" and

"Organizational culture" recorded (r) values of .497, .457 and .436 respectively which are all considered as fair significant relationships. The lowest (r) value was for the "Government regulations" variable which recorded a value of .238 which is considered as a poor significant relationship.

In order to confirm the relationships` significance and to measure their strength, the Regression analysis test will be conducted in the following section which will lead to establishing or rejecting the developed hypotheses in addition to measuring the relationships' strengths based on the recommendations of Blaikie (2004), Wilson (2014), Rowley (2014), and Saunders et al. (2016).

5.5.2.3. Regression Analysis Test

Wilson (2014) defined regression analysis as "A statistical technique for investigating the strength of a relationship between variables", and explained that it is used to establish the effect of one variable on the other. There are two main types of regression analysis: simple linear regression and multiple linear regressions. Simple linear regression determines the strength of relationship between the dependent variable (y) on independent variable (x) while multiple linear regression aims to determine the strength of relationship between the dependent variable and several independent variables where the linear regression formula is represented by:

$$y= a + bx$$

Where:

x= independent variable.

y= depend variable.

a= point where the line intersects the y-axis.

b= gradient of the line.

Blaikie (2004) pointed out that the regression analysis assumes that the relationship between two variables is linear and the increase in the value of one variable is associated with an increase in the other variable if the relationship is positive or decreases if the relationship is negative and the relationship is presented by the coefficient of determination (R^2).

Rowley (2014) confirmed that the regression analysis goes one step further than correlation as it is not only showing the relationship between variables but it additionally develops a "line of best fit" of the relationship between the two variables which depends on the level of match which is measured by a statistic called (R^2). Wilson (2014) confirmed that the regression analysis will provide the coefficient of determination presented by (R^2) and explained that it is a measure of the proportion of variability explained by, or due to, the linear relationship in a sample of paired data. It is represented by a number between 0 and 1: a value of 1 indicates that the equation is a perfect predictor; while a value of 0 means that the equation predicts none of the variation.

Saunders et al. (2016) confirmed that regression analysis is measuring the proportion of the variation in a dependent variable that can be explained statistically by the independent variable or variables which is presented in the coefficient of determination (R^2) which can take any value between 0 and +1 which could be converted to a percentage which measures the strength of relationship of the dependent variable and one independent variable in simple linear regression and measures the strength of the relationship between the dependent variable and two or more independent variables in multiple linear regression.

Based on the recommendations of Blaikie (2004), Wilson (2014), Rowley (2014), and Saunders et al. (2016), regression analysis will be performed to confirm and augment the earlier significant relationships which were established through the Pearson correlation test and to measure the strength of the relationships between the dependent and independent variables by calculating the coefficient of determination (R^2).

Saunders et al. (2016) explained that the ANOVA and t-test in the regression analysis are used to confirm the probability of the relationship represented in the regression analysis test; they highlighted that the single linear regression test will include the output of the t-test which determines the value of the unstandardized coefficient (β) which is the gradient of the regression line (earlier b in the regression formula "y= a + bx ") in addition to the model significance where the output of ANOVA test which will determine the F-value which is resulting from dividing the mean of the regression sum of squares by the mean residual sum of squares. The result will then be compared with the F distribution to

determine whether the model is significant and has good predictive capabilities or not. They also added that in the case of simple linear regression the t-test and ANOVA test will give the same answer and confirmed to refer to (R^2) value as the adjusted (R^2) value is related to the multiple regression analysis only.

Due to all the research variables being uni-dimensional bivariate, the simple regression analysis test will be conducted for the dependent variable (Change in the client role towards adoption of innovation) against each of the independent variables which were proved to have significant relationships through the previous Pearson correlation test which are (Client experience & competence, Client Characteristics, Government regulations, Environmental sustainability, Organizational culture and Performance improvement). The SPSS software was used to run the regression analysis by clicking on ('Analyze>'Regression'>'Linear'), that was followed by selecting the dependent factor with one independent factor, and this process was done for each independent factor with the one dependent factor separately due to the test being a single regression analysis based on the variables being uni-dimensional bivariate. The regression analysis results are illustrated below in **Table. 14**.

Independent Variables	**Regression against Dependent Variable "Change in client role towards innovation adoption"**		
	F-value & sig. level	**R^2**	**β**
Client experience & competence	15.442 (.000)	.128	.740
Client Characteristics	27.683 (.000)	.209	1.524
Government regulations	6.310 (.014)	.057	.429
Environmental sustainability	34.464 (.000)	.247	1.074
Organizational culture	24.592 (.000)	.190	1.359
Performance improvement	69.732 (.000)	.399	1.966

Table.14: Regression Analysis Test Results

The table above shows the regression analysis results. The client experience and competence showed an F-value of 15.442 which is highly significant at level .000 ($p<.01$) which means a confidence level of 99%, whereas the R^2 was 12.8% which means that the client experience and competence explains 12.8% of the variance in the change in the client role towards innovation adoption. The client characteristics factor recorded an F-value of 27.683 highly significant at level .000 ($p<.01$) which equals 99% confidence with

an R^2 value of 20.9%. Therefore it is concluded that client characteristics is explaining 20.9% of the variance in the change in the client role toward innovation adoption. The government regulation variable showed F-value of 6.310 as significant but at level .014 ($p<.05$) which equals 95% confidence with an R^2 value of 5.7% which is considered low as it is much nearer to zero based on the works of Blaikie (2004), Wilson (2014), and Saunders et al. (2016).

The environmental sustainability and organizational culture showed F-values of 34.464 and 24.592 respectively and both were significant at level 000 ($p<.01$) which equals 99% confidence. The R^2 value for environmental sustainability was 24.7% and 19% for organizational culture which both explain how much variance in the change in the client role towards innovation is explained by these two factors. The performance improvement variable showed an F-value of 69.732 highly significant at level 000 ($p<.01$) which equals 99% confidence with R^2 value of 39.9% which was the highest among all the factors and could be interpreted that the 39.9% of the variance in the change in the client role toward adoption of innovation is explained by the performance improvement variable being the most predicting variable among the other variables. The β value was calculated for the entire conducted single linear regression tests as per the values shown in the table above which equals the gradient of the regression line where all the tests showed significant results similar to the F-test due to the analysis being simple linear regression (Sauders et al. 2016).

5.6. Discussion

This section recalls the development of the research's seven hypotheses, illustrated in **Figure.7**, which emerged from the literature review findings of the seven defined factors which were found to be influencing the change in the client's role towards the adoption of innovation. This will be followed by discussing the collected data analysis results for each hypothesis in order to establish or reject the hypothesis.

The seven defined factors are: market demand and competition, client experience and competence, client characteristics, government regulations, environmental sustainability, organizational culture and performance improvement. Each was found to be influencing change in the client's role towards driving the adoption of innovation, and was defined as a

uni-dimensional bivariate independent variable comprised from three items measured on the Likert five-point scale and hypothesized to have a statistical relationship with the "The change in the client role towards adopting innovation" variable which was defined as the uni-dimensional bivariate dependent variable comprised from nine items measured on the Likert five-points scale.

Internal consistency using Cronbach`s alpha was measured for the items which comprised the variables of each hypothesis to confirm the data's reliability where the reliable data was only used for the hypotheses statistical significance testing to ensure the results' consistency and thus concluded in reliable findings based on the works of Schmitt (1996), Amaratunga et al (2002), Passmore et al. (2002), Blaikie (2004), Gorrell, et al. (2011), and Bonett and Wright (2014). The Pearson`s correlation test was conducted to test the significance of the statistical relationship between each hypothesis' reliable variables. The regression analysis tests were further used to confirm the significant relationship found in the Pearson`s correlation test and to measure the strength of the statistical relationship between the hypothesis variables to enable the acceptance or the rejection of the proposed hypotheses as discussed below:

Hypothesis.1: Market demand is encouraging the change in the construction client`s role towards driving adoption of innovation.

Hypothesis.1 was drawn from the literature review which showed that market demand and competition has been defined as an important factor which is influencing the change in the construction client's role towards driving the adoption of innovation in construction projects to comply with the customer's requirements and increase competitiveness (Mitropoulos & Tatum 2000; Bossink 2004; Blayse & Manley 2004; Asad et al. 2005; Hartmann 2006; Yitmen 2007; Thorpe et al. 2008; Brandon & Lu 2008; Hartmann et al. 2008; Kulatunga 2010; Kissi et al. 2010; Xue et al. 2014; Kilinc et al. 2015).

The first run of Cronbach`s alpha reliability test showed an acceptable alpha value for the "The change in the client role towards adopting innovation" variable which recorded an acceptable α=0.664 as it was above the defined minimum acceptable level of 0.65, while the alpha value for the "Market demand and competition" variable recorded a low value of

α=0.536 which is below the minimum acceptable level. The second test run which was conducted to improve the alpha value showed an even lower alpha value therefore it has been concluded that all the "Market demand and competition" variable items were not consistent and thus unreliable, therefore the correlation and regression tests cannot be conducted to test the statistical relationship between the hypothesis variables. Therefore H.1 is rejected which is contrary to the literature review findings.

Hypothesis.2: There is a positive significant relationship between the construction client experience and competence with the change in the client`s role toward adoption of innovation.

Hypothesis.2 emerged from the literature review which revealed that there has been consensus among the researchers that the construction client's experience and competence is a main factor which is changing the client's role towards stimulating the adoption of innovation in construction projects, as it gives the construction client the confidence and the required skills to manage the complexity of innovation and their associated risks thus ensuring successful implementation (Bossink 2004; Ivory 2004; Blayse & Manley 2004; Ivory 2005; Hatmann et al. 2006; Yitmen 2007; Hartmann et al. 2008; Brandon & Lu 2008; Kulatunga 2010; Love et al. 2012; Loosemore & Richard 2015; Jones et al. 2016).

The first run of Cronbach`s alpha test showed a value of α=0.721 for the "Client experience and demand" variable in addition to α=0.664 for the "The change in the client role towards adopting innovation" variable, both of which were more than the minimum acceptable threshold of 0.65. Therefore the data for the two variables was considered internally consistent and thus reliable to be tested through the correlation and regression tests.

The Pearson`s correlation recorded a correlation coefficient (r) value of .358 significant at level (p<0.01) which equals 99% confidence, therefore the two variables were found to have a positive significant relationship which is categorized as a fair relationship based on the (r) value. The simple regression test was then conducted to confirm the relationship's significance and to measure its strength which confirmed a significant relationship between the two variables which was found significant at level (p<0.01) which equals 99%

confidence with coefficient of determination R^2 value of .128, which means that the client experience and competence explains 12.8% of the variance in the change in the client role towards adopting innovation. Therefore it has been concluded that Hypothesis.2 is established, which is consistent with the literature review.

Hypothesis.3: There is a positive significant relationship between the construction client`s characteristics with the change in the client`s role toward adoption of innovation.

Hypothesis.3 was derived from the literature review which confirmed that the construction client's characteristics is one of the main factors which influences the change of the client's role towards co-creating innovation. Those client characteristics include leadership, championing, communication, flexibility and receptiveness to changes and their associated risks, ability to build long-term relationships, self-motivation, commitment, and conflict management (Bossink 2004; Hartmann et al. 2006; Hartmann 2006; Hartmann et al. 2008; Kulatunga 2010; Gambatese & Hallowell 2011; Xue et al. 2014; Loosemore & Richard 2015).

The first run of Cronbach`s alpha test showed a value of $\alpha = 0.579$ for the "Client characteristics" variable and a value of $\alpha = 0.664$ for the "The change in the client role towards adopting innovation" variable. Due to the alpha of the "Client experience" variable being below the minimum approved level of 0.65, the Cronbach alpha test was redone for the "Client characteristics" variable after deleting the second item which improved the alpha value up to 0.744 and was thus approved. The second item was deleted and the variable "Client characteristics" was recomputed using the reliable items only to ensure the data consistency. Therefore the data for the revised "Client experience" variable and "The change in the client role towards adopting innovation" variable were considered internally consistent and thus reliable to be tested through the correlation and regression tests.

The Pearson`s correlation test recorded a correlation coefficient (r) value of .457 significant at level ($p<0.01$) which equals 99% confidence, therefore the two variables were found to have a positive significant relationship which is categorized to be highly fair

based on the (r) value. That was followed by conducting the simple regression test which confirmed the significant relationship between the two variables which was found significant at level (p<0.01) which equals 99% confidence with a coefficient of determination R^2 value of .209, which means that client experience and competence explains 20.9 % of the variance in the change in the client's role towards adopting innovation. Therefore it has been concluded that the Hypothesis.3 is established which is consistent with the literature review findings.

Hypothesis.4: Government regulations are stimulating the change in the construction client`s role towards adoption of innovation.

Hypothesis.4 was derived from the literature review which confirmed that government regulations such as performance-based regulations and building codes and standards which are issued and regulated by governmental bodies have been found to be exerting pressure on the construction client to adopt innovative approaches to comply with these regulations. Therefore government regulations have been concluded to be one of the main factors behind the change in the construction client's role towards co-creating innovation in the construction industry (Blayse & Manley 2004; Bossink 2004; Hartmann 2006; Hemstrom et al. 2011; Love et al. 2012).

The first run of the Cronbach`s alpha test showed a value of α= 0.713 for the "Government regulations" variable and a value of α=0.664 for the "The change in the client role towards adopting innovation" variable, both of which were more than the minimum acceptable threshold of 0.65. Therefore the data for these variables were considered internally consistent and thus reliable to be tested through the correlation and regression tests.

The Pearson`s correlation test recorded a correlation coefficient (r) value of 0.238 significant at level (p<0.05) which equals 95% confidence, therefore the two variables were found to have a positive significant relationship which is categorized as a poor relationship due to the low value of (r). That was followed by conducting the simple regression test which confirmed the significant relationship between the two variables which was found significant at level (p<0.05) which equals 95% confidence with a coefficient of determination R^2 value of .057, which means that government regulations

explains 5.7 % of the variance in the change in the client' role towards adopting innovation. Therefore it has been concluded that Hypothesis.4 is established which is consistent with the literature review findings.

Hypothesis.5: There is a positive significant relationship between environmental sustainability and the change in the construction client`s role in co-creating innovation among the project stakeholders.

Hypothesis.5 was drawn from the literature review findings which highlighted the wide recognition that the construction industry is heavily implicated in environmental degradation which has triggered the initiating of many policies and regulations to reduce and control the industry's negative environmental impacts which has been seen to influence the change in the client's role towards the adoption of innovations to improve the industry's environmental performance (Jaillon & Poon 2008; Thorpe et al. 2008; Qi et al. 2010; Hemstrom et al. 2011; Love et al. 2012; Xue et al. 2014; Kinlinc et al. 2015; Jones et al. 2016).

The first run of Cronbach`s alpha test showed a value of $\alpha = 0.812$ for the "Government regulations" variable and value of $\alpha = 0.664$ for the "The change in the client's role towards adopting innovation" variable, both of which had more than the minimum acceptable limit of 0.65. Therefore the data for these variables were considered to have internal consistency and thus reliable enough to be tested though the correlation and regression tests.

The Pearson`s correlation test was conducted to examine the correlation between the two variables which recorded a correlation coefficient (r) value of .497 significant at level ($p<0.01$) which equals 99% confidence. Therefore the two variables were found to have a positive significant relationship which is categorized as highly fair and low to moderately strong based on the (r) value. That was followed by conducting the simple regression test which confirmed the significant relationship between the two variables which was found significant at level ($p<0.01$) which equals 99% confidence with a coefficient of determination R^2 value of .247, which means that environmental sustainability explains 24.7 % of the variance in the change in the client's role towards adopting innovation.

Therefore it has been concluded that Hypothesis.5 is established which is consistent with the literature review.

H.6: There is a positive significant relationship between the construction client organizational culture and the new role of the construction in co-creating innovation.

Hypothesis.6 was developed from the literature review which revealed that organizational culture presents one of the main factors which is influencing the change of the construction client role towards co-creating innovation in the construction industry as it provides the proper climate which promotes and fosters innovation culture (Mitropoulos & Tatum 2000; Dulaimi et al. 2003; Dulaimi et al. 2005; Hartmann 2006; Rutten et al. 2009; Kissi et al. 2010, Gambatese & Hallowell 2011).

Cronbach`s alpha first run showed a value of $\alpha = 0.540$ for the "Organizational culture" variable and an alpha value of $\alpha = 0.664$ for the "The change in the client role towards adopting innovation" variable. The test was redone for the "Organizational culture" variable due to its alpha value being below the minimum acceptable level of 0.65 by removing the second item which improved the variable alpha up to 0.782. After that, the "Organizational culture" variable was recomputed based on the reliable items only. Therefore the data for the revised "Organizational Culture" variable and "The change in the client role towards adopting innovation" variable were considered internally consistent and thus reliable to be tested through the correlation and regression tests.

The Pearson`s correlation test recorded a correlation coefficient (r) value of .436 significant at level ($p<0.01$) which equals 99% confidence, therefore the two variables were found to have a positive significant relationship which is categorized as a highly fair relationship based on the (r) value. That was followed by conducting the simple regression test which confirmed the significant relationship between the two variables which was found significant at level ($p<0.01$) which equals 99% confidence with a coefficient of determination R^2 value of .190 which means that the organizational culture explains 19 % of the variance in the change in the client's role towards adopting innovation. Therefore it has been concluded that Hypothesis.6 is established which is consistent with the literature review findings.

Hypothesis.7: The construction performance improvement is found to be promoting the change in the construction client`s role towards innovation co-creation.

Hypothesis.7 emerged from the literature review which showed consensus between the researchers that innovation is resulting in significant improvements in the construction industry's performance from many perspectives such as duration, cost, and quality, which is found to influence the client's role to be changing towards driving the construction team to adopt innovation in order to improve the construction project's performance and thus increase the perceived benefits (Asad et al. 2005; Hartmann et al. 2006; Manely et al. 2009; Yitmen 2007; Kissi et al. 2010; Hemstrom et al. 2011; Xue et al. 2014).

The Cronbach`s alpha first run showed a value of α= 0.336 for the "Performance improvement" variable and an alpha value of α=0.664 for the "The change in the client role towards adopting innovation" variable. The test was redone for the "Performance improvement" variable due to its alpha value being below the minimum acceptable level of 0.65 by removing the third item which improved the variable alpha up to 0.676. After that, the "Performance improvement" variable was recomputed based on the reliable items only. Therefore the data for the revised "Performance improvement" variable and "The change in the client role towards adopting innovation" variable were considered internally consistent and thus reliable to be tested through the correlation and regression tests.

The Pearson`s correlation test recorded a correlation coefficient (r) value of .632 significant at level ($p<0.01$) which equals 99% confidence. Therefore the two variables were found to have a positive significant relationship which is categorized to be moderately strong based on the (r) value. That was followed by conducting the simple regression test which confirmed the significant relationship between the two variables which was found significant at level ($p<0.01$) which equals 99% confidence with a coefficient of determination R^2 value of .399 which means that the performance improvement explains 39.9 % of the variance in the change in the client role towards adopting innovation. Therefore it has been concluded that Hypothesis.6 is established which is consistent with the literature review findings.

6. Chapter Six- Conclusions and Recommendations

6.1. Conclusions

The construction industry has witnessed the new trend of innovation adoption which has been looked at as the solution that enables the industry to cope with its traditional drawbacks and improves significantly its performance. The construction client's role in the traditional procurement method has been defined to undermine innovation adoption due to the separation between the construction project's team members which hinders team communication and is therefore considered a barrier for innovation adoption.

The extensive literature review in the context of the research's defined aim and objectives revealed the noticeable increasing change in the construction client's role away from the role in the traditional procurement method towards undertaking the new role of co-creating innovation in construction projects by removing the traditional barriers and inducing the project`s stakeholders to work closely and collaboratively to co-create innovation. The adoption of Building Information Modeling (BIM) and Prefabrication were reviewed as examples for innovation adoption in the construction industry.

The literature review investigated the diffusion of innovation in the construction industry and explored seven factors which were found to be influencing the change in the construction client`s role towards the new role of co-creating innovation which are: market demand and competition, client experience and competence, client characteristics, government regulations, environmental sustainability, organizational culture, and performance improvement. These factors were used to derive seven hypotheses to be tested based on the data collected from professionals working in the UAE construction industry.

A survey was conducted to collect data from a sample of professionals representing the different UAE construction industry stakeholders, such as clients, consultants, contractors, subcontractors, and suppliers to validate the derived hypotheses and augment the research findings. The completed 107 responses were analyzed using the statistical package for social sciences software (SPSS). The collected data descriptive analysis is presented in **Table.9** and **Table.10** which are followed by **Table.11** to present the hypotheses' variables data reliability. The Hypothesis.1: "Market demand is encouraging the change in the

construction client`s role towards driving adoption of innovation" was excluded from the hypotheses testing due to its data unreliability. Therefore Hypothesis.1 was rejected which is contrary to the literature review findings.

The other six hypotheses were tested to examine the correlation between each hypothesis variables. The Pearson correlation and regression analysis tests confirmed the existence of significant statistical positive relationships between the change in the construction client's role towards adopting innovation and the defined six factors which are ranked according to their relationship strength on descending order as follows: performance improvement, environmental sustainability, client characteristics, organizational culture, client experience and competence, and government regulations. The related six hypotheses (H2, H3, H4, H5, and H6 & H7) were established and that was consistent with the literature review. Therefore these six factors are confirmed to be responsible for the change in the construction client's role away from the role in the traditional procurement method towards the new role of co-creating innovation in the construction industry and these findings could be generalized to the research targeted population in the UAE.

6.2. Recommendations for Professionals

Based on the research findings, the construction client's role under the traditional procurement method has been confirmed to be changing towards driving the adoption of innovation in the construction industry. Therefore it could be extrapolated that innovation should be considered as the new performance parameter in addition to the traditional three parameters of cost, time and quality. It should be interpreted that the construction industry organizations which are providing services for construction clients shall address the new client`s innovation requirements on top of their priorities. These organizations shall work on developing their innovation capacity by investing in the research and development departments to boost their innovation capabilities to be able to comply with the new clients' requirements to ensure their organization's competiveness and economical sustainability in addition to the perceived benefits within the organization itself in terms of increased profitability and reputation.

6.3. Recommendations for Future Studies

This study was not without limitation. Three limitations will be addressed: The first limitation in the study was limiting the investigation of the change in the construction client`s role to the traditional procurement method, the second limitation was the selection of two adopted innovation examples which are BIM and Prefabrication, the third limitation was the sample size which was based on a targeted population of 250 organizations working in the construction industry. These limitations however serve as a platform for future studies to further investigate the change in the construction client's role towards adopting innovation by targeting different samples and investigating the new construction client`s role in innovation co-creation under the other available procurement methods in addition to exploring further examples of innovation adoption in construction projects.

7. Chapter Seven- References and Appendices

7.1. References

Aapaoja, A., Haapasalo, H. & Soderstrom, P. (2013). Early Stakeholder Involvement in the Project Definition Phase: Case Renovation, *ISRN Industrial Engineering*, vol. 1, pp. 1-14.

Aarts, S., Winkens, B. & Akker, M.V.D. (2012). The insignificance of Statistical Significance, *European Journal of General Practice*, vol. 18, pp. 50-52.

Abdul Hameed, M., Counsell, S. & Swift, S. (2012). A Conceptual Model for the Process of IT Innovation Adoption in Organizations, *Journal of Engineering and Technology Management,* vol. 29, pp. 358-390.

Abdul Kadir, M.R., Lee, W.P., Jaafar, M.S., Sapuan, S.M. & Ali, A.A.A. (2006). Construction Performance Comparison between Conventional and Industrialized Building Systems in Malaysia, *Structural Survey*, vol. 24 (5), pp. 412-424.

Akintan, O.A. & Morledge, R. (2013). Improving the Collaboration between Main Contractors and Subcontractors within Traditional Construction Procurement, *Journal of Construction Engineering*, vol.1, pp. 1-11.

Akintola, A., Goulding, J.S. & Zaedie, G. (2012). *Construction Innovation and Process Improvement*. 1st edn. Chichester: John Wiley & Sons Ltd.

Aladag, H., Demirdogen, G. & Isik, Z. (2016). Building Information Modeling (BIM) Use in Turkish Construction Industry, *Procedia Engineering*, vol. 161, pp. 174-179.

Al-Hajj, A. & Hamani, K. (2011). Material Waste in the UAE Construction Industry: Main Causes and Minimization Practices, *Architectural Engineering and Design Management*, vol. 7, pp. 221-235.

Alharthi, A., Soetanto, R. & Edum-Fotwe, F. (2014). Revisiting Client Roles and Capabilities in Construction Procurement, *Proceedings of the International Conference on Construction in a Changing World-CIB W92 Procurement Systems- Sri Lanka*.

Al-Malkawi, H.N. & Pillai, R. (2013). The Impact of financial Crisis on UAE Real Estate and Construction Sector: Analysis and Implications, *Humanomics*, vol. 29 (2), pp. 115-135.

Amaratunga, D., Baldry, D., Sarshar, M. & Newton, R. (2002). Quantitative and Qualitative Research in the Built Environment: Application of "Mixed" Research Approach, *Work Study*, vol. 51 (1), pp. 17-31.

Arif, M. & Egbu, C. (2010). Making a Case for Offsite Construction in China, *Engineering, Construction and Architectural Management*, vol. 17 (6), pp. 536-548.

Aritua, B., Male, S. & Bower, D. (2009). Defining the Intelligent Public Sector Construction Procurement Client, *Management, Procurement and Law*, vol. 162 (MP0), pp. 75-82.

Artusi, R., Verderio, P. & Marubini, E. (2002). Bravais-Pearson and Spearman Correlation Coefficients: Meaning, Test of Hypothesis and Confidence Interval, *The International Journal of Biological Markers*, vol. 17 (2), pp. 148-151.

Asad, S., Fuller, P., Pan, W. & Dainty, A.R.J. (2005). Learning to Innovate in Construction: A Case Study, *21st Annual ARCOM Conference,* 7-9-September 2005, SOAS, University of London. Association of Researchers in Construction Management, vol. 2, pp. 1215-1224.

Azman, M.N.A., Ahamad, M.S.S. & Hussin, W.M.A.W. (2012). Comparative Study on Prefabrication Construction Process, *International Surveying Research Journal*, vol. 2 (1), pp. 45-58.

Babatunde, S.O., Opawole, A. & Ujaddughe, I.C. (2010). An Appraisal of Project Procurement Methods in the Nigerian Construction Industry, *Civil Engineering Dimension*, vol. 12(1), pp. 1-7.

Bari, N.A.A, Abdullah, N.A., Yusuff, R., Ismail, N. & Jaapar, A. (2012). Environmental Awareness and Benefits of Industrialized Building Systems (IBS), *Procedia-Social and Behavioral Sciences*, vol. 50, pp. 392-404.

Bartlett, J.E., Kotrlik, J.W. & Higgins, C.C. (2001). Organizational Research: Determining Appropriate Sample Size in Survey Research, *Information Technology, Learning and Performance Journal*, vol. 19 (1), pp. 43-50.

Baruch, Y. & Holtom, B.C. (2008). Survey Response Rate Levels and Trends in Organizational Research, *Human Relations*, vol. 61 (8), pp. 1139-1160.

Bernard, H.R. (2006). *Research Methods in Anthropology: Qualitative and Quantitative Approaches.* 4th edn. Oxford: Altamira Press.

Blaikie, N. (2004). Analyzing Quantitative Data. 1st edn. London: Sage Publications Ltd.

Blayse, A.M. & Manley, K. (2004). Key Influences on Construction Innovation, *Construction Innovation*, vol. 4, pp. 143-154.

Bonett, D.G. & Wright, T.A. (2014). Cronbach`s Alpha Reliability: Interval Estimation, Hypothesis Testing, and Sample Size Planning, *Journal of Organizational Behavior*, vol.36, pp. 3-15.

Boone Jr, H.N. & Bonne, D.A. (2012). Analyzing Likert Data, *Journal of Extension*, vol. 50 (2), pp. 1-5.

Bossink, B.A.G. (2004). Managing Drivers of Innovation in Construction Networks, *Journal of Construction Engineering and Management*, vol. 130 (3), pp. 337-345.

Brandon, P. & Lu, S.L. (2008). *Clients Driving Innovation*. 1st edn. Chichester: John Wiley & Sons.

Bryde, D., Broquetas, M. & Volm, J.M. (2013). The Project Benefits of Building Information Modeling (BIM), *International Journal of Project Management*, vol. 31, pp. 971-980.

Bryman, A. & Bell, E. (2011). *Business Research Methods*. 3rd edn. Oxford: Oxford University Press.

Bueno, J. C. (2015). The Projects & Construction Review. 5th edn. *Law Business Research Ltd*.

Cassell, C., Symon, G., Buehring. A. & Johnson, P. (2006). The Role and Status of Qualitative Methods in Management Research: An Empirical Account, *Management Decision*, vol. 44 (2), pp. 290-303.

Chan, Y.H. (2003). Biostatistics 104: Correlational Analysis, *Singapore Med J*, vol. 44 (12), pp. 614-619.

Chiang, Y.H., Chan, E.H.W. & Lok, L.K.L. (2006). Prefabrication and barriers to Entry- A Case Study of Public Housing and Institutional Buildings in Hong Kong, *Habitat International*, vol. 30, pp. 482-499.

Chinyio, E. & Olomolaiye, P. (2010). *Construction Stakeholder Management*. 1st edn. Chichester: Wiley-Blackwell.

Cochran, W. G. (1977). *Sampling Techniques*. 3rd edn. USA: John Wiley & Sons.

Construction Business News. (2016). *Construction & Innovation in UAE: An Outlook.* [Accessed 10 October 2016]. Available at: http://www.cbnme.com/expert-insight/construction-innovation-in-uae-an-outlook/

Couper, M.P., Traugott, M.W. & Lamias, M.J. (2001). Web Survey Design and Administration, *Public Opinion Quarterly*, vol. 65, pp. 230-253.

Cova, B. & Salle, R. (2008). Marketing Solutions in Accordance with the S-D Logic: Co-Creating Value with Customer Network Actors, *Industrial Marketing Management*, vol. 37, pp. 270-277.

Cox, A. & Piroozfar, P. (2011). Prefabrication as a Source for Co-Creation: An Investigation into the Potentials for Large-Scale Prefabrication in the UK, *6th Nordic Conference on Construction Economics & Organization: Shaping the Construction-Copenhagen, Denmark*, pp. 219-232.

Creswell, J.W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. 4th edn. London: Sage Publications Ltd.

Croasmun, J.T. & Ostorm, L. (2011). Using Likert-Type Scales in the Social Sciences, *Journal of Adult Education*, vol. 40 (1), pp. 19-22.

Cronbach, L.J. (1951). Coefficient Alpha and the Internal Structure of Tests, Psychometrika, vol. 16 (3), pp. 297-334.

Dada, M.O. (2012). Predictors of Procurement Selection: An Investigation of Traditional and Integrated Methods in Nigeria, *Journal of Construction in Developing Countries*, vol. 17 (1), pp. 69-83.

Dale, J. (2007). Innovation in Construction: Ideas are the Currency of the Future, CIOB Survey, *The Chartered Institute of Building (CIOB).*

Damanpour, F. & Wischnevsky, J.D. (2006). Research on Innovation in Organizations: Distinguishing Innovation-Generating from Innovation-Adopting Organizations, *Journal of Engineering and Technology Management*, vol. 23, pp. 269-291.

Damanpour, F. & Schneider, M. (2008). Characteristics of Innovation and Innovation Adoption in Public Organizations: Assessing the Role of Managers, *Journal of Public Administration Research and Theory*, vol. 19, pp. 495-522.

Davies, N. & Jokiniemi, E. (2011). *Architect`s Illustrated Pocket Dictionary*. 1st edn. Oxford: Architectural Press.

Delre, S.A., Jager, W., Bijmolt, T.H. & Janssen, M.A. (2010). Will It Spread or Not? The Effects of Social Influences and Network Topology on Innovation Diffusion, *Journal of Product Innovation Management*, vol. 27, pp. 267-282.

Desmarchelier, B. & Fang, E. S. (2016). National Culture and Innovation Diffusion, Exploratory Insights from Agent-Based Modeling, *Technological Forecasting & Social Change*, vol. 105, pp. 121-128.

Draugalis, J.R. & Plaza, C.M. (2009). Best Practices for Survey Research Reports Revisited: Implications of Target Population, Probability Sampling and Response Rate, *American Journal of Pharmaceutical Education*, vol. 73 (8), pp. 1-3.

Drost, E.A. (2011). Validity and Reliability in Social Science Research, *Education Research and Perspective*s, vol. 38 (1), pp. 105-123.

Dulaimi, M.F., Ling, F.Y.Y. & Bajracharya, A. (2003). Organizational Motivation and Inter-Organizational Interaction in Construction Innovation in Singapore, *Construction Management and Economics*, vol. 21, pp. 307-318.

Dulaimi, M.F., Nepal, M.P & Park, M. (2005). A Hierarchical Structure Model of Assessing Innovation and Project Performance, *Construction Management and Economics*, vol. 23, pp. 565-577.

Eadie, R., Browne, M., Odeyinka, H., Mckeown, C. & Mcniff, S. (2013). BIM Implementation throughout the UK Construction Project Lifecycle: An Analysis, *Automation in Construction*, vol. 36, pp. 145-151.

Eadie, R., Odeyinka, H., Browne, M., Mckeown, C. & Yohanis, M. (2013). An Analysis of the Drivers for Adopting Building Information Modeling, *Journal of Information Technology in Construction*, vol. 18, pp. 338-352.

Elchalakani, M., Aly, T. & Abu-Aisheh, E. (2014). Sustainable Concrete with High Volume GGBFS to Build Masdar City in the UAE, *Case Studies in Construction Materials*, vol. 1, pp. 10-24.

Eldabi, T., Irani, Z., Paul, R.J. & Love, P.E.D. (2002). Quantitative and Qualitative Decision-Making Methods in Simulation Modeling, *Management Decision*, vol. 40 (1), pp. 64-73.

El-Sayegh, S.M. (2008). Risk assessment and Allocation in the UAE Construction Industry, *International Journal of Project Management*, vol. 26, pp. 431-438.

Engineering and Construction Management, *Kandy, Sri Lanka, 11th-13th December 2015*, pp. 22-32.

Field, A. (2006). Reliability Analysis, *Research Methods II*, pp.1-7.

Field, A. (2009). Discovering Statistics Using SPSS. 3rd edn. London: Sage Publications Ltd.

Frattini, F., Bianchi, M., Massis, A.D. & Sikimic, U. (2014). The Role of Early Adopters in the Diffusion of New Products: Differences between Platform and Non-platform Innovations, *Journal of Product Innovation Management*, vol. 31 (3), pp. 466-488.

Fuentes, M. & Smyth, H. (2016). Value Co-Creation in a Project Setting: A Service-Dominant Logic Perspective, *Proceedings of the 32nd Annual ARCOM Conference (Association of Researchers in Construction Management),* 5-7 September 2016, Manchester, UK, vol. 2, pp. 1059-1068.

Galvagno, M. & Dalli, D. (2014). Theory of Value Co-Creation: A systematic Literature Review, *Managing Service Quality*, vol. 24 (6), pp. 643-683.

Gambatese, J.A. & Hallowell, M. (2011). Enabling and Measuring Innovation in the Construction Industry, *Construction Management and Economics*, vol. 29, pp. 553-567.

Gorrell, G., Ford, N., Madden, A., Holdridge, P. & Eaglestone, B. (2011). Countering Method Bias in Questionnaire-Based User Studies, *Journal of Documentation*, vol. 67 (3), pp. 507-524.

Green, S.B., Lissitz, R.W., & Mulaik, S.A. (1977). Limitations of coefficient alpha as an index of test unidimensionality 1, *Educational and Psychological Measurement*, vol. 37 (4), pp. 827-838.

Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P. & Kyriakidou, O. (2004). Diffusion of Innovation in Service Organizations: Systematic Review and Recommendations, *The Milbank Quarterly*, vol. 82 (4), pp. 581-629.

Gronroos, C. (2011). Value Co-Creation in Service Logic: A Critical Analysis, *Marketing Theory*, vol. 11 (3), pp. 279-301.

Gronroos, C. & Vioma, P. (2012). Critical Service Logic: Making Sense of Value Creation and Co-Creation, Journal of the *Academy of Marketing Science*, vol. 41 (2), pp. 133-150.

Gulf News. (2016). *UAE Mega Projects Among World`s Most Innovative, Least Wasteful*. [Accessed 2 September 2016]. Available at: http://gulfnews.com/business/sectors/construction/uae-mega-projects-among-world-s-most-innovative-least-wasteful-1.1932870

Haider, M. & Kreps, G.L. (2004). Forty Years of Diffusion of Innovations: Utility and Value in Public Health, *Journal of Health Communication*, vol. 9, pp. 3-11.

Hale, D.R., Shrestha, P.P., Gibson, G.E. & Migliaccio, G.C. (2009). Empirical Comparison of Design/Build and Design/Bid/Build Project Delivery Methods, *Journal of Construction Engineering and Management*, vol. 135 (7), pp. 579-587.

Harrison, R.L. & Reilly, T.M. (2011). Mixed Methods Designs in Marketing Research, *Qualitative Market Research: An International Journal*, vol. 14 (1), pp. 7-26.

Hartley, J. (2013). Some Thoughts on Likert-Type Scales, *International Journal of Clinical and Health Psychology*, vol. 13, pp. 83-86.

Hartmann, A. (2006). The Context of Innovation Management in Construction Firms, *Construction Management and Economics*, vol. 24, pp. 567-578.

Hartmann, A. (2006). The Role of Organizational Culture in Motivating Innovative Behavior in Construction Firms, *Construction Innovation*, vol. 6, pp. 159-172.

Hartmann, A., Dewulf, G. & Reymen, I. (2006). Understanding the Innovation Adoption Process of Construction Clients, *Clients Driving Innovation: Moving Ideas into Practice (12-14 March 2006), Cooperative Research Centre (CRC) for Construction Innovation.*

Hartmann, A., Reymen, I.M.M.J. & Oosterom, G.V. (2008). Factors Constituting the Innovation Adoption Environment of Public Clients, *Building Research & Information*, vol. 36 (5), pp. 436-449.

Hauke, J. & Kossowski, T. (2011). Comparison of Values of Pearson`s and Spearman`s Correlation Coefficients on the Same Sets Of Data, *Quaestiones Geographicae*, vol. 30 (2), pp. 87-93.

Hemstrom, K., Mahapatra, K. & Gustavsson, L. (2011). Adoption of Innovations in Building Construction: Hindrances and Actor Influence as Perceived by Swedish Architects, *Summer Study. Energy Efficiency First: The Foundation of Low-Carbon Society*, pp. 1133-1140.

Holt, G.D. & Goulding, J.S. (2014). Conceptualization of Ambiguous-Mixed-Methods within Building and Construction Research, *Journal of Engineering, Design and Technology*, vol. 12 (2), pp. 244-262.

Hughes, W. & Murdoch, J. (2001). *Roles in Construction Projects: Analysis and Terminology*. 1st edn. UK: University of Reading.

Ibbs, C.W., Kwak, Y.H., Ng, T. & Odabasi, A.M. (2003). Project Delivery Systems and Project Change: Quantitative Analysis, *Journal of Construction Engineering and Management*, vol. 129 (4), pp. 382-387.

IBM. (2012). *IBM SPSS Statistics 21 Core System User's Guide*. USA: IBM Corporation.

Ivory, C. (2004). Client, User and Architect Interactions in Construction: Implications for Analyzing Innovative Outcomes from User-Producer Interactions in Projects, *Technology Analysis & Strategic Management*, vol. 16 (4), pp. 495-508.

Ivory, C. (2005). The Cult of Customer Responsiveness`: Is Design Innovation the Price of a Client-Focused Construction Industry?, *Construction Management and Economics*, vol. 0, pp. 1-10.

Jaillon, L & Poon, C.S. (2008). Sustainable Construction Aspects of Using Prefabrication in Dense Urban Environment: A Hong Kong Case Study, *Construction Management and Economics*, vol. 26, pp. 953-966.

Jaillon, L. & Poon, C.S. (2009). The Evolution of Prefabricated Residential Building systems in Hong Kong: A Review of the Public and the Private Sector, *Automation in Construction*, vol. 18, pp. 239-248.

Jin, X.H., Zhang, G., Zuo, J. & Lindsay, S. (2013). Sustainable High-Rise Design Trends-Dubai`s Strategy, *Civil Engineering and Architecture*, vol. 1 (2), pp. 33-41.

Jones, K., Stegemann, P.J., Sykes, J. & Winslow, P. (2016). Adoption of Unconventional Approaches in Construction: The Case of Cross-Laminated Timber, *Construction and Building Materials*, vol. 125, pp. 690-702.

Kamar, K.A.M., Abd Hamid, Z., Azman, M.N.A. & Ahamad, M.S.S. (2011). Industrialized Building System (IBS): Revisiting Issues of Definition and Classification, *International Journal of emerging Sciences*, vol. 1 (22), pp. 120-132.

Khalifa, M. & Farrell, P. (2015). The Concept of Partnering in Public-Private Partnership Projects in the United Arab Emirates, *Management, Procurement and Law*, vol. 1, pp. 1-8.

Kilinc, N, Ozturk, G.B. & Yitmen, I. (2015). The Changing Role of the Client in Driving Innovation for Design-Build Projects: Stakeholders` Perspective, *Procedia Economics and Finance*, vol. 21, pp. 279-287.

Kimberlin, C.L. & Winterstein, A.G. (2008). Validity and Reliability of Measurement Instruments Used in Research, *American Journal of Health-System Pharmacy*, vol. 65, pp. 2276-2284.

Kissi, J., Payne, R., Luke, S., Dainty, A. & Liu, A. (2010). Identifying the Factors that Influences Innovation Championing Behavior in Construction Support Services Organizations: A Review of the Role of Middle Management, *18th CIB World Building Congress, 10-14 May 2010, Salford, UK*, pp. 434-446.

Kometa, S.T., Olomolaiye, P.O. & Harris, F.C. (1995). An Evaluation of Clients` Needs and Responsibilities in the Construction Process, *Engineering, Construction and Architectural Management*, vol. 2 (1), pp. 57-76.

Kothari, C. R. (2004). *Research Methodology: Methods & Techniques*. 2nd edn. New Delhi: New Age International Publisher.

Krejcie, R.V. & Morgan, D.W. (1970). Determining Sample Size for Research Activities, *Educational and Psychological Measurement*, vol. 30, pp. 607-610.

Krosnick, J.A. & Presser, S. (2010). Question and Questionnaire Design, *Handbook of Survey Research*, Edition. 2, pp. 263-314.

Kristensson, P., Matthing, J. & Johansson, N. (2008). Key Strategies for the Successful Involvement of Customers in the Co-Creation of New Technology-Based Services, *International Journal of Service Industry Management*, vol. 19 (4), pp. 474-491.

Kulatunga, K., Kulatunga, U., Amaratunga, D. & Haigh, R. (2011). Client`s Championing Characteristics That Promote Construction Innovation, *Construction Innovation*, vol. 11 (4), pp. 380-398.

Linderoth, H.C.J. (2010). Understanding Adoption and Use of BIM as the Creation of Actor Networks, *Automation in Construction*, vol. 19, pp. 66-72.

Litu, A.M.M., Fellows, R. & Chan, I.Y.S. (2014). Fostering Value Co-Creation in Construction: A Case Study of an Airport Project in India, *International Journal of Architecture, Engineering and Construction*, vol. 3 (2), pp. 120-130.

Lock, I. & Seele, P. (2015). Quantitative Content Analysis as a Method for Business Ethics Research, *Business Ethics: A European Review*, vol. 24 (S1), pp. S24-S40.

Loosemore, M. & Richard, J. (2015). Valuing Innovation in Construction and Infrastructure, *Engineering, Construction and Architectural Management*, vol. 22 (1), pp. 38-53.

Love, P.E.D., Niedzweicki, M., Bullen, P.A. & Edwards, D.J. (2012). *Journal of Construction Engineering and Management*, vol. 138, pp. 652-660.

Lyytinen, K. & Damsgaard, J. (2001). What's wrong with the diffusion of innovation theory?, *Diffusing software product and process innovations*, Springer US, pp. 173-190.

Madakam, S. & Ramaswamy, R. (2016). Sustainable Smart City: Masdar (UAE) (A City: Ecologically Balanced), *Indian Journal of Science and Technology*, vol. 9 (6), pp. 1-9.

Madichie, N.O. (2011). IRENA - Masdar City (UAE) - Exemplars of Innovation into Emerging Markets, Foresight, vol. 13 (6), pp. 34-47.

Male, S., Bower, D.A. & Artiua, B. (2007). Design Management: Changing Roles of the Professions, *Management, Procurement and Law*, vol. 160 (MP2), pp. 75-82.

Malhotra, N.K. (2004). Marketing Research: An Applied Orientation, 4th edn, *Pearson Education*.

Malina, M.A., Norreklit, H.S.O. & Selto, F.H. (2011). Lesson Learned: Advantages and Disadvantages of Mixed Method Research, *Qualitative Research in Accounting & Management*, vol. 8 (1), pp. 59-71.

Malterud, K. (2001). Qualitative Research: Standards, Challenges and Guidelines, *The Lancet*, vol. 358, pp. 483-488.

Manely, K. & McFallan, S. (2003). Innovation Adoption Behavior in the Construction Sector: The Case of the Queenland Road Industry, *2nd International Conference on Innovation in Architecture, Engineering and Construction, 25-27 June 2003, Loughborough University United Kingdom.*

Manely, K., McFallan, S. & Kajewski, S. (2009). The Relationship between Construction Firm Strategies and Innovation Outcomes, *Journal of Construction Engineering and Management*, vol. 135 (8), pp. 764-771.

Masood, R., Kharal, M.K.N. & Nasir, A.R. (2014). Is BIM Adoption Advantageous for Construction Industry of Pakistan?, *Procedia Engineering*, vol. 77, pp. 229-238.

Mathonsi, M.D. & Thwala, W.D. (2012). Factors Influencing the Selection of Procurement Systems in the South African Construction Industry, *African Journal of Business Management*, vol. 6 (10), pp. 3583-3594.

McAuley, B. Hore, A. & West, R. (2016). BICP BIM Global Study, *Irish Building Magazine*, vol. 3, pp. 61-65.

Mehran, D. (2016). Exploring the Adoption of BIM in the UAE Construction Industry for AEC Firms, *Procedia Engineering*, vol. 145, pp. 1110-1118.

Mehta, A. (2014). Working Capital Management and Profitability Relationship-Evidences from Emerging Markets of UAE, *International Journal of Management Excellence*, vol. 2 (3), pp.195-202.

Mitropoulos, P. & Tatum, C.B. (2000). Forces Driving Adoption of New Information Technologies, *Journal of Construction Engineering and Management*, pp. 340-348.

Mollaoglu, S., Chergia, C., Ergen, E. & Syal, M. (2015). Diffusion of Green Building Guidelines as Innovation in Developing Countries, *Construction Innovation*, vol. 16 (1), pp. 11-29.

Morledge, R. & Smith, A. (2013). *Building Procurement*. 2nd edn. Chichester: Wiley-Blackwell.

Muhammad, M.R.R. (2015). The Significance of Building Information Modeling to the Quantity Surveying Practices in the UAE Construction Industry, *6th International Conference on Structural*.

Muijs, D. (2004). *Doing Quantitative Research in Education with SPSS*. 1st edn. London: Sage Publications Ltd.

Mukaka, M.M. (2012). Statistics Corner: A Guide to Appropriate Use of Correlation Coefficient in Medical Research, *Malawi Medical Journal*, vol. 24 (3), pp. 69-71.

Murdoch, J. & Hughes, W. (2008). *Construction Contracts: Law and Management*. 4th edn. Abingdon: Taylor & Francis.

Murray, J. (2013). Likert Data: What to Use, Parametric or Non-Parametric?, *International Journal of Business and Social Science*, vol. 4 (11), pp. 258-264.

Mustonen-Ollila, E. & Lyytinen, K. (2003). Why Organizations Adopt Information System Process Innovations: A Longitudinal Study Using Diffusion of Innovation Theory, *Info Systems Journal*, vol. 13 (3), pp. 275-297.

Naoum, S. & Egbu, C. (2015). Critical Review of Procurement Method Research in Construction Journals, *Procedia Economics and Finance*, vol. 21, pp. 6-13.

Norman, G. (2010). Likert Scales, Levels of Measurement and the "Laws" of Statistics. Advances in Health Sciences Education, vol.15 (5), pp. 625-632.

Nulty, D.D. (2008). The adequacy of Response Rates to Online and Paper Surveys: What Can Be Done?, *Assessment & Evaluation in Higher Education*, vol. 33 (3), pp. 301-314.

Nunnally, J.C. & Bernstein, I.H. (1994). Psychometric Theory, 3rd edn, *Mcgraw-Hill*.

Ofori, G. (2015). Nature of the Construction Industry, Its Needs and its Development: A Review of Four Decades of Research, *Journal of Construction in Developing Countries*, vol. 20 (2), pp. 115-135.

Ogwueleka, A.C. (2015). Upgrading from the Use of 2D CAD Systems to BIM Technologies in the Construction Industry: Consequences and Merits, *International Journal of Engineering Trends and Technology*, vol. 28 (8), pp. 403-411.

Ojo, S.O., Adeyemi, A.Y. & Fagbenle, O.I. (2006). The Performance of Traditional Contract Procurement on Housing Projects in Nigeria, *Civil Engineering Dimension*, vol. 8 (2), pp. 81-86.

Olanrewaju, A.L. & Abdul-Aziz, A.R. (2015). Building Maintenance Processes and Practices. *Springer*.

Onyeizu, E.N. & Abu Bakar, A.H. (2011). The Utilization of Industrialized Building System in Design Innovation in Construction Industry, *World Applied Sciences Journal*, vol. 15 (2), pp. 205-213.

Osei, V. (2013). The Construction Industry and its Linkages to the Ghanaian Economy-Policies to Improve the Sector`s Performance, *International Journal of Development and Economic Sustainability*, vol. 1 (1), pp. 56-72.

Oxford Dictionaries. (2016). English Oxford Living Dictionaries. [Accessed 9 September 2016]. Available at: https://en.oxforddictionaries.com/definition/role

Panuwatwanich, K., Stewart, R.A. & Mohamed, S. (2009). Critical Pathways to Enhanced Innovation Diffusion and business Performance in Australian Design Firms, *Automation in Construction*, vol. 18, pp. 790-797.

Passmore, C., Dobbie, A.E., Parchman, M. & Tysinger, J. (2002). Guidelines for Constructing a Survey, *Family Medicine*, vol. 34 (4), pp.281-286.

Pasta, D.J. (2009). Learning when to be Discrete: continuous Vs. Categorical Predictors, *SAS Global Forum 2009, ICONIC Clinical Research, San Francisco, CA.*

Payne, A.F., Storbacka, K. & Frow, P. (2008). Managing the Co-Creation of Value, Journal of the *Academy of Marketing Science*, vol. 36, pp. 83-96.

Pecur, I.B., Milovanovic, B., Carevic, I. & Alagusic, M. (2014). Precast Sandwich Panel-Innovative Way of Construction, *10th CCC Congress LIBEREC*. Session T2: Advanced Structural Systems and Technologies in Buildings, Industrial and Water Construction.

Pell, G. (2005). Use and Misuse of Likert Scales, *Medical Education*, vol. 39 (9), pp. 970-970.

Pfeffermann, D. (1993). The Role of Sampling Weights when Modeling Survey Data, *International Statistical Review*, vol. 61 (2), pp. 317-337.

Poon, C.S. (2007). Reducing Construction Waste, *Waste Management*, vol. 27, pp. 1715-1716.

Porwal, A. & Hewage, K.N. (2013). Building Information Modeling (BIM) Partnering Framework for Public Construction Projects, *Automation in Construction*, vol. 31, pp. 204-214.

Project Management Institute. (2013). 4th edn. A Guide to the Project Management Body of Knowledge (PMBOK Guide). *Project Management Institute*.

Qi, G.Y., Shen, L.Y., Zeng, S.X. & Jorge, O.J. (2010). The Drivers for Contractors` Green Innovation: An Industry Perspective, *Journal of Cleaner Production*, vol. 18, pp. 1358-1365.

Randeree, K. & Chaudhry, A. (2012). Leadership-Style, Satisfaction and Commitment: An Exploration in the United Arab Emirates` Construction Sector, *Engineering, Construction and Architectural Management*, vol. 19 (1), pp. 61-85.

Ranstam, J. (2008). Statistical Significance, *Acta Radiologica*, vol. 49 (2), pp. 220-221.

Ren, Z., Atout, M. & Jones, J. (2008) Root Causes of Construction Project Delay in Dubai, 24th *Annual ARCOM Conference, 1-3 September 2008, Cardiff, UK, Association of Researchers in Construction Management*, vol. 24, pp. 749-757.

Rice, W.R. (1989). Analyzing Tables of Statistical Tests, *Evolution*, vol. 43 (1), pp. 223-225.

Rogers, E.M. (1995). *Diffusion of Innovations*. 4th edn. New York: The Free Press.

Rowley, J. (2014). Designing and Using Research Questionnaires, *Management Research Review*, vol. 37 (3), pp. 308-330.

Rutten, M.E.J, Doree, A.G. & Halman, J.I.M. (2009). Innovation and Inter-Organizational Cooperation: A Synthesis of Literature, *Construction Innovation*, vol. 9 (3), pp. 285-297.

Ryd, N. (2014). Construction Clients Challenges – Emphasizing Early Stages, *Procedia-Social and Behavioral Sciences*, vol. 119, pp. 134-141.

Saunders, M., Lewis, P. & Thornhill, A. (2016). *Research Methods for Business Students*. 7th edn. Harlow: Pearson Education Limited.

Schmitt, N. (1996). Uses and Abuses of Coefficient Alpha, *Psychological Assessment*, vol. 8 (4), pp. 350-353.

Sebastian, R. (2011). Changing Roles of the Clients, Architects and Contractors through BIM, *Engineering, Construction and Architectural Management*, vol. 18 (2), pp. 176-187.

Sedgwick, P. (2012). Pearson`s Correlation Coefficient, *BMJ*, vol. 345 (7), pp.1-2.

Segerstedt, A. & Olofsson, T. (2010). Supply Chains in the Construction Industry, *Supply Chain Management*, vol. 15 (5), pp. 347-353.

Siva, J.P.S. & London, K. (2011). Investigating the Role of Client Learning for Successful Architect-Client Relationships on Private Single Dwelling Projects, *Architectural, Engineering and Design Management*, vol. 7, pp. 177-189.

Smyth, H., Razmdoost, K. & Kusuma, I. (2016). Innovation and the Co-Creation of Value in Construction, *Proceedings of the Construction, Building and Real Estate Research Conference of the Royal Institution of Chartered Surveyors (RICS)*, 20-22 September 2016, Toronto, Canada, pp.1-9.

Spector, P.E. (1992). Summated Rating Scale Construction: An Introduction, issue. 82, *Sage*.

Spohrer, J. & Maglio, P.P. (2008). The Emergence of Service Science: Towards Systematic Service Innovations to Accelerate Co-Creation of Value, *Production and Operation Management*, vol. 17 (3), pp. 238-246.

Subedi, B.P. (2016). Using Likert Type Data in Social Science Research: Confusion, Issues and Challenges, *International Journal of Contemporary Applied Sciences*, vol. 3 (2), pp. 36-49.

Sukamolson, S. (2010). Fundamental of Quantitative Research, *Language Institute, Chulalongkorn University*.

Suliman, A.M.T. (2001). Are We Ready to Innovate? Work Climate-Readiness to Innovate Relationship: The Case of Jordan, *Creativity and Innovation Management*, vol. 10 (1), pp. 49-59.

Tam, V.W.Y., Tam, C.M., Zeng, S.X. & Ng, W.C.Y. (2007). Towards Adoption of Prefabrication in Construction, *Building and Environment*, vol. 42, pp. 3642-3654.

Tangkar, M. & Arditi, D. (2000). Innovation in the Construction Industry, *Dimensi Teknik Sipil*, vol. 2 (2), pp. 96-103.

Tavakol, M. & Sandars, J. (2014). Quantitative and Qualitative Methods in Medical Education Research: AMEE Guide No 90: Part II, *Medical Teacher*, vol. 36, pp. 838-848.

Thanasegaran, G. (2009). Reliability and Validity Issues in Research, *Integration & Dissemination*, vol. 4 (1), pp. 35-40.

The Chartered Institute of Building (CIOB). (2010). Procurement in the Construction Industry, *Englemere. Berkshire. United Kingdom.*

Thorpe, D. Ryan, N. & Charles, M.B. (2008). Environmental Sustainability-A Driver for Innovation in Construction SMES?, *Proceedings from the 3rd International Conference Cooperative Research Centre (CRC) for Construction Innovation.* 12-4 March, pp. 1-12.

United Arab Emirates Ministry Of Cabinet Affairs. The Prime Minister`s Office. (2015). *UAE National Innovation Strategy*. [Accessed 20 November 2016]. Available at: http://www.uaeinnovates.gov.ae/docs/default-source/pdfs/national-innovation-strategy-en.pdf?sfvrsn=2

United Arab Emirates Ministry Of Economy. (2015). *The Annual Economic Report*. (2015). [Accessed 25 November 2016]. Available at: http://www.economy.gov.ae/EconomicalReportsEn/MOE%20Annual%20Report%20English%20-%202015.pdf

United Arab Emirates Ministry Of Energy. (2012). *3rd National Communication under the United Nations Framework Convention on Climate Change*. [Accessed 5 November 2016]. Available at: https://www.moenr.gov.ae/assets/b8502605/uae-3rd-national-communication-report.aspx

United Arab Emirates National Media Council. (2013). United Arab Emirates Year Book 2013. [Accessed 12 November 2016]. Available at: https://www.mofa.gov.ae/EN/Documents/3556.pdf

Vargo, S.L. & Lusch, R.F. (2004). Evolving to a New Dominant Logic for Marketing, *Journal of Marketing*, vol. 68, pp. 1-17.

Vargo, S.L. & Lusch, R.F. (2008). Service-Dominant Logic: Continuing the Evolution, Journal of the *Academy of Marketing Science*, vol. 36, pp. 1-10.

Vargo, S.L., Maglio, P.P. & Akaka, M.A. (2008). On Value and Value Co-Creation: A Service Systems and Service Logic Perspective, *European Management Journal*, vol. 26, pp. 145-152.

Vaske, J.J. (2008). Survey research and analysis: Applications in parks, recreation and human dimensions, *Venture Publishing*.

Vaske, J.J., Beaman, J. & Sponarski, C.C. (2016). Rethinking Internal Consistency in Cronbach`s Alpha, *Leisure Sciences*, vol. 0, pp. 1-11.

Vennstrom, A. & Erriksson, P.E. (2010). Client Perceived Barriers to Change of the Construction Process, *Construction Innovation*, vol. 10 (2), pp. 126-137.

Villaitramani, K.R. & Hirani, D.P. (2014). Prefabricated Construction for Mass Housing in Mumbai, *International Journal of Innovative Research in Advanced Engineering*, vol. 1 (9), pp. 134-138.

Walker, D. & Hampson, K. (2003). *Procurement Strategies: A Relationship-Based Approach*. 1st edn. Oxford: Blackwell Science Ltd.

Wang, Y.S., Wu, S.C., Lin, H.H., Wang, Y.M. & He, T.R. (2012). Determinants of User Adoption of Web ATM: An Integrated Model of TCT and IDT, *The Service Industries Journal*, vol. 32 (9), pp. 1505-1525.

Wilson, J. (2014). *Essentials of Business Research: A Guide to Doing Your Research Project*. 2nd edn. London: Sage Publications Ltd.

Witell, L., Kristensson, P., Gustafsson, A. & Lofgren, M. (2011). Idea Generation: Customer Co-Creation versus Traditional Market Research Techniques, *Journal of Service Management*, vol. 22 (2), pp. 140-159.

Xue, X., Zhang, R., Yang, R. & Dai, J. (2014). Innovation in Construction: A Critical Review and Future Research, *International Journal of Innovation*, vol. 6 (2), pp. 111-126.

Yilmaz, M. & Bakis, A. (2015). Sustainability in Construction Sector, *Procedia-Social and Behavioral Sciences*, vol. 195, pp. 2253-2262.

Yitmen, I. (2007). The Challenge of Change for Innovation in Construction: A North Cyprus Perspective, *Building and Environment*, vol. 42, pp. 1319-1328.

Yitmen, I. (2011). Intellectual Capital: A Competitive Asset for Driving Innovation in Engineering Design Firms, *Engineering Management Journal*, vol. 23 (2), pp. 3-19.

Yu, A.T.W. & Shen, G.Q.P. (2013). Problems and Solutions of Requirements Management for Construction Projects under the Traditional Procurement Systems, *Facilities*, vol. 31 (5/6), pp. 223-237.

Yurdugul, H. (2008). Minimum Sample Size for Cronbach`s Coefficient Alpha: A Monte-Carlo Study, *H. U. Journal of Education*, vol. 35, pp. 397-405.

Zahrizan, Z., Ali, N.M., Haron, A.T., Marshall-Ponting, A. & Abd Hamid, Z. (2013). Exploring the Adoption of Building Information Modeling (BIM) in the Malaysian Construction Industry: A Qualitative Approach, *International Journal of Research in Engineering and Technology*, vol. 2 (8), pp. 384-395.

Zaneldin, E.K. (2006). Construction Claims in United Arab Emirates: Types, Causes and Frequency, International Journal of Project Management, vol. 24, pp. 453-459.

Zhang, J., Zhao, Y. & Wang, Y. (2016). A Study on Statistical Methods Used in Six Journals of Library and Information Science, *Online Information Review*, vol. 40 (3), pp. 416-434.

Ziegler, M. & Hagemann, D. (2015). Testing the Unidimensionality of Items, *European Journal of Psychological Assessment*, vol. 31 (4), pp. 231-237.

7.2. Appendices

7.2.1. Appendix. A- Survey Questionnaire

The New Role of the Client in Adopting Innovation in Construction Projects

Page 1

Dear Sir/ Madam,

The researcher is conducting a dissertation in partial fulfillment of the requirements for the degree of MSc in Construction Management titled "The New Role of the Client in Adopting Innovation in Construction Projects".

The dissertation is aiming to investigate the factors which are influencing the change of the construction client role under the traditional procurement method "Design-Bid-Build" towards driving the adoption of innovation in the construction industry such as Prefabrication & BIM "Building Information Modeling".

This questionnaire enables you to share your opinions and assessments for many topics which are related to the change in the construction client`s role towards the new role of "Innovation Co-Creator". Please feel free to participate in your point of view and please note that there is no right or wrong answer.

The questionnaire will be used to collect the primary data needed for the dissertation purposes; therefore we seek your assistance to be as open, fair, honest as possible as you can in your responses.

The researcher assures the confidentiality of the respondents and their organizations and the results of the study will be strictly used by the researchers for the research purpose only.

The questionnaire comprises of 3 sections:
1. General information.
2. Construction Client Role.
3. The Factors Influencing the Change in the Construction Client Role.

Thank you

The Researcher

Section.1: General Information

1. Education *

◯ Bachelor ◯ Masters ◯ Doctorate

2. Total Years of Experience *

◯ 0-5 ◯ 5-10 ◯ 10-15 ◯ 15-20 ◯ Above 20

3. Managerial Level *

◯ First level ◯ Middle level ◯ Senior level

4. Organization type *

◯ Client/Developer ◯ Consultant ◯ Contractor/Subcontractor ◯ Supplier

5. Organization`s employees number *

◯ 0-250 ◯ 250-500 ◯ 500-1,000 ◯ Above 1,000

Section.2: Construction Client`s Role

1. The traditional procurement method "Design-Bid-Build" is separating the design team from the construction team *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

2. The traditional procurement method "Design-Bid-Build" is not facilitating project team communication to adopt innovation in the construction industry *

◯ Strongly Disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly Agree

3. The construction client role in the traditional procurement method "Design-Bid-Build" is undermining the adoption of innovation in the construction industry *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

4. The construction client role is changing towards driving adoption of innovation in the construction industry *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

5. The construction client is undertaking construction team leadership to stimulate adoption of innovation *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

6. The construction client involvement is positively influencing the adoption of innovation in the construction industry *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

7. Construction client role is changing to that of innovation co-creator *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

8. Construction client is encouraging communication between the project stakeholders to co-create innovation *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

9. Client`s new role of co-creation is enhancing innovation adoption in the construction industry *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

Section.3: Factors Influencing The Change in The Construction Client Role Towards Driving Innovation

1. Market demand & competition is stimulating construction clients to innovate *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

2. Market demand & competition is positively changing the construction client's behavior towards innovation *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

3. There is no relation between market demand and the construction client`a willingness to adopt innovation *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

4. The construction client experience & competence level is promoting its participation in innovation. *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

5. The construction client`s experience & competence increases its capacity in adopting innovation *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

6. There is no relationship between the construction client`s experience & competence and its behavior in innovation *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

7. The construction client`s characteristics are a major factor which enables the client to stimulate innovation *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

8. The construction client`s characteristics are not related to the capacity of the client to innovate *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

9. The construction client`s participation in the innovation process is relying on its characteristics *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

10. Government regulations are pushing the construction client to adopt innovation *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

11. Government regulations are changing the construction client`s role towards adopting innovation *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

12. There is no significant relationship between the government regulations and the construction client`s behavior in innovation *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

13. Environmental compliance is driving the construction clients to adopt innovation in the construction industry *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

14. Environmental awareness is increasing the construction client`s participation in innovation *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

15. The construction client is stimulating innovation to improve the construction industry`s environmental sustainability

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

16. Organizational culture is an essential factor which motivates the construction client to adopt innovation *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

17. There is no relationship between the organizational culture and the construction client`s attitude to adopting innovation *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

18. The supportive organizational culture is promoting the construction clients to adopt innovation *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

19. Construction clients are increasingly adopting innovation to improve their projects` performance *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

20. Innovation adoption is enhancing the construction projects` performance *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

21. There is no relationship between the construction project performance and the construction client behavior in innovation *

◯ Strongly disagree ◯ Disagree ◯ Undecided ◯ Agree ◯ Strongly agree

You have completed the survey. Thank you very much for your participation.

You can now close the window.

7.2.2. Appendix. B- Analysis Tests Results

1. Descriptive Statistics:

Statistics

		Education	Experience	Managerial. Level	Organization. Type	Employee. No
N	Valid	107	107	107	107	107
	Missing	0	0	0	0	0
Mean		1.40	3.51	2.39	2.39	2.74
Median		1.00	3.00	3.00	3.00	3.00
Mode		1	3	3	3	4
Std. Deviation		.511	1.058	.711	.979	1.261

Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bachelor	65	60.7	60.7	60.7
	Master	41	38.3	38.3	99.1
	Doctorate	1	.9	.9	100.0
	Total	107	100.0	100.0	

Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-5	1	.9	.9	.9
	5-10	19	17.8	17.8	18.7
	10-15	35	32.7	32.7	51.4
	15-20	28	26.2	26.2	77.6
	above 20	24	22.4	22.4	100.0
	Total	107	100.0	100.0	

Managerial. Level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	First level	14	13.1	13.1	13.1
	Middle level	37	34.6	34.6	47.7
	Senior level	56	52.3	52.3	100.0
	Total	107	100.0	100.0	

Organization. Type

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Client	27	25.2	25.2	25.2
	Consultant	22	20.6	20.6	45.8
	Contractor/subcontractor	47	43.9	43.9	89.7
	Supplier	11	10.3	10.3	100.0
	Total	107	100.0	100.0	

Employee. No

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-250	29	27.1	27.1	27.1
	250-500	15	14.0	14.0	41.1
	500-1000	18	16.8	16.8	57.9
	above 1000	45	42.1	42.1	100.0
	Total	107	100.0	100.0	

2. Cronbach`s Alpha Reliability Test:

2.1. Variable “Market Demand” Items= Market.1 Market.2 Market.3:

Reliability Statistics

Cronbach's Alpha	N of Items
.536	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Influencing.Factors.1	7.64	2.514	.331	.463
Influencing.Factors.2	7.65	2.360	.379	.385
Influencing.Factors.3	7.75	2.511	.336	.455

2.2. Variable “Client Experience & Competence” Items= Experience.1 Experience.2 Experience.3:

Reliability Statistics

Cronbach's Alpha	N of Items
.721	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Influencing.Factors.4	7.46	2.968	.547	.629
Influencing.Factors.5	7.53	2.742	.630	.531
Influencing.Factors.6	7.76	2.676	.467	.741

2.3. Variable “Client Characteristics” Items= Character.1 Character.2 Character.3:

Reliability Statistics

Cronbach's Alpha	N of Items
.579	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Influencing.Factors.7	7.11	1.855	.504	.303
Influencing.Factors.8	7.53	2.119	.227	.744
Influencing.Factors.9	7.26	2.006	.475	.360

Test Iteration for Items= Character.1 Character.3:

Reliability Statistics

Cronbach's Alpha	N of Items
.744	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Influencing.Factors.7	3.69	.630	.593	.
Influencing.Factors.9	3.84	.701	.593	.

2.4. Variables “Government Regulations” Items= Regulation.1 Regulation.2 Regulation.3:

Reliability Statistics

Cronbach's Alpha	N of Items
.713	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Influencing.Factors.10	7.08	3.285	.635	.489
Influencing.Factors.11	6.94	3.186	.697	.408
Influencing.Factors.12	6.98	4.585	.308	.871

2.5. Variable “Environmental Sustainability” Items= Sustainability.1 Sustainability.2 Sustainability.3:

Reliability Statistics

Cronbach's Alpha	N of Items
.812	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Influencing.Factors.13	7.35	2.455	.657	.749
Influencing.Factors.14	7.33	2.732	.603	.801
Influencing.Factors.15	7.40	2.186	.735	.664

2.6. Variable “Organizational Culture” Items= Org.Culture.1 Org.Culture.2 Org.Culture.3:

Reliability Statistics

Cronbach's Alpha	N of Items
.540	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Influencing.Factors.16	7.37	1.765	.514	.165
Influencing.Factors.17	7.50	2.422	.132	.782
Influencing.Factors.18	7.41	1.924	.468	.257

Test Iteration for Items= Org.Culture.1 Org.Culture.3:

Reliability Statistics

Cronbach's Alpha	N of Items
.782	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Influencing.Factors.16	3.73	.709	.643	.
Influencing.Factors.18	3.77	.766	.643	.

2.7. Variable “Performance Improvement” Items= Performance.1 Performance.2 Performance.3:

Reliability Statistics

Cronbach's Alpha	N of Items
.336	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Influencing.Factors.19	7.52	1.610	.271	.070
Influencing.Factors.20	7.37	1.557	.416	-.223[a]
Influencing.Factors.21	7.42	2.435	-.041	.676

a. The value is negative due to a negative average covariance among items. This violates reliability model assumptions. You may want to check item codings.

Test Iteration for Items= Performance.1 Performance.2:

Reliability Statistics

Cronbach's Alpha	N of Items
.676	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Influencing.Factors.19	3.79	.718	.514	.
Influencing.Factors.20	3.64	.894	.514	.

2.8. Variable "Change in the Client Role towards Adoption of Innovation" Items= Traditional.1 Traditional.2 Traditional.3 Adopt.Innovation.1 Adopt.Innovation.2 Adopt.Innovation.3 New.Role.1 New.Role.2 New.Role.3:

Reliability Statistics

Cronbach's Alpha	N of Items
.664	9

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Client.Role.1	27.66	19.225	.256	.661
Client.Role.2	27.76	20.318	.189	.674
Client.Role.3	27.83	22.085	.040	.700
Client.Role.4	27.41	19.226	.438	.619
Client.Role.5	27.42	18.397	.442	.614
Client.Role.6	27.21	18.227	.470	.607
Client.Role.7	27.52	18.591	.522	.601
Client.Role.8	27.31	18.781	.482	.609
Client.Role.9	27.27	19.860	.343	.637

2.9. All Variables Items "Total"= Traditional.1 Traditional.2 Traditional.3 Adopt.Innovation.1 Adopt.Innovation.2 Adopt.Innovation.3 New.Role.1 New.Role.2 New.Role.3 Market.1 Market.2 Market.3 Experience.1 Experience.2 Experience.3 Character.1 Character.2 Character.3 Regulation.1 Regulation.2 Regulation.3 Sustainability.1 Sustainability.2 Sustainability.3 Org.Culture.1 Org.Culture.2 Org.Culture.3 Performance.1 Performance.2 Performance.3:

Reliability Statistics

Cronbach's Alpha	N of Items
.880	30

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Client.Role.1	105.36	181.363	.252	.881
Client.Role.2	105.45	185.627	.142	.883
Client.Role.3	105.52	192.044	-.061	.887
Client.Role.4	105.10	177.791	.522	.874
Client.Role.5	105.11	177.893	.433	.876
Client.Role.6	104.91	177.519	.453	.875
Client.Role.7	105.21	177.812	.518	.874
Client.Role.8	105.00	178.038	.497	.874
Client.Role.9	104.96	181.036	.377	.877
Influencing.Factors.1	104.74	178.704	.448	.875
Influencing.Factors.2	104.75	177.964	.470	.875
Influencing.Factors.3	104.84	182.795	.289	.879
Influencing.Factors.4	104.70	179.947	.433	.876
Influencing.Factors.5	104.78	174.666	.650	.871
Influencing.Factors.6	105.00	176.302	.481	.874
Influencing.Factors.7	104.78	176.327	.645	.872
Influencing.Factors.8	105.20	184.914	.209	.881
Influencing.Factors.9	104.93	181.843	.415	.876
Influencing.Factors.10	105.20	175.480	.478	.874
Influencing.Factors.11	105.06	175.469	.491	.874
Influencing.Factors.12	105.09	184.652	.184	.882
Influencing.Factors.13	104.93	175.825	.630	.872
Influencing.Factors.14	104.91	177.312	.609	.872
Influencing.Factors.15	104.98	176.320	.578	.873
Influencing.Factors.16	104.85	176.393	.611	.872
Influencing.Factors.17	104.97	186.178	.164	.881
Influencing.Factors.18	104.89	178.836	.525	.874
Influencing.Factors.19	104.98	175.377	.603	.872
Influencing.Factors.20	104.83	175.726	.665	.871
Influencing.Factors.21	104.88	186.862	.147	.882

Test Iteration for Items= Traditional.1 Traditional.2 Traditional.3 Adopt.Innovation.1 Adopt.Innovation.2 Adopt.Innovation.3 New.Role.1 New.Role.2 New.Role.3 Experience.1

Experience.2 Experience.3 Character.1 Character.3 Regulation.1 Regulation.2 Regulation.3 Sustainability.1 Sustainability.2 Sustainability.3 Org.Culture.1 Org.Culture.3 Performance.1 Performance.2:

Reliability Statistics

Cronbach's Alpha	N of Items
.881	24

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Client.Role.1	83.03	138.782	.250	.883
Client.Role.2	83.12	142.013	.160	.885
Client.Role.3	83.20	148.706	-.083	.891
Client.Role.4	82.78	135.893	.513	.874
Client.Role.5	82.79	135.095	.461	.876
Client.Role.6	82.58	134.548	.491	.875
Client.Role.7	82.89	135.101	.549	.874
Client.Role.8	82.67	135.184	.532	.874
Client.Role.9	82.64	138.423	.382	.878
Influencing.Factors.4	82.37	137.595	.432	.877
Influencing.Factors.5	82.45	132.589	.670	.870
Influencing.Factors.6	82.67	136.807	.381	.878
Influencing.Factors.7	82.45	134.910	.621	.872
Influencing.Factors.9	82.60	139.243	.417	.877
Influencing.Factors.10	82.87	132.794	.512	.874
Influencing.Factors.11	82.73	132.690	.529	.874
Influencing.Factors.12	82.77	144.030	.092	.887
Influencing.Factors.13	82.60	133.167	.673	.871
Influencing.Factors.14	82.58	134.869	.634	.872
Influencing.Factors.15	82.65	133.266	.634	.871
Influencing.Factors.16	82.52	134.007	.637	.872
Influencing.Factors.18	82.56	136.381	.539	.874
Influencing.Factors.19	82.65	132.549	.654	.871
Influencing.Factors.20	82.50	133.366	.695	.870

3. Pearson`s Correlation Test:

Correlations

		Experience. Factor	New. Character. Factor	Regulation. Factor	Sustainability. Factor	New. Org. Culture. Factor	New. Performance. Factor	Client. Role
Experience.Factor	Pearson Correlation	1	.413**	.361**	.481**	.537**	.451**	**.358****
	Sig. (2-tailed)		.000	.000	.000	.000	.000	**.000**
	N	107	107	107	107	107	107	**107**
New. Character. Factor	Pearson Correlation	.413**	1	.200*	.527**	.449**	.432**	**.457****
	Sig. (2-tailed)	.000		.039	.000	.000	.000	**.000**
	N	107	107	107	107	107	107	**107**
Regulation. Factor	Pearson Correlation	.361**	.200*	1	.432**	.205*	.418**	**.238***
	Sig. (2-tailed)	.000	.039		.000	.034	.000	**.014**
	N	107	107	107	107	107	107	**107**
Sustainability. Factor	Pearson Correlation	.481**	.527**	.432**	1	.631**	.700**	**.497****
	Sig. (2-tailed)	.000	.000	.000		.000	.000	**.000**
	N	107	107	107	107	107	107	**107**
New. Org. Culture. Factor	Pearson Correlation	.537**	.449**	.205*	.631**	1	.601**	**.436****
	Sig. (2-tailed)	.000	.000	.034	.000		.000	**.000**
	N	107	107	107	107	107	107	**107**
New. Performance. Factor	Pearson Correlation	.451**	.432**	.418**	.700**	.601**	1	**.632****
	Sig. (2-tailed)	.000	.000	.000	.000	.000		**.000**
	N	107	107	107	107	107	107	**107**
Client. Role	Pearson Correlation	.358**	.457**	.238*	.497**	.436**	.632**	**1**
	Sig. (2-tailed)	.000	.000	.014	.000	.000	.000	
	N	107	107	107	107	107	107	**107**

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4. Regression Analysis Test:

1. “Client experience & competence” against “Change in the client role towards adoption innovation”:

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Experience.Factor[b]	.	Enter

a. Dependent Variable: Client.Role

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.358[a]	.128	.120	4.55542

a. Predictors: (Constant), Experience.Factor

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	320.455	1	320.455	15.442	.000[b]
	Residual	2178.947	105	20.752		
	Total	2499.402	106			

a. Dependent Variable: Client.Role

b. Predictors: (Constant), Experience.Factor

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	22.508	2.187		10.292	.000
	Experience.Factor	.740	.188	.358	3.930	.000

a. Dependent Variable: Client.Role

2. “Client characteristics” against “Change in the client role towards adoption innovation”:

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	New.Character.Factor[b]	.	Enter

a. Dependent Variable: Client.Role

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.457[a]	.209	.201	4.34020

a. Predictors: (Constant), New.Character.Factor

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	521.481	1	521.481	27.683	.000[b]
	Residual	1977.921	105	18.837		
	Total	2499.402	106			

a. Dependent Variable: Client.Role

b. Predictors: (Constant), New.Character.Factor

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	19.448	2.221		8.755	.000
	New.Character.Factor	1.524	.290	.457	5.261	.000

a. Dependent Variable: Client.Role

3. “Government regulation” against “Change in the client role towards adoption innovation”:

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Regulation.Factor[b]	.	Enter

a. Dependent Variable: Client.Role

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.238[a]	.057	.048	4.73861

a. Predictors: (Constant), Regulation.Factor

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	141.691	1	141.691	6.310	.014[b]
	Residual	2357.711	105	22.454		
	Total	2499.402	106			

a. Dependent Variable: Client.Role

b. Predictors: (Constant), Regulation.Factor

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	26.415	1.853		14.257	.000
	Regulation.Factor	.429	.171	.238	2.512	.014

a. Dependent Variable: Client.Role

4. “Environmental sustainability” against “Change in the client role towards adoption innovation”:

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Sustainability.Factor[b]	.	Enter

a. Dependent Variable: Client.Role

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.497[a]	.247	.240	4.23337

a. Predictors: (Constant), Sustainability.Factor

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	617.652	1	617.652	34.464	.000[b]
	Residual	1881.750	105	17.921		
	Total	2499.402	106			

a. Dependent Variable: Client.Role

b. Predictors: (Constant), Sustainability.Factor

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	19.075	2.060		9.262	.000
	Sustainability.Factor	1.074	.183	.497	5.871	.000

a. Dependent Variable: Client.Role

5. “Organizational culture” against “Change in the client role towards adoption innovation”:

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	New.Org.Culture. Factor[b]	.	Enter

a. Dependent Variable: Client.Role

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.436[a]	.190	.182	4.39166

a. Predictors: (Constant), New.Org.Culture.Factor

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	474.298	1	474.298	24.592	.000[b]
	Residual	2025.104	105	19.287		
	Total	2499.402	106			

a. Dependent Variable: Client.Role

b. Predictors: (Constant), New.Org.Culture.Factor

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	20.738	2.098		9.886	.000
	New.Org.Culture.Factor	1.359	.274	.436	4.959	.000

a. Dependent Variable: Client.Role

6. “Performance improvement” against “Change in the client role towards adoption innovation”:

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	New.Performance.Factor[b]	.	Enter

a. Dependent Variable: Client.Role

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.632[a]	.399	.393	3.78209

a. Predictors: (Constant), New.Performance.Factor

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	997.458	1	997.458	69.732	.000[b]
	Residual	1501.944	105	14.304		
	Total	2499.402	106			

a. Dependent Variable: Client.Role

b. Predictors: (Constant), New.Performance.Factor

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	16.337	1.785		9.153	.000
	New.Performance.Factor	1.966	.235	.632	8.351	.000

a. Dependent Variable: Client.Role