Project manager perceptions factors influencing the delivery of successful innovation in construction projects

تأثير عوامل فهم و إدراك مدير المشروع في الوصول إلى إبداع و إبتكار ناجح و سليم علي مستوي مواقع مشروعات التشييد و البناء

by

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Abstract

There has been an increase in the adoption of innovation in the construction industry over time. Innovation in construction is related mostly to new materials, processes, method of constructions, services, and new forms of construction organisation. Unlike in other industries, implementation of innovation is not at an organisation level but at a project level. From this point of view, there is an agreement between studies that project managers of construction projects have a significant role in innovation management at project level.

In addition to that, the rate of innovation in construction is less than that of most other industries because of the nature of the industry. It is possible that less research and development might be the reason for limiting innovation growth. Therefore, this research tends to add evidence to the existing knowledge of the influence of project manager perceptions factors on delivering successful innovation at construction project level and provides important insights for further research. In this research there are 25 major items of project manager perceptions identified from the literature and categorised into four factors of project manager perceptions that most probably have an influence on innovation.

This research used quantitative methodology by applying an online survey to collect data from 66 respondents that included 5 pilot samples. Ethical issues were anticipated and considered in this research. Data was collected, tested and found valid and reliable after analysis by computer software SPSS. Demographic information and the employment background of participants are relevant to this research and the respondents were considered experienced in the construction industry and familiar with project management disciplines.

The main findings show that there is an influence of project manager perceptions factors on delivering successful innovation at a construction project level with evidence that his leadership, capabilities/competences, personality traits, and skills (non-engineering skills) are relatively important for the significance influence.

Based on this influence, construction organisations need to adopt an innovation policy, a culture for innovation, and innovation diffusion methods which concentrate more on the characteristics of the project manager's job and his ability to contribute or assess delivering successful innovation at project level to increase the possibilities of his influence to innovation. Also, it is recommended that construction organisations need to implement a set of selection characteristics for the position of project manager that examine his perceptions factors toward contributions in innovation. And it is recommended for the innovative client to add these characteristics to the project requirements.

Keywords: Project Manager, Construction Innovation, Delivering Successful Innovation, Construction Industry, Perceptions Factors, Leadership, Capabilities, Competences, Personality Traits, Skills.

ملخص البحث:

من الملحوظ أن هــناك إزدياداً في تبني عملية الإبداع و الإبتكار في صناعة التشييد و البناء على مر العصور. بطريقة أو بأخري تتمحور عملية الإبداع و الإبتكار في صناعة التشييد و البناء في الأغلب حول إستحداث مواد بناء جديدة، أو إستخدام نهج جديد، أو تطبيق طرق بناء حديثة، أو اللجوء الي توفير خدمات جديدة، أو إستحداث نظم جديدة و أكثر تقدماً لتنظيم عملية البناء. إن تطبيق و تنفيذ الإبداع و الإبتكار في صناعة التشييد و البناء ليس على غرار مجالات الصناعة الأخرى، التي تعتمد على تطبيقه في نظم إدارة الشركات و المؤسسات، وإنما يتم تطبيق و تنفيذ و تطوير الإبداع و الإبتكار في مواقع مشاريع التشييد و البناء. من هذا المنطلق، و بناءً على الدور المنوط بمدير مشروع التشييد و البناء، فإن هنالك كماً لايستهان به من المناقشات بين الباحثين حول إطلاع مدير مشروع التشييد و البناء بدور في عملية إدارة و تطوير الإبداع و الإبتكار على مستوى موقع مشروع التشييد و البناء.

قد تحد طبيعة صناعة التشييد و البناء من معدلات تطوير الإبداع و الإبتكار مقارنةً بمجالات الصناعات الأخري. وقد يكون من أسباب ذلك قلة البحث و التطوير في هذا المجال. ولذلك فإن هذا البحث يعمد إلى إضافة أدلة و براهين لما هو متعارف عليه حاليا عن تأثير عوامل فهم و إدراك مدير المشروع في الوصول إلى تطوير ناجح و سليم لعملية الإبداع و الإبتكار على مستوى مواقع مشروعات التشييد و البناء. كما يقدم البحث أهم العوامل في هذا النطاق و التي يمكن أن تشكل أساساً جيداً لأبحاث و دراسات مستقبليه لدعم فكرة التطوير المقترن بالإبداع و الإبتكار في مجال صناعة التشييد و البناء على مستوى مواقع تنفيذ المشاريع و مواقع العمل. حيث تم من خلال المراجعة المنهجية للأبحاث ذات الصلة، تحديد 25 عنصراً رئيسياً مرتبطا بفهم و إدراك مدير المشروع والتي تشكل تأثيراً كبيراً في المساعدة على الوصول إلى الإبتكار بصوره فاعلة.

إعــتمد هذا البحث منهج البحوث الكمية لجمع المعلومات و البيانات من خلال عمل إستبيان عن طريق أحد التطبيقات على الإنترنت. كما قام البحث بإطلاق نسخة أولية تجريبية تم توزيعها على عدد خمسة أشخاص لقياس مدى كفاءة و فاعلية الإستبيان ثم تم إجراء التعديلات و التحسينات قبل إطلاق النسخة النهائية و التي تم من خلالها الحصول على عدد 6 إستبياناً صحيحاً و مقبولاً لإجراء التحليل النوعي للبيانات عن طريق برنامج كمبيوتر مسمي بـــ SPSS. كما أخذ بعين الإعتبار و بصورة سليمة، الإعتبارات الأخلاقية المرتبطه بعملية جمع البيانات من الأشخاص. إضافة الي ذلك, و قبل البدء في عملية تحليل البيانات تم التأكد من صلاحية جميع الإستبيانات و خلو البيانات التي تم جمعها من الأخطاء أو النقصان. كذلك تم قياس درجة الوثوق في البيانات، و قدرتها على تكرار نفس النتائج في حالات مختلفة، أو بإستخدام عدة أدوات تحليلية أخرى. و تجدر الإشاره، الي أن العينة التي تم إستهدافها في هذا الإستبيان جميعها تنتمي إلي صناعة التشييد و البناء وعلى دراية و خبرة بتخصصات إدارة المشاريع.

تــم في هذا البحث إثبات و إستنتاج عدة أهداف تدعم نظرية تأثير عوامل فهم و إدراك مدير المشروع في الوصول الي عملية تطوير إبتكار ناجح و سليم في مجال التشييد و البناء على مستوى مواقع التنفيذ و العمل. مع إثبات أهمية كل من عوامل القيادة و قدرات و كفاءة مدير المشروع، و كذلك سمات شخصيته و مهاراته في مقدرته على التأثير في عملية الإبتكار.

بـــناء على هذا التأثير فإن عدداً من التوصيات تم الوصول اليها، و منها أن الشركات التي تعمل فـي مجـال التشـييد و البناء يجب أن تتبني سياسات تدعم عملية الإبداع و الإبتكار، من خلال إنشاء بيئـة داعمـة للإبتكـار، و تطبيـق منـاهج الإبتكار التي تركز بصورة كبيرة على خصائص وظيفة مدير المشروع، كي تولي الإهتمام بمقدرتـه علـى المسـاهمة و دعـم الوصـول الـي الإبـداع و الإبتكـار النـاجح فـي موقـع العمل. كمـا أن علـى الشـركات وضـع ضـوابط و معـايير لإختيار و توظيف مديري المشاريع و التي تقيس مدى قدرتهم على المساهمه و على دعم الإبداع و الإبتكـار. إضـافة الـي ذلـك، فـإن هـذا البحـث يوصـي أيضـاً بـأن يقـوم مالـك المشـروع بوضـع هـذه الضـوابط و المعـايير فـي شـروط و متطلبات المشروع المتعلقة بإختيار مديري المشاريع.

كلمـــات البحـــث: *مدير المشروع، الإبتكار في التشييد و البناء، الوصول إلي إبتكار ناجح، صناعة التشييد و البناء، عوامل الإدراك، عوامل القيادة، عوامل الكفاءة و القدرات، السمات الشخصية، المهارات.*

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Chapter One: Introduction

1.1 Background

Several studies disclose that from the 20th to the 21st century there were changes in the way project management leadership was perceived. The return-on-investment approach based on the 'iron triangle' of time, cost and quality has been replaced by a philosophy that looks to more wide-ranging benefits such as increased administrative competence and the adding of value to organisations involved in the execution of construction projects (Hwang & Ng 2013; Lloyd-Walker & Walker 2011; Svejvig & Andersen 2015). Changes in the environment of the construction industry in the 1990s were imposed on companies under the circumstances of recession which changed the traditional procurement methods to alternative methods which influenced the role of project managers to keep abreast of developments in knowledge (Edum-Fotwe & McCaffer 2000; Shi 2011). Project management development had a significant growth due to the increased number of projects in different industries. Studies show a continuous development of project management standards and practices in different organisations (Winter, Smith, Morris & Cicmil 2006). The project manager's abilities to enhance and integrate the different advancing practices require an understanding of his personality and mind set (Sauer & Reich 2009). There is evidence that lack of engagement with new practices influences a project's success (Shi 2011). Hence, the project management creates value by committing to the effective execution of the project and the successful delivery of the product. Project management must be developed to be suitable to the organisation's strategy and policies (Shi 2011). There are studies of projects from different perspectives, for example, as a problem of network organisation, as a problem of information, as a problem of critical management, and as a problem of institutionalisation. Each perspective provides a basis to develop the various project management theories and approaches (Pinto & Winch 2016).

Several authors argued that project management techniques applied successfully to improve performance in other industries were not applicable to the construction industry, and does not achieve similar improvement values for techniques such as, for example, partnering with suppliers (Dubois & Gadde 2002). In the same context, the demand for construction project management (CPM) is increasing significantly within the industry. Therefore several professional associations are providing training and education for project managers to keep the industry up-to-date with recent project management approaches. For example CPM standards and certificates established by organisations such as the International Project Management Association (IPMA), the Australian Institute of Project Management (AIPM), the Association for Project Management (APM) in the UK, the Project Management Institute (PMI), the Chartered Institute of Building (CIOB), the Institution of Civil Engineers (ICE), and many other organisations worldwide were established to develop project management vocations (Bakar, Razak, Karim, Yusof & Modifa 2011; Creasy & Anantatmula 2013; Hwang & Ng 2013; Thomas & Mengel 2008; Papke-Shields, Beise & Quan 2010). The required knowledge for construction project management is unique and can be acquired by a combination of experience and training that can be obtained from one of the professionally accredited associations (Bygballe & Ingemansson 2014; Edum-Fotwe & McCaffer 2000). The enhancement of both project briefs and customer focus has reduced the difficulties of construction business performance since 1995 and has led to create tools and techniques to accommodate the required integration between the necessary knowledge and skills among the project parties (Barlow 2000; Hwang & Ng 2013).

There is a wide and growing range of project management studies from those that focus mainly on technical skills to those that look at managing the activities required to achieve project success (Crawford et al 2006). The recent approaches argue that there is an interaction between projects and the organisation's strategic direction. Also there are theories that frame projects as information processing systems and also look at the issue of project uncertainty. From other research perspectives the critical management perception between projects and project management can be used as a tool of control (Winter et al 2006).

1.2 Projects

1.2.1 What is the construction project?

The construction project is an effort to organise human, material and financial resources in a way to commence a unique scope of work with certain specifications, within a budget, and on time (Dubois & Gadde 2002; Cartlidge 2015; Turner & Müller 2003, Walton 1984). Construction projects consist of essential terms. The project is unique, the project execution will not use the exact same approach of previous projects, and the project has a start and finish time. The construction project also is a complex effort to accomplish a specific objective within time and cost and interferes with organisational lines, and usually the construction project is unique and not replicated exactly within the company (Belout & Gauvreau 2004; Dubois & Gadde 2002; Cartlidge 2015; Munns & Bjeirmi 1996; Turner & Müller 2003, Walton 1984). The project is a process transfer from initial to final stage, executed in a generally complex and changeable situation (Sauer & Reich 2009; Stal-Le Cardinal & Marle 2006).

1.2.2 The Project Lifecycle

There are a large number of studies describing the project lifecycle. The project lifecycle consist of initiating, planning, executing, controlling, and closing the project (Cartlidge 2015; Stal-Le Cardinal & Marle 2006; Pinto & Prescott 1988). The first stage can be described as initiating, and consists of strategy, company standards, company resources availability, limitations, and assumptions. Planning is preparing and estimating the project's activities to meet the project's requirements and objectives (Cartlidge 2015; Stal-Le Cardinal & Marle 2006). Execution is performing the actual work of the project and using resources to install materials into the intended project outcomes and deliverables (Pinto & Prescott 1988). Both planning and executing activities by project resources transform the project from initiation toward the final situation. This transformation requires human management, procurement management, and quality control management (Cartlidge 2015; Stal-Le Cardinal & Marle 2006).

Project planning and control are important for because they concentrate on several aspects for the project's success such as defining goals, resources management, contract administration, risk and change management, and procurement management. This importance escalates in complex and large projects so planning must be done long before execution and control during the project's progress. Planning provides the project participants with an estimation of the information required to execute their activities and evaluate progress against the plan to know if they are ahead or behind schedule (Toor & Ogunlana 2009). Several studies argued that projects are temporary, run over a limited period, and execute tasks that have never been executed before (Malach-Pines, Dvir & Sadeh 2009).

1.2.3 The Temporary Nature of Projects

Several studies have suggested moving away from the idea of the project as a tool to the idea of the project as a temporary organisation. Therefore, the project can be identified as a temporary organisation developed by the company to execute an obligation on its behalf (Pinto & Winch 2016; Svejvig & Andersen 2015; Turner & Müller 2003).

The project base always consists of project management complexity. Identifying the project base complexity assists determining the required strategy, cooperation and controls. Also the project base complexity obstructs identifying the goals and objectives. The project base complexity influences several aspects including the required skills and techniques of the project manager and influences procurement, management, time, cost and quality of the project (Baccarini 1996).

1.2.4 Types of Projects

There are several project classifications. Well-known classifications argue that there are three types of construction projects: infrastructure, buildings and process plant (Love 2002; Oberlender 1993). Infrastructure projects are transportation systems that consist of roads, bridges, airports, highways, and also include utility projects that consist of electrical and telephone transmission and distribution, cable lines, gas, water and sewerage systems. Buildings projects are commercial property, offices, hospitals and schools. Process projects are power plants, oil refining, chemical plants, and pharmaceuticals (Love 2002; Oberlender 1993). Several researchers categorise projects in matrices of 2X2 or 3X3 consisting of technical uncertainty and increasing of project scope. Also the matrices could consist of the increasing of project goals' understanding and the required methods to achieve the project goals (Müller & Turner 2010).

1.3 The Project Manager

1.3.1 What is a Project Manager?

The term project manager is used to indicate responsibilities of managing projects ranged between small, large, complex, urgent and any types of project which require the focus of the project manager on the execution of activities and installation of goods within certain parameters such as time, cost, regulation, specifications and required quality to deliver a project successfully (Crawford et al 2006). Project Managers are objectively passive, concentrate on people, controlling and administrating a group of people, and are committed to keep the project's progress as planned (McKenna 2012; Ploughman 1995; Xue et al 2014). Effective project managers must be aware of project-related knowledge such as key objectives, scope of work, problems, and critical issues. Also, he has to be familiar with market perceptions and the commercial values of the project to the industry (Ploughman 1995). Project Managers also create the fundamentals toward improving cooperation within the project's stakeholders and participants (Eskerod & Blichfeldt 2005).

1.3.2 Management as Leadership

Management and leadership characteristics are both are necessary for the management of complex companies. Leadership is a strength that produces a capability among a group of people to do a task better. It is also inspire others to change and to do more tasks (McKenna 2012). There are three stages of leadership: project, technical, and team leadership including different skills such as establishing the project's direction, aligning project teams, motivating team members (Edum-Fotwe & McCaffer 2000). The construction project manager's skills must consist of the supervision of the project team, leadership, motivating others, and organisational skills (Cartlidge 2015). There are two types of project manager as a leader: transformational leaders where the project managers focus on relationships, and transactional leaders where the project managers focus on process (Müller & Turner 2007). The project manager must adopt a variety of leadership styles including autocratic, participative and delegatory styles to manage the project successfully (Cartlidge 2015).

1.3.3 The Project Manager Role

The essential knowledge of the project manager primarily is to be in possession of the technical aspects to understand the materials, deliverables, installation of goods, and methods of execution to deliver the project successfully and efficiently. Besides that, he requires non-engineering knowledge: positive personality traits, good communication skills, and appropriate workplace behaviour. He also requires awareness of new tools and techniques to provide him with a better ability to enhance the performance of the project and to adopt changes (Cartlidge 2015; Creasy & Anantatmula 2013; Hwang & Ng 2013). Also the construction industry requires skills and knowledge of the construction project manager that combine traditional engineering knowledge and new project management approaches in order to accommodate the new changes and preserve professional efficiency (Edum-Fotwe & McCaffer 2000; Kapsali 2011). The project execution examines challenges that require the participant to contribute and to solve them. The role of the project manager in this situation is to solve problems successfully (Bygballe & Ingemansson 2014). From similar challenges to project management and project managers, there was a change in approach that involved developing project managers able to manage projects successfully by enhancing his practitioners (Crawford et al 2006). Moreover, the role of the project manager focuses on several issues including sharing information, managing activities, supporting the project team, enhancing communication, project analysis, using best practice methods, keeping the project on track, and meeting deadlines (Ploughman 1995).

1.3.4 The Project Managers and their Role in Project Success

There is an argument that the competence of the project participants and the project's ultimate success are correlated, and the project manager's competence as an important participant of the project is a factor of successful project delivery (Geoghegan & Dulewicz 2008). The construction project's performance is enhanced by the project manager's experience and managerial skills because it is the project manager who implements the best practices of project management (Anderson 1992). Different types of project management consist of different ability profiles and leadership of the construction project manager (Müller & Turner 2007). Risk management is a part of the project manager's role to project success (Reed & Knight 2010). The project success factors and innovation on the construction site are always related to the project manager's role, leadership style, flexibility, managerial culture, competence and personality traits (Geoghegan & Dulewicz 2008; Hwang & Ng 2013; Kapsali 2011; Turner & Müller 2005). The construction project manager is responsible for the success of the project execution within the cost, time, quality, and project objectives (Edum-Fotwe & McCaffer 2000; Malach-Pines, Dvir & Sadeh 2009; Oberlender 1993; Yang, Huang & Wu 2011).

1.4 Innovation

1.4.1 What is Innovation?

Innovation has been a part of human nature since man first started to use tools, and progress and development has always been associated with innovation (Woodman, Sawyer, & Griffin 1993). Innovation is an important factor that contributes to national economic growth, competitiveness, and developed living standards (Ozorhon 2012). The national innovation system consists of economic, political, and social factors that affect the development of innovation (Bloch 2007). The public sector refers to innovation by the level of innovation adoption within macro systems (Kapsali 2011). Also the innovation described by the Oslo Manual consists of using technology to produce new or significantly improved products and processes (Blayse & Manley 2004; Davis, Gajendran, Vaughan, & Owi 2016; Murphy, Perera & Heaney 2015). Besides, process innovation is defined by the Organization for Economic Cooperation and Development (OECD) as the introduction of advanced management methods (Murphy, Perera & Heaney 2015).

Innovation is an interaction between the organisation and other actors to develop knowledge and technology, and is influenced by culture, regulations and organisational factors (Bloch 2007). Innovation can include the creativity of the individual's behaviour influenced by current and past events and also influenced by the cognitive and non-cognitive aspects of the individual's thinking. Personal creativity includes the previous conditions, cognitive style, motivation, knowledge, personality and abilities (Woodman, et al. 1993). Innovation also can be referred to as creating new concepts based on the capability to think and perform independently, or renewing and changing ideas (Kapsali 2011). Innovation is an element of evolution in all industries. It is an effort to generate purposeful intensive change in an initiative's economy or social prospects. It is novelty offers the advantage of superior performance over rivals. Innovative is a term attributed to products or services, while innovativeness is a term frequently intended by organisations (Asad et al 2005; Creasy & Anantatmula 2013). Innovation is a compilation of theoretical, inventive and commercial aspects. Innovation starts with theoretical concepts transferred into technical innovations and converted into a product (Brockmann, Brezinski & Erbe 2016). Thus, there is a wide and complex range of definitions of innovation. Innovation in construction consists of processes that enforce together products, technology, technical knowledge, and organisational management into a new level of performance (Brockmann, Brezinski & Erbe 2016). It is a use of new ideas, including construction methods, with the aim of developing additional value and benefits, but it is fraught with risks and challenges (Asad, Fuller, Pan & Dainty 2005; Bygballe & Ingemansson 2014). It is an aspect of improvement to be considered in a new or existing product, process or system to be developed or used by the organisation (Slaughter 2000).

1.4.2 Types and Forms of Innovation

The range of innovation types are varied and may include the following forms: product, service, process, managerial, technological (Adams, Bessant & Phelps 2006; Barrett & Sexton 2006). Innovation can also include new advantages or new technology, and breakthroughs in innovation can result in important improvements. It can be explained that adopting new ideas to produce a new product is based on the capability and willingness of organisation, manufacturer, and specialists to do so (Asad et al 2005; Creasy & Anantatmula 2013).

An innovation laboratory is a form of innovation that consists of structure and infrastructure content. The structure content involves making specific experimental forms and that also includes the project architecture that can influence participant behaviour. The infrastructure content involves measuring the variables using simple tools to show the concept. Also, it is developing information and communication technology (ICT) to utilise brainstorming (Lewis & Moultrie 2005).

From the construction perspective, innovation can be categorised into organisational and technical innovation. Organisational innovation is used to develop modifications to organisational structures, applying advanced management systems, and adopting new strategic plans. Technical innovation is used for product innovation if the result is a new product, or used for process innovation if the product is exposed to new ideas and advanced methods of production (Asad et al 2005; Bygballe & Ingemansson 2014). There are several types of innovation in construction while there are an important five types identified in various notable studies: incremental, modular, architectural, system, and radical (Blayse & Manley 2004; Bygballe & Ingemansson 2014; Murphy, Perera & Heaney 2015; Ozorhon, Abbott & Aouad 2013; Slaughter 1998).

1.4.3 Implementing Innovation

Implementing innovation consists of several stages or sequences that vary from a process of connecting sequences of idea arising to idea exploitation dependent on the changes in the process (Asad et al 2005) or from inception, manufacture, execution, commission and closure while taking evidence of benefits to the business (Murphy, Perera & Heaney 2015). Identifying appropriate innovation efforts can enhance the performance to achieve the successful implementation of innovation. These efforts must indicate the organisational competencies and relative factors (Barrett & Sexton 2006). In the construction industry, acceptance of innovation implementation methods relies on the adoption of project management techniques, whereas associations can successfully innovate by implementing technology, change management, looking for alternatives, flexibility and evaluation of the cost implications of the innovation process. There is an argument that the innovation process can be managed by identifying the idea, evaluating the benefits, committing to it is execution, preparing comprehensively, implementing thoroughly, and then evaluating the entire process post-use. Besides that, there is evidence that successful implementation is influenced by the development of all stakeholders' competences (Asad et al 2005; Murphy, Perera & Heaney 2015; Slaughter 2000).

1.4.4 Factors that may constrain innovation

Organisations have been measuring their innovation activities since the 1980s, according to surveys occurred in several counties in European Union. The OECD has produced the Oslo Manual for innovation guidelines which they have published in several editions since 1992 (Bloch 2007). The guidelines clarify that organisations depend mainly on internal information to survey and identify innovative ideas. There are several sources of innovation frequently quoted and explained (OECD 1999) that result from information about competitors, external provenance, customers, and suppliers (Blayse & Manley 2004; Ozorhon 2012; Salter & Gann 2003).

The value of innovation is influenced by the ability and understanding of project team members to create change and to be supportive of novel ideas. The organisational capability for innovation concentrates on generating an appropriate environment for effective innovation to support a long-term strategy, risk allowances, incorporation of decision-making, and a proper selection of managers and management's method (Creasy & Anantatmula 2013). Encouragement of individuals to participate in introducing new ideas is a type of managerial support required for innovation (Kock & Georg Gemünden 2016). The environment for interaction is the one of the major factors influencing innovation. In the case of aggressive interaction the result will lead to reactive behaviour. There are other factors consisting of methods for using people and technology effectively. Also, environmental stability can increase attention on the business strategy and addition of value (Barrett & Sexton 2006; Bygballe & Ingemansson 2014).

The factors unique to the construction industry - the short time given to projects, type of participants, procurement methods, complexity of the supply chain, the needs of specialists, and organisational structure - means that there are limits to the capabilities for innovation (Barlow 2000). The construction project execution environment has obstructions to innovation such as liability for each of projects, immobility, uncertain demand, separation, and smallness (Shelton, Martek & Chen 2016). There are a variety of internal and external factors that affect innovation within the construction industry such as the client who can be supportive of innovation, and the procurement method that would enable organisations to grow their innovation. Also, individual attitudes and organisational processes can encourage innovation by creating stronger cooperation between departments, employing supportive policies and priorities, the use of a no-blame culture, effective leadership, and expert team members working together to enhance the performance (Asad et al 2005).

1.4.5 Innovation in Projects and Project Management

Innovation essentially leads to enhancement on the ground. The innovation in the construction industry introduces and applies novel ideals, technology, products and processes to enhance the efficiency of the execution and to solve difficulties (Barrett & Sexton 2006; Nybakk & Jenssen 2012). Innovation in projects might be an output because of the nature of execution using different project teams. The innovativeness can be used by project managers through promoting and encouraging the innovation trends of subordinates and motivating project teams to encourage innovation (Creasy & Anantatmula 2013). There are three major areas for innovation activity that can make a major enhancement for quality and value: the management of the supply chain and partnering; management of value and risk; and technical innovation (Barrett & Sexton 2006). Usually the problems are solved on site and, to take the form of true innovation, the solutions are required to be recorded, learned, and applied for future projects. Based on the temporary nature of the construction project and the short period of the relationship between project teams, obtaining information from trusted sources such as contractors, subcontractors, suppliers, and other specialists can affect the success of innovation results (Barrett & Sexton 2006).

1.4.6 The Role of Managers in Delivering and Enhancing Innovation

Developing innovation strategy is essential for innovation and can improve the capability of innovation for the organisation. Also, it can create a commitment for innovation which leads to increase the probability of establishing an effective innovation system. The role of the organisation's managers is to adopt the innovation strategy and create an innovation environment for the successful implementation of innovation. Besides, facilitating the work climate for individuals to innovate will lead to enhanced creativity among employees. Plus maintaining innovation strategy preferences and adopting R&D methods can encourage innovation and positively influence the financial performance of the organisation (Nybakk & Jenssen 2012; Panuwatwanich, Stewart & Mohamed 2008).

1.4.7 The Role of Project Managers in Delivering and Enhancing Innovation in Projects

Successful construction project managers in the 21st century require certain characteristics such as adopting different approaches, acquiring skills and knowledge to enable the successful operation of a complex project environment, and supporting all project participants successfully. Furthermore, the best decision in the construction project requires an interaction and integration between project parties to produce innovative ideas to solve the project execution problems that may appear (Turner & Müller 2005; Lloyd-Walker & Walker 2011). There is a consensus among several studies that innovation is implemented within the construction industry at project level (Blayse & Manley 2004; Bygballe & Ingemansson 2014; Ozorhon 2012; Slaughter 1998; Slaughter 2000; Winch 1998). And there is a significant role for the project manager in innovation management at project level because of the nature of his responsibilities in managing the project toward success (Fisher 2011; Meng & Boyd 2017; Panuwatwanich, Stewart & Mohamed 2008).

Furthermore, there are arguments that support the idea that the enhancement and improvement of construction productivity are influenced by innovation. It can be seen that there are several major challenges that obstruct the evaluation of innovation in the construction industry and have a direct influence on the project manager's role in managing the project. Those challenges consist of managing the changes to meet the client's needs, dealing with the increase in complexity of the project, using developed equipment, dealing with project cost reduction, increasing the requirements of building operations and maintenance, and developing new technology in the construction industry. Also, lack of both knowledge sharing and advanced skills of project managers leads to lack of innovation in the construction industry (Davis et al 2016).

1.5 The Research Map

1.5.1 The Current Research Situation

Several studies compare innovation in other business fields with innovation in the construction industry. Fewer authors refer to innovation in construction organisations. There are several studies that explain the characteristics and aspects of a project manager's leadership, skills, capabilities and competency. Most research tends to focus on innovation at organisational level and considers less the impact of middle management and the project manager. There is an argument that the construction industry requires more research to understand the influence on perceptions factors on innovation at middle-management level (Kissi, Dainty & Liu 2012). This paper contributes to the existing knowledge and theories for construction project managers' perceptions factors that influence delivering successful innovation in construction projects, and provides evidence for their influence, in addition to providing evidence for the importance of the identified perceptions factors. This research also provides significant insights for future extensions.

1.5.2 The Research Problem

The increase in project management practices led to increasing the need to study new approaches and concepts for advancing standards of construction project management to enhance the abilities of the construction leaders and project managers to deal with the organisational environment, project teams, innovation projects and project complexity (Kapsali 2011; Thomas & Mengel 2008). Innovation in the construction industry is unlike other industries because novel ideas and innovative projects are executed at site level by different project teams that are brought together on a temporary basis (Slaughter 2000; Winch 1998). A great amount of literature focused on innovation at organisational level and project level was ignored (Ozorhon 2012; Slaughter 2000; Winch 1998). Research in innovation management identified a gap in the development of useful tools for the implementation of successful innovation in the construction industry (Murphy, Perera & Heaney 2015). Using new ideas is associated with difficulties in managing construction projects and there is a difficulty in managing ideas across other projects. This situation often leads to failure and loss of opportunities to innovate using ideas that are improperly implemented and managed (Murphy, Perera & Heaney 2015). Understanding the role of project participants is essential to understand the successful development and implementation of innovation (Ozorhon, Abbott & Aouad 2013). The project manager is identified as one of the key participants for innovation management (Murphy, Perera & Heaney 2015). As an important project participant, one of the project manager's objectives is to encourage innovation and to manage the project toward success (Barlow 2000). Project success is influenced by the construction project manager's competencies, therefore organisations must put an emphasis on their project manager's perception, skills and capabilities (Hwang & Ng 2013). Thus, organisations adopting innovation policies and seek to be benefiting from creativity requires focussing on the project manager to improve the successful development of innovative ideas at construction project level which can be used by the organisation to share and transfer knowledge to other project managers in the organisation which will benefit the company's overall strategy.

The aim of this paper is to investigate the influence of the project managers' perception factors on delivering successful innovation in project.

The objective is to identify and analyse the project manager's perceptions factors that influence the delivery of successful innovation and to clarify the project manager's ability to deal with the creative ideas needed to improve the construction project's success and mitigate project execution problems.

1.5.3 The Research Questions

1. What is innovation within the context of projects and project management?
2. What are the project managers' perception factors that are associated with delivering successful construction projects?
3. What is the influence of project managers' perception factors on delivering successful innovation in construction project?

1.5.4 Research structure

This dissertation will examine the influence of project manager perceptions factors on delivering successful innovation. This dissertation is composed of six chapters: introduction, literature review, research methodology, analysis of data and findings, discussion of results, and conclusion.

Chapter 1 will introduce the research topic including the background and introduction to the project manager's role in project management and innovation, essential definitions, the research problem, and research questions.

Chapter 2 will review in depth the literature of project management and innovation, project success and failure, innovation definitions in the construction industry, and theories. Also, it will investigate the role of the project manager in executing successful projects and delivering successful innovation. This chapter will also include the theoretical underpinning and theoretical framework.

Chapter 3 is concerned with the research methodology used for this dissertation. Explaining quantitative method is based on 66 online survey questionnaires.

Chapter 4 presents results and findings of the research focusing on descriptive and inferential statistics of data collected from the online survey questionnaire.

Chapter 5 will discuss results and the main findings, including hypotheses examination results and recommendations.

Chapter 6 will provide a summary of the research topic and a critique of the findings. Also, the limitations of the research will be examined and recommendations for further research.

Chapter Two: Literature Review

2.1 What is a successful project?

The successful project achieves all of the project's aims, objectives, and stakeholders' expectations (De Wit 1988; Jari & Bhangale 2013). For a project's success it is important to select effective project management approaches that managers and teams will apply in order to increase the chances of the project's success. Several researchers define project success from the perspective of different factors, for example, achieving project objectives, budget, project progress, and the effective operation of the deliverable (Chou & Yang 2012; Shenhar, Dvir, Levy & Maltz 2001). Project success is to accomplish the desired expectations of the stakeholders and achieves the purposes of the project and it can be achieved by identifying and listing the required outcomes and deliverables. The successful project is also defined as executing the project on time, within the budget, and with respect to the essential aspects or triple constraints of the project's success: time, cost, and the desired quality (De Wit 1988; Jari & Bhangale 2013; Munns & Bjeirmi 1996; Ogunlana 2010).

2.2 Types and forms of project success and project failure

Project success essentially depends on the integration between the project's various parties to share knowledge and experience and to work as a team (Dulaimi et al 2002; Ibrahim, Costello & Wilkinson 2011; Lloyd-Walker, Mills & Walker 2014). It also depends on the project team's understanding of the required result and deliverables of the project (Davis 2014; Jari & Bhangale 2013). Factors such as communication, cost and scope management influence the project's success or failure (Chou & Yang 2012). Success or failure in the construction field varies from project to project depending on various aspects such as participants, scope of work, size of the project, design difficulty, required technology for execution, and is extended to factors associated with the industry to satisfy the individual aims and objectives from the project for the client, designer and contractor (Cserhati & Szabo 2014; Jari & Bhangale 2013; Ogunlana 2010; Papke-Shields et al 2010). The control of the project manager over the project's success is influenced by project management techniques but affected by several other factors out of his or her direct control. Failure of project management to achieve the project success would include factors such as incompetence of the project manager, uncooperative senior management, absence or abuse of suitable management techniques, participants' non-commitment to the project, and factors related to planning and communication. It is not necessarily the failure of the project's management that leads to project failure because the project might still achieve higher objectives and long-term aims (Bakar et al 2011; De Wit 1988; Dulaimi et al 2002; Munns & Bjeirmi 1996). Good project management might influence the level of the project's success but it is unlikely to rescue a project that was misconceived from its inception. The project might be a failure for an individual participant by virtue of his or her failure to achieve certain objectives, but at the same time the project can be a success for other participants (Cserhati & Szabo 2014; Davis 2014; De Wit 1988; Ogunlana 2010; Shenhar, et al 2001). Therefore, the adoption of project management techniques toward a successful project must be oriented to the participants and stakeholders (Cserhati & Szabo 2014).

2.3 Theories of project success and project failure

Traditionally, project cost, time, progress, safety measures, and project performance are used in the construction field to demonstrate the project success. The Delphi method uses eight factors to measure the project's success: customer satisfaction, quality of performance, time, cost, communication, safety, trust and innovation. The Mass House Building Project considers four major categories to identify the project's success: the impact on the environment, quality, time and cost. The Enterprise Resource Planning in the construction industry uses progress control and quality management to indicate the project's success (Chang, Chih, Chew, Pisarski 2013; Chou & Yang 2012: Davis 2014; Papke-Shields et al 2010; Turner & Müller 2005). Other researchers argue that project success theories can be categorised based on two perspectives of success. The first method is the macro success that concentrates on achieving the aim of the project from the end-user and project recipient point of view. This method is directly related to operation of the deliverables on efficiency in the long run. The second method is the micro success which focuses on the achieving of the objectives of the construction parties, and considers constrains of time, cost and quality, and efficiency in the short term (Ogunlana 2010; Toor & Ogunlana 2009).

In addition to that, there are several indicators that can be used to indicate the project's success in addition to the traditional factors such as the satisfaction of all of the customers, stakeholders, suppliers, and project teams (Chou & Yang 2012; Ogunlana

2010). Indeed, the evaluation of success criteria during the project's execution can be influenced by several aspects such as the project participants' resolution, team motivation, and productivity (Davis 2014). Furthermore, the method of project success framework (PSFW) can be used to show the relationship between different objectives, and to determine success by evaluating the achievement of these objectives (De Wit 1988).

2.4 Factors that impact upon the success of projects

Several research projects have been conducted to identify which factors influence project success. Some well-known studies argue that there is no one set of factors that are appropriate to all projects, and those factors' impact can vary between projects based on the importance to the project (Cooke-Davies 2002; Cserhati & Szabo 2014; Ogunlana 2010; Shenhar, et al 2001). Diversity in skill, experience and knowledge among project teams and members can influence the project's success. Lack of cooperation and communication, conflicts, and culture diversity can also challenge the success of the project. Therefore, several researchers address the importance of good integration between project team, members and participants (Davis 2014; Ibrahim, Costello & Wilkinson 2011; Lloyd-walker, Mills & Walker 2014). The nature of construction projects make the success factors vary from project to project because of the changes in the project participants and differences between projects that creates different priorities (Dubois & Gadde 2002; Jari & Bhangale 2013).

There are several factors influencing project success and there are factors more critical than others which are termed Critical Success Factors (CSFs). CSFs in the construction project management are factors of forecasting the success of the project (Jari & Bhangale 2013; Papke-Shields et al 2010). Essentially, CSFs takes into consideration the significance of understanding the project's processes by the project participants (Davis 2014), as well as the influence of the project manager's leadership traits and capabilities (Turner & Müller 2005). It is important to differentiate between project success and project management success because project success is concerned with achieving specific project objectives, while project management success relies on performance against traditional factors and other related factors using management techniques and tools (Ogunlana 2010; Papke-Shields et al 2010). The factors that influence the project's success can be grouped into Project Success Criteria (PSCs) that evaluate the success, and Project Success Factors (PSFs) that enable the accomplishment of the success. The PSCs contain project management success criteria including time, cost and required quality; they also consist of the product's successes that enable the achievement of the stakeholders' expectations, satisfaction, and objectives. Indeed the project success is essentially more complicated than implementing project management success because it includes second-order controls (**Figure 2.1**) (Cooke-Davies 2002; De Wit 1988; Jari & Bhangale 2013; Ogunlana 2010; Turner & Müller 2005). In the same way, an argument over the significance of owner participation resulted in four specific conditions for success, consisting of deciding the PSCs with stakeholders at the beginning of the project and evaluating them during the project stages (Davis 2014). Furthermore, the PSFs are influenced by the project manager role in the project's various phases (Davis 2014; Edum-Fotwe & McCaffer 2000; Turner & Müller 2005). Also, the PSCs are usually cited as key performance indicators (KPIs). However, common indicators between previous projects must be identified and adopted by project managers and construction teams when considering the limitations and the context of the current project (Ogunlana 2010).

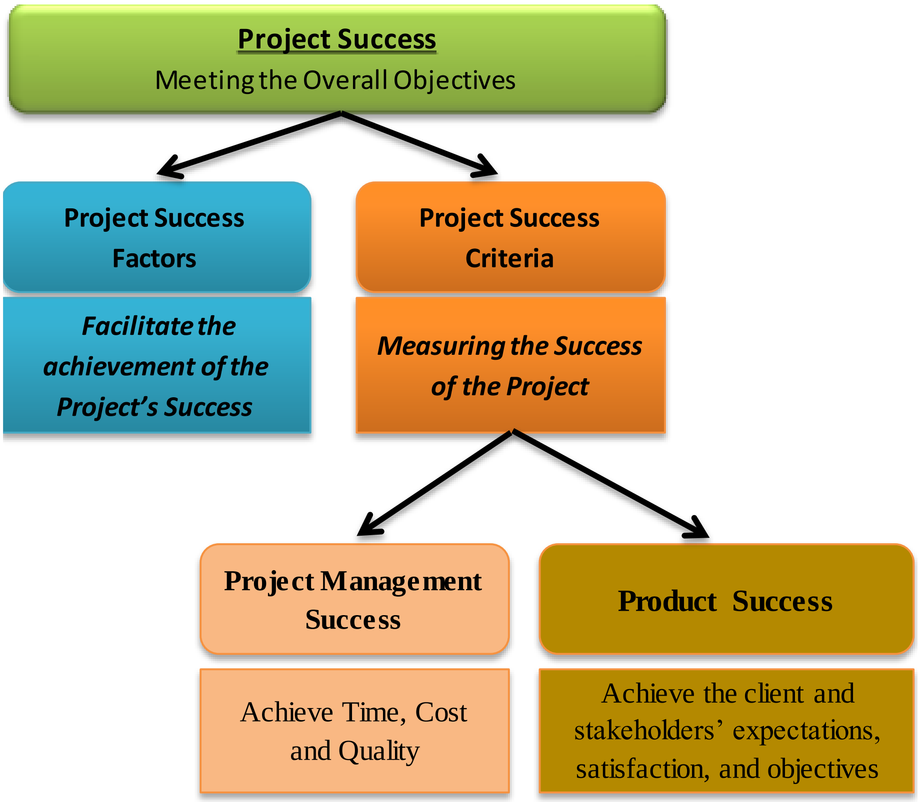


Figure 2.1: Distinguish between Project Success, PSFs, PSCs, Project Management Success and Product Success.

The execution of construction projects has a variety of success factors such as identifying the project objectives, defining the scope of the work, the project manager's abilities and skills, the obligations of the project teams, the participants' capabilities and their level of cooperation, planning, control of schedule, costs and quality, size of the project, management of information and communication, cooperation of senior management, and the provision of health, safety and environmental standards (Cserhati & Szabo 2014; Munns & Bjeirmi 1996; Jari & Bhangale 2013). In addition to that, the project manager's ability to plan the execution of the project's activities, his skills, leadership traits and relevant experience also influence the project's success (Davis 2014; Turner & Müller 2005). Project planning and cost controls are required to overcome issues such as cost overrun, underestimation of mark-up for overheads and profit, and delays in the handing over of the project (Munns & Bjeirmi 1996). It can be observed that project success is multi-dimensional and consists of project efficiency dimensions that are related to the project execution with prime efficiency measurements to be able to complete the project on time and within budget. It must also be taken into consideration that the success of achieving these goals might not result in long-term success and value for the company. The dimension of customer satisfaction includes achieving customer needs and the requirements of the project's desired outcomes. The business dimension consists of long-term implications associated with the impact of the project on the organisation's strategic planning and management. Also, future dimensions are a matter of arranging the organisation and internal structure for upcoming challenges, innovations and other developments related to the future of the industry (Ogunlana 2010; Papke-Shields et al 2010; Shenhar, et al 2001).

2.5 The role of the project manager in delivering successful projects

The project manager of both the client and the contractor is responsible for each part of the project in different project stages. The project manager must be able to perform in different tasks such as understanding project technology, the evaluation of the project and the economic outcomes, personal management, communication and operation at site, planning and control, financial and procurement knowledge, speaking at and managing meetings successfully (Bakar et al 2011; Cserhati & Szabo 2014; Davis 2014; Edum-Fotwe & McCaffer 2000; Fisher 2011; Munns & Bjeirmi 1996; Jari & Bhangale 2013; Walton 1984). The project manager must evaluate, measure, and determine the project team integration practices during the project period to enhance the project team's integration and to influence the project's performance (Ibrahim, Costello & Wilkinson 2011). Also, project managers need to understand their leadership role in the project. They need to adopt a personality that inspires respect among project participants, organise responsibilities between project members, motivate project teams, and to have the experience and technical knowledge related to the project (Cserhati & Szabo 2014; Edum-Fotwe & McCaffer 2000; Jari & Bhangale 2013; Turner & Müller 2005). The project manager's behaviours and capabilities directly affect his efficiency. Also, he must focus on people, creating trust and demonstrating understanding of his team's needs in order to enhance the project's progress. In the same context, factors such as ability to communicate effectively, lead, and motivate the project team also affect the project manager's performance (Fisher 2011; Jari & Bhangale 2013).

In addition to that, several researchers argue that the project manager plays an important leadership role in motivating project teams, which creates a suitable working environment toward project success (Turner & Müller 2005). Furthermore, effective project managers motivate their teams to execute their work and improve their performance by inspiring them with a positive attitude (Fisher 2011).

2.6 What is successful innovation?

Factors that define successful innovation in the context of the construction industry vary from one researcher to another. Successful innovation can be considered as a successful management of all activities which endeavour to execute unique ideas within the context of the competition of the industry market, and enhance the company's ability and readiness to innovate (Hartmann 2006). A recent study clarified that innovation is an important tool for an organisation to survive and grow within the market (Baregheh, Rowley & Sambrook 2009; Yepes, Pellicer, Alarcon & Correa 2015). A long-term competitive approach can be obtained by the organisation through innovation identifying the critical component (Slaughter 2000). In the same way, successful innovation is the ability to improve products or services to enhance the organisation's value creation (Blayse & Manley 2004; Panuwatwanich, Stewart & Mohamed 2008; Von Myrow, Mutze-Niewohner & Duckwitz 2014). Furthermore, the recognition of new ideas or practices can be referred to as innovation. In the same way, innovation can be a technology or it can be administrative. Technology that is new such as a product, process, production method, equipment, or instrument. Administrative practices that is new to an organisation such as structure, setup, training, and strategy. Both technological and administrative innovation involves changes in the operation of the organisation (Kale & Arditi 2009). Reputed researchers developed an integrated definition for successful innovation considering different disciplines and perspectives, and argued that innovation is a process of multi stages whereby organisations tend to transform ideas to create new or improved products or services with the purpose of achieving successful outcomes within their industry (Baregheh, Rowley & Sambrook 2009).

A research focus on innovation in construction explains innovation from a different point of view. Innovation is performing a new or existing activity using a different or new method; it can also be an adjustment in routine to form a new combination (Bygballe & Ingemansson 2014). Other explanations initiate a definition consisting of two parts. The first part within the organisation, where innovation is generating, developing and implementing ideas considered as new to the organisation and contains practical benefits or commercial value. The second part covers products or processes that are adopted and implemented outside the organisation (Dulaimi, Nepal & Park 2005). Other research developed at a construction project level defined construction innovation as a system consisting of a model with elements considered subjective, strategic, environmental and organisational (Ozorhon, Abbott & Aouad 2013).

2.7 Delivering successful innovation

Innovation tends to change because the organisation uses innovation to influence a changeable market environment. An organisation might use different types of change based on the organisation's resources, abilities, strategy and requirements. It can be observed that most known innovation types are related to new materials, processes, methods of construction, services, and new forms of construction organisation. Those forms enhance the role of different teams and professional disciplines in delivering successful innovation (Baregheh, Rowley & Sambrook 2009). A recent piece of research in construction management presented several studies confirming the significant role of the project managers in innovation management (Meng & Boyd 2017). Although, project managers tend to minimise the use of resources on projects and that influences their management methods toward innovation in projects (Keegan & Turner 2002). In addition to that, a reputed publication in the context of effective project managers identified groups of managerial skills and behaviour. The author argues that project managers behaviour lead by example and improve other people's skills by motivating them toward innovation (Fisher 2011).

Hypothesis H1: There is a positive influence of a project manager's perceptions on delivering successful innovation in a construction project.

2.8 Delivering successful innovation in construction projects

Project management is the most common activity in construction projects to adopt innovation. Though many believe this approach is imperfect and is required to combine between project management and the innovation process (Murphy, Heaney & Perera 2011). The increase in the role of innovation in the construction industry results in identifying the factors that influence successful innovation. The author argues that social psychology has a direct impact on the climate of innovation. Organisational culture, leadership, and team spirit are three levels of social psychology that affect innovation diffusion results and business performance. Mutually, leadership and team spirit have an indirect contribution to the innovation diffusion results of an organisational culture. Hence, the author justifies that organisational culture is important for the successful diffusion of innovation. The culture for innovation must be adopted by an organisation to encourage team members to develop new ideas (Dulaimi et al 2002). The organisation must ensure that the culture of innovation between members and managers is in place and understood. In addition to that there is a significant role for managers by encouraging an innovative climate within the team and contributing to the organisational culture by the association of novel ideas and adopting innovation efforts between team members. Therefore, the need increases to develop innovative leaders to encourage innovative traits among team members within an organisation (Panuwatwanich, Stewart & Mohamed 2008). The innovation orientation can occur in the project manager's leadership style. The innovation of the project manager refers to the amount of reinforcement and encouragement of the innovation orientation of his subordinates. The innovation orientation between the project teams depends on the ability of team members to adapt to changing situations, and the contribution and association of new ideas (Creasy & Anantatmula 2013).

Furthermore, factors such as relationships between project participants, project features and characteristics, construction company features, and industry features influence the level of innovation among project parties to deliver successful innovation. The relationship between project participants can also influence the success of innovation. For example, clients usually review several types of solutions, and manufacturers as well as specialist suppliers are a source of innovation because they are able to provide the construction companies and projects with different or new solutions. Therefore, innovation is influenced by relationships among individuals and organisations within the construction industry and between the construction industry and external bodies such as research organisations, universities and professional institutes. In addition to that, the management of relationships between client, consultant, contractor, subcontractor, supplier, and other project participants must be applied to ensure successful innovation (Barrett & Sexton 2006; Blayse & Manley 2004; Bosch-Sijtsema & Postma 2009; Bygballe & Ingemansson 2014; Slaughter 2000). The client can foster innovation by applying pressure on project parties to enhance performance, maintain the required standards, and achieve innovation requirements. Also clients can promote innovation in construction projects by making innovative characteristic demands, taking a positive involvement role, diffusing information, and effectively coordinating between parties. Contractors can be considered as mediators to apply organisational innovations, and manufacturing companies develop innovative processes and products (Ozorhon 2012). Also, innovation and productivity can be enhanced by long-term relationships and developments between parties. Commitment to continuous collaboration between participants in different projects can foster learning and innovation. In reality, the majority of organisations involved in temporary networks do not have any arrangements for joint plans further than the project (Barrett & Sexton 2006; Bosch-Sijtsema & Postma 2009; Blayse & Manley 2004; Bygballe & Ingemansson 2014; Dubois & Gadde 2002).

Hypothesis H2: There is a positive influence of the project manager's leadership on delivering successful innovation.

Project features and characteristics appear to influence the development of information and the creation of knowledge in the context of implementation. A project with certain characteristics and features that cannot be executed with traditional methods requires the development of new solutions. Managing innovation involves carrying out properly the identification of risks resulting from new solutions and managing the required changes in a complex system without creating unexpected consequences (Bygballe &

Ingemansson 2014; Dubois & Gadde 2002). Risk is a major factor usually associated with the implementation of innovation in constriction project (Slaughter 2000). In construction projects the tradition of sub-contracting means that new solutions must be discussed between project parties. This influences the level of innovation based on the ability to change, the different level of interest, and the integration of systems between project parties (Bygballe & Ingemansson 2014; Dubois & Gadde 2002). That is consistent with the argument that both manufactures and suppliers are considered as the primary sources of innovation in the construction industry. Also, a specialist contractor has the ability to contribute into related construction innovation. Therefore, the negotiation of innovation-related changes or requirements is essential for successful implementation between construction teams (Slaughter 1998; Slaughter 2000).

Hypothesis H3: There is a positive influence of the project manager's capabilities on delivering successful innovation

The construction company plays a significant role in delivering successful innovation in construction projects, such as its organisational ability to exchange learning and knowledge between projects and the company. The organisation benefits from the ability to implement new solutions or problem-solving on projects and to transfer the results at an organisational level (Bygballe & Ingemansson 2014). There are different types of difficulties that could limit the benefits of transferring knowledge from former projects such as difference in objectives, time and resources, and also the difficulties in the organisation to integrate transferred knowledge into existing knowledge within the company system (Blayse & Manley 2004; Bygballe & Ingemansson 2014; Dubois & Gadde 2002). Obtained knowledge from innovative projects can be transferred to an organisation's projects by adopting a supportive strategy, focusing on lessons learned and best practices. The strategy must adopt changes and overcome organisational difficulties by endorsing knowledge-sharing across project boundaries through personal communication across projects, coordination roles between projects, cross-project teams or adopting an incentive structure depending on team performance (Bosch-Sijtsema & Postma 2009). In addition to that, quality of resources, team experience, attitude, behaviour, and adopted processes for development are prominent features for construction companies toward successful innovation. Within the same context, culture, capacity, and champions of innovation are part of the organisation's resources as well as individuals' abilities, the knowledge recording system, and the strategy for innovation

(Bygballe & Ingemansson 2014). Innovation champions refer to individuals that have impetus and are faithful to endorsing innovation in the construction industry (Kissi, Dainty & Liu 2012).

Industry features in the general overview show an obstruction to innovation because of the disintegration and detached responsibilities of project parties (Bygballe & Ingemansson 2014). Also, a short-term perspective enhances performance but obstructs innovation and technical improvement. The diffusion of ideas and problem-solving practices are hampered because of the unavailability of couplings in the construction industry (Dubois & Gadde 2002). However, regulations, standards and different interests interact to influence innovation. The author argues that regulation makers have a significant role in facilitating innovation within the construction industry while considering industry-specific knowledge during the creation of regulations and policies. The policies must encourage innovation instead of price competition. Traditional procurement systems are based on the lump sum contract and this does not facilitate innovation within the industry. Countries such as the UK encourage other types of procurement that encourage partnering between parties to improve innovation levels (Bygballe & Ingemansson 2014; Dubois & Gadde 2002; Lloyd-Walker, Mills & Walker 2014) and a similar type has been adopted by the Singapore construction industry to achieve better team integration and innovation (Dulaimi et al 2002). For example, a piece of research based on the UK construction industry found that adopting Public Private Partnership/Private Finance Initiative (PPP/PFI) facilitates and enhances the opportunities for approaches of creativity and innovation from client and contractor. Because this procurement approach describes the required deliverable rather than the details of execution inputs, it allows contractors to compete based on the capability to develop novel ideas and innovative approaches to execute the project (Li, Akintoye, Edwards & Hardcastle 2005; Lloyd-Walker, Mills & Walker 2014). To the same extent "a design-build, construction management, project management or BOOT" is able to enhance innovation results (Blayse & Manley 2004). The same concept has been confirmed and identified as a key driver for innovation in construction (Ozorhon 2012).

2.9 Theories of innovation

The construction industry has a wide range of new ideas but the rate of innovation is less than in most other industrial sectors. Also, innovation work is mostly oriented toward process enhancement rather than deliverable improvement (Bosch-Sijtsema & Postma 2009; Dubois & Gadde 2002; Ozorhon, et al 2010; Winch 1998; Panuwatwanich, Stewart & Mohamed 2008; Yepes et al 2015). Less research and development activity in innovation could be the reason for limiting innovation development and the resultant inefficiencies in the construction field (Dulaimi et al 2002). On the other hand, a research based on innovation within the construction context explains that there are several arguments around the traditional measures of innovation to fit or not fit the construction features. However, the possibilities of improving the level of innovation within the industry are potentially high (Bygballe & Ingemansson 2014). The nature of the construction industry and the uniqueness of each construction project results in several innovation implementation theories that depend on a variety of variables. Therefore, the organisation must identify, utilise and enhance the factors influencing the ability to innovate (Blayse & Manley 2004; Hartmann 2006; Yepes et al 2015). Construction differs from other industries in that innovation is not implemented within the organisation but on the construction projects themselves. Moreover, the engagement of different stakeholders makes it necessary to negotiate innovative ideas with other parties (Blayse & Manley 2004; Bygballe & Ingemansson 2014; Ozorhon 2012; Slaughter 1998; Slaughter 2000; Winch 1998). A study contributes to the construction innovation by establishing risk assessment methodology for innovation which is "failure mode and effect analysis". And concludes that innovation failure is often result from stakeholder mismanagement and recommend that management approach must associate with a stakeholder centred approach. Therefore, delivering successful innovation is depending on assigning the right participant competencies to the right place at the proper stage (Murphy, Heaney & Perera 2011). A study on project-based contexts categorised traditional innovation management into three major contexts: organisational contexts tending to achieve or ignore innovation; slack resources that encourage or discourage innovation; and the usefulness of the innovation idea collectively. The researcher found that traditional innovations are applicable to a project-based organisation. The nature of the project-based organisation makes it constantly innovative, because the projects are unique and the desired outcome is to achieve the aims and objectives of the participants (Dubois & Gadde 2002; Keegan & Turner 2002). Innovation in project-based organisations is associated with managing innovation over organisational boundaries, and between independent suppliers, manufactures, clients, consultants, and regulatory bodies (Ozorhon 2012). Innovation can be categorised into three stages: as a process, as a discrete item, and as an attribute of the organisation (Baregheh, Rowley & Sambrook 2009). Also, the project-based organisation is inherently flexible and tends to innovate. Likewise, the owner's contribution to the project can influence innovation and the project's outcome (Hobday 2000; Keegan & Turner 2002). Also, several studies explain that early engagement of the supplier can contribute to the project and result in enhanced project outcomes which lead to innovation (Dulaimi et al 2002; Gentry & Savitskie 2008; Naoum and Mustapha 1994). Also, early engagement of architectural and structural designers is considered to be an important source of innovation (Slaughter 2000). Early engagement of project stakeholders can also influence the project management's ability to innovate by increasing the possibility of making project objectives understood and complying with the various project phases. Such engagement most probably would obtain end-user satisfaction (Lloyd-walker, Mills & Walker 2014; Ozorhon 2012). Cooperation among other firms in the construction industry will lead to innovation in projects, for example, cooperation in the form of subcontracting, strategic alliances, innovation networks, associations, and joint ventures (Bosch-Sijtsema & Postma 2009).

Technical innovation and organisational innovation are influenced by business performance and organisational type. Also taken into consideration are the economic conditions during training and changes made within the organisation toward innovation. A system of motivation and encouragement between client and project participants to share benefits and incentives from innovation can enhance the interest in innovation among parties (Bygballe & Ingemansson 2014; Dulaimi et al 2002; Lloyd-Walker, Mills & Walker 2014). A successful management uses incentive structures to guide decision-making toward innovation (Slaughter 2000; Winch 1998).

Implementation strategy in construction requires models of innovation that consider the magnitude of change and the expected correlation between innovation, components and systems (Slaughter 1998). There are five well-known models of innovation in construction identified as incremental, modular, architectural, system, and radical which guide the construction company during the selection and implementation of innovation. They are shown in **Table 2.1**. In the construction industry the incidence of innovation is usually associated with the diffusion and adoption of new practices because of the developments in technology in the construction business. Construction innovations are considered incremental instead of radical. Incremental innovations are common in the construction industry and implemented within construction companies. Modular innovations in the construction industry often appear in manufactures and suppliers. Architectural innovations require knowledge and control over components and systems which can be performed by contractors and clients. System innovations associated with technical competence are similar to modular innovations, and require knowledge and control, as in architectural innovations. This competence must be composed with organisational authorities to guarantee association and integration. Radical innovations are developed within companies that have strong competences of engineering and science. Innovation that is categorised under a certain model for one field can be categorised under another model for a different field depending on the company view of the amount of change and linkages to other components and systems (Blayse & Manley 2004; Bygballe & Ingemansson 2014; Murphy, Perera & Heaney 2015; Norman & Verganti 2014; Ozorhon, Abbott & Aouad 2013; Slaughter 1998).

These five models of innovation assist planning the implementation of activities but are not aimed at directing the management of activities during the project's execution (Murphy, Perera & Heaney 2015). Later on a proposal was made by reputed researchers concerning the implementation of innovation within the construction industry. It described six stages of innovation based on theoretical and empirical literature. The framework consists of the identification of innovation activities: evaluation, commitment, comprehensive preparation, effective use, and post-use evaluation (Murphy, Perera & Heaney 2015; Ozorhon 2012; Ozorhon, Abbott & Aouad 2013; Slaughter 2000). It can be concluded that the five models can be identified with the existing resources of the organisation in order to develop strategy and implement innovation. Whereas, the six stages is consider construction activities that influence supply and the installing of innovative activities by manufacturers and suppliers. However, there was no consideration for the diversity of stakeholders, and project constraints during implementation such as limited time and budget (Murphy, Perera & Heaney 2015).

There is a more appropriate method used to develop new management tools suitable for sustainable innovation in the construction industry and it is termed "process modelling". The expression "conceptual information modelling" is also used to detail the data collected from the construction project and to build up the significance of the process models for the communication of innovative ideas and procedures in the construction field. Conceptual information modelling is a predecessor to process modelling, used in developing a communication tool to use in the construction field. There is an argument that when process modelling is developed to make innovative products, the project will progress improvements in existing processes. That means innovation modelling which recognises innovative products usually results in improvements in processes. Therefore, process improvements are associated with and sustain product innovations (Murphy, Perera & Heaney 2015; Slaughter 2000).

Model	Criteria
Incremental Innovations	• No major change, and depends on existing knowledge and experience. • Occur constantly and predictably. • Develops small improvements • Range of parties: manufacturers, suppliers, contractors, Client, and operator.
Radical Innovations	• New science or technology to the industry. • Rare and unpredictable appearance and impacts. • Develops new comprehension of phenomena and articulating approaches toward solving issues. • Based on research from outside the industry introduced into construction industry from several avenues.
Modular Innovations	• Concept significantly changed considering same components, unchanged linkage to other components and systems. • Developed within the organisation. • Implement parties participated in selection or development of other components.
Architectural Innovations	• Change in other components' links and systems, components remain with small changes. • Needs a change in series of collaborating components and systems. • Developed by a company that has an interest in changing the existing linkages. • Successful implementation requires strong understanding of the necessary changes in the linkage by developer and applicator. • Usually introduced to the construction industry in the field by sub-contractors and specialists.
System Innovations	• Integrated innovations, multiple innovations, incorporate independent innovations. • Make new or improved performance or functions. • Linkages are obvious between innovations. • Requires changes to other components and system. • Has wide range of sources. • Associated with clear connection and modification between components of the system. • Frequently appear in construction industry; and developed by a company that has an interest to change the existing configurations of components and systems.
(Blayse & Manley 2004; Bygballe & Ingemansson 2014; Murphy, Perera & Heaney 2015; Ozorhon, Abbott & Aouad 2013; Slaughter 1998)	

Table 2.1: Five models of innovation in construction

2.10 Diffusion of innovation theory

Diffusion of innovation is a process to communicate innovations though various channels during the project's duration between the members of the system. It makes the project's participants share each other's information in order to be able to reach a common understanding (Ozorhon, Abbott & Aouad 2013). Diffusion of innovation consists of three stages forming, an S-shape. The first stage is initiation and implementation; the second stage is adoption; and the third stage is saturation. Several studies and meta-analysis reviews argue that innovation diffusion modelling is an approach to study the S-shape curve with a significant contribution to the innovation diffusion context. Diffusion can be explained as a process to connect innovation with members of the system within a period of time (Kale & Arditi 2009).

Diffusion of innovation is an expanding process of innovation between organisations (Panuwatwanich, Stewart & Mohamed 2008). A well-known study detects two basic processes to implement new ideas. It concludes that the rate of diffusion of new ideas depends on the frequency of adoption of a new idea within a population over a specific period. Then, innovations must be installed and commissioned to meet the required technical specifications and to achieve benefits for the organization's strategic plan (Winch 1998).

Reviews of innovation in the construction industry argue that organisations need to adopt new forms to overcome increases in complexity. These conclude that organisations tend to increase their dependence on projects to organise the execution of complex deliverables. Several related factors lead innovation within the industry such as the increase in demand for new types of building materials, construction methods, information and communication. Technology influences construction toward innovation such as using modelling to build a prototype to improve decision-making and to plan, define the scope, and execute the project (Gann & Salter 2000).

A study on the innovation climate shows that effective diffusion of innovation indicates a bottom-up approach for innovative ideas and a top-down approach to adopt and implement innovation. The study refers to a survey of 900 firms in different industries, including construction, and concludes that innovation plays a significant role and has a positive impact on increases in corporate performance (Panuwatwanich, Stewart & Mohamed 2008). Similarly, a study based on project management addressed construction innovation and argued that bottom-up decision-making is influenced by a supportive environment and mentioned, for example, project alliances that may lead to innovation (Lloyd-Walker, Mills & Walker 2014).

2.11 Theoretical underpinning

The literature review provides the link between the project manager's perceptions and delivering successful projects. Based on that, two global variables can be identified. The first variable is the project manager's perceptions, as the Uni-dimensions independent variable consists of five important factors that most likely influence innovation: Leadership, Capabilities, Personality Traits, and Skills. The second is delivering successful innovation as the Uni-dimension dependent variable.

2.11.1 Project manager perceptions

The discussion of the global independent variable in the following part reflect factors and items recognised from the literature review above and the next parts will try to summarise the link between these factors and items and explain the value of items for the project manager's perceptions based on the subjects discussed in this chapter and further supporting studies in the construction industry context.

A. <u>Leadership</u>

Leadership has a direct impact on subordinates' performance (Kissi, Dainty & Liu 2012) and drives their innovation activities (Bossink 2004). Also, leadership has a direct impact on innovation between project team members (Panuwatwanich, Stewart & Mohamed 2008) and has an important individual effect on innovation (Kissi, Dainty & Liu 2012). Leadership is a key management tool for successful innovation (Bossink 2004; Ozorhon 2012). The project team must be led by a good project manager to achieve project success (Bakar et al 2011), and he or she must have a strong leadership style (Fisher 2011). The leadership part of a project manager's role provides direction to project teams and this results in achieving project goals (Dulaimi, Nepal & Park 2005). Decision empowerment for innovation champions (Bossink 2004; Blayse & Manley 2004), including project managers, is an important factor for delivering successful innovation to overcome resistance to innovation (Dulaimi, Nepal & Park 2005), and a major factor in delivering innovation (Kissi, Dainty & Liu 2012). Organisations supporting innovative behaviour encourages project managers to act as innovation champions (Kissi, Dainty & Liu 2012). Based on the presented arguments in this chapter of the literature review and further contexts presented below, leadership in innovation consists of the following major items:

The sharing of both knowledge and experience is identified by the literature to as important factor of the leadership of a project manager and been clarified thus**:** the integration between project teams enhances the level of innovation (Blayse & Manley 2004; Lloyd-Walker, Mills & Walker 2014). Working as an integrated project team makes knowledge shared and transferred between members (Ibrahim, Costello & Wilkinson 2011). Project teams formed of different skills and knowledge enhance the efficiency and effectiveness of project delivery (Baiden, Price & Dainty 2006). This type of collaboration with these differences between parties usually leads to innovation (Lloyd-Walker, Mills & Walker 2014). The project manager has a significant role in requesting project team contributions and the sharing of information (Fisher 2011). The project manager should have sufficient information to manage innovation methodology between stakeholders and mitigate the risk of abandoned constraints (Bossink 2004; Murphy, Heaney & Perera 2011). **Relevant experience and technical knowledge** is one of the major items of the project manager's leadership**:** essential experience and knowledge are needed to obtain successful management of the construction project by project managers (Edum-Fotwe & McCaffer 2000). Relevant experience and technical knowledge influence the project manager's perceptions of success (Muller & Turner 2007). Managing projects at a high level of innovation requires that project managers have great relevant experience (Keegan & Turner 2002). In addition to experience and technical knowledge **Financial and procurement knowledge** also been identified**:** focusing on enhancing procurement improves the delivery process (Baiden, Price & Dainty 2006). Recognising the benefits of the procurement method that encourage project team integration and results in enhanced innovation results (Blayse & Manley 2004; Dulaimi et al 2002; Lloyd-Walker, Mills & Walker 2014). **Organising responsibilities between project members:** integrating project teams is merging various disciplines with various goals, requirements and cultures into a cohesive associate team, besides improving team culture and attitudes (Baiden, Price & Dainty 2006). Innovative leaders assign roles and responsibilities for project teams to perform and act taking into account the new goals and requirements of innovation implementation (Bossink 2004). **Motivating project teams:** strategy that gathers project teams based on their collective strength contributes to project success (Baiden, Price & Dainty 2006). A project manager leads others to be creative and innovative by adopting a suitable leadership style that involves motivating the project team toward innovation (Bossink 2004; Fisher 2011). Leadership forms an atmosphere that supports creativity and innovation between project teams (Kissi, Dainty & Liu 2012). A project manager can motivate, encourage and inspire team members to work together to innovate (Bossink 2004; Dulaimi, Nepal & Park 2005) and to achieve goals and objectives (Kissi, Dainty & Liu 2012). **Encouragement of an innovative climate/environment between project teams:** in the construction industry innovation is implemented at project level (Blayse & Manley 2004; Bygballe & Ingemansson 2014; Ozorhon 2012; Slaughter 2000; Winch 1998). Project environment that support innovation and adequate resource would encourage project managers to involve into innovation activates and fostering innovation implementation (Dulaimi, Nepal & Park 2005). Leadership has an indirect performance impact on shaping climate and environment between project team members (Kissi, Dainty & Liu 2012). Thus, the project manager has a significant role in innovation management **(**Meng & Boyd 2017). And, the project manager can significantly encourage the innovation climate of the team (Bossink 2004; Panuwatwanich, Stewart & Mohamed 2008) and influence innovation behaviour among team members (Kissi, Dainty & Liu 2012). **Support of novel ideas:** a supportive leadership style by superiors encourages an environment of creativity among subordinates (Kissi, Dainty & Liu 2012). A project manager can support new ideas by motivating team members and encouraging members to work together toward innovative ideas (Dulaimi, Nepal & Park 2005). **Support new solutions or problem solving:** the project manager can participate to increase the innovation level by contributing to the problem solving process (Dulaimi, Nepal & Park 2005). Therefore, an effective project manager must be flexible (Fisher 2011).

B. Capabilities / Competences

Competences are characteristics needed to perform certain tasks successfully, combining knowledge, technical skills, and performance to contribute to the personal effectiveness of the project manager (Murphy, Perera & Heaney 2015). The project manager's competence is a very important factor in the successful execution of a project. Elements such as technical skills, commitment, administrative ability, and competence are important for the project manager during the project execution phases (Babu & Sudhakar 2015). Competences contribute to either the success or failure of innovation implementation in the project (Murphy, Perera & Heaney 2015). Competences influence innovation whereas project leaders have to take decisions about technical issues and design issues related to new ideas and innovation (Bossink 2004).

Management of innovation at the project level is influenced by the project manager's knowledge of managing construction projects (Bosch-Sijtsema & Postma 2009). According to that and to the required competences of the project manager in managing the project there are major items identified from the literature that, it is argued, have an influence on delivering innovation in construction projects. These are explained as follows:

Understanding of the required results and deliverables: the construction project manager is responsible for the general success of the project within constraints and requirements (Edum-Fotwe & McCaffer 2000). Lack of clarity and other uncertainties result in difficulties for the project manager's attemps at innovation. Therefore, project managers must be able to understand the requirements of the project's outcomes to be able to manage innovation (Bosch-Sijtsema & Postma 2009). **Understanding project processes and technology:** these assist the project manager in delivering innovation as explained by the argument that innovation champions in construction need to have technical capability to be able to overcome the uncertainty of innovation (Bossink 2004; Blayse & Manley 2004). The project manager has various roles as a champion for innovation (Dulaimi, Nepal & Park 2005). He must be able to do effective analysis based on clear understanding of the project during the implementation of innovation (Murphy, Perera & Heaney 2015). **Project management knowledge:** is an essential aspect during execution and implementing of innovation because the project manager must have information and a good knowledge background related to the specific work to be executed and installed (Crawford 2005), including the ability to manage the plan for execution of the project activities and to use project management tools and techniques such as identifying KPIs. The project manager must be able to plan activities and control their execution to achieve successful project performance (Fisher 2011). Successful innovation requires planning and interfacing capability with related stakeholders by project leaders (Bossink 2004). Also associated is the ability to recognise the required activities to implement innovation using the necessary resources and monitor their progress (Murphy, Perera & Heaney 2015). The project manager must understand CSFs to facilitate their decision making. The project manager needs to apply the right management techniques to plan and execute the construction project successfully (Babu & Sudhakar 2015). **Evaluate, measure, and determine the project team integration:** collaboration among and within project teams is essential for innovation in construction projects (Ozorhon 2012). Also, cooperative relationships enhance decisions and creativity in development projects (Ozorhon, Abbott & Aouad 2013). A well-integrated project team drives innovation successfully (Blayse & Manley 2004; Lloyd-Walker, Mills & Walker 2014). Project manager can integrate the required information from several sources besides integrating and facilitating team members' creative ideas (Dulaimi, Nepal & Park 2005). Innovation difficulties such as additional cost, lack of experience of certain project teams, resistance to change, and unavailability of required products can be overcome by good project team integration (Ozorhon 2012). **Building trust** is another major item. Trust between collaborating firms is a factor with sub-factors of cognitive, affective, and behaviour, including reciprocity. Trust means both organisations within the collaboration have confidence in each other regarding the collaborative outcomes (Bosch-Sijtsema & Postma 2009). Building trust between leaders and followers enhances commitment to the organisation's goals and improves project team members' ability to innovate and support new ideas (Kissi, Dainty & Liu 2012). Also, building trust is one of the results of respectful relationships between project parties which create a supportive environment to discuss and share knowledge (Lloyd-Walker, Mills & Walker 2014). The construction project manager has a role in motivating the project team in pursuit of trust and commitment between each other. And this type of trust leads to innovation by encouraging team members to address problems without being worried about the negative outcomes. Personal contact between project manager and team members tends to develop an environment of trust that leads to develop solutions by innovation champions (Kissi, Dainty & Liu 2012). **Focus on people** is important for project managers to influence innovation because an effective project manager needs to be people-oriented (Fisher 2011). The project manager's focus on project team members leads to increase his attention to make an effort toward innovation which makes individuals see opportunities and create innovative ideas (Dulaimi, Nepal & Park 2005). Providing support to project team members by the project manager leads to creativity and innovation and challenges individuals to think creatively, and influences individual innovation behaviours and performance (Kissi, Dainty & Liu 2012). **Ability to adapt to change** is one of the project manager's characteristics that assist his project management capabilities and influence his ability to accommodate innovative ideas. Also, the talent to contribute and combine new ideas influences the project manager's capability to be innovation-oriented and to make the required changes to achieve innovation (Creasy & Anantatmula 2013). **Understanding**

project team members is a key part of the project manager's influence on innovation. The project manager must identify team members' characteristics before selecting a suitable leadership style (Dulaimi, Nepal & Park 2005). The quality of relationship between managers and their project teams influences the potential for innovation because good relationships enhance the innovation environment. In the same way, it has been argued that encouraging team members to think in different ways about certain issues can increase the capability to develop their innovative behaviours (Kissi, Dainty & Liu 2012).

C. Personality Traits

There is an argument that project manager's personality traits are influencing project success and successful innovation (Malach-Pines, Dvir & Sadeh 2009). There is evidence from the literature of innovation in the construction industry that personal responsibility and flexibility toward innovation enhances the project manager's ability to overcome the resistance of the project team during the implementation of innovation (Kissi, Dainty & Liu 2012). The following major items identified from the literature have an influence over the delivery of innovation:

The project manager needs to **adopt a personality that inspires respect among the project participants.** In order to achieve successful innovation, project leaders must be able to respect, inspire, support, and improve subordinates' performance (Bossink 2004). Furthermore, obtaining the respect of team members facilitates the achievement tasks of the project manager (Fisher 2011). Innovative **behaviour** is a major item of the project manager's personality traits required for innovation. The project manager's behaviour has a direct impact on his efficiency (Fisher 2011). The project manager's ability to foster innovation is connected with the production and applying of ideas, and he also inspires team members towards creativity (Kissi, Dainty & Liu 2012). Rewards for innovative leadership methods are important for successful innovation implementation (Bossink 2004). **A positive attitude** is considered as a major item among a project manager's personality traits in order to achieve innovation. A positive attitude, showing kindness and open-mindedness, encourage creativity and innovation among project teams **(**Ozorhon 2012). Moreover, others consider a project manager with a positive attitude as an effective project manager (Fisher 2011). Project manager **flexibility** in managing innovation is another major item. Innovation is associated with flexibility in projects and effective management of flexibility is correlated with acquisition and development of personnel ability (Murphy, Perera & Heaney 2015). A project manager's flexibility can influence his performance to adapt to unexpected problems and new ideas (Fisher 2011). A project manager is required to be able to respond to changing situations and not to adhere rigidly to processes if they prove to be inadequate (Dainty, Cheng & Moore 2003). Innovative project manager is most likely flexible and problem solver (Malach-Pines, Dvir & Sadeh 2009).

Hypothesis H4: There is a positive influence of a project manager's personality traits on delivering successful innovation.

D. Skills

Within the organisation's resources it is important to have skills that successfully adopt innovation (Blayse & Manley 2004). System integration requires skills to integrate components into a cohesive function (Winch 1998). Construction project managers need additional non-engineering knowledge and skills to comply with their professional responsibilities (Edum-Fotwe & McCaffer 2000). The development of competence is based on the skills and effective performance of construction project managers (Fisher 2011). A variety of influencing skills is required to be adopted by project managers to convince other project participants of the advantages of innovation and to ensure the supportive implementation toward delivering successful innovation (Dulaimi, Nepal & Park 2005). A great number of studies argue about the importance of the project manager's skills to the success of a project. From this context and based on the above literature review, the skills influencing the delivery of successful innovation consist of the following major items:

Evaluation of the project and its financial outcomes is an essential skill (Bakar et al 2011; Cserhati & Szabo 2014; Davis 2014; Edum-Fotwe & McCaffer 2000; Fisher 2011; Munns & Bjeirmi 1996; Jari & Bhangale 2013; Walton 1984). This evaluation can influence the project manager and the project team's decisions (Davis 2014). The project manager is required to ensure that the status of the project is understood and to monitor costs and timings in cooperation with the financial manager (Gann & Salter 2000). The evaluation would stand on the actual performance of the construction phase as affected by accepted innovation. It will identify the areas of improvement or failure due to the implementation of innovation, besides finding out if that implementation led to organisational benefits (Slaughter 2000). **Communication skills:** an effective project manager must be able to communicate with project teams (Fisher 2011). The importance of communication skills appear on large and complex projects creating great challenges to effective communication that will impact on innovation (Blayse & Manley 2004). Project managers have to use mechanisms and tools to enhance knowledge sharing among project team members to enable innovation (Ozorhon, Abbott & Aouad 2013). **Planning and control skills:** project management and control over resources, material, labour and all the project's related activities are essential instruments for the project's success (Bosch-Sijtsema & Postma 2009). Control over the required resources and main project parties creates a significant influence for decision-making and can affect the guidance of change and modifications with respect to implementation of innovation (Slaughter 2000). **Managerial skills:** managerial skills are essential for the project manager to successfully influence innovative ideas (Dulaimi, Nepal & Park 2005). Managerial skills can foster innovation (Ozorhon, Abbott & Aouad 2013). A variety of managerial skills is essential to manage complex projects (Bakar et al 2011). The project manager has an important role in coordinating project participants and making relevant decisions during the implementation of innovation (Slaughter 2000). **Negotiate innovative ideas:** The nature of the construction project makes the negotiation of innovative ideas among project participants essential (Blayse & Manley 2004; Bygballe & Ingemansson 2014; Slaughter 1998; Slaughter 2000; Winch 1998). Therefore, the project manager must be able to convince the various project parties with innovative ideas (Dulaimi, Nepal & Park 2005; Slaughter 2000) and obtain the required approval. Skills such as technical, managerial and social are essential for the project manager to negotiate successfully innovative ideas (Dulaimi, Nepal & Park 2005). The project manager during the implementation of innovation will coordinate, discuss and negotiate the relevant matters between project teams and will make important decisions to achieve a successful innovation (Slaughter 2000).

Hypothesis H5: There is a positive influence of the project manager skills (non-engineering) on delivering successful innovation.

2.11.2 Delivering successful innovation

The discussion of the global dependent variable in the following part reflects factors and items recognised from the literature review above and the arguments below and will try to explain the value of these items for the successful delivery of innovation based on the subjects discussed in this chapter and further supporting studies in the construction industry context.

Organisational culture for innovation: the organisation's innovative climate reinforces successful innovation (Bossink 2004; Dulaimi, Nepal & Park 2005) and has a strong positive relationship with innovation in construction at project level (Gambatese & Hallowell 2011). The creativity and innovation climate is associated with a rise in overall productivity, and influence the project manager's efficiency (Powl & Skitmore 2005). The culture for innovation must be understood and applied properly by project members and managers. Within the culture for innovation, managers are responsible for associating and adopting innovative ideas to contribute to the organisational culture (Panuwatwanich, Stewart & Mohamed 2008). The organisation's commitment to innovation often shows by the allocation of resources to the application of innovation, and in statements and acknowledgements to use innovation (Slaughter 2000). It is important within an organisation's to have an attitude and processes that lead to innovation (Blayse & Manley 2004; Dulaimi et al 2002; Lloyd-Walker, Mills & Walker 2014). Facilitating the availability of resources enhances the possibility of achieving innovation. Also it has a positive impact on the project manager's perception of the innovative climate and environment between project teams to produce and apply innovations (Kissi, Dainty & Liu 2012). The organisation's senior management must be supportive of innovative behaviour implementation as this makes project managers commit to the delivery of successful innovation (Kissi, Dainty & Liu 2012). **Innovation orientation:** the project manager can be innovation-orientated to the extent of the amount of reinforcement and encouragement given to innovation between team members **(**Creasy & Anantatmula 2013). An individual's innovation orientation is influenced by the organisational climate for innovation (Dulaimi, Nepal & Park 2005). Innovation orientation is influenced by the ability to adopt change and contribute to innovative ideas (Creasy & Anantatmula 2013). Managers who consider innovation orientation have a positive impact on environmental innovativeness (Bossink 2004). **Form of true innovation** in construction projects is executing novel ideas in the project to solve problems successfully. After that, the organisation's ability to develop and use this innovation is influenced by the appropriate recording of and learning from innovation, so that it can be applied for future projects (Barrett & Sexton 2006; Lloyd-Walker, Mills & Walker 2014). The benefits of successful innovation executed on one project can extend to benefit future projects (Slaughter 2000). **Market competition:** recognising an opportunity to innovate is the first part of innovation process cycle. Improving an organisation's capability to innovate, results in an improved market position (Barrett & Sexton 2006; Slaughter 1998). Innovation plays a significant role in the organisation's survival and growth in the market (Baregheh, Rowley & Sambrook 2009; Murphy, Perera & Heaney 2015; Slaughter 1998; Yepes, Pellicer, Alarcon & Correa 2015), and also positively influences the organisation's reputation and long term competency. The timely implementation of innovation benefits and enhances the reputation of the organisation (Ozorhon 2012; Slaughter 2000). Construction companies need to innovate at certain levels to stay competitive (Gambatese & Hallowell 2011). Construction organisations are innovating because of the various benefits, such as winning bids for projects, enhancing financial outcomes, maintaining the ability to compete, and improving their competitive advantage based on adopted technology (Blayse & Manley 2004). **Improving deliverables:** implementation of innovation within the construction industry provides evidence that there is improvement and enhancement in performance (Slaughter 2000). There are correlations between improving construction performance by managing innovation and developing technical capabilities in the project (Gann & Salter 2000). There is evidence for innovation benefits to the construction project such as enhanced performance by being cost effective, increased probability of cost saving for future projects depending on experience gained, influencing environmental performance, financial benefits, reduction of project duration, improvements in quality and safety, reduction of waste, and several other benefits based on the project objectives (Kissi, Dainty & Liu 2012; Ozorhon 2012; Slaughter 1998).

2.12 Theoretical framework

From the previous section is a theoretical underpinning of the theoretical framework developed and summarised in **Tables 2.2, 2.3 and 2.4** for the project manager perceptions factors influencing the delivery of successful innovation with associated variables. These perceptions factors are identified with relevant variables and predict the ranking of relative importance based on observation from the literature review and the theoretical underpinning (**Table 2.4**). Moreover, the theoretical framework illustrated in **Figure 2.2** shows the independent and dependent variables with assigned hypotheses H1 to H5. This section has been made to demonstrate information in both table and figure form, and to form the major items for the questionnaire prior to drafting questions for the survey and to assess the questionnaire structure. The following section will explain the methodology and the survey structure used to collect the data required for this research.

Project manager perceptions			
Perceptions Factors	**Variables**	**Relative literature References Code (Table 2.4)**	**Predicted Ranking based on Observation**
Leadership	1. Transfer and share knowledge and experience. 2. Relevant experience and technical knowledge. 3. Financial and procurement knowledge. 4. Organising responsibilities between project members. 5. Motivate project teams 6. Encourage innovative climate/environment between project teams 7. Supportive of novel ideas. 8. Support new solutions or problem solving	2, 3, 6, 8, 9, 14, 15, 16, 17, 20, 22, 23, 24, 26, 27, 29, 31, 33, 36, 38	Very Important to Innovation success
Capabilities / Competences	1. Understanding of the required result and deliverables. 2. Understanding the project processes and technology. 3. Project management knowledge. 4. Evaluate, measure, and determine the project team integration. 5. Building trust. 6. Focus on people. 7. Ability to adapt change 8. Understanding of project team members.	1, 6, 7, 8, 10, 11, 15, 16, 17, 23, 24, 30, 31, 32	Important to Innovation success

Project manager perceptions (*continue…*)			
Perceptions Factors	**Variables**	**Relative literature References Code (Table 2.4)**	**Predicted Ranking based on Observation**
Personality Traits	1. To adopt a personality that inspires respect among project participants. 2. Behaviour. 3. Positive attitude. 4. flexibility	8, 17, 23, 25, 30, 31	Important to Innovation success
Skills	1. Evaluation of the project and the financial outcomes. 2. Communication skills. 3. Planning and control skills. 4. Managerial skills. 5. Negotiate innovative idea.	3, 6, 7, 9, 12, 13, 15, 16, 17, 18, 19, 21, 28, 32, 35, 36, 37,38	less Important to Innovation success

Table 2.2: Project manager perceptions factors influencing delivering successful innovation

Delivering successful innovation		
Factors	**Variables**	**Relative literature References Code (Table 2.4)**
Organisational culture for innovation	1. Reinforce successful innovation. 2. Understood and applied by members. 3. Associate and adopt innovative ideas.	6, 8, 14, 15, 18, 23, 24, 33, 34, 36
Innovation orientation (Project Manager)	1. Reinforcement and encouragement. 2. Adopt change. 3. Contribute and associate innovative ideas.	8, 11, 15
Form of True innovation	1. Execute novel ideas successfully. 2. Idea to be recorded. 3. Idea to be learned. 4. Idea to be applied for future projects.	5, 24, 36
Market competition	1. Improved organisation's capability for innovation. 2. Innovation to survive and grow. 3. Innovation for long-term competence.	4, 5, 6, 18, 30, 31, 35, 36, 39
Improving Deliverable	1. Implementation of innovation to improve performance. 2. Managing innovation to enhance. 3. Managing innovation to develop technical capabilities. 4. Innovation to develop new solutions	19, 23, 31, 35, 36

Table 2.3: Delivering successful innovation factors

Relative literature - References Code			
Code	**References**	**Code**	**References**
1	Babu & Sudhakar 2015	**21**	Jari & Bhangale 2013
2	Baiden, Price & Dainty 2006	**22**	Keegan & Turner 2002
3	Bakar et al 2011	**23**	Kissi, Dainty & Liu 2012
4	Baregheh, Rowley & Sambrook 2009	**24**	Lloyd-Walker, Mills & Walker 2014
5	Barrett & Sexton 2006	**25**	Malach-Pines, Dvir & Sadeh 2009
6	Blayse & Manley 2004	**26**	Meng & Boyd 2017
7	Bosch-Sijtsema & Postma 2009	**27**	Muller & Turner 2007
8	Bossink 2004	**28**	Munns & Bjeirmi 1996
9	Bygballe & Ingemansson 2014	**29**	Murphy, Heaney & Perera 2011
10	Crawford 2005	**30**	Murphy, Perera & Heaney 2015
11	Creasy & Anantatmula 2013	**31**	Ozorhon 2012
12	Cserhati & Szabo 2014	**32**	Ozorhon, Abbott & Aouad 2013
13	Davis 2014	**33**	Panuwatwanich, Stewart & Mohamed 2008
14	Dulaimi et al 2002	**34**	Powl & Skitmore 2005
15	Dulaimi, Nepal & Park 2005	**35**	Slaughter 1998
16	Edum-Fotwe & McCaffer 2000	**36**	Slaughter 2000
17	Fisher 2011	**37**	Walton 1984
18	Gambatese & Hallowell 2011	**38**	Winch 1998
19	Gann & Salter 2000	**39**	Yepes, Pellicer, Alarcon & Correa 2015
20	Ibrahim, Costello & Wilkinson 2011		

Table 2.4: Relative literature & codes of project manager perceptions factors influencing delivering successful innovation

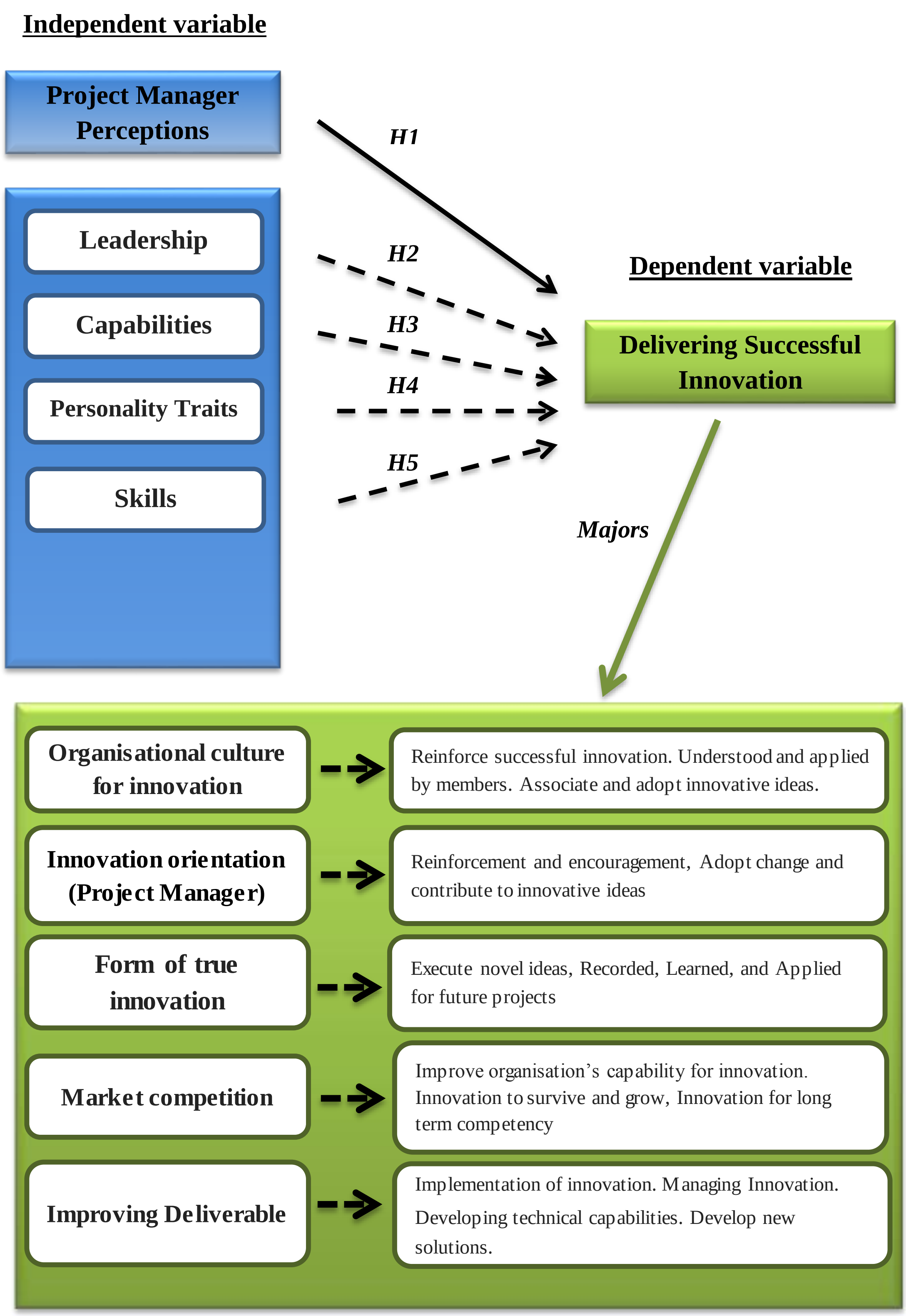


Figure 2.2: Theoretical Framework.

Chapter Three: Research Methodology

3.1 Introduction

This chapter will explain the research methodology used to answer the research questions. This dissertation adopted a quantitative methodology to collect the required data to achieve the objectives of the research. Based on the literature review and conceptual framework my research survey questionnaire was developed. Then the online survey was distributed and focused on participants from the construction field. The data collected will be analysed by data analysis computer software (SPSS). The output information will be used for data analysis, illustration, and dissection of results.

3.2 Research Strategy

The nature of this research topic leads to focus on construction management and interference to site activities execution. Therefore, empirical data is needed to verify the gap between theory and practice. So, a survey questionnaire was designed based on valid theories collected from secondary data. Then the hypotheses can be tested based on the data collected by testing the significance to accept or reject the hypotheses. Also, data analysis will be used to build and verify theories in a conceptual framework (Flynn et al 1990). **Figure 3.1** shows the adopted research process.

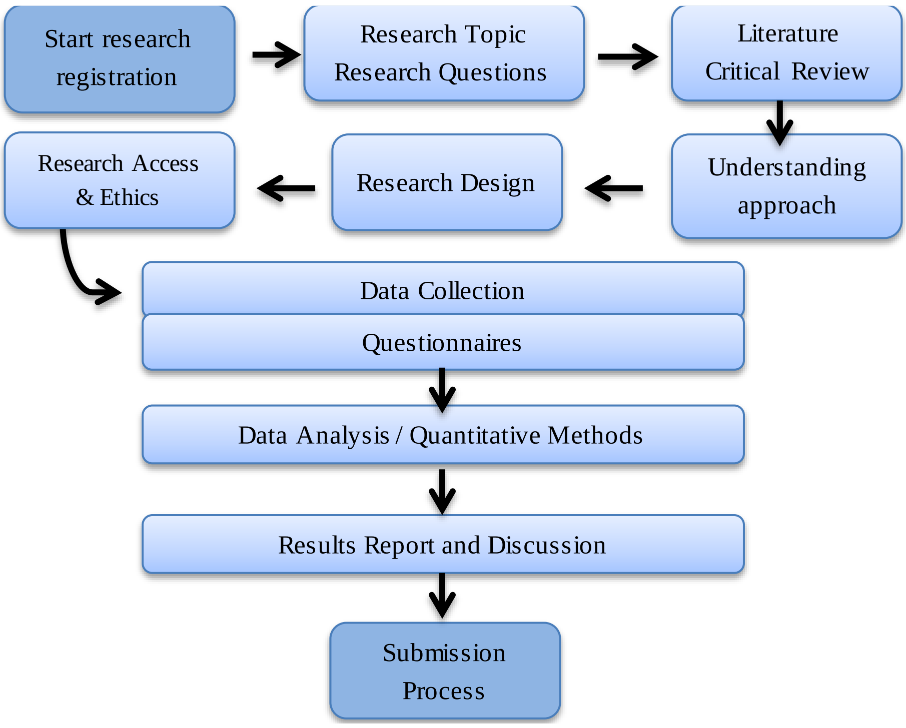


Figure 3.1: **The Research Process** (Saunders, Lewis & Thornhill 2009, p.11).

3.3 Research Approach and Limitation

Based on the existing literature and developed conceptual framework a qualitative methodology was used for this research. It has been observed during reviewing of the literature that the quantitative method has been used for similar studies related to construction management, site operation and project participants' interferences such as Dulaimi, Nepal & Park 2005. In addition to that, this dissertation used quantitative methods because of the relation between qualitative and quantitative research methods which are considered complementary instead of opposing. This relationship is shown in the methodology of research designs that integrates the data of the qualitative method into the quantitative method. Also, this relationship appears in combining the findings of both methods and using the qualitative method to explain the relationship between the findings in the quantitative method. Also, qualitative criteria are used for the appraisal of the research quality of the quantitative method (Flick 2014). Therefore, the literature review chapter examined several examples of case study approaches which have a direct relation with the aims and objectives of this dissertation such as Kissi, Dainty & Liu 2012; Ozorhon 2012; Ozorhon, Abbott & Aouad 2013.

There is number of limitation such as, the focus of this dissertation is on the construction industry and its participants. This study considered the project manager and site manager perceptions factors of project participants that influence project execution phases such as the participants of the client, contractors, subcontractors, suppliers and manufactures. Also, time limitations influenced the number of collected online surveys. Thus, it was not possible to approach the audience several times to encourage them to participate in the online survey (Flynn et al 1990). The nature of the project execution phase and the role of the project manager or site manager limited their ability to give time over to participating in the survey. Different definitions and understanding of innovations limit the ability to encourage project participants that do not consider innovation as essential or necessary for the construction execution phase to participate in the survey. Therefore, these dissertation objectives will raise the awareness in the construction industry of project manager perceptions factors that influence delivering successful innovation in construction projects.

3.4 Collecting Data

In order to collect the required data and information for this dissertation to do data analysis and establish findings used for a discussion of the results, an online survey was created and sent to my audience to answer the questionnaire via a website. E-mails, social media and academic research websites were used to send the online survey's web link. There are arguments to suggest that adopting internet tools to approach possible participant audiences is easy and can be repeated (Huang 2006; Saunders, Lewis & Thornhill 2009) but there is also evidence that online surveys have no significant differences from printed surveys based on similar formats of questionnaire structure. Also, it facilitates the targeting of specific audiences (Huang 2006). Therefore, the online survey method was adopted as it is suitable for the characteristics and constraints of this dissertation and the limitations of time and funding.

3.4.1 Survey

The survey is a standard tool commonly used for quantitative research. This survey includes a group of homogeneous respondents from the construction industry (Flynn et al 1990). Survey methodology is widely used in operation management to collect data from companies (Malhotra & Grover 1998). Also, the survey is common in management research. A pre-survey contact and notice of communication issued to possible participants and encouraged them to participate and to provide feedback (Boyer et al 2002; Saunders, Lewis & Thornhill 2009). The survey method is more practical to collect data with respect to time, distance, and number of approached participants. Respondents' comments space has been adopted for recommendations and additional information so that the study may benefit from their experience (Meredith et al 1989). Data collected from survey is considered representative of a sample population and will be used to test the relationship between the variables (Malhotra & Grover 1998; Saunders, Lewis & Thornhill 2009).

3.4.2 Research Sampling

Approaching and collecting data from an entire population is impractical within these research constraints. Therefore, a random sample selection method was adopted. The sample was selected based on the participants' relevant experience in the construction field to make sure that their answers are relevant to the research context (Saunders, Lewis & Thornhill 2009). The random sample size is 100 participants and the completed questionnaire application found to be 70 respondents representing response rate of 70%. The random sample method is usually used with survey research (Malhotra & Grover 1998). Respondents identified themselves if related or not to the construction industry in the first part of survey, namely, the general information. Then data from unrelated respondents was eliminated. Also, respondents categorised themselves by several characteristics to ensure the sample is representative and relevant to this dissertation. Those characteristics included years of experience, job level, primary role, organisation discipline, and recent working location. There is an argument that sample size for the random method must be balanced between accuracy and findings considering the following measures: confidence of the data collected to represent the characteristics of the population, error margin, and size of total population (Saunders, Lewis & Thornhill 2009). For these measures this research has a confidence in the data collected because it considers a wide range of project participants. The error margin is accepted because the level of required accuracy is not great because the variables are driven from the literature review and the results will be compared to the existing literature as well as other research findings. Also the required output is to identify if there is an influence between the independent and the dependent variable. It is not required to include the entire population of the construction industry in my survey as that is beyond the capability of this study.

3.4.3 Pilot Sample

A pilot sample is required before starting the process of data collection. The pilot sample required time to be sure that the samples were representative. Also, it is used to test and improve the questions' validity and reliability. It will result in refining the questionnaire so that the respondents will not have a problem answering the questions (Boyer et al 2002; Drost 2011; Saunders, Lewis & Thornhill 2009). Five responses were collected and a few enhancement and adjustments were made to the survey questionnaire such as adding hints, a description at the beginning of each part, and examples to explain choices. Pilot sample answers show that respondents actually understand what the question means and their feedback improves the overall questionnaire experience. Face validity process shows that the questions make sense and are suitable for the respondents.

3.4.4 Survey Administration

The survey took less than three weeks from the issuing of the pilot questionnaire to the last respondent successfully completing the survey. The collected sample amounted to 70 respondents including 5 pilot surveys as shown in **appendix B**. Part of the collected sample was eliminated because it was not completed or not related to the construction industry. The total number of successfully completed and accepted surveys amounted to 66 respondents. The random sample method involved different cases from respondents in the construction industry (Malhotra & Grover 1998). Therefore, the collected responses are appropriate and sufficient for this dissertation to do data analysis and establish findings.

3.5 Survey Structure and Measures

The questionnaire was designed to find the effect of variables and factors in the theoretical framework for project manager perceptions and the delivering of successful innovation, which will provide the required data for data analysis. The components of the survey consist of a cover letter with an introduction message including the purpose of the questionnaire and ethical acknowledgment, and then an introduction to the subjects of the three parts of the questions. The structure of the survey consists of three parts as shown in **Table 3.1**. Part 1 is for the demographic characteristics and consists of questions related to general information to identify the representative sample of the population and to link audience experiences to their answers. Part 2 and 3 consists of questions derived from the literature review, theoretical underpinning, and theoretical framework as shown in **Table 2.2** in chapter two. Part 2 deals with project manager perceptions and consists of questions related to the independent variable, as well as the following factors: leadership, capability, personality traits and skills. Part 2 also includes a question for self-rating the importance of these factors. Part 3, delivering successful innovation, consists of questions related to dependent variables and major items. Parts 2 and 3: the variables, factors and major items are explained in detail in the theoretical underpinning section and shown in **Table 2.2** in chapter two. Questions in parts 2 and 3 are designed to record respondents' opinions about items and major items using the rating questions method based on the 5 points of the Likert rating scale ranging between strongly agree for higher rate to strongly disagree for lower rate as shown in **appendix A**. The rating method is usually associated if the opinion data is conducted and always reduces the required time to answer each question (Saunders, Lewis & Thornhill 2009). Therefore the rating method was suitable for this questionnaire and the required data collection. Matrix questions were used to group similar questions together at once to facilitate respondents' focus. Such a matrix with a check box should assist the avoiding of difficulties related to wording that might threaten the validity of survey responses (Huang 2006; Saunders, Lewis & Thornhill 2009) and the online Likert scale would significantly lower the possibilities of missing responses to questions (Boyer et al 2002).

<table>
<tr><th>Questionnaire Parts</th><th>Description</th><th>NO. Of Questions</th><th>Scale</th></tr>
<tr><td>Part 1: the demographic characteristics</td><td>Sex, Education, Age, years in current organisation, years of experience, job level, primary role, principal industry, organisation discipline, recent working location, instrument used to participate</td><td>11</td><td>Multiple choice 2 or 3 or 5 or 8 points scale</td></tr>
<tr><td rowspan="6">Part 2: Project manager perceptions Factors</td><td>Rank of importance</td><td>4</td><td rowspan="5">5 points Likert rating scale</td></tr>
<tr><td>Leadership</td><td>8</td></tr>
<tr><td>Capabilities / Competency</td><td>8</td></tr>
<tr><td>Personality Traits</td><td>4</td></tr>
<tr><td>Skills (Non-Engineering)</td><td>5</td></tr>
<tr><td>Comments for additional perceptions factors</td><td></td><td>N/A</td></tr>
<tr><td rowspan="6">Part 3: Delivering successful innovation</td><td>Organisational culture for innovation</td><td>3</td><td rowspan="5">5 points Likert rating scale</td></tr>
<tr><td>Innovation orientation</td><td>3</td></tr>
<tr><td>Form of True innovation</td><td>4</td></tr>
<tr><td>Market competition</td><td>3</td></tr>
<tr><td>Improving Deliverable</td><td>4</td></tr>
<tr><td>Comments for additional factors</td><td></td><td>N/A</td></tr>
<tr><td>General text box</td><td>Comments / Recommendation</td><td></td><td>N/A</td></tr>
<tr><td colspan="2">Total No. Of Questions (No. Of Items)</td><td>57</td><td></td></tr>
</table>

Table 3.1: The Questionnaire structure

3.6 Method of analysis

The quantitative method will be applied on this dissertation through an online survey then the data collected will be analysed. Computer software SPSS will be used to study and analyse the statistics of the collected data (Boyer et al 2002; Saunders, Lewis & Thornhill 2009). A reliability test using Cronbach's alpha analysis is required for positive assessment (Malhotra & Grover 1998) and to evaluate measurement reliability (Pinto & Prescott 1988). Regression and correlation tests will be applied to test the strength of the relationship between the variables of the theoretical framework (Malhotra & Grover 1998; Saunders, Lewis & Thornhill 2009). Single analysis methods of multiple-regression will be applied to determine and reveal the relative importance of predictors to explain the importance (Johnson and LeBreton 2004) of project manager perceptions factors to deliver innovation. The data collected will be presented in tables and graphs to explain the meaning of the information, and the output data can be summarised and analysed in both analysis of the data chapter and discussion of the results chapter of this dissertation.

The reliability test is used to evaluate the measurements' repeatability in different executions and occasions with different conditions and instruments (Drost 2011). Also it is correlated with stability and consistency in measurement because absences of reliability result to random error. In other words, to which limit the questionnaire (Flynn et al 1990) or the instruments used for measurement will produce the same results on repeated tests (Forza 2002). Reliability and validity makes data collected from the survey valuable if it can demonstrate them (Flynn et al 1990). Reliability and validity are required to be conducted before proceeding with the psychological test (Drost 2011) and theoretical relationship test (Forza 2002). The researcher and reader must know the measurement error level and the effect of error on results. Error must be at the lowest level possible (Drost 2011, Forza 2002). Validity is identifying the item's ability to measure what it is made to measure. It is critical for the content of the data collected (Flynn et al 1990).

The Pearson correlation and regression tests are data analysis techniques usually used to measure the relationship strength between variables. The correlation coefficient allows quantifying the linear relationship strength of variables as explained in the analysis in the data chapter and shown in **Bar Chart 4.2**. The probability for the data collected from the correlation coefficient is determined by computer software; in case the probability is very low it considers statistically significant for values less than 0.05 and not statistically significant for values above 0.05. The regression coefficient allows assessing the mathematical relationship strength between the dependent variables and independent variables. The coefficient of R^2 evaluates the rate of the variation in a dependent variable which is possibly explained statistically by the independent variables (Saunders, Lewis & Thornhill 2009). An F-test was conducted to identify the total probability of the relationship among dependent variables and independent variables (Saunders, Lewis & Thornhill 2009) in the statistical model that best represent the data (Gambatese & Hallowell 2011). The terminology of regression analysis is used for this test and includes one independent variable, and the multiple regression coefficients is used for two or more independent variables. Regression analysis is also used to predict the value of dependent variables produced by independent variables using the regression equation (**y = a + B x**, where: **y:** is amount of dependent variable, **a:** regression constant, the intercept by Y axis value, **B:** is beta coefficients, slop value, **x:** value of independent variable (Saunders, Lewis & Thornhill 2009).

3.7 Ethical Considerations

Data collection methods are associated with ethical concerns. Issues such as privacy, the identity of the participants, confidentiality of data collected, participants response to method used for data collection, and behaviour of the researcher are ethical considerations. Ethical principles need to be applied while using internet tools to approach potential participants. The survey's strategy is usually considered to be the least of the ethical problems because of the nature of questionnaire which does not tend to explore answers and avoids seeking additional revealed information (Saunders, Lewis & Thornhill 2009). Ethical issues are anticipated and considered in this research. In the cover letter sent with the survey's introduction message, it was clearly stated that data collected will be used for this dissertation only. It was also stated that the identity of participants will not be identified and questions will not requested for confidential information. Multiple responses by the same respondent were prevented on the questionnaire's website. The data collected was reported honestly and fairly.

3.8 Conclusions

In this chapter of the dissertation the research methodology was discussed and explained. The quantitative method technique was adopted and found to be appropriate and suitable for this research. The data collection method used an online survey and a pilot test was applied to test and enhance the validity and reliability of the questionnaire.

The total accepted survey application is 66 respondents. Five pilot samples were successfully applied and influenced the overall questionnaire experience. The quantitative model for data analysis used computer software SPSS to analyse information and the output was summarised in tables and illustrated in diagrams. The ethical issues related to this study and online survey were predicted and taken into consideration during the research and clearly mentioned in the cover letter of the online survey. Analysis in the data chapter and the discussion in the results chapter will explain in depth the data collected, statistical analysis conducted, the findings and the results.

Chapter Four: Analysis of Data and Findings

4.1 Introduction

This chapter of the dissertation analysed data collected from the online survey by statistical analysis carried out using computer software (SPSS). The empirical data will be used for correlation and regression tests, and the results will assess the relationship between the project manager's perceptions factors and delivering successful innovation. Also, the results will be used to test the hypothesis. Results and findings will be illustrated in tables, figures and graphs to demonstrate and prepare results for further discussion.

4.2 Descriptive and Inferential statistics

4.2.1 Validity of data collected

Applying validity is required to decrease the probabilities of getting wrong answers as explained in the research methodology chapter in the pilot sample section. It is important because it will influence the subject of findings that are concerned with the enhancement of data accuracy (Drost 2011; Saunders, Lewis & Thornhill 2009). This section will concentrate on measuring the validity of used collected data to ensure the rest of the required statistical tests are valid for the research results.

70 responses were successfully collected and 4 were eliminated because they were either not completed or not related to the construction industry. Therefore, the total accepted number of participants is 66, with a success rate of 94% as shown in **appendix B**. For responses applied in SPSS, there were no errors or missing data from the accepted 66 responses of the online survey. Certain procedures used for data entry in SPSS were followed successfully such as logging, data identification, coding, identifying illogical relationships then correct them, and excluding missing data. Issues related to that were facilitated by the online web survey options that have led to improve validity (Boyer et al 2002; Huang 2006).

4.2.2 Demographic Variables

The research used demographic characteristics as shown in **appendix B and C** of personal and job-related variables to screen their relationship with project manager perceptions, factors, and variables. **Tables 4.1 and 4.3, and Bar Chart 4.1;** show personal variables with the participants being 90.9% male and 9.1% female. The values of the mean, median and standard deviation were respectively: 1.09; 1; and 0.290. Educational achievement of the respondents was college degree for 66.7% as a majority of participants, high-school diploma was 6.1%, and masters or higher degree was 27.3%. The values of the mean, median and standard deviation are respectively: 3.61; 3; and 0.892. The personal variables show the age of the respondents: 59.1% were aged 36 to 46; 39.4% were aged 25 to 35; and only 1.5% were less than 25 years old. The values of the mean, median and standard deviation respectively are: 2.58; 3; and 0.528.

Tables 4.2 and 4.3, **and Bar Chart 4.1;** show the job-related variables of 7 major items. Number of years respondents worked in their current organisation: 16.7% were one year or less; 53% ranged from 2 to 7 years; 18.2% ranged from 8 to 13 years; and 12.1% ranged from 14 to 19 years. The values of the mean, median and standard deviation respectively are: 2.26; 2; and 0.882. Years of experience of respondents were 18.2% between 2 to 7 years; 30.3% between 8 to 13 years; 50% between 14 to 19 years; and 1.5% had 20 years or more. The values of the mean, median and standard deviation respectively are: 3.35; 4; and 0.794. Job stats: 36.4% were first level; 57.6% were middle level; and 6.1% were lower level. The value of the mean, median and standard deviation are respectively: 1.70; 2; and 0.581. Current primary role of respondent at the time of participating in the online survey: 19.7% were project team members; 31.8% were project managers or site managers; 31.8% were other managers; 4.5% were directors, general managers, or CEOs; and 12.1% others. The value of the mean, median and standard deviation are respectively: 2.58; 2; and 1.216. The principal industry of the respondents: 100% were related to the construction industry. The values of the mean, median and standard deviation respectively are: 1; 1; and 0.000. The organization disciplines of the respondents were: 19.7% client; 33.3% consultant; 37.9% contractor; 7.6% subcontractor; and 1.5% supplier or manufacture. The values of the mean, median and standard deviation are respectively: 2.38; 2; and 0.941. The current experience location of respondents was: 71.2% UAE; 19.7% GCC; and 9.1% other countries or regions. The values of the mean, median and standard deviation are respectively: 1.38; 1; and 0.651.

Personal Variables			
	SEX	Education	Age
Male	60		
Female	6		
College Degree		44	
High Diploma		4	
Master or Above		18	
Less than 25			1
25-35			26
36-46			39
Total	66	66	66

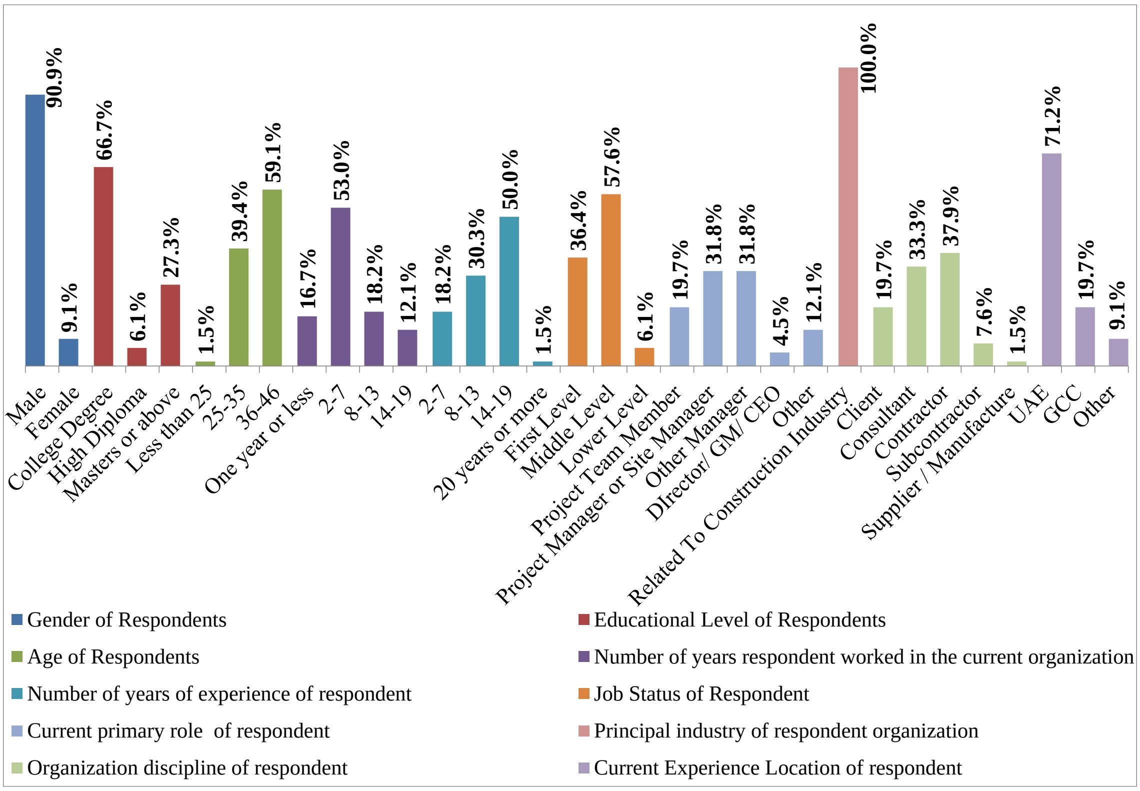
Table 4.1: Personal Variables

Job related Variables	No. Of Years						
	In current organisation	Of Experience	Job Level	Primary role	Principal industry	Organisation discipline	Working location
One year or less	11						
2-7	35						
8-13	12						
14-19	8						
2-7		12					
8-13		20					
14-19		33					
20 Years or more		1					
First Level			24				
Middle level			38				
Lower Level			4				
Project Team Member				13			
Project Manager or Site Manager				21			
Other Manager				21			
Director / GM / CEO				3			
Other				8			
Related to Construction industry					66		
Client						13	
Consultant						22	
Contractor						25	
Subcontractor						5	
Supplier / manufacture						1	
UAE							47
GCC Countries							13
Other							6
Total	66	66	66	66	66	66	66

Table 4.2: Job related Variables

Descriptive Stats										
				No. Of Years						
	SEX	Education	Age	In current organisation	Of Experience	Job Level	Primary role	Principal industry	Organisation discipline	Working location
Mean	1.09	3.61	2.58	2.26	3.35	1.70	2.58	1	2.38	1.38
Median	1	3	3	2	4	2	2	1	2	1
Std. Deviation	0.290	0.892	0.528	0.882	0.794	0.581	1.216	0.000	0.941	0.651

Table 4.3: Personal and Job related descriptive stats



Bar Chart 4.1: Personal and job-related variables rate

	Client	Consultant	Contractor	Subcontractor	Supplier	Total
Project team member	5	2	5	1	-	13
Project manager or Site manager	4	10	7	0	-	21
Other managers	3	6	8	4	-	21
Director/GM/CEO	-	2	1	-	-	3
Other	1	2	4	-	1	8
Total	13	22	25	5	1	66

Table 4.4: Respondents' professions orientation to organisational disciplines

The background of the participants is illustrated in **Table 4.4** showing the distribution of respondents' professions and their organisational disciplines. The majority of respondents (63%) were project/site/other managers, and the respondents' primary roles were consultant and contractor representing about 71% of the respondents' organisational disciplines. In addition to the percentage of middle-level respondents shown above the majority of respondents considered themselves experienced in construction projects and project manager role. This indicates that there can be confidence in the level of accuracy and reliability achieved in the data collected in the manner described in the work of Toor & Ogunlana (2009) and similar to the recombination in the work of Murphy, Perera & Heaney (2015) who identified that the background and experience of survey participants may influence the reliability of results.

4.2.3 Reliability Test

This study applied the reliability test for internal consistency according to Drost (2011) and Saunders, Lewis & Thornhill (2009) by using Cronbach's alpha coefficient method in SPSS as shown in **appendix D**. Both global variables and four factors of global independent variable were reliability tested and found that the project manager perceptions factors for the total 25 items achieved a reliability coefficient of 0.851 and delivered successful innovation for a total of 17 items achieving a reliability coefficient of 0.921 as shown in **Table 4.5**. And leadership with total 8 items achieved a reliability coefficient of 0.70, capabilities/competency achieved a reliability coefficient of 0.72, personality traits achieved a reliability coefficient of 0.70, and skills (non-engineering) achieved a reliability coefficient of 0.75 as shown in **Table 4.6**. Reliability level results are above the minimum accepted level of 0.70 according to the defined value of satisfactory level by Drost (2011) and Suliman Al-Junaibi (2010).

	Project manager perceptions factors	**Delivering successful innovation**
Cronbach's alpha	0.851	0.921
No. Of Items	25	17

Table 4.5: Cronbach's alpha results (Global variables)

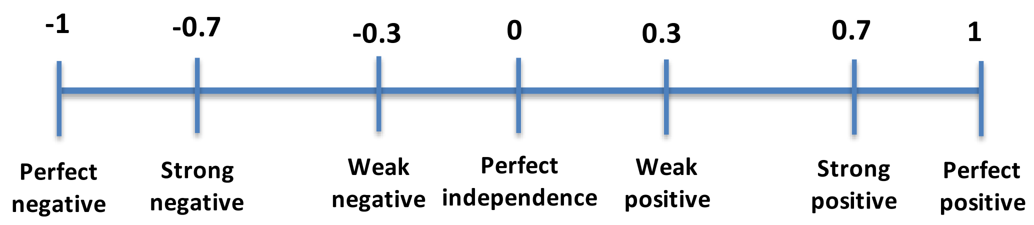
Dependent variables	**No. Of Items**	**Crombach's alpha**
Leadership	8	0.70
Capabilities / Competency	8	0.72
Personality Traits	4	0.70
Skills (Non-Engineering)	5	0.75

Table 4.6: Cronbach's alpha results (Factors of global independent variable)

Therefore, all Cronbach's alphas are reliable with inter-consistency of scale and remaining elements. For both global variables, the first score is good reliability and the second score is high reliability, and each score of the four factors of global independent variable are acceptable reliability, thus results do not require additional improvements.

4.2.4 Pearson Correlation Test

The correlation test will be used to assess the strength of the relationship between independent variables and the dependent variable. The **Bar Chart 4.2** shows that the correlation coefficient value varied between -1 perfect negative and +1 perfect positive. This means that two variables are indeed related and in the right side of the scale. Where there is an increase in the variable values the other variable values will increase; and on the other side of the scale where there is an increase in one variable value the other variable value will decrease (Saunders, Lewis & Thornhill 2009).



Bar Chart 4.2: **Value of the Correlation Coefficient** (Saunders, Lewis & Thornhill 2009, p. 459)

Based on the acceptance of the reliability test the strength of relationship between variables will be tested by the Pearson correlation test in SPSS as shown in **appendix E** (Saunders, Lewis & Thornhill 2009). The results will assess the examination of the hypothesis. The correlation test was applied for all factors dependent and independent plus both global factors. **Table 4.7** shows the results of 9 factors plus two global factors for a total of 11 variables. The scale is a range between 1 to 11 and presenting the same variable shown on the left side in the same order. The Person correlation results are equal to 1 for the same variable in the vertical and horizontal axis.

It can be observed from the correlation matrix in **Table 4.7** that relationships between the entire variables implicated in this research are significant and positive, and the correlations coefficients ranging between 0.292 (weak positive strength) and 0.872 (strong positive strength). The two global variables, project manager perceptions factors and delivering successful innovation, are significantly and strongly positively related with a coefficient value of 0.677 (Sig. Level 0.000). That means that the more positive the project manager's perceptions are at construction site level, the greater the chances of delivering successful innovation in the construction project.

Variable		1	2	3	4	5	6	7	8	9	10	11
Leadership	Pearson Correlation	1										
	Sig. (2-tailed)											
	N	66										
Capabilities / Competences	Pearson Correlation	0.609**	1									
	Sig. (2-tailed)	0.000										
	N	66	66									
Personality Traits	Pearson Correlation	0.443**	0.430**	1								
	Sig. (2-tailed)	0.000	0.000									
	N	66	66	66								
Skills	Pearson Correlation	0.384**	0.302*	0.387**	1							
	Sig. (2-tailed)	0.001	0.014	0.001								
	N	66	66	66	66							
Organisational culture for innovation	Pearson Correlation	0.309*	0.350**	0.325**	0.397**	1						
	Sig. (2-tailed)	0.012	0.004	0.008	0.001							
	N	66	66	66	66	66						
Innovation orientation	Pearson Correlation	0.516**	0.535**	0.504**	0.585**	0.611**	1					
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000						
	N	66	66	66	66	66	66					
Form of True innovation	Pearson Correlation	0.507**	0.401**	0.372**	0.577**	0.493**	0.547**	1				
	Sig. (2-tailed)	0.000	0.001	0.002	0.000	0.000	0.000					
	N	66	66	66	66	66	66	66				
Market competition	Pearson Correlation	0.376**	0.292*	0.324**	0.529**	0.470**	0.610**	0.677**	1			
	Sig. (2-tailed)	0.002	0.017	0.008	0.000	0.000	0.000	0.000				
	N	66	66	66	66	66	66	66	66			
Improving Deliverable	Pearson Correlation	0.418**	0.350**	0.352**	0.574**	0.426**	0.621**	0.713**	0.710**	1		
	Sig. (2-tailed)	0.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000			
	N	66	66	66	66	66	66	66	66	66		
Project manager perceptions	Pearson Correlation	0.844**	0.827**	0.683**	0.641**	0.448**	0.697**	0.607**	0.487**	0.546**	1	
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
	N	66	66	66	66	66	66	66	66	66	66	
Delivering successful innovation	Pearson Correlation	0.522**	0.462**	0.450**	0.653**	0.697**	0.797**	0.869**	0.846**	0.872**	0.677**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	N	66	66	66	66	66	66	66	66	66	66	66

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.7: Pearson Correlation Results between all variables

4.2.5 Regression Test

The regression test was used to assess the strength of the numerical relationship between the dependent variable and independent variables. The regression test was applied in SPSS to test the relationship between variables SPSS as shown in **appendix F** (Saunders, Lewis & Thornhill 2009). The assumption is that the relationship between project manager perceptions variables and delivering successful innovation is linear, as shown in the correlation test having a significant relationship, the dependant variable is normally distributed, and the values are homogeneity of variances. The regression test will be applied for the prediction of perception of dependent variable against the entire independent variables.

As shown in **Table 4.8**, it can be seen that project manager perceptions have regressed against delivering successful innovation in construction. It has R^2 and Adjusted R^2 values of 0.458 and 0.449 respectively. This result indicates that there is a high degree of goodness of fit of the regression model. Furthermore, the value of R^2 (45.8%) and adjusted R^2 explains why more than 45% of the reasons why innovation can be successfully delivered in construction at site level are explained by project manager perceptions factors. By looking into the value of F-ration of 54.016 that is significant at $p<0.001$ with 99% confidence it indicates that the regression test predict delivering successful innovation well. Also, the unstandardized coefficient beta value of 0.643 shows that the more the influence of project manager perceptions the more of a positive impact to delivering successful innovation. Therefore, we need to adopt more the project manager perceptions toward innovation in construction industry at site level.

Independent Variables (Predictors) regressed against delivering successful innovation	**Dependent Variable – Delivering Successful Innovation**				
	Model Summary		**ANOVA**		**Unstandardized Coefficients**
	R Square	**Adjusted R Square**	***F*-Value**	***P* (Sig. level)**	**B**
Project Manager Perceptions	0.458	0.449	54.016	0.000	0.643
Leadership	0.540	0.510	17.907	0.000	0.476
Capabilities / Competency					0.345
Personality Traits					0.460
Skills (Non-Engineering)					1.660

Table 4.8: Regression test results of dependent global variable and independent global variable and entire factors.

Hence, it can be concluded from these findings and the correlation results explained above that ***Hypothesis H1: There is a positive influence of a project manager's perceptions on delivering successful innovation in a construction project*** is accepted and can be established.

It can be seen in **Table 4.8** that project manager perceptions factors have regressed against delivering successful innovation in construction. It has together R^2 and Adjusted R^2 values of 0.540 and 0.510 respectively. This result indicates that there is a high degree of goodness of fit of the regression model. As shown in **Table 4.8** project manager perceptions factors consist of 4 elements: leadership, competency, personality traits and skills, regressed against delivering successful innovation. Therefore, by looking into the value of R^2 (54%) and Adjusted R^2, the four factors manage to explain about 54% of the variance in successful innovation in construction at site level. In addition to that the value of F-ration of 17.907 that is significant at $p<0.001$ with 99% confidence indicates that the regression test predicts delivering successful innovation well. Also, the unstandardized coefficient beta value of the four factors of leadership, competency, personality traits and skills of 0.476, 0.345, 0.460, and 1.660 respectively shows that the higher beta value of factors have the main influence of the explanation with a strong positive relationship of the factor impact to delivering successful innovation. Therefore, we need to adopt more of the project manager's skills (Non-engineering skills) together with the other three factors toward innovation in construction industry at site level.

A further regression test was conducted for individual independent variables to examine the relationship between project manager perceptions individual factors and delivering successful innovation on the construction site. **Table 4.9** shows that the leadership factor of the project manager perceptions has regressed against delivering successful innovation in construction. It has R^2 and Adjusted R^2 values of 0.272 and 0.261 respectively. This result indicates that there is a high degree of goodness of fit of the regression model. Based on that, the value of R^2 (27.2%) and adjusted R^2 explain about 27% of the variances of why delivering successful innovation can be explained by the leadership factor of project manager perceptions. Looking into the F-value of 23.915 that is significant at $p<0.001$ with 99% confidence, it is indicating that the regression test predicts delivering successful innovation well. Also, the unstandardized coefficient beta value of 1.284 shows that the more influence there is of a project manager's leadership the more positive the impact on delivering successful innovation. Therefore, we need to adopt more leadership of the project manager toward innovation in the construction industry at site level.

Hence, it can be concluded from these findings and the correlation results explained above that ***Hypothesis H2: There is a positive influence of the project manager's leadership on delivering successful innovation*** is accepted and can be established.

Independent Variables (Predictors) regressed against delivering successful innovation	Dependent Variable – Delivering Successful Innovation				
	Model Summary		ANOVA		Unstandardized Coefficients
	R Square	Adjusted R Square	*F*-Value	*P* (Sig. level)	B
Leadership	0.272	0.261	23.915	0.000	1.284
Capabilities / Competency	0.214	0.201	17.400	0.000	1.075
Personality Traits	0.202	0.190	16.239	0.000	1.880
Skills (Non-Engineering)	0.427	0.418	47.622	0.000	2.206

Table 4.9: Regression test results of dependent global variable and independent global factors individually.

Another regression test has been conducted for the individual independent variable as shown in **Table 4.9:** capabilities factor of project manager perceptions regressed against delivering successful innovation in construction. It has R^2 and Adjusted R^2 values of 0.214 and 0.201 respectively. This result indicates that there is a high degree of goodness of fit of the regression model. Based on that, the value of R^2 (21.4%) and adjusted R^2 explain about 21% of the variances of why delivering successful innovation can be explained by capabilities factor of project manager perceptions. Looking into the F-value of 17.400 that is significant at $p<0.001$ with 99% confidence, it is indicating that the regression test predicts delivering successful innovation well. Also, the unstandardized coefficient beta value of 1.075 shows that the more influence of the project manager's capabilities the more positive impact there is to deliver successful innovation. Therefore, we need to adopt more of the capabilities of the project manager toward innovation in the construction industry at site level.

Hence, it can be concluded from these findings and the correlation results explained above that ***Hypothesis H3: There is a positive influence of the project manager's capabilities on delivering successful innovation*** is accepted and can be established.

One more regression test has been conducted for the individual independent variable as shown in **Table 4.9:** personality traits factor of project manager perceptions regressed against delivering successful innovation in construction. It has R^2 and Adjusted R^2 values of 0.202 and 0.190 respectively. This result indicates that there is a high degree of goodness of fit of the regression model. Based on that, the value of R^2 (20.2%) and adjusted R^2 explain approximately 20% of the variances of why delivering successful innovation can be explained by the personality traits factor of project manager perceptions. Looking into the F-value of 16.239 that is significant at $p<0.001$ with 99% confidence, it indicates that the regression test predicts delivering successful innovation well. Also, the unstandardized coefficient beta value of 1.880 shows that the greater the influence of the project manager's personality traits the more positive the impact on delivering successful innovation. Therefore, we need to adopt more of the personality traits of the project manager toward innovation in construction industry at site level.

Hence, it can be concluded from these findings and the correlation results explained above that ***Hypothesis H4: There is a positive influence of a project manager's personality traits on delivering successful innovation*** is accepted and can be established.

The last regression test was conducted for the individual independent variable as shown in **Table 4.9** skills (Non-Engineering): factor of project manager perceptions regressed against delivering successful innovation in construction. It has R^2 and Adjusted R^2 values of 0.427 and 0.418 respectively. This result indicates that there is a high degree of goodness of fit of the regression model. Based on that, the value of R^2 (42.7%) and adjusted R^2 explain nearly 42% of the variances of why delivering successful innovation can be explained by the skills factor of project manager perceptions. Looking into F-value of 47.622 that is significant at $p<0.001$ with 99% confidence, it is indicating that the regression test predicts delivering successful innovation well. Also, the unstandardized coefficient beta value of 2.206 shows that the more influence of the project manager non-engineering skills the more positive the impact on delivering successful innovation. Therefore, we need to adopt more non-engineering skills for the project manager to achieve innovation in the construction industry at site level.

Hence, it can be concluded from these findings and the correlation results explained above that ***Hypothesis H5: There is a positive influence of the project manager skills (non-engineering) on delivering successful innovation*** is accepted and can be established.

4.3 Factors Importance analysis

Measuring the relative importance of variables is popular in statistical analysis among researchers. There are several techniques and methods used to determine relative importance. Considering that, there are some techniques more adequate than others based on variances such as considering the effect of variables on each other and their significance levels (Johnson 2000). The self-ranking scale has been used in this research with the 5-point Likert rating scale as explained in chapter 3 of the methodology and results analysis shown in the following section. Also, statistical techniques were used to analyse the relative importance of variables. This method adopted is similar to the work of Murphy, Perera & Heaney (2015) who argue that using self-rating will focus on participants' responses to questions. And it is similar to the argument of Johnson and LeBreton (2004) who explain that direct ratings tend to be higher in the scale and the relative importance of statistical tests would show the actual importance. The following section adopts the most relative techniques taking in consideration of constraints and variances.

4.3.1 Respondents self-ranking scale

Respondents were asked to scale their responses concerning relative importance of project manager perceptions factors toward successful innovation based on their experiences as shown in **appendix A**. The responses of the collected rating scale results are shown in **Table 4.10**. The scale shows that leadership ranked first with an average score 4.77 (the closest to a score of 5 [strongly important] in the scale); capabilities ranked second with an average score of 4.45 (between strongly important and important in the scale); personality traits ranked third with an average score of 4.33 (nearer to important in the scale); and skills ranked fourth with an average score of 4.24 (the closest to a score of 4 [important] in the importance scale filled by respondents as shown in **appendix B**. This part has been conducted during the survey to collect information based on respondents' experience to compare the results with their answers after conducting the statistical analysis to stand on the variances between the direct understanding of importance and the actual influencing to delivering successful innovation. These ranking results are very similar to predicting the ranking of relative importance based on observation from the literature review and the theoretical underpinning shown in **Table 2.2** in the theoretical framework section of chapter 2.

Client	Strongly Important 5	Important 4	Undecided 3	Not Important 2	Strongly Important 1	Total	Arithmetic average	Rank
Leadership	7	6				13	4.54	1
Capabilities / Competences	5	8				13	4.38	2
Personality Traits	4	8	1			13	4.23	3
Skills " Non-Engineering Skills"	7	6				13	4.54	1
Consultant								
Leadership	16	6				22	4.73	1
Capabilities / Competences	10	11		1		22	4.36	2
Personality Traits	8	14				22	4.36	2
Skills " Non-Engineering Skills"	4	17	1			22	4.14	3
Contractor								
Leadership	22	3				25	4.88	1
Capabilities / Competences	12	13				25	4.48	2
Personality Traits	10	15				25	4.40	3
Skills " Non-Engineering Skills"	6	16	3			25	4.12	4
Subcontractor								
Leadership	5					5	5.00	1
Capabilities / Competences	4	1				5	4.80	2
Personality Traits		5				5	5.00	1
Skills " Non-Engineering Skills"	2	3				5	4.40	3
Supplier								
Leadership	1					1	5.00	1
Capabilities / Competences	1					1	5.00	1
Personality Traits	1					1	5.00	1
Skills " Non-Engineering Skills"	1					1	5.00	1
Overall Responses Results								
Leadership	51	15	-	-	-	66	4.77	1
Capabilities / Competences	32	33	-	1	-	66	4.45	2
Personality Traits	23	42	1	-	-	66	4.33	3
Skills " Non-Engineering Skills"	20	42	4	-	-	66	4.24	4
Leadership	77.27%	22.73%	-	-	-	100%	4.77	1
Capabilities / Competences	48.48%	50.00%	-	1.52%	-	100%	4.45	2
Personality Traits	34.85%	63.64%	1.52%	-	-	100%	4.33	3
Skills " Non-Engineering Skills"	30.30%	63.64%	6.06%	-	-	100%	4.24	4

Table 4.10: Perceptions factors relative importance from survey self-rating scale results.

4.3.2 Relative importance based on statistical analysis using regression test

To determine the relative importance of variables, it is very effective to have a method that considers the direct effect of predictors on each other and the joint effect associated with other variables conditioning the predictable criterion variance between them (Johnson 2000). A similar study suggests that the measure of relative importance must consider together the effect of the predictor isolated from the other predictors and in combination with the other predictors (Johnson and LeBreton 2004), which in this case involves a stepwise regression test and beta ranking methods respectively. Based on the recommendations in literature, several statistical tests are applied to determine the relative importance of factors of project manager perceptions. In the following section are analysis methods of beta ranking and the stepwise regression test. Also, the other conducted tests results are found to be the same, so only two methods were presented in this study but other tests results are presented in the **Appendix G** for reference.

4.3.2.1 Beta Ranking

The regression test has been conducted to calculate standardized coefficients Beta values for all of the project manager perceptions factors as shown in **appendix G**. The standardized coefficients Beta values are shown below in **Table 4.11**: skills has the largest beta value of 0.491, which indicates that skills are the most important perception factor to make a variance in delivering successful innovation. Therefore, the skills factors is ranked first; the leadership factor is ranked second with a beta value of 0.194; the capability factor is ranked third with a beta value of 0.148; and the personality traits factor is ranked fourth with a beta value of 0.110 as the lowest important influence on delivering successful innovation. This method has been confirmed by the work of Johnson (2000) who suggests that standardized coefficients Beta weights are one of the methods used for importance ranking. And the work of Johnson and LeBreton (2004) shows that standardized coefficients Beta weights are a common method used to measure relative importance.

Project Manager perceptions factors	Standardized Coefficients Beta
Leadership	0.194
Capabilities / Competency	0.148
Personality Traits	0.110
Skills (Non-Engineering)	0.491

Table 4.11: Beta values from a regression test run for all 4 perceptions factors.

4.3.2.2 Stepwise regression test

The stepwise regression test has been conducted to determine a combination of variables of project manager perceptions factors that are considered the best combination of predictors as shown in **appendix G**. The highest variable value of bivariate correlation demonstrated with delivering successful innovation will be selected first then the variable of project manager perceptions is selected to produce the highest increase in R^2. This leads to identify the significant prediction of the variable with highest correlation value. In case this variable is not significant it will be dropped from the test. The same steps will be repeated until project manager perceptions factors are all entered and accepted or the remaining variables are not creating a significant increase in R^2 (Nathans, Oswald & Nimon 2012). The SPSS creates the stepwise regression linear test by selecting all independent variable to be regressed against delivering successful innovation as dependent variable and method to be stepwise (Saunders, Lewis & Thornhill 2009).

Independent Variables (Predictors) regressed against delivering successful innovation	**Dependent Variable – Delivering Successful Innovation**				
	Model Summary		**ANOVA**		**Unstandardized Coefficients**
	R Square	**Adjusted R Square**	***F*-Value**	***P* (Sig. level)**	**B**
Skills (Non-Engineering)	0.427	0.418	47.622	0.000	2.206
Skills (Non-Engineering),	0.513	0.497	33.126	0.000	1.794
Leadership					0.782

Table 4.12: Stepwise regression test of project manager perceptions factors against delivering successful innovation

The values of the stepwise regression test are shown in **Table 4.12**. R^2 value of 0.427 for the first independent variable with largest correlation is regressed against the dependent variable and the best combination R^2 value is 0.513. The best combination consists of skills and leadership factors of project manager perceptions and R^2 and adjusted R^2 shows that there is a high degree of goodness of fit of the regression model. Also, R^2 and adjusted R^2 value shows that about 51% of variance in delivering successful innovation is explained by the combination of skills and leadership factors of project manager perceptions. By looking into the value of F-ration of 33.126 that is significant at $p<0.001$ with 99% confidence it is indicating that the regression test predicts delivering successful innovation well. Also, the beta value of both variables are 1.794 and 0.782, and this shows that the greater the increase into both skills and leadership factors of project manager perceptions the more positive the impact to delivering successful innovation. Therefore, we need to adopt more of both skills and leadership factors in the project manager perceptions toward innovation in the construction industry at site level.

In addition to that the results confirm the importance of both skills and leadership factors with the same priority in importance order to influence delivering successful innovation. Considering the constraints and cautions proscribed in using this method to identify variable importance, this method been popular in a number of studies. The results are most likely to confirm the findings of other tests conducted above, therefore, skills and leadership importance in delivering successful innovation are accepted and the other two variables - capabilities and personality traits factors of project manager perceptions - are excluded in stepwise regression test because they are not making a significant increase in R^2 (Nathans, Oswald & Nimon 2012).

4.4 Conclusions

In summary, these results show that 66 responses was eligible for the data analysis using computer software SPSS. Respondents' demographic majority was male, holding a college degree, aged between 36 and 46, working in the same organisation between 2 and 7 years, total years of experience between 14 and 19 years, in the middle level of their career, the majority were project and other managers, belonging to a contractor organisation, and majority working currently in the UAE.

Overall, the results in this chapter indicate that project manager perceptions factors significantly affect delivering successful innovation in construction at site level. Despite the relatively small sample size, the majority of statistical results are significant because there is a strong correlation between predictors and dependent variables (Gambatese & Hallowell 2011). The correlation results demonstrate a strong positive strength between both global variables. The regression results indicate the high level of explanation by project manager perceptions to deliver successful innovation. Taken together, these results of testing the strength of relationship between independent variables and dependent variable suggest that there is a strong positive strength between project manager perceptions factors and delivering successful innovation, and variances in global variable can be explained by these factors. The relative importance results shows that leadership, capabilities/competences, personality traits and skills factors of project managers perceptions are important to deliver successful innovation in construction. The next chapter will discuss the results and findings of the data analysis illustrated in this chapter.

Chapter Five: Discussion of Results

5.1 Introduction

This chapter of the dissertation discusses the results and findings generated from the statistical analysis carried out by computer software (SPSS) in the previous chapter. Based on the literature review and analysis of data, the hypotheses will be discussed and evaluated. The results and findings are in line with various studies published in the construction industry. This dissertation's results and findings further support the literature review and theoretical framework in chapter 2 and shows that there is a relationship between project manager perceptions factors and delivering successful innovation on the construction site.

5.2 The influence of project manager perceptions on delivering successful innovation in construction projects

The current study found that project manager perceptions factors have a strong positive strength relationship with delivering successful innovation on the construction site ($r = 0.546$, $p < 0.001$). The increase of one or more of these factors will lead to an increase in delivering successful innovation. These results confirm that greater the influence of project manager perceptions there is the greater the positive impact to delivering successful innovation as clarified earlier in the theoretical framework and theoretical underpinning section. The project manager perceptions factors consist of 4 factors: leadership, capabilities/competence, personality traits, and skills. Also, delivering successful innovation is associated with five factors: organisational culture for innovation, innovation orientation, forms of true innovation, market competition, and improving deliverables.

These results further support the idea of the project manager's influence on delivering innovation and his perceptions are the most important factors that have a significant influence on innovation within the construction organisation (Gambatese & Hallowell 2011). This finding supports the previous researches of Dainty, Cheng & Moore (2003); Friedrich et al (2010); Hunter & Cushenbery (2011); Kissi, Dainty & Liu (2012); Murphy, Heaney & Perera (2011); Nam & Tatum (1997); Odusami (2002); Ozorhon (2012); Ozorhon (2013); Xue et al (2014), they found that perceptions of project manager including leadership, skills, competence, and personality traits influence creativity and the innovation process during project execution and are connected with several innovation aspects. Also, Toor & Ogunlana (2009) found that the project manager's leadership and capabilities significantly influence project outcomes. These findings are also aligned with the advanced literature for innovation approach that considers delivering innovation achieved by a process which depends on the skills and competency method instead of traditional project management (Murphy, Heaney & Perera 2011, Ozorhon 2012).

Based on the acceptance of the hypothesis H1 and the Pearson correlation of project manager perceptions factors with organisational culture for innovation ($r = 0.448$, $p < 0.001$) and with market competition ($r = 0.487$, $p < 0.001$) both have a strong positive relationship but their values are less than other factors. A possible explanation for these results might be based on that project manager perceptions factors have less direct impact on these two factors of delivering successful innovation compared to three other factors. Organisational culture for innovation has to start and be established from the organisation level first to lead to innovation and then the project manager perceptions can successfully influence the innovation at site level as explained in the work of Kissi, Dainty & Liu (2012) who found that organisation policy for innovation and senior management's supportive behaviour for innovation increase the project manager's commitment to deliver innovation. Market competition is influenced by several aspects of the organisation's ability to innovate as described in published studies (Barrett & Sexton 2006; Slaughter 1998) which confirm that recognising an innovation opportunity by an organisation is the first part of the innovation process cycle. On the other hand, innovation orientation ($r = 0.697$, $p < 0.001$), form of true innovation ($r = 0.607$, $p < 0.001$), and improving deliverables ($r = 0.546$, $p < 0.001$) have higher strong positive relationships with project manager perceptions factors because of the level of direct control over for the project manager on these three factors more than the other two factors of delivering successful innovation. There are similarities between this direct influence expressed by the project manager on the three factors and those described by Barrett & Sexton (2006); Bossink (2004); Creasy & Anantatmula (2013); Gann & Salter (2000); Kissi, Dainty & Liu (2012); Lloyd-Walker, Mills & Walker (2014); Ozorhon (2012); Slaughter (1998, 2000). Further work is required to establish the perceptions factors that have or have not a significant influence to deliver successful innovation in construction projects to clarify the unexplained relationship part.

5.3 The influence of the project manager’s leadership on delivering successful innovation

The results of this study show that the leadership factor of project manager perceptions has a strong positive strength relationship with delivering successful innovation on the construction site ($r = 0.522$, $p < 0.001$). The more perceptions and influence of a project manager’s leadership will lead to an increase in delivering successful innovation. This finding supports previous studies which link the influence of leadership of a project manager on successful innovation as clarified earlier in the theoretical framework and theoretical underpinning section. This finding is in agreement with Ozorhon’s (2012) findings which showed that leadership is one of the main management actions for delivering successful innovation.

Furthermore, a possible explanation for this finding may be the significant role of the construction project manager’s leadership in successful project management (Kissi, Dainty & Liu 2012). Successful innovation requires tools similar to project management tools to deliver innovation (Bossink 2004; Ozorhon 2012). Managing construction projects by project managers leads to the controlling of different aspects influenced by different stakeholders’ decisions and management (Dulaimi, Nepal & Park 2005). Leadership by intellectual stimulation, including motivating and inspiring project team members, leads to encourage their creativity for new ideas and problem-solving (Turner & Müller 2005). Therefore, the project manager’s leadership has a strongly positive impact on delivering successful innovation in construction projects.

In addition to that, the results are associated with major items mentioned and explained earlier in the theoretical framework and theoretical underpinning. These major items include the project manager’s leadership in transferring and sharing both knowledge and experience, having relevant experience and technical knowledge, financial and procurement knowledge, organising responsibilities between project members, motivating project teams, encouraging an innovative climate/environment between project teams, supporting novel ideas, and supporting new solutions or problem-solving.

Based on the above findings and the acceptance of the hypothesis H2, the increase of one or more of these major items would lead to an increase in the possibilities of delivering successful innovation with the project manager’s leadership in construction projects. Further work is required to establish the entire leadership major items that have or have not a significant influence to deliver successful innovation in construction projects to explain the unexplained relationship part.

5.4 The influence of project manager’s capabilities on delivering successful innovation

The results of this study show that the capabilities factor of project manager perceptions has a strong positive strength relationship with delivering successful innovation on the construction site ($r = 0.462$, $p < 0.001$). The more perceptions and influence of project manager’s capabilities and competence will lead to an increase in delivering successful innovation. This finding supports previous researches which link the influence of capabilities of the project manager on successful innovation as clarified earlier in the theoretical framework and theoretical underpinning section. These findings support the results described by Toor & Ogunlana (2009) who confirm the influence of the competence of the project manager on success factors and innovation. They also support the idea that strong capabilities and competence of an effective project manager will assist the focus of innovative champions within the project team to deliver innovation (Murphy, Heaney & Perera 2011, Ozorhon 2012).

This result may be explained by previous studies which corroborate the influence of project manager capabilities/competence on delivering innovation on different aspects such as enhancing his ability to execute the project successfully (Babu & Sudhakar 2015), influencing the project manager’s decisions in the innovation process (Bossink 2004), being able to manage innovation (Bosch-Sijtsema & Postma 2009; Murphy, Perera & Heaney 2015), better understanding the innovation requirements associated with project management (Bosch-Sijtsema & Postma 2009; Bossink 2004), increasing the project manager’s ability to overcome innovation difficulties (Bossink 2004; Blayse & Manley 2004; Ozorhon 2012), building trust and providing support between project teams (Bosch-Sijtsema & Postma 2009; Dulaimi, Nepal & Park 2005), and encouraging people to innovate (Kissi, Dainty & Liu 2012). Therefore, the project manager’s capabilities have a strong positive relationship with delivering successful innovation in construction projects.

In addition to that, the results are associated with major items that were mentioned and explained earlier in the theoretical framework and theoretical underpinning. These major items include the project manager's ability to understand the project's deliverables and the project's processes and technology, and having sufficient project management knowledge. They also include the ability to evaluate, measure, and determine the project team's integration, the competence required to build trust, a focus on people, an ability to adapt to change, and an understanding of the project team members' perceptions.

Based on the above findings and the acceptance of the hypothesis H3, the increase of one or more of these major items would lead to an increase in the possibilities of delivering successful innovation with the project manager's capabilities/competence in construction projects. Further work is required to establish the entire capabilities/competence major items that have or have not a significant influence to deliver successful innovation in construction projects to explain the unexplained relationship part.

5.5 The influence of the project manager's personality traits on delivering successful innovation

The results of this study show that the personality traits factor of the project manager's perceptions has a strong positive strength relationship with delivering successful innovation on the construction site ($r = 0.450$, $p < 0.001$). The more perceptions and influence of the project manager's personality traits will lead to an increase in delivering successful innovation. This finding supports previous studies which link the influence of personality traits of the project manager on successful innovation as clarified earlier in the theoretical framework and theoretical underpinning section.

This result may be explained by previous studies which corroborate the influence of the project manager's personality traits on delivering innovation in different characteristics such as flexibility (Fisher 2011; Kissi, Dainty & Liu 2012), respecting others, inspiring people, supporting the project's team performance (Bossink 2004), behaviour of fostering innovation (Kissi, Dainty & Liu 2012; Geoghegan & Dulewicz 2008), rewarding innovative behaviour (Bossink 2004), positive attitude of project manager (Fisher 2011; Ozorhon 2012), showing kindness, and open-mindedness for innovation

(Ozorhon 2012). Therefore, the project manager's personality traits have a strong positive relationship with delivering successful innovation in construction projects.

In addition to that, the results are associated with major items that were mentioned and explained earlier in the theoretical framework and theoretical underpinning. These major items include the project manager's personality traits to inspire respect among project participants, effective behaviour, positive attitude, and flexibility in dealing with others.

Based on the above findings and the acceptance of the hypothesis H4, the increase of one or more of these major items would lead to an increase in the possibilities of delivering successful innovation with these personality traits of the project manager in the construction project. Further work is required to establish the entire personality traits major items that have or have not a significant influence to deliver successful innovation in construction projects to explain the unexplained relationship part.

5.6 The influence of the project manager's skills (non-engineering) on delivering successful innovation

The results of this study show that the skills (non-engineering skills) factor of project manager perceptions has a strong positive strength relationship with delivering successful innovation on the construction site ($r = 0.653$, $p < 0.001$). The more perceptions and influence of project manager's skills will lead to an increase in delivering successful innovation. This finding supports previous studies which link the influence of skills of the project manager on successful innovation as clarified earlier in the theoretical framework and theoretical underpinning section.

This result may be explained by previous studies which corroborate the influence of the project manager's skills on delivering innovation in different characteristics such as skills to convince other project participants of the advantage of innovation (Dulaimi, Nepal & Park 2005), talent to convince others with innovative ideas (Blayse & Manley 2004; Bygballe & Ingemansson 2014; Dulaimi, Nepal & Park 2005; Slaughter 1998; Slaughter 2000; Winch 1998), using skills to understand the financial status of the project (Gann & Salter 2000), to be able to estimate the innovation impact on performance (Slaughter 2000), appropriate skills to communicate effectively with large and complex project teams (Blayse & Manley 2004; Murphy, Perera & Heaney 2015;

Fisher 2011), using different methods to share knowledge and information among project participants (Ozorhon, Abbott & Aouad 2013), skills for controlling project resources and activities (Slaughter 2000), and adopting managerial skills that foster innovation (Dulaimi, Nepal & Park 2005; Ozorhon, Abbott & Aouad 2013). Therefore, the project manager’s skills have a strong positive relationship with delivering successful innovation in construction projects.

In addition to that, the results are associated with major items that were mentioned and explained earlier in the theoretical framework and theoretical underpinning section. These major items of the project manager's skills include evaluating the project, evaluating financial outcomes, using effective communication skills, planning and control over skills, essential managerial skills, and ability to negotiate innovative ideas successfully.

Based on the above findings and the acceptance of the hypothesis H5, the increase of one or more of these major items would lead to an increase in the possibilities of delivering successful innovation with these skills of the project manager in construction projects. Further work is required to establish the entire major items of skills that have or have not a significant influence to deliver successful innovation in construction projects to explain the unexplained relationship part.

5.7 Importance of the project manager’s perceptions factors

The results of the importance ranking can be summarized as shown in **table 5.1. The** statistical ranking analysis results are similar in different test types, reflecting the homogeneity and the various impacts of the project manager perceptions factors to deliver successful innovation in construction projects. This similarity in the findings between different methods is further supported by the idea of using different methods to calculate relative importance and most likely ends in very similar solutions because there are no large differences between results values to be of concern (Johnson 2000). Therefore, the two statistical methods chosen to present in this research where other methods have been conducted and results are not shown in **Table 5.1** but presented in **Appendix G** for reference.

Project Manager perceptions factors	Respondents ranking scale	Relative importance from regression tests	
		Standardized coefficients Beta Ranking	Stepwise regression test
Leadership	**1**	**2**	**2**
Capabilities / Competency	**2**	**3**	**N/A**
Personality Traits	**3**	**4**	**N/A**
Skills (Non-Engineering)	**4**	**1**	**1**

Table 5.1: Summary of project manager perceptions factors ranking results

As shown in **Table 5.1** there is a slight difference in the relative importance ranking between respondents' self-rating and the regression tests results. This distinguishes between respondents' ranking results and the regressions ranking results of variables importance are explained by the demographic variables because of the differences in their background (**Table 4.4)** and different understanding of delivering innovation between stakeholders as explained by the work of Ozorhon (2012). Also, it is because the characteristics of the respondents have a different influence due to the relative importance of perceptions factors to the overall evaluation as explained by the work of Johnson and LeBreton (2004) which is in this case the differences of respondents' organisational disciplines and background. It is important to mention that ranking of relative importance does not relieve lower ranking to be important or to get insufficient attention. But most likely, factors ranking higher are rather relative to some other factors which are considered more important in this perspective (Toor & Ogunlana 2009). The elaboration of major relative importance factors by respondents show strongly an important ranking for the leadership factor by around 77% of responses, capabilities/competence by approximately 48% of responses, personality traits by approximately 42% of responses, and skills demonstrated by about 30% of responses as shown in **Table 4.10** and ranking results summaries in **Table 5.1** confirming that these factors are relatively important in delivering innovation.

On the other hand, the client side results (**Table 4.10**) show leadership and skills are strongly important; capabilities and personality traits are ranked third and fourth respectively. These results are similar to the regressions relative importance results. This finding confirms the argument that the client has the essential influence on innovation and most commonly uses leadership and skills factors to achieve innovation which has interfere and a direct proportion on the influence of the project manager perceptions on delivering innovation (Gambatese & Hallowell 2011). These results also explain the variances in client understanding for project participants' roles and interference, and comprehension of client needs by project parties (Toor & Ogunlana 2009).

It can be observed that the majority of respondents determine the level of importance for the factors of project manager perceptions between strongly important and important to deliver successful innovation on the construction site. Statistical analysis shows the same results of importance as the four factors found to be important and significantly positive correlated to delivering successful innovation. Statistical results show the skills factor is of major relative importance, followed by leadership, capabilities/competence, and personality traits. The differences between respondents' direct responses/self-rating of importance level and statistical analysis results are possibly explained by the differences between practical experience and theoretical concepts and influenced by variables shown in **Table 4.2** especially respondents' primary role, background and their organisation discipline. These differences support the previous research of Murphy, Perera & Heaney (2015) who suggest that self-rating will focus on participants' response rather than theoretical competence. Respondents' ranking results of variable importance are based on practices and regressions ranking results of variable importance explained by theories of the relationship between factors of project manager perceptions and delivering successful innovation.

Rankings are influenced by differences in samples and respondents' demographics as stated by the work of Johnson (2000) and influenced by their differences in background and organisational discipline (Toor & Ogunlana 2009). Therefore, and based on the above explanation, the findings of the rankings confirm the associated importance produced by the four factors of project manager perceptions on delivering innovation, and not presenting the priorities. Also, these findings are built on the major items identified in the literature review and summaries in **Table 2.2** in Chapter 2 which confirm the predicted ranking of relative importance supported by previous studies. In case there are changes in these items there may be a change in the results. These findings are similar to results found by Toor & Ogunlana (2009) who show that there is an importance of the project manager's leadership and capabilities to manage the project and consequently to manage innovation. Also, they support the argument that the innovation process requires acquisition and development of skills, personality traits and competence between project stakeholders including the project manager which is identified to be part of adoption and implementation of innovation with a predicted level of relative importance (Murphy, Perera & Heaney 2015). Future studies must focus on the major items influencing each factor and impacting project manager's perceptions factors in delivering successful innovation on construction projects to explain the relationship strength with different factor combinations.

5.8 Conclusions

This chapter has discussed the findings and related discussions for the dissertation's five hypotheses. Also, it has discussed the acceptance of relative importance of project manager perceptions factors on delivering innovation. And it can be seen that there is an influence of project manager perceptions at project level on delivering successful innovation, confirming the findings of Dainty, Cheng & Moore (2003); Friedrich et al (2010); Gambatese & Hallowell (2011); Hunter & Cushenbery (2011); Kissi, Dainty & Liu (2012); Murphy, Heaney & Perera (2011); Nam & Tatum (1997); Odusami (2002); Ozorhon (2012); Ozorhon (2013); Xue et al (2014), and showing that these findings are evident in the literature. These four perceptions factors are, therefore, relatively important to deliver innovation. A summary of the main findings and recommendations which have been discussed in this chapter will be described in the next chapter.

Chapter Six: Conclusion

The purpose of this chapter of the dissertation is to describe recommendations and conclusions including the summary of findings of this study. This chapter also describes the limitations of the current study and suggestions for further research into this area.

6.1 Conclusion

The construction industry has produced a wide range of new ideas and innovations but the rate of innovation is less than most other industries (Bosch-Sijtsema & Postma 2009; Dubois & Gadde 2002; Ozorhon, et al 2010; Winch 1998; Panuwatwanich, Stewart & Mohamed 2008; Yepes et al 2015). The delivery of innovation in construction has inspired theories associated with different variables that must be considered by organisations to enhance their ability for innovation (Blayse & Manley 2004; Hartmann 2006; Yepes et al 2015). Innovations in construction are implemented mostly at the project level, unlike in other industries (Blayse & Manley 2004; Bygballe & Ingemansson 2014; Ozorhon 2012; Slaughter 1998; Slaughter 2000; Winch 1998). Innovation success and failure depends on the approach of innovation management used by stakeholders, and the approach of managing innovation between project parties and project participants considering their skills and competencies to deliver innovation (Murphy, Heaney & Perera 2011, Ozorhon 2012). From this perspective and based on the role of project manager in project management and project success, there is a predicted significant influence between the project manager and innovation management (Fisher 2011; Keegan & Turner 2002; Meng & Boyd 2017; Murphy, Perera & Heaney 2015).

This dissertation has argued that there is an influence of project manager perceptions factors on delivering successful innovation at project level. In order to achieve the aims and objectives of this research and to answer the research questions the relevant literature has been reviewed and the theoretical framework was developed which identifies project manager perceptions factors that influence delivering successful innovation. Also, a quantitative research methodology was used to collect and analyse data using the relevant tools and techniques.

The findings were based on data collected from an online survey from a sample considered related to the construction industry. The respondents demonstrated experience in the construction project with acceptable validity and a confident level of accuracy and reliability. The findings show that project manager perceptions factors have a strong positive strength relationship with delivering successful innovation on the construction site which leads to an influence of project manager perceptions on delivering successful innovation.

These findings consider four factors from the literature of project manager perceptions consisting of: leadership, capabilities/competences, personality traits, and skills which are categorised into 25 major items. The leadership factor of the project manager perceptions has a strong positive strength relationship with delivering innovation on the construction site which leads to an influence of leadership of the project manager on delivering successful innovation. The capabilities factor of the project manager perceptions shows a strong positive strength relationship with delivering innovation on the construction site which leads to an influence of capabilities of the project manager on delivering successful innovation. The personality traits factor of the project manager perceptions shows a strong positive strength relationship with delivering innovation on the construction site which leads to an influence of personality traits of the project manager on delivering successful innovation. And, the skills (non-engineering skills) factor of project manager perceptions shows a strong positive strength relationship with delivering innovation on the construction site which leads to an influence of skills of the project manager on delivering successful innovation. Furthermore, the findings are confirming the relative importance produced by the associated four factors for project manager perceptions in delivering successful innovation. Unexpected findings not part of the research scope suggest that the client has the essential influence on delivering innovation and commonly uses leadership and skills factors to achieve innovation.

6.2 Recommendations/Implications

Although the current study is based on a small sample of participants, the findings suggest that project manager perceptions factors are relatively important as an influence on the project manager delivering successful innovation. The results of this dissertation indicate that construction organisations need to adopt innovation policy which is paid more attention to project manager perceptions that influence on innovation. In general, the results recommend that organisations must adopt project manager selection characteristics that examine his ability to makes contributions in innovation through perceptions factors of leadership, capabilities/competences, personality traits, and skills (non-engineering skills). Construction organisations need to consider enhancing the influence of project manager perceptions factors on delivering innovation during the adopting and diffusing of innovation methods. Methods such as suitable information sharing channels (Ozorhon, Abbott & Aouad 2013), innovation diffusion modelling (Kale & Arditi 2009), a bottom-up approach for innovative ideas, a top-down approach to adopt and implement innovation (Lloyd-Walker, Mills & Walker 2014; Panuwatwanich, Stewart & Mohamed 2008), and considering the development of project manager's skills and competencies (Murphy, Perera & Heaney 2015) to increase the possibilities of achieving successful innovation. In addition to that, the evidence from this research suggests that organisations need to adopt a culture for innovation and consider market competition aspects that lead to motivating project managers and focusing on his perceptions factors to deliver successful innovation within the company context.

Here are additional recommendations, based on the identified role of project end-users, clients and owners in the construction project innovation process. Project owners are able to improve the possibility of achieving innovation by the recommendations of this study to assign certain characteristics in project requirements for the position of project managers/site managers of project participants. These characteristics needs to be based on goals and objects of successful innovation management. Clients need to contribute positively to the innovation process managed by the project/site manager during the execution phase.

6.3 Limitations of the study

The findings of this dissertation are subject to the following limitations: first, it is limited to the construction industry. Second, the data collected and the results calculated are limited to the demographic and background of the participants. Third, the findings are limited to the project manager's four perceptions factors. Fourth, this research is limited to the site execution phase of the construction project lifecycle. Therefore, the conclusions of these findings might not be relevant in the other contexts such as other industries, other project phases, other perceptions factors, and different locations or countries other than the UAE or GCC.

6.4 Recommendations for further research

This dissertation showed up several aspects needing to be investigated. The literature review of project manager perceptions factors identified and discussed in the previous section provides evidence for the significant influence on delivering successful innovation. The results and findings support previous findings and contribute additional evidence based on data collected that suggests that the increase of adopting more influence of the project manager perception factor results in more of a positive impact to delivering successful innovation. Data analysis shows that these perceptions factors explain part of the reason why innovation can be successfully delivered by project manager perceptions factors. It is recommended that further research assess the influence of other project manager perceptions factors that explain the unexplained variance. It would be interesting for further study to compare project manager perceptions factors within the same context. Also, it can be suggested that the association of these four perceptions factors is investigated in further studies. Further work is needed to concentrate on establishing whether other perceptions factors are relatively important to deliver successful innovation at site level or if these four factors are the only important ones. A further study investigating if perceptions factors influence on delivering innovation necessarily equate to successful project delivery is strongly recommended.

Moreover, the results of this research explain the variance of why delivering successful innovation can be explained by four factors of project manager perceptions. Each factor associated with the major items that result from an influence of individual and combined factors on delivering successful innovation. There is an unexplained relationship that needs to be investigated in future research to explain unexplained variance and to identify other items that have a relationship.

In addition to that, the findings of this study provide the following perceptions for further research: project manager leadership, competency, personality traits, and non-engineering skills. More research is needed for a better understanding of these four factors from the perspectives of enhancing the delivery of successful innovation. It is needed to give a clear definition of innovation’s critical success factors in construction projects. Then we can examine the influence of project manager perceptions on these success factors. It would be interesting to consider different project sizes and types.

Based on the literature review there is evidence that project owners are directing innovation in the construction industry. Therefore, further research needs to examine the influence of project owners' interference on project manager perceptions factors.

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Appendix A: Questionnaire

C-1 Online survey format as appear to participants in the link of website

(https://www.esurveycreator.com)

The Project Manager Perceptions Factors Influencing Delivering Successful Innovation In Construction Project at Site Level

Page 1

Dear Sir/ Madam,
I will be grateful if you could take 10 - 12 minutes of your time to answer the following questionnaire. This Questionnaire gives you the opportunity to express your view on a wide range of issues related to the project manager perceptions factors influencing delivering successful innovation in construction project at site level. Please note that there is no right or wrong answer.

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

The researcher assures you that no individuals will be identified from their responses and there are no requests for confidential information included in the questionnaire. The results of the analysis will be strictly used by the researcher for study purposes only.

The questionnaire comprises 3 parts:
1- General Information
2- Project manager perceptions factors
3- Delivering successful innovation

Thanks
Researcher

Page 2

PART ONE: GENERAL INFORMATION
Please tick one box for each question:

A. Sex: *

◯ 1) Male
◯ 2) Female

B. Education: *

◯ 1) Less than high school
◯ 2) High School
◯ 3) College Degree
◯ 4) High Diploma
◯ 5) Master or Above

C. Age: *

- 1) Less than 25
- 2) 25-35
- 3) 36-46
- 4) 47-57
- 5) 58 or above

D. No. Of Years worked in current organisation: *

- 1) One year or less
- 2) 2-7
- 3) 8-13
- 4) 14-19
- 5) 20 Years or above

E. No. Of Years of experience: *

- 1) One year or less
- 2) 2-7
- 3) 8-13
- 4) 14-19
- 5) 20 Years or above

F. Job Status: *

- 1) First Level
- 2) Middle level
- 3) Lower Level

G. What is your current primary role: *

- 1) Project Team Member (e.g, Document controller, secretary, Foreman, Inspector, site engineer, project engineer, technical engineer, QA/QC, QS, MEP, etc.)
- 2) Project Manager or Site Manager
- 3) Other Manager (e.g, Area, Division, Operation, Procurement, Planning, Architect, MEP, Design, etc.)
- 4) Director / GM / CEO
- Other, Please specify :

H. What is the principal industry of your organization *

◯ 1) Related to Construction industry

◯ 2) Not Related to Construction Industry

I. What is your organization discipline: *

◯ 1) Client

◯ 2) Consultant

◯ 3) Contractor

◯ 4) Subcontractor

◯ 5) Supplier / manufacture

J. Current Experience Location: *

◯ 1) UAE

◯ 2) GCC Countries

◯ Other, Please specify

K. How did you hear about this survey? *

◯ 1) Facebook

◯ 2) Linkedin

◯ 3) Whatsapp

◯ 4) Email

◯ 4) Twitter

◯ 5) researchgate.net

◯ 6) mendeley.com

◯ Other, Please specify

Page 3

PART TWO: PROJECT MANAGER PERCEPTIONS FACTORS
Please tick one box for each question:

Project manager perceptions factors influence delivering successful innovation in construction project. Many argue that Innovation in construction defined as executing activities using new, developed or existing method, process, material, etc. that considered as new to the implemented company.

In your experience of working on construction sector, please indicate the level of importance of the following project manager perceptions factors toward successful innovation: *

	Strongly important	Important	Undecided	Not important	Strongly Not important
1. Leadership	◯	◯	◯	◯	◯
2. Capabilities / Competences	◯	◯	◯	◯	◯
3. Personality Traits	◯	◯	◯	◯	◯
4. Skills	◯	◯	◯	◯	◯

A. In your experience of working on construction sector, To what extent the following are describing the Project Manager Perceptions (From the perspective of Leadership): *

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
5. Transfer and share knowledge and experience	◯	◯	◯	◯	◯
6. Relevant experience and technical knowledge.	◯	◯	◯	◯	◯
7. Financial and procurement knowledge.	◯	◯	◯	◯	◯
8. Organizing responsibilities between project members.	◯	◯	◯	◯	◯
9. Motivate project teams	◯	◯	◯	◯	◯
10. Encourage innovative climate/environment between project teams	◯	◯	◯	◯	◯
11. Supportive of novel ideas.	◯	◯	◯	◯	◯
12. Support new solutions or problem solving	◯	◯	◯	◯	◯

B. In your experience of working on construction sector, To what extent the following are describing the Project Manager Perceptions (From the perspective of Capabilities / Competences): *

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
13. Understanding of the required result and deliverables.	○	○	○	○	○
14. Understanding the project processes and technology.	○	○	○	○	○
15. Project management knowledge.	○	○	○	○	○
16. Evaluate, measure, and determine the project team integration.	○	○	○	○	○
17. Building trust.	○	○	○	○	○
18. Focus on people.	○	○	○	○	○
19. Ability to adapt change	○	○	○	○	○
20. Understanding of project team member	○	○	○	○	○

C. In your experience of working on construction sector, To what extent the following are describing the Project Manager Perceptions (From the perspective of Personality Traits): *

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
21. To adopt a personality that inspires respect among project participants.	○	○	○	○	○
22. Behaviour.	○	○	○	○	○
23. Positive attitude.	○	○	○	○	○
24. Flexibility	○	○	○	○	○

D. In your experience of working on construction sector, To what extent the following are describing the Project Manager Perceptions (From the perspective of Skills (Non-Engineering Skills)): *

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
25. Evaluation of the project and the financial outcomes.	○	○	○	○	○
26. Communication skills.	○	○	○	○	○
27. Planning and control skills. (Control-over)	○	○	○	○	○
28. Managerial skills.	○	○	○	○	○
29. Negotiate innovative idea.	○	○	○	○	○

C. In your experience of working on construction sector, To what extent the following are describing Delivering Successful innovation in construction project (From the perspective of Form of True innovation): *

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
7. Execute innovative ideas successfully	◯	◯	◯	◯	◯
8. Successful ideas to be Recorded	◯	◯	◯	◯	◯
9. Successful ideas to be Learned	◯	◯	◯	◯	◯
10. Successful ideas to be Applied for future projects.	◯	◯	◯	◯	◯

D. In your experience of working on construction sector, To what extent the following are describing Delivering Successful innovation in construction project (From the perspective of Market competition): *

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
11. Improve organisation capabilities for innovation.	◯	◯	◯	◯	◯
12. Innovation strengthens the organisation ability to survive and grow.	◯	◯	◯	◯	◯
13. Innovation influences on the Long Term competency	◯	◯	◯	◯	◯

E. In your experience of working on construction sector, To what extent the following are describing Delivering Successful innovation in construction project (From the perspective of Improving Deliverable): *

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
14. Implementation of innovation improves construction performance	◯	◯	◯	◯	◯
15. Managing Innovation enhances construction performance.	◯	◯	◯	◯	◯
16. Using innovative ideas improves technical capabilities.	◯	◯	◯	◯	◯
17. Innovation leads to develop new solutions.	◯	◯	◯	◯	◯

18. In addition to the above, is there any other major factors influence delivering successful innovation in construction project?

Comments or Recommendations: (I do appreciate if you can write notes related to the above questionnaire and research topic to improve the research results)

**Please Press DONE to complete the Survey.

Thank you very much for your valuable time and your support to my research, If you can share the survey link to others to benefit from their experience that would make the research valuable

» Redirection to final page of eSurvey Creator

Appendix B: Questionnaire Responses Results

B-1 Respondent results as extracted from the online survey website (https://www.esurveycreator.com)

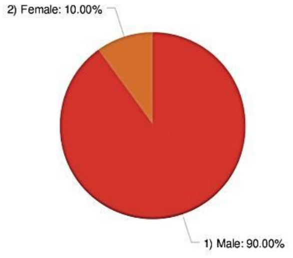
The Project Manager Perceptions Factors Influencing Delivering Successful Innovation In Construction Project at Site Level

1. A. Sex: *

Number of participants: 70

63 (90.0%): 1) Male

7 (10.0%): 2) Female



2. B. Education: *

Number of participants: 70

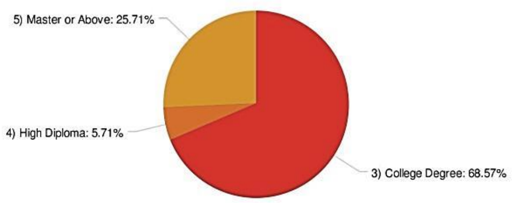
- (0.0%): 1) Less than high school

- (0.0%): 2) High School

48 (68.6%): 3) College Degree

4 (5.7%): 4) High Diploma

18 (25.7%): 5) Master or Above



3. C. Age: *

Number of participants: 70

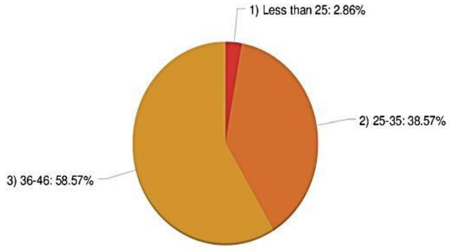
2 (2.9%): 1) Less than 25

27 (38.6%): 2) 25-35

41 (58.6%): 3) 36-46

- (0.0%): 4) 47-57

- (0.0%): 5) 58 or above



4. D. No. Of Years worked in current organisation: *

Number of participants: 70

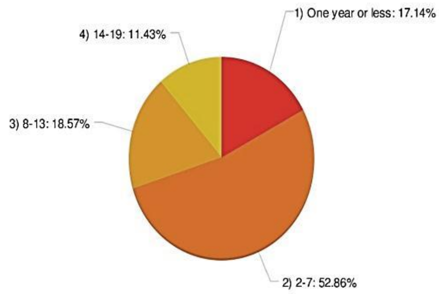
12 (17.1%): 1) One year or less

37 (52.9%): 2) 2-7

13 (18.6%): 3) 8-13

8 (11.4%): 4) 14-19

- (0.0%): 5) 20 Years or above



5. E. No. Of Years of experience: *

Number of participants: 70

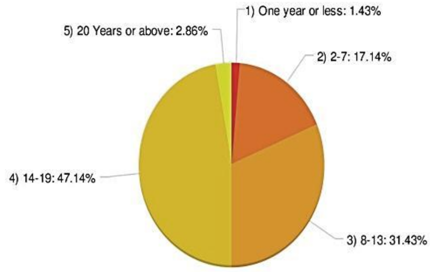
1 (1.4%): 1) One year or less

12 (17.1%): 2) 2-7

22 (31.4%): 3) 8-13

33 (47.1%): 4) 14-19

2 (2.9%): 5) 20 Years or above



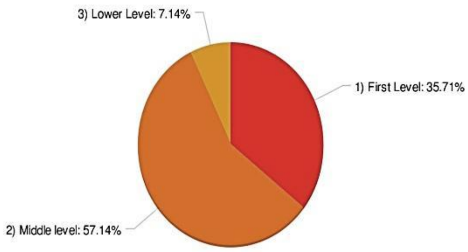
6. F. Job Status: *

Number of participants: 70

25 (35.7%): 1) First Level

40 (57.1%): 2) Middle level

5 (7.1%): 3) Lower Level



7. G. What is your current primary role: *

Number of participants: 69

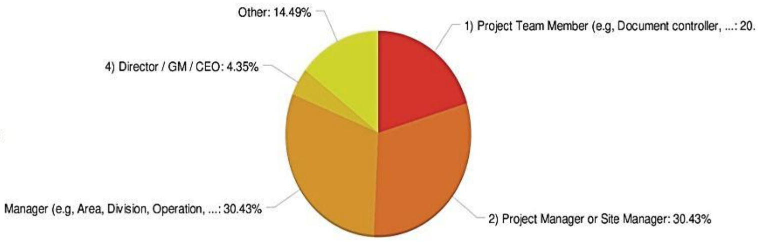
14 (20.3%): 1) Project Team Member (e.g, Document controller, secretary, Foreman, Inspector, site engineer, project engineer, technical engineer, QA/QC, QS, MEP, etc.)

21 (30.4%): 2) Project Manager or Site Manager

21 (30.4%): 3) Other Manager (e.g, Area, Division, Operation, Procurement, Planning, Architect, MEP, Design, etc.)

3 (4.3%): 4) Director / GM / CEO

10 (14.5%): Other



Answer(s) from the additional field:

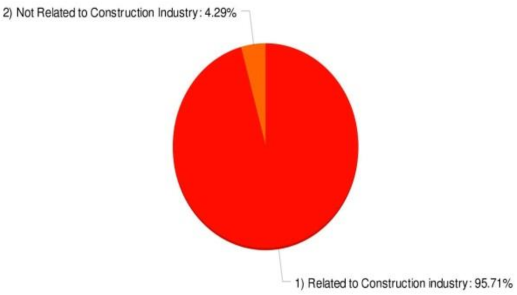
- FM manager
- Lead Construction Engineer
- employee
- Project Technical Manager
- Consultant Sales Manager
- Senior Project Engineer
- Instructor
- HSE Manager
- Projects Manager
- HR exicutive

8. H. What is the principal industry of your organization *

Number of participants: 70

67 (95.7%): 1) Related to Construction industry

3 (4.3%): 2) Not Related to Construction Industry



9. I. What is your organization discipline: *

Number of participants: 69

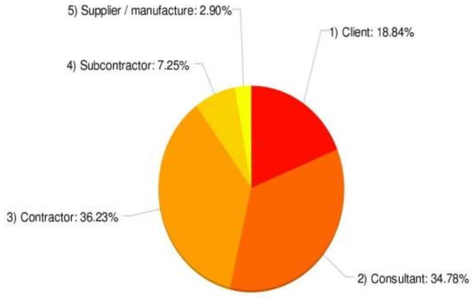
13 (18.8%): 1) Client

24 (34.8%): 2) Consultant

25 (36.2%): 3) Contractor

5 (7.2%): 4) Subcontractor

2 (2.9%): 5) Supplier / manufacture



10. J. Current Experience Location: *

Number of participants: 70

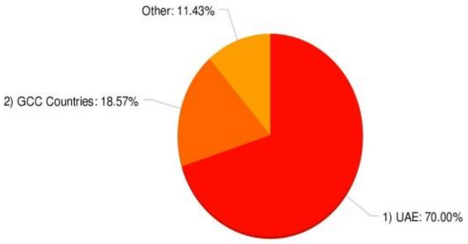
49 (70.0%): 1) UAE

13 (18.6%): 2) GCC Countries

8 (11.4%): Other

Answer(s) from the additional field:

- Egypt
- Egypt
- Australia
- Egypt
- egypt
- Egypt
- Europe
- egypt



11. K. How did you hear about this survey? *

Number of participants: 70

7 (10.0%): 1) Facebook

5 (7.1%): 2) Linkedin

31 (44.3%): 3) Whatsapp

16 (22.9%): 4) Email

1 (1.4%): 4) Twitter

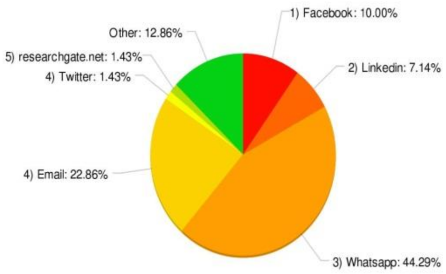
1 (1.4%): 5) researchgate.net

- (0.0%): 6) mendeley.com

9 (12.9%): Other

Answer(s) from the additional field:

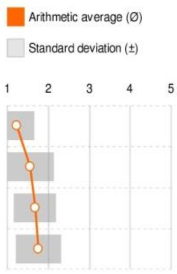
- Friend
- Friend
- raslan
- Friend
- Friend
- Friend
- A friend
- Friend
- Friends



12. In your experience of working on construction sector, please indicate the level of importance of the following project manager perceptions factors toward successful innovation: *

Number of participants: 66

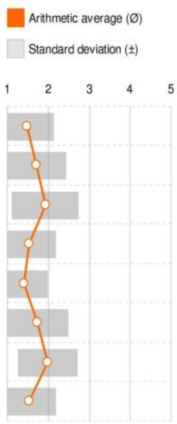
	Strongly important (1)		Important (2)		Undecided (3)		Not important (4)		Strongly Not important (5)			
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±
1. Leadership	51x	77.27	15x	22.73	-	-	-	-	-	-	1.23	0.42
2. Capabilities / Compet...	32x	48.48	33x	50.00	-	-	1x	1.52	-	-	1.55	0.59
3. Personality Traits	23x	34.85	42x	63.64	1x	1.52	-	-	-	-	1.67	0.51
4. Skills	20x	30.30	42x	63.64	4x	6.06	-	-	-	-	1.76	0.56



13. A. In your experience of working on construction sector, To what extent the following are describing the Project Manager Perceptions (From the perspective of Leadership): *

Number of participants: 66

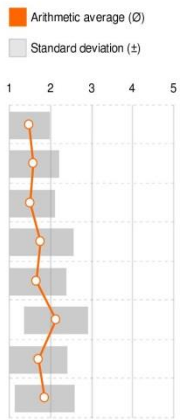
	Strongly Agree (1)		Agree (2)		Undecided (3)		Disagree (4)		Strongly Disagree (5)			
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±
5. Transfer and share kn...	38x	57.58	25x	37.88	2x	3.03	1x	1.52	-	-	1.48	0.64
6. Relevant experience a...	26x	39.39	36x	54.55	1x	1.52	3x	4.55	-	-	1.71	0.72
7. Financial and procurem.	20x	30.30	35x	53.03	7x	10.61	4x	6.06	-	-	1.92	0.81
8. Organizing responsibi...	36x	54.55	26x	39.39	3x	4.55	1x	1.52	-	-	1.53	0.66
9. Motivate project team..	42x	63.64	21x	31.82	3x	4.55	-	-	-	-	1.41	0.58
10. Encourage innovative..	27x	40.91	31x	46.97	6x	9.09	2x	3.03	-	-	1.74	0.75
11. Supportive of novel i...	16x	24.24	37x	56.06	11x	16.67	2x	3.03	-	-	1.98	0.73
12. Support new solution...	36x	54.55	26x	39.39	3x	4.55	1x	1.52	-	-	1.53	0.66



14. B. In your experience of working on construction sector, To what extent the following are describing the Project Manager Perceptions (From the perspective of Capabilities / Competences): *

Number of participants: 66

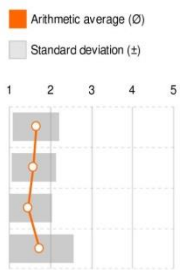
	Strongly Agree (1)		Agree (2)		Undecided (3)		Disagree (4)		Strongly Disagree (5)			
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±
13. Understanding of the…	34x	51.52	32x	48.48	-	-	-	-	-	-	1.48	0.50
14. Understanding the pr…	33x	50.00	28x	42.42	5x	7.58	-	-	-	-	1.58	0.63
15. Project management…	37x	56.06	25x	37.88	4x	6.06	-	-	-	-	1.50	0.61
16. Evaluate, measure, a…	28x	42.42	29x	43.94	6x	9.09	3x	4.55	-	-	1.76	0.80
17. Building trust.	32x	48.48	26x	39.39	7x	10.61	1x	1.52	-	-	1.65	0.73
18. Focus on people.	11x	16.67	40x	60.61	10x	15.15	5x	7.58	-	-	2.14	0.78
19. Ability to adapt chan…	27x	40.91	34x	51.52	3x	4.55	2x	3.03	-	-	1.70	0.70
20. Understanding of pro…	21x	31.82	36x	54.55	7x	10.61	2x	3.03	-	-	1.85	0.73



15. C. In your experience of working on construction sector, To what extent the following are describing the Project Manager Perceptions (From the perspective of Personality Traits): *

Number of participants: 66

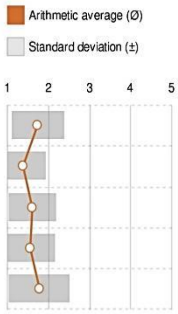
	Strongly Agree (1)		Agree (2)		Undecided (3)		Disagree (4)		Strongly Disagree (5)			
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±
21. To adopt a personali…	26x	39.39	37x	56.06	3x	4.55	-	-	-	-	1.65	0.57
22. Behaviour.	29x	43.94	35x	53.03	2x	3.03	-	-	-	-	1.59	0.55
23. Positive attitude.	39x	59.09	24x	36.36	3x	4.55	-	-	-	-	1.45	0.59
24. Flexibility	30x	45.45	25x	37.88	9x	13.64	2x	3.03	-	-	1.74	0.81



16. D. In your experience of working on construction sector, To what extent the following are describing the Project Manager Perceptions (From the perspective of Skills (Non-Engineering Skills)): *

Number of participants: 66

	Strongly Agree (1)		Agree (2)		Undecided (3)		Disagree (4)		Strongly Disagree (5)			
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±
25. Evaluation of the pro...	24x	36.36	35x	53.03	7x	10.61	-	-	-	-	1.74	0.64
26. Communication skills.	43x	65.15	21x	31.82	2x	3.03	-	-	-	-	1.38	0.55
27. Planning and control ...	29x	43.94	34x	51.52	3x	4.55	-	-	-	-	1.61	0.58
28. Managerial skills.	34x	51.52	28x	42.42	4x	6.06	-	-	-	-	1.55	0.61
29. Negotiate innovative...	26x	39.39	30x	45.45	9x	13.64	1x	1.52	-	-	1.77	0.74



17. 30. In addition to the above, are there any other major perceptions factors influence the project manager role in delivering successful innovation in construction project?

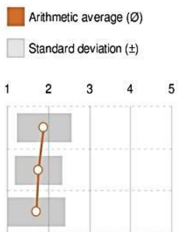
Number of participants: 9

- Nothing
- Dealing with different personalities and managing team arguments and disagreements
- Adapt with latest up to date technology of construction tools and software
- No thanks
- Yes, He is not the signing the official letters.. it means he is not the driver
- More communication and contracts knowledge
- Contract understanding
- P M is found to solve problems , never panic and think out of the box
- Adequate understanding and awareness of projects risks and to be cooperative with all department managers.

18. A. In your experience of working on construction sector, To what extent the following are describing Delivering Successful innovation in construction project (From the perspective of Organisational culture for innovation): *

Number of participants: 66

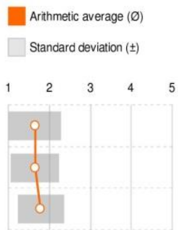
	Strongly Agree (1)		Agree (2)		Undecided (3)		Disagree (4)		Strongly Disagree (5)			
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±
1. Are Reinforce success...	18x	27.27	37x	56.06	11x	16.67	-	-	-	-	1.89	0.66
2. Must be Understood an..	21x	31.82	40x	60.61	5x	7.58	-	-	-	-	1.76	0.58
3. Must Associate and ad...	27x	40.91	34x	51.52	3x	4.55	2x	3.03	-	-	1.70	0.70



19. B. In your experience of working on construction sector, To what extent the following are describing Delivering Successful innovation in construction project (From the perspective of Innovation orientation for Project Manager): *

Number of participants: 66

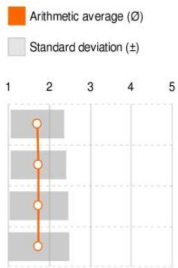
	Strongly Agree (1)		Agree (2)		Undecided (3)		Disagree (4)		Strongly Disagree (5)			
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±
4. Project manager prov...	29x	43.94	31x	46.97	6x	9.09	-	-	-	-	1.65	0.64
5. Influenced by project ...	27x	40.91	35x	53.03	4x	6.06	-	-	-	-	1.65	0.59
6. Influenced by project ...	19x	28.79	42x	63.64	5x	7.58	-	-	-	-	1.79	0.57



20. C. In your experience of working on construction sector, To what extent the following are describing Delivering Successful innovation in construction project (From the perspective of Form of True innovation): *

Number of participants: 66

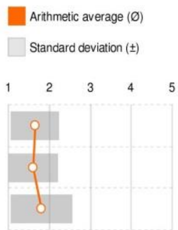
	Strongly Agree (1)		Agree (2)		Undecided (3)		Disagree (4)		Strongly Disagree (5)			
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±
7. Execute innovative ide..	26x	39.39	35x	53.03	4x	6.06	1x	1.52	-	-	1.70	0.66
8. Successful ideas to be..	26x	39.39	33x	50.00	6x	9.09	1x	1.52	-	-	1.73	0.69
9. Successful ideas to be..	26x	39.39	32x	48.48	7x	10.61	1x	1.52	-	-	1.74	0.71
10. Successful ideas to b..	27x	40.91	31x	46.97	6x	9.09	2x	3.03	-	-	1.74	0.75



21. D. In your experience of working on construction sector, To what extent the following are describing Delivering Successful innovation in construction project (From the perspective of Market competition): *

Number of participants: 66

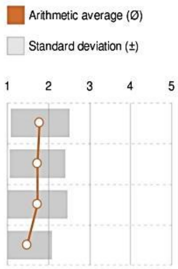
	Strongly Agree (1)		Agree (2)		Undecided (3)		Disagree (4)		Strongly Disagree (5)			
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±
11. Improve organisation...	27x	40.91	35x	53.03	4x	6.06	-	-	-	-	1.65	0.59
12. Innovation strengthe...	30x	45.45	32x	48.48	4x	6.06	-	-	-	-	1.61	0.60
13. Innovation influences...	25x	37.88	30x	45.45	10x	15.15	1x	1.52	-	-	1.80	0.75



22. E. In your experience of working on construction sector, To what extent the following are describing Delivering Successful innovation in construction project (From the perspective of Improving Deliverable): *

Number of participants: 66

	Strongly Agree (1)		Agree (2)		Undecided (3)		Disagree (4)		Strongly Disagree (5)			
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±
14. Implementation of in...	24x	36.36	33x	50.00	8x	12.12	1x	1.52	-	-	1.79	0.71
15. Managing Innovation ...	25x	37.88	35x	53.03	5x	7.58	1x	1.52	-	-	1.73	0.67
16. Using innovative idea...	27x	40.91	30x	45.45	8x	12.12	1x	1.52	-	-	1.74	0.73
17. Innovation leads to d...	37x	56.06	26x	39.39	3x	4.55	-	-	-	-	1.48	0.59



23. 18. In addition to the above, is there any other major factors influence delivering successful innovation in construction project?

Number of participants: 7

- Project manager should encourage team work and social activities between project team.
- The Environment
- Lessons learned
- No
- Provide authorities for the professional and good team members
- Nill
- No

24. Comments or Recommendations: (I do appreciate if you can write notes related to the above questionnaire and research topic to improve the research results)

Number of participants: 4

- - most of your questions are agree and disagree questions, try to include some questions that allow the respondents to choose the factors that impact certain variables.
  - include some questions that are indirect that and not straight forward for the respondents.
- "Neutral" could be better choice option than "Undecided" to describe the case between the Agreement and Disagreement.
- Strong technical support for pm is required
- Wish for good luck

Appendix C: SPSS Descriptive statistics

C-1 <u>Personal and Job related descriptive stats</u>

Statistics

		Gender of Respondents	Educational Level of Respondents	Age of Respondents	Number of years respondent worked in the current organization	Number of years of experience of respondent	Job Status of Respondent	Current primary role of respondent	Principal industry of respondent organization	Organization discipline of respondent	Current Experience Location of respondent	How did Respondent got this survey
N	Valid	66	66	66	66	66	66	66	66	66	66	66
	Missing	0	0	0	0	0	0	0	0	0	0	0
Median		1.00	3.00	3.00	2.00	4.00	2.00	2.00	1.00	2.00	1.00	3.00
Std. Deviation		0.290	0.892	0.528	0.882	0.794	0.581	1.216	0.000	0.941	0.651	1.848

C-2 Personal and Job related descriptive stats

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Gender of Respondents	66	1	2	1.09	0.290
Educational Level of Respondents	66	3	5	3.61	0.892
Age of Respondents	66	1	3	2.58	0.528
Number of years respondent worked in the current organization	66	1	4	2.26	0.882
Number of years of experience of respondent	66	2	5	3.35	0.794
Job Status of Respondent	66	1	3	1.70	0.581
Current primary role of respondent	66	1	5	2.58	1.216
Principal industry of respondent organization	66	1	1	1.00	0.000
Organization discipline of respondent	66	1	5	2.38	0.941
Current Experience Location of respondent	66	1	3	1.38	0.651
Valid N (listwise)	66				

Appendix D: SPSS Reliability Test Results

D-1 Independent variables

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	66	100.0
	Excluded[a]	0	0.0
	Total	66	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
0.851	25

D-2 Dependent Variables

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	66	100.0
	Excluded[a]	0	0.0
	Total	66	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability

Cronbach's Alpha	N of Items
0.921	17

D-3 Factors of global independent variable - Leadership

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	66	100.0
	Excluded[a]	0	0.0
	Total	66	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
0.700	8

D-4 Factors of global independent variable – Capabilities

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	66	100.0
	Excluded[a]	0	0.0
	Total	66	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
0.718	8

D-5 Factors of global independent variable – Personality traits

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	66	100.0
	Excluded[a]	0	0.0
	Total	66	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
0.700	4

D-6 Factors of global independent variable –Skills

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	66	100.0
	Excluded[a]	0	0.0
	Total	66	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
0.749	5

Appendix E: SPSS Pearson Correlation Test Results

E-1 Pearson Correlation Results between all variables

Correlations

		Leader	Capabilities	PersonalityTraits	Skills	OrganisCult	innovOrien	FormTruInn	MarketComp	ImmproveDeliverable	ProjectManagerPercp	DelivSuccInnovation
Leader	Pearson Correlation	1	.609**	.443**	.384**	.309*	.516**	.507**	.376**	.418**	.844**	.522**
	Sig. (2-tailed)		0.000	0.000	0.001	0.012	0.000	0.000	0.002	0.000	0.000	0.000
	N	66	66	66	66	66	66	66	66	66	66	66
Capabilities	Pearson Correlation	.609**	1	.430**	.302*	.350**	.535**	.401**	.292*	.350**	.827**	.462**
	Sig. (2-tailed)	0.000		0.000	0.014	0.004	0.000	0.001	0.017	0.004	0.000	0.000
	N	66	66	66	66	66	66	66	66	66	66	66
PersonalityTraits	Pearson Correlation	.443**	.430**	1	.387**	.325**	.504**	.372**	.324**	.352**	.683**	.450**
	Sig. (2-tailed)	0.000	0.000		0.001	0.008	0.000	0.002	0.008	0.004	0.000	0.000
	N	66	66	66	66	66	66	66	66	66	66	66
Skills	Pearson Correlation	.384**	.302*	.387**	1	.397**	.585**	.577**	.529**	.574**	.641**	.653**
	Sig. (2-tailed)	0.001	0.014	0.001		0.001	0.000	0.000	0.000	0.000	0.000	0.000
	N	66	66	66	66	66	66	66	66	66	66	66
OrganisCult	Pearson Correlation	.309*	.350**	.325**	.397**	1	.611**	.493**	.470**	.426**	.448**	.697**
	Sig. (2-tailed)	0.012	0.004	0.008	0.001		0.000	0.000	0.000	0.000	0.000	0.000
	N	66	66	66	66	66	66	66	66	66	66	66
innovOrien	Pearson Correlation	.516**	.535**	.504**	.585**	.611**	1	.547**	.610**	.621**	.697**	.797**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	0.000
	N	66	66	66	66	66	66	66	66	66	66	66
FormTruInn	Pearson Correlation	.507**	.401**	.372**	.577**	.493**	.547**	1	.677**	.713**	.607**	.869**
	Sig. (2-tailed)	0.000	0.001	0.002	0.000	0.000	0.000		0.000	0.000	0.000	0.000
	N	66	66	66	66	66	66	66	66	66	66	66
MarketComp	Pearson Correlation	.376**	.292*	.324**	.529**	.470**	.610**	.677**	1	.710**	.487**	.846**
	Sig. (2-tailed)	0.002	0.017	0.008	0.000	0.000	0.000	0.000		0.000	0.000	0.000
	N	66	66	66	66	66	66	66	66	66	66	66
ImmproveDeliverable	Pearson Correlation	.418**	.350**	.352**	.574**	.426**	.621**	.713**	.710**	1	.546**	.872**
	Sig. (2-tailed)	0.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000		0.000	0.000
	N	66	66	66	66	66	66	66	66	66	66	66
ProjectManagerPercp	Pearson Correlation	.844**	.827**	.683**	.641**	.448**	.697**	.607**	.487**	.546**	1	.677**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000
	N	66	66	66	66	66	66	66	66	66	66	66
DelivSuccInnovation	Pearson Correlation	.522**	.462**	.450**	.653**	.697**	.797**	.869**	.846**	.872**	.677**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	N	66	66	66	66	66	66	66	66	66	66	66

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

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

Appendix F: SPSS Regression Test Results

F-1 Regression test Results of dependent Global variable and Independent global variable

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	ProjectManagerPercp[b]		Enter

a. Dependent Variable: DelivSuccInnovation

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.677[a]	0.458	0.449	5.55251

a. Predictors: (Constant), ProjectManagerPercp

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1665.343	1	1665.343	54.016	.000[b]
	Residual	1973.142	64	30.830		
	Total	3638.485	65			

a. Dependent Variable: DelivSuccInnovation

b. Predictors: (Constant), ProjectManagerPercp

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.040	9.523		0.319	0.751
	ProjectManagerPercp	0.643	0.088	0.677	7.350	0.000

a. Dependent Variable: DelivSuccInnovation

F-2 <u>Regression test Results of dependent Global variable and Independent entire factors</u>

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Skills, Capabilities, PersonalityTraits, Leader[b]		Enter

a. Dependent Variable: DelivSuccInnovation

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.735[a]	0.540	0.510	5.23774

a. Predictors: (Constant), Skills, Capabilities, PersonalityTraits,

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1965.017	4	491.254	17.907	.000[b]
	Residual	1673.468	61	27.434		
	Total	3638.485	65			

a. Dependent Variable: DelivSuccInnovation

b. Predictors: (Constant), Skills, Capabilities, PersonalityTraits, Leader

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-0.057	9.043		-0.006	0.995
	Leader	0.476	0.285	0.194	1.673	0.099
	Capabilities	0.345	0.262	0.148	1.320	0.192
	PersonalityTraits	0.460	0.429	0.110	1.073	0.288
	Skills	1.660	0.329	0.491	5.039	0.000

a. Dependent Variable: DelivSuccInnovation

F-3 Regression test Results of dependent Global variable and Independent global factors individually

F-3.1 Dependent Global variable and Leadership

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Leader[b]		Enter

a. Dependent Variable: DelivSuccInnovation

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.522[a]	0.272	0.261	6.43324

a. Predictors: (Constant), Leader

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	989.743	1	989.743	23.915	.000[b]
	Residual	2648.742	64	41.387		
	Total	3638.485	65			

a. Dependent Variable: DelivSuccInnovation

b. Predictors: (Constant), Leader

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	28.316	9.141		3.098	0.003
	Leader	1.284	0.263	0.522	4.890	0.000

a. Dependent Variable: DelivSuccInnovation

F-3.2 Dependent Global variable and Capabilities / Competency

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Capabilities[b]		Enter

a. Dependent Variable: DelivSuccInnovation

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.462[a]	0.214	0.201	6.68570

a. Predictors: (Constant), Capabilities

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	777.774	1	777.774	17.400	.000[b]
	Residual	2860.711	64	44.699		
	Total	3638.485	65			

a. Dependent Variable: DelivSuccInnovation

b. Predictors: (Constant), Capabilities

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	35.923	8.890		4.041	0.000
	Capabilities	1.075	0.258	0.462	4.171	0.000

a. Dependent Variable: DelivSuccInnovation

F-3.3 Dependent Global variable and Personality Traits

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	PersonalityTraits[b]		Enter

a. Dependent Variable: DelivSuccInnovation

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.450[a]	0.202	0.190	6.73391

a. Predictors: (Constant), PersonalityTraits

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	736.373	1	736.373	16.239	.000[b]
	Residual	2902.112	64	45.345		
	Total	3638.485	65			

a. Dependent Variable: DelivSuccInnovation

b. Predictors: (Constant), PersonalityTraits

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	39.828	8.236		4.836	0.000
	PersonalityTraits	1.880	0.467	0.450	4.030	0.000

a. Dependent Variable: DelivSuccInnovation

F-3.4 Dependent Global variable and Skills

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Skills[b]		Enter

a. Dependent Variable: DelivSuccInnovation

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.653[a]	0.427	0.418	5.70933

a. Predictors: (Constant), Skills

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1552.313	1	1552.313	47.622	.000[b]
	Residual	2086.172	64	32.596		
	Total	3638.485	65			

a. Dependent Variable: DelivSuccInnovation

b. Predictors: (Constant), Skills

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	24.408	7.055		3.460	0.001
	Skills	2.206	0.320	0.653	6.901	0.000

a. Dependent Variable: DelivSuccInnovation

Appendix G: Relative importance based on statistical analysis using regression test Results

G-1 R2 differences

This method is based on the differences usefulness of the variable in different combination of predictors (Johnson 2000; Johnson and LeBreton 2004). Regression test has been conducted to calculate R^2 values in different combination of project manager perception factors. The total differences between R^2 of the 4 perception factors and the value of R^2 after dropping factor by factor will be used to rank the relative importance as the largest difference indicate that dropped factor has the largest impact to R^2.

G-1.1 Regression test for all perceptions factors

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.735[a]	0.540	0.510	5.23774

a. Predictors: (Constant), Skills, Capabilities, PersonalityTraits, Leader

G-1.2 Regression test for Capabilities, Personality traits, and skills

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.720[a]	0.519	0.496	5.31325

a. Predictors: (Constant), Skills, Capabilities, PersonalityTraits

G-1.3 Regression test for Leadership, Personality traits, and skills

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.726[a]	0.527	0.504	5.26902

a. Predictors: (Constant), Leader, Skills, PersonalityTraits

G-1.4 Regression test for Leadership, Capabilities, and skills

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.729[a]	0.531	0.509	5.24409

a. Predictors: (Constant), Capabilities, Skills, Leader

G-1.5 Regression test for Leadership, Capabilities, and Personality traits

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.590[a]	0.349	0.317	6.18290

a. Predictors: (Constant), PersonalityTraits, Capabilities, Leader

G-1.6 R2 differences values

Project manager perceptions factors (Dropped factor)	R^2 Value for all perceptions factors	R^2 Value after dropped the perceptions factor	Differences
Leadership	0.540	0.519	0.021
Capabilities / Competency	0.540	0.527	0.013
Personality Traits	0.540	0.531	0.009
Skills (Non-Engineering)	0.540	0.349	0.191

Regression test for leadership, Capabilities, personality traits, and skills has total R^2 value of 0.540 as shown in **table G-1.1**. R^2 values after dropping one by one of perception factors are shown above in **tables G-1.2, G-1.3, G-1.4 and G-1.5**. The differences between all perceptions factors and dropped perceptions factors of R^2 shown in **table G-1.6** where the value of R^2 after dropping leadership factor is 0.021, after dropping capabilities factor is 0.013, after dropping personality traits is 0.009, and after dropping skills is 0.191 as**.** It can be seen that the largest differences in R^2 value has been obtained when skills factor dropped. Therefore the influence of skills factors has the largest impact to R^2 than other factors. Based on that skills factor ranked first, leadership factor ranked second, capabilities factor ranked third, and personality traits factor ranked forth.

G-2 Beta Ranking from Regression test results of dependent Global variable and Independent entire factors

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-0.057	9.043		-0.006	0.995
	Leader	0.476	0.285	0.194	1.673	0.099
	Capabilities	0.345	0.262	0.148	1.320	0.192
	PersonalityTraits	0.460	0.429	0.110	1.073	0.288
	Skills	1.660	0.329	0.491	5.039	0.000

a. Dependent Variable: DelivSuccInnovation

G-3 Part Correlation

Standardized regression test is associated with zero-order correlation that consider as one of the methods to measure the relative importance of the predictor variable and the dependent variable (Johnson 2000; Johnson and LeBreton 2004). Regression test has been conducted to calculate zero-order correlation values the entire project manager perception factors. Partial correlation values are shown below in **Table G-3.1**. Skills factor has the largest value followed by leadership value then capabilities value, and in the last place comes the personality traits value. Despite the many restraints to use this method to identify the importance order (Johnson 2000; Nathans, Oswald & Nimon 2012) the overall ranking order are similar to other methods conducted above because constraints are not applicable or been avoided in this research.

G-3.1 Coefficients table for regression test of project manager perceptions factors

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Correlations Partial	Correlations Part
1	(Constant)	-0.057	9.043		-0.006	0.995			
	Leader	0.476	0.285	0.194	1.673	0.099	0.522	0.210	0.145
	Capabilities	0.345	0.262	0.148	1.320	0.192	0.462	0.167	0.115
	PersonalityTraits	0.460	0.429	0.110	1.073	0.288	0.450	0.136	0.093
	Skills	1.660	0.329	0.491	5.039	0.000	0.653	0.542	0.438

a. Dependent Variable: DelivSuccInnovation

G-4 Stepwise regression test of project manager perceptions factors against delivering successful innovation

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Skills		Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Leader		Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: DelivSuccInnovation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.653[a]	0.427	0.418	5.70933
2	.716[b]	0.513	0.497	5.30567

a. Predictors: (Constant), Skills

b. Predictors: (Constant), Skills, Leader

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1552.313	1	1552.313	47.622	.000[b]
	Residual	2086.172	64	32.596		
	Total	3638.485	65			
2	Regression	1865.025	2	932.512	33.126	.000[c]
	Residual	1773.460	63	28.150		
	Total	3638.485	65			

a. Dependent Variable: DelivSuccInnovation

b. Predictors: (Constant), Skills

c. Predictors: (Constant), Skills, Leader

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	24.408	7.055		3.460	0.001
	Skills	2.206	0.320	0.653	6.901	0.000
2	(Constant)	6.341	8.506		0.745	0.459
	Skills	1.794	0.322	0.531	5.576	0.000
	Leader	0.782	0.235	0.318	3.333	0.001

a. Dependent Variable: DelivSuccInnovation

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	Leader	.318[b]	3.333	0.001	0.387	0.852
	Capabilities	.292[b]	3.131	0.003	0.367	0.909
	PersonalityTraits	.232[b]	2.337	0.023	0.282	0.850
2	Capabilities	.174[c]	1.577	0.120	0.196	0.623
	PersonalityTraits	.138[c]	1.371	0.175	0.172	0.748

a. Dependent Variable: DelivSuccInnovation

b. Predictors in the Model: (Constant), Skills

c. Predictors in the Model: (Constant), Skills, Leader

G-5 Summary of project manager perceptions factors ranking results are similar in different test types

Project Manager perceptions factors		Relative importance from regression tests		
	R2 differences	**Standardized coefficients Beta Ranking**	**Part Correlation**	**Stepwise regression test**
Leadership	**2**	**2**	**2**	**2**
Capabilities / Competency	**3**	**3**	**3**	**N/A**
Personality Traits	**4**	**4**	**4**	**N/A**
Skills (Non-Engineering)	**1**	**1**	**1**	**1**