The Contingent Effects of Value Creation Processes on Project Value

–An Empirical Analysis from Project Managers' Perspective

By

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Author's Declaration

This is to certify that the intellectual content of this thesis is solely the product of my own work. Due acknowledgement has been made in the text to all other materials used and for all assistance received in preparation.

This thesis does not exceed the word length for this degree and it has not been submitted for any other degree or purpose.

Boris Fabrizio Heredia Rojas

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ABSTRACT

Projects are seen as platforms for bringing changes that may create value for stakeholders. There are two main schools of thought on the value creation processes; one based on transactional exchange theories and the other on relations-based theories. The former focus on value creation through reduction of transactional costs, while the latter emphasises addressing project stakeholder's needs through establishing close interactions with involved parties. Accordingly, this research examines effects on project value of the two value creation processes for project delivery: independent value creation– where the firm relies on its capabilities and expertise to deliver the project, without the need for seeking collaboration from other firms; and value co-creation– where the firm and key stakeholders collaborate to deliver the project based on close relationships.

Extant studies have conceptually identified the effects on project value of both value creation processes. Nevertheless, there is a little empirical investigation of these effects. Hence, the main objective of this research is to investigate how both processes of value creation affect project value and the moderating effects of two critical contingent variables – requirements uncertainty and project complexity– on the relationship between value creation processes and project value. The study employs a deductive approach to fulfil this aim, and applies a cross-sectional survey to collect data; 168 valid responses from Chilean project managers were returned. A multivariate analysis using PLS-SEM was conducted to validate the conceptual framework and to test the hypotheses.

Contributing to literature, the findings demonstrate that both value creation processes impact jointly on project value, and these impacts are moderated by the current level of requirements uncertainty and project complexity. The theoretical and practical implications of the findings are discussed. Directions for future research are elaborated.

Keywords: *Value creation processes, project value, project complexity, requirements uncertainty, moderating effects, partial least square-structural equation modelling.*

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ABBREVIATIONS

α	Cronbach's Alpha
ANOVA	Analysis of Variance
AVE	Average Variance Extracted
BCA	Bias-Corrected and Accelerated
BSI	British Standard Institute
CA	Conceptual Agreements
CO	Coordination
CL	Collaboration
CLF	Common Latent Factor
CR	Composite Reliability
CW	Collaborative Work
ECI	Early contractor involvement
EVA	Economic Valued Added
EVM	Earned Value Management
GDP	Gross Domestic Product
HSSE	Health, Safety, Security and Environmental
HTMT	Heterotrait-Montrait Ratio
IC	Impact on the Client
IN	Innovating
IOR	Inter-Organisational Relationships
IS/IT	Information Systems / Information Technologies
JPS	Joint Problem-Solving
KPI	Key Performance Indicator
LISREL	Linear Structural Relations
MC	Monitoring & Controlling
NPV	Net Present Value
OECD	Organisation for Economic Co-operation and Development
OS	Organisational and Business Success
OTG	Omnibus Test of Group
PBO	Project-Based Organisations
PC	Project Complexity
PDM	Project Delivery Model
PE	Project Efficiency
PF	Preparing for the Future
PLS	Partial Least Square
PLS-MGA	Partial Least Square – Multi Group Analysis
PLS-SEM	Partial Least Square – Structural Equation Modelling
PMBoK	Project Management Body of Knowledge
PMI	Project Management Institute
PMS	Project Management Success
PPP	Public – Private Partnership
PS	Project Size

PSU	Project Success
PV	Project Value
QI	Quality of Interactions
RBV	Resource Based View
RC	Relational Contracting
RE	Relational Engagement
RN	Relational Norms
RU	Requirements Uncertainty
R&D	Research and Development
SEM	Structural Equation Modelling
SET	Social Exchange Theory
SIE	Strategic Information Exchange
SVA	Shareholder Value Analysis
SVN	Stakeholder Value Network
TCE	Transaction Cost Economics
TOL	Tolerance Factor
U	Unidimensionality
UK	United Kingdom
USA	United States of America
VIF	Variance Inflation Factor

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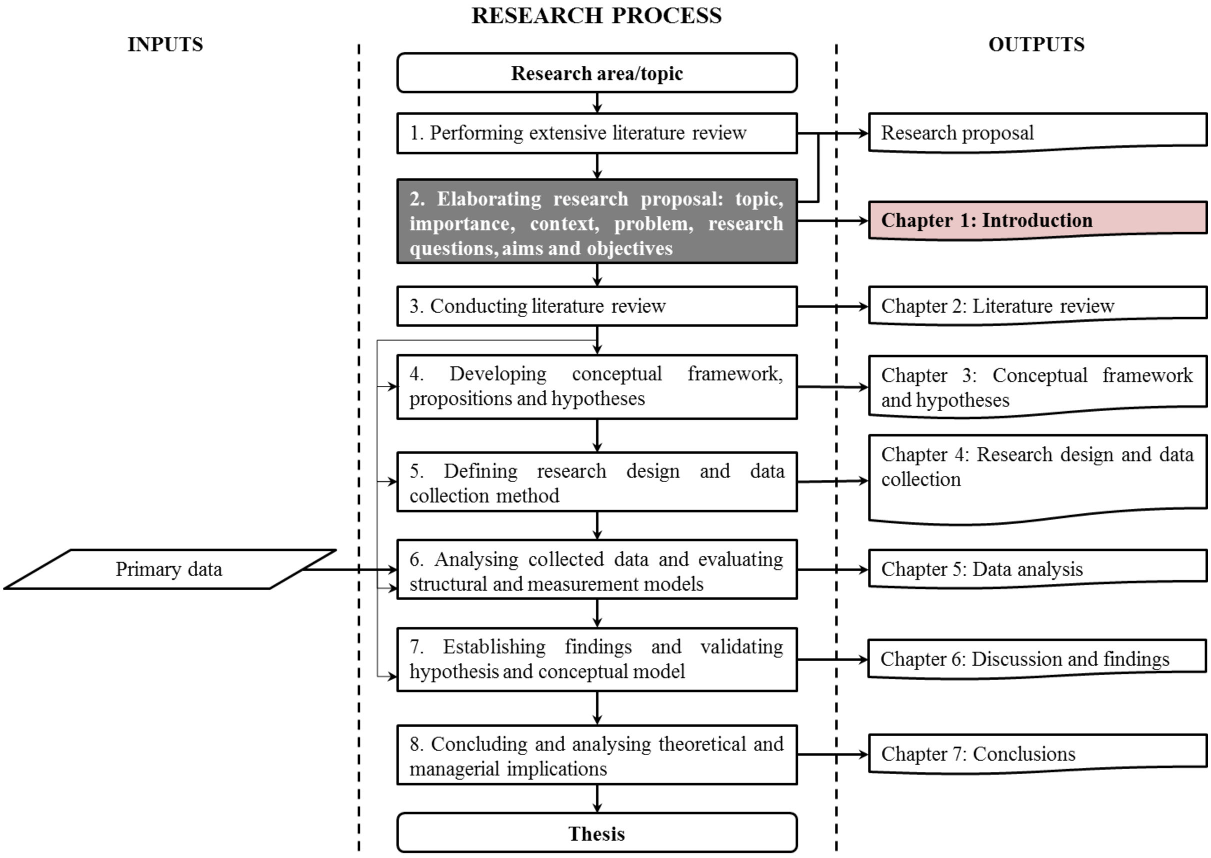
Chapter 1: INTRODUCTION

- Background
- Research design
- Research contributions
- Chapters overview



1.1 Background

Determining how an organisation creates value is controversial and much discussed in management and business research. Considering is debate as the main motive, Ghoshal, Bartlett, and Moran (1999) believe that there are two fundamental types of orientations to management. One emphasises efficiency through cost reduction, with static and internally oriented monitoring and control; and the other approach focuses on effectiveness, collaboration and value-maximisation, dynamic and externally oriented management. Ghoshal et al. (1999, p. 9) claim that “managers need to define their companies as value creators rather than as value appropriators”.

The question is, how does an organisation create value for stakeholders? In consideration that one of the most recognised dimensions of value is the difference between benefits received and sacrifices made (Kliniotou, 2004; Voss 2012), scholars have looked through different theoretical lenses to explain the value creation process for stakeholders. For instance, transaction cost economics (TCE) focuses on minimising the transaction costs of exchange (Williamson, 1985) where the value creation process is related to maximising shareholder profits (Gummerus, 2013; Moran & Ghoshal, 1996; Patanakul & Shenhar, 2007; Pitelis & Vasilaros, 2010). Meanwhile, stakeholder theory and other relational-based theories suggest that value is generated by relationships with the interested parties (Freeman, Harrison, Wicks, Parmar, & De Colle, 2010). Although traditionally the perspective of value creation on economic and financial gains has represented a unique and meaningful measurement of organisational success, value maximisation through close relationships and permanent interactions with involved parties increases the stakeholders' satisfaction and long-term returns in the form of benefits realisation (Harrison & Wicks, 2013; Jensen, 2001) and social/public value creation when there are government initiatives (Caldwell, Roehrich and George, 2017).

The process of value creation can be defined in terms of the activities and capabilities of the organisation (Bowman & Ambrosini, 2000; Harrison & Wicks, 2013; Lepak, Smith, & Taylor, 2007), but also as a collaborative and close work of co-creation with key stakeholders (Kelly, 2007; Zajac & Olsen, 1993). Consequently, the value creation process can be categorised as either independent or co-created. The independent value creation process refers to a series of activities performed by a firm independently (Vargo, Maglio, & Akaka, 2008) without the need to seek the collaboration of other firms (Austin & Seitanidi, 2012), relying solely on the organisation's own resources, competencies and capabilities (Bowman & Ambrosini, 2000). Typically, the focal firm has the capability to deliver what has been requested of them without seeking extensive help from other project parties. In this case, the product or service to be delivered is relatively simple, straightforward and within the firm's area of expertise. Conversely, the value co-creation process refers to a system where parties need to work closely together through continuous interactions, active dialogue, motivation, and co-built experiences with clients (Grönroos & Voima, 2013; Gummerus, 2013; Ng & Smith, 2012; Prahalad & Ramaswamy, 2004) and other stakeholders (Rod, Lindsay, & Ellis, 2014; Roser, DeFillippi, & Samson, 2013). Co-creation requires support in collaborative environments where the parties involved have a high resource complementarity, distinctive competency and strong or broad linked interests (Austin & Seitanidi, 2012). For instance, in the construction industry, major infrastructure projects are good examples of how value co-creation operates where key stakeholders such as government agencies, designers, contractors, and local communities are often needed to collaborate to achieve the expected outcomes.

Extant studies focus on the individual effects of either process where each process requires specific organisational configurations, especially in inter-organisational governance, mode of interaction and management foci (Clauss & Spieth, 2016; Fang, Palmatier, & Evans, 2008; J. Hsu, Hung, Chen, & Huang, 2013; Lau, 2011; Murthy, Padhi, Gupta, & Kapil, 2016;

Wagner, Eggert, & Lindemann, 2010; Wu, Wang, & Chen, 2017; S. Zhao, Yu, Xu, & Bi, 2014). Yet there exists a dearth of an empirical examination of the fit between relationships in the value creation processes and the organisational configuration in the context of the projects. Therefore,

RQ1: How do value creation processes affect project value?

Drawing on the contingency theory that proclaims that contextual conditions affect the fit between organisational characteristics and performance (L. Donaldson, 2001), at the project level, requirements uncertainty and project complexity are two contextual contingency factors in the literature that are considered to be critical (Eriksson & Westerberg, 2011; Hanisch & Wald, 2014; Padalkar & Gopinath, 2016; Shenhar & Dvir, 2007). While the requirements uncertainty reflects the extent to which the client is unsure about the purpose of the project or about how to achieve the purpose (Kossmann, 2013); project complexity directly refers to the arrangement of elements and subsystems in the whole project, and to the changing relationships between project components and between the project and its context over time (Brady & Davies, 2014)

Understanding how the complexity and requirements uncertainty of a project influence the effects of the value creation processes is critical for effective delivery of project values. When the levels of requirements uncertainty and complexity in a project are high, collaborative relationships support effective project delivery and are conducive to project value maximisation (Eriksson, 2014; Eriksson & Westerberg, 2011; Pesämaa, Eriksson, & Hair, 2009; M. Rahman & Kumaraswamy, 2005). In contrast, when the levels of requirements uncertainty and complexity in a project are low, the use of formal controls and coordination suffice to deliver the expected project values (Eriksson & Westerberg, 2011). Therefore,

RQ2: How do requirements uncertainty and project complexity moderate the relationship between value creation processes and project value?

This research proposes and validates a conceptual model at the project level about the effects of value creation processes on project value, contingent upon the requirements uncertainty and project complexity. By the literature review, it identifies governance strategy, mode of interaction, and management foci as the triple enabling factors underpinning the value creation processes of project delivery models (PDM). Additionally, this study provides analyses indicating that the joint effects of these triple factors have a contingent effect on project value, moderated by the project's requirements uncertainty and complexity.

1.2 Research design

First, a conceptual framework of the contingent effects of value creation processes was developed based on the literature review. Subsequently, a questionnaire was designed and used to collect data to validate the conceptual model. The cross-sectional survey obtained 168 valid responses, yielding a response rate of 46%. The results of data analysis using partial least square-structural equation modelling (PLS-SEM) then validated the framework.

1.3 Research contributions

This research contributes mainly toward filling the theoretical and empirical gaps present in the research about the joint effects of value creation processes on project value and the moderating effects of requirements uncertainty and project complexity.

In particular, existing definitions of specific project delivery models (PDMs) are typically presented in terms of contract conditions; relationships between main stakeholders; and responsibilities of the parties involved, among other considerations. Because of the multi-dimensional delineation of the models and the current lack of a theoretical model describing how each PDM functions, there are two options for an examination of the effects of PDMs as value creation platforms on project value. The first option is to treat each PDM of a project as a black box and examine the effects associated with a particular PDM over a sample of projects with random PDMs. The second option is to develop a conceptual model based on the research literature that represents the value creation logics of the respective PDMs and examines the association between the theoretical model and the effects. Because the former option does not add to the understanding of the inner workings of PDMs, this study chooses the latter option to develop a conceptual model that represents the value creation processes of PDMs. In this way, this research provides empirical evidence linking the conceptual model and therefore the PDMs with project value.

Findings demonstrate not only that these two processes impact jointly on project value, but also how strongly this relationship affected by the current level of requirements uncertainty and complexity of the project. Moreover, for practitioners, the findings provide insight into how to effectively design value creation processes and how to support the processes by fostering appropriate governance mechanisms, suitable modes of stakeholder interaction, and management orientations in order to maximise project value. These contributions are significantly relevant for owners in choosing the most suitable PDM during the early stages of a project in order to face different conditions of requirements uncertainty and project complexity.

1.4 Chapters overview

This thesis has been organised into seven chapters.

Chapter 1 introduces the background for this thesis and discusses the importance and relevance of the research topic, including a description of the problem, purpose, research questions, and contributions.

Chapter 2 reviews the literature on value creation and defines the key concepts used in this thesis. Two value creation processes are conceptualised based on existing theories such as TCE, RBV, agency theory, relational view and relational contracting. Through the literature review, extant findings and gaps in past research are identified and research questions are specified.

Chapter 3 develops the conceptual framework and the research hypotheses for addressing the identified gaps and proposed research questions. Consistent with the contingency approach, this framework theorises that the influence of value creation processes on project value are moderated by two contextual factors, requirements uncertainty and project complexity.

Chapter 4 discusses the research design applied, the data collection method used and the data analysis technique selected for this thesis, beginning with the research process application, followed by a detailed explanation of the research design and the chosen data collection method. The sampling frame is then defined, and the questionnaire design and implementation process are elucidated. The final part highlights the PLS-SEM as the selected data analysis method.

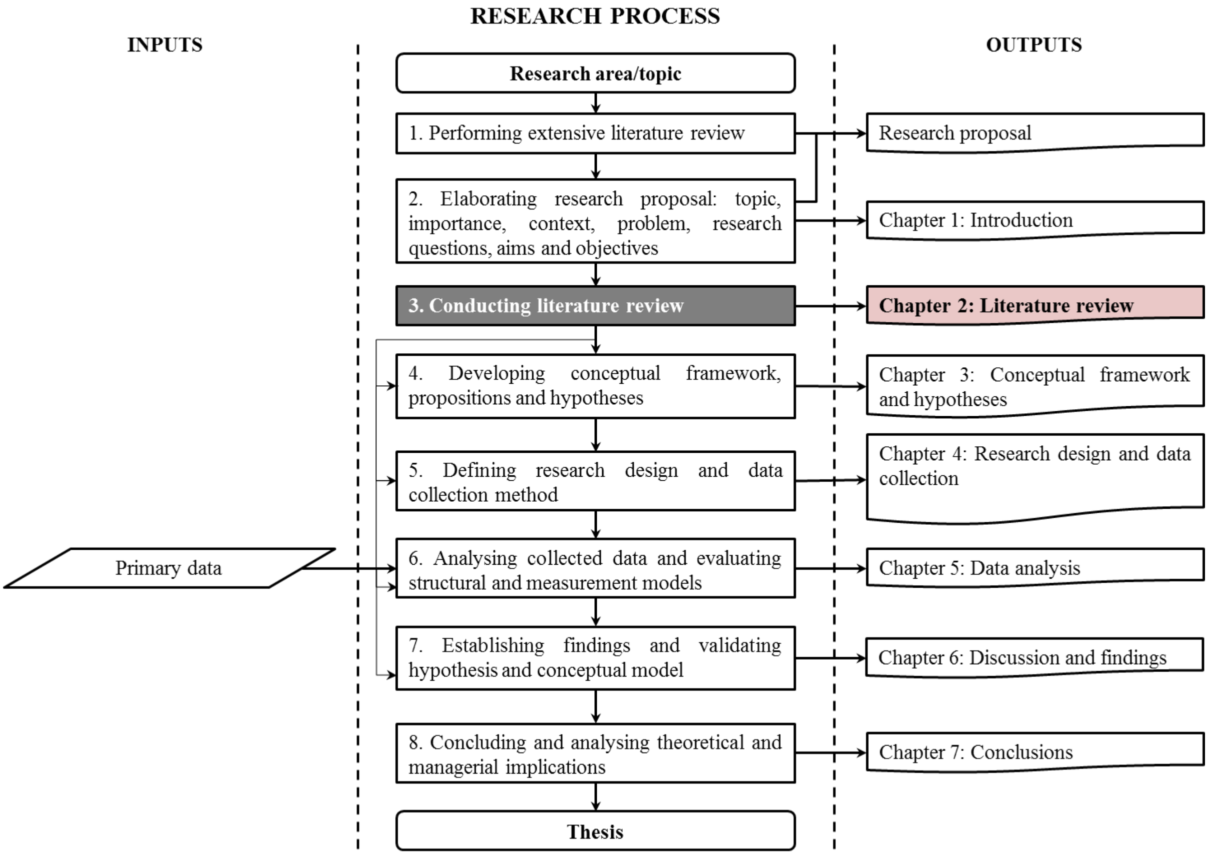
Chapter 5 displays the definition and evaluation of the measurement models and structural model, considering the previous data preparation related to missing values and outliers, exhibiting all the results of measurement models and structural model assessments. The results of the moderation analysis of project complexity and requirements uncertainty on value creation processes and project value relationships are then presented at the end.

Chapter 6 examines whether or not the research hypotheses are supported and discusses the related findings.

Chapter 7 presents the summary and main conclusions of this thesis, which include compression of the research method, a summary of the main findings and conclusions, an exploration of theoretical and managerial implications of this investigation, and concluding with a presentation of limitations and recommendations for future research.

Chapter 2: LITERATURE REVIEW

- Introduction
- The concept of value creation
- Project delivery models as platforms for creating value
- Drivers of value creation processes
- Literature gaps and research questions
- Summary



2.1 Introduction

This chapter summarises and evaluates the previous literature on value creation, beginning with a definition of the key concepts and existing logics of value creation (Section 2.2). Identifying projects as platforms for creating value, two value creation processes – independent value creation and value co-creation – are conceptualised and explained (Section 2.3). The subsequent section presents a description of the main factors in these value creation processes, found in the prior empirical management research where governance strategy, mode of interaction and management foci are recognised as prominent value creation drivers (Section 2.4). The final section identifies and discusses the gaps in the existing research and details the research questions (Section 2.5).

2.2 The concept of value creation

2.2.1 Value

Ng and Smith (2012, p. 1) state that "the concept of value has been discussed for 2000 years with various nuanced meanings" in which philosophical, economic and management foundations show a significant and non-integrated theoretical basis for understanding the definition of value. Through a detailed review, Ng and Smith (2012) propose six categories of value, namely value as a utility; value as the economic worth of the customer to the firm; value as perceived satisfaction; value as a net benefit; value as a means-end; and value as a phenomenological experience. Similarly, Gummerus (2013) categorises the value concept according to four approaches – value as benefits/sacrifices; value as a means-end; value as phenomenological; and value as an experience outcome. Both Ng and Smith and Gummerus' studies are based on literature in marketing and strategic management. Table 2.1 summarises the following six definitions of value which may be identified.

Particularly in the engineering and construction industry, value management and value engineering methodologies have been successfully applied mainly during the design phase of a project through structured activities called value management workshops (Kelly, 2007). These workshops are performed by a multidisciplinary and representative group of people (i.e. stakeholders) that analyse and propose the best value solution for a situation at the lowest total cost (Male, Kelly, Gronqvist, & Graham, 2007). In this direction, British Standard Institute (BSI) defines value as the relationship between satisfaction with needs and the resources required to deliver them (Kliniotou, 2004; Male et al., 2007; Patanakul & Shenhar, 2007). This definition of value is directly related to 'value for money', which is commonly referred to as a key performance indicator (KPI) broadly used mainly in infrastructure projects (Bowman & Ambrosini, 2000; Lam & Gale, 2014; MacDonald, Derek, & Moussa, 2012).

Table 2.1: The concept of value – different definitions

Definition of value
Value as *utility* represents the traditional definition of value, i.e., what the client is willing to pay for the total satisfaction received from consuming a product or service (offering) (Ng & Smith, 2012).
Value as *the economic worth of the client to the firm* is the net present value of the future profit flow over a client's lifetime (Ng & Smith, 2012).
Value as *perceived satisfaction* is often equated to exceeding the client's expectations of the quality and price of an offering, i.e. value is the inherent property of a product or service (Ng & Smith, 2012).
Value as *benefits/sacrifices* is the difference between the perceived benefits and sacrifices associated with buying and consuming particular goods or services (Gummerus, 2013; Ng & Smith, 2012).
Value as a *means-ends* is the way that a product/service selection facilitates the achievement of the desired end, i.e., the degree to which use of the product/services can achieve the client's goals and purposes (Gummerus, 2013; Ng & Smith, 2012).
Value as *phenomenological experience* or *experience outcomes* is always determined by the beneficiary through the user experience of the product or service (Gummerus, 2013; Ng & Smith, 2012).

Within project and program management, the benefits management approach recognises value with regard to benefits. Benefits are measurable outcomes generated by the needs of the project stakeholders (Patanakul & Shenhar, 2007), or flows of value that are produced by the realisation of target outcomes of the project, for any stakeholder (Zwikael & Smyrk, 2012). According to this perspective, the concept of value as benefits/sacrifices makes the most sense at a project level; hence, value defined as the difference between the benefits received by stakeholders and the sacrifices made by them has been extensively recognised (Ahola, Laitinen, Kujala, & Wikström, 2008; Kliniotou, 2004; Möller, 2006; Voss, 2012). This definition implies the capacity for satisfying stakeholder needs from both tangible and intangible outcomes, rather than only focusing on an economic perspective.

In summary, value has been traditionally associated with economic and financial benefits for shareholders (Moran & Ghoshal, 1996; Patanakul & Shenhar, 2007; Pitelis & Vasilaros, 2010) in the form of maximisation of wealth and profits. However, in recent years, the focus has shifted to stakeholders and their mutual relationships as a fundamental source of value creation, especially in the form of non-financial and intangible benefits (Garriga, 2014; Harrison & Wicks, 2013; Jensen, 2001; O'Cass & Ngo, 2011).

2.2.2 Value creation

Value creation has accordingly represented a significant topic within strategic management research. Normann and Ramirez (1993, p. 65) point out that “strategy is the art of creating value” and Bowman and Ambrosini (2000) indicate that firms exist to create value. Moreover, value creation has been increasingly recognised as a useful lens through which to gauge the long-term sustainability and competitiveness of organisations, industries and nations (Pitelis & Vasilaros, 2010). These statements express the belief that value creation is the fundamental principle for an organisation to accomplish long-term competitiveness, and represents the most critical business objective (Jensen, 2001; O'Cass & Ngo, 2011).

Traditionally, value creation has been understood in an economic and financial sense, through concepts of the perceived use value and the exchange value (Bowman & Ambrosini, 2000; Lepak et al., 2007; O'Cass & Ngo, 2011; Priem, 2007). In this perspective, value creation has been represented as a dynamic process that produces the perceived needs valued by the client, and that generates exchange value when the product or service is sold (Bowman & Ambrosini, 2000). Nevertheless, scholars from different disciplines have highlighted value creation as an effective process for achieving competitive advantage through minimising cost exchanges (Williamson, 1985), improving transactional relationships (Zajac & Olsen, 1993); developing social capital, and facilitating the generation of intellectual capital (Nahapiet & Ghoshal, 1997).

Stabell and Fjeldstad (1998) identify three value creation logics across a broad range of industries and organisations that provide the theoretical foundation for analysing competitive advantage. (1) *Value chain*, based on long-linked interdependency which delivers value for transforming inputs into products. (2) *Value shop*, based on intensive interdependency which delivers value for resolving unique customer problems. (3) *Value network*, based on mediated interdependency which delivers value for enabling direct and indirect exchange between consumers.

The first, *value chain* logic, was developed by Michael Porter to represent and analyse primary and support activities in a firm to create value that provides a competitive advantage in a specific industry (Stabell & Fjeldstad, 1998). According to this logic, value can be created by product or service differentiation, or by lower buyer cost, where the main drivers of value creation are policy choices, linkages, timing, location, sharing of activities, learning, integration, scale and institutional factors (Amit & Zott, 2001). Considering the value chain logic as the transformation of inputs into products (Stabell & Fjeldstad, 1998), supply chain is defined as a network of organisations from the supplier of the supplier up to the client of the client that involves different processes to produce value in the form of products and services for the final client (Harland, 1996). This approach assumes that firms do business based on permanent vertical long-term relationships and sequential interdependencies between clients and suppliers, where the flows, processes, activities, technologies, systems and actors of the supply chain should be integrated, with the focal firm as the integrator (Bygballe, Håkansson,

& Jahre, 2013). Although there is a notable advancement of supply chain management in engineering and construction (e.g., through lean construction discipline), this approach is limited and “requires a model of knowledge and understanding that better reflects dynamic project-driven characteristics” (Tennant & Fernie, 2014, p. 83).

The second logic, *value shop,* is oriented towards solving specific customer problems where interactive relationships with clients are cyclical, and the firm’s reputation is the key value driver (Stabell & Fjeldstad, 1998). Within this logic, Bygballe and Jahre (2009) state that project-oriented firms specifically work according to a value shop logic perspective because each project is a specific issue to be resolved. Hence, a project as “a temporary organisation established in order to create a unique product or service” (Pellicer, Yepes, Teixeira, Pereira, & Catala, 2013, p. 4) is associated and organized to build value through benefits for different actors (Winter & Szczepanek, 2009) with reciprocal interdependences (Bygballe et al., 2013).

Most of the traditional points of view of projects have been represented as input-process-output models with a strong emphasis on output performance through cost, time and quality/scope measures (‘iron triangle’ or ‘triple constraint’) (Zwikael & Smyrk, 2012), where the project produces the desired artifact (Winch, 2006). Recently, however, researchers have turned their attention to projects as a value creation process, focusing on the generated asset as required to achieve three dimensions of value: providing a contribution to the client’s business processes; providing a contribution to the project-based firm’s business processes; and providing a contribution to society as a whole (Winch, 2006). The project as a process to attain a target outcome introduces a new project phase that extends beyond execution, known as benefits realisation (Zwikael & Smyrk, 2012). Indeed, Winter and Szczepanek (2008) suggest that projects represent a value creation process where the most strategic domain of creating value is provided at the second level of the customer relationship as presented in Figure 2.1.

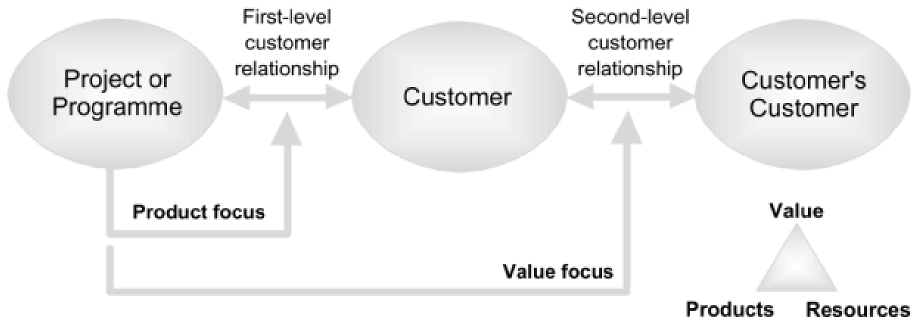


Figure 2.1: Projects as value creation process (Winter & Szczepanek, 2008)

The third type, *value network* logic, relies strongly on mediating interdependence between the firm and its clients to facilitate exchange relationships, thereby creating value (Stabell & Fjeldstad, 1998). Value network logic "includes the notion of inter-organisational relationships that extend beyond the individual project and capture the importance of both direct and indirect relationships in the broader network of relationships" (Bygballe et al., 2013, p. 111). Thus, relationships for or through third parties (i.e., stakeholders and stakeholder networks) based on pooled interdependencies are a relevant factor for business development (Bygballe et al., 2013). Additionally, Artto, Davies, Kujala, and Prencipe (2011) denote this perspective as a business network that represents a permanent stakeholder network for strategically maintaining the efficiency and innovativeness of each firm in long-term business relationships. Evidently, value network logic has been emphasised regarding stakeholder salience and management. For example, Feng, Lessard, Crawley, De Weck, and Cameron (2012) recently developed a qualitative/quantitative network approach for large engineering projects, namely the Stakeholder Value Network (SVN) analysis which models the multiple relationships among stakeholders for effectively measuring indirect stakeholder influences over a focal firm and other actors.

Recognising these three proposed value creation logics and considering that engineering and construction firms work in complex environments, this research assumes that the value creation logic is a hybrid (i.e., includes features from value chain, value shop and value network logics) where the projects are fundamentally vehicles for creating value for all stakeholders. In project management literature this hybrid logic is known as project coalition (Pryke, 2004; Winch, 2001, 2006, 2008) and project network (Artto et al., 2011; Chinowsky, Diekmann, & Galotti, 2008; El-Sheikh & Pryke, 2010). A better explanation of value creation can be achieved by using a hybrid perspective because project-oriented organisations can be understood as a social network where interactions among stakeholders are a critical source of creating value for and from these concerned parties.

Project-based organisations (PBO) with the primary goal of satisfying the needs of their stakeholders can create value during and beyond the life cycle of the project. Indeed, value creation goes beyond the delivery of project outputs to the client and involves co-creating value in the form of benefits for all stakeholders. Thus, Winter and Szczepanek (2009) argue that outcomes regarding benefits should be the result of a value creation process. This process has three main phases: (1) the *strategic phase,* which includes the definition of desired outcomes and outputs needed; (2) the *development phase,* which delivers the outputs needed; and (3) the *realisation phase,* which makes use of these outputs to achieve the desired project outcomes. Figure 2.2 shows the project value creation process and defines the objective for each step and its overall impact on project value.

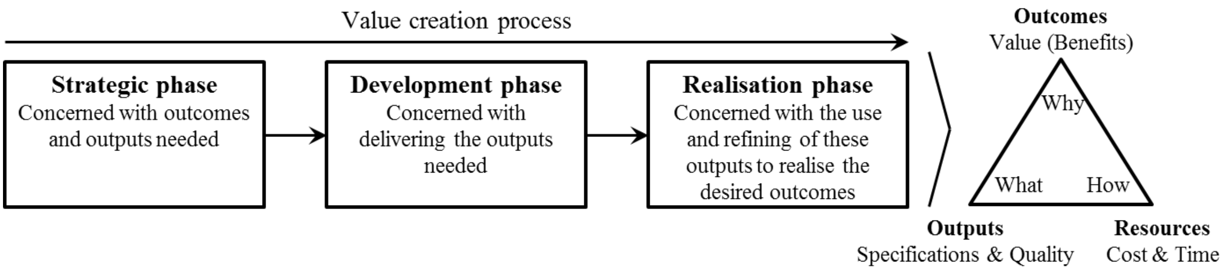


Figure 2.2: Phases of a project value creation process
Adapted from (Winter & Szczepanek, 2009)

2.3 Project delivery models as platforms for creating value

Strategic management and project management literature has emphasised the relevance of value creation from different perspectives, highlighting its critical role in any organisational business model. According to Pekuri, Pekuri, and Haapasalo (2013), business models represent the manner in which organisations create value for clients and other key stakeholders, including benefits for themselves. Specifically, as stated by Magretta (2002), a business model describes how all of the components of an organisation (i.e., resources, capabilities, strategy) fit together to create value for the firm and its clients. Most business models have focused largely on the organisational level, while project management research emphasises that business models cross the intra and inter-organisational boundaries of companies and projects (Wikström, Artto, Kujala, & Söderlund, 2010). Thus, PBOs such as engineering and construction firms should understand the value creation process of different types of projects to develop business models that better meet the needs of specific clients or market segments while also providing organisational competitiveness (Pekuri et al., 2013). A business model should be designed to provide support for a sustainable competitive advantage (Davies, Frederiksen, Dewulf, Taylor, & Chinowsky, 2010), representing a critical issue to better address the value created from the project level (S. Kujala, Artto, Aaltonen, & Turkulainen, 2010; Wikström et al., 2010).

In this challenging scenario, especially in PBOs in the engineering and construction industry, the project delivery model (PDM) is the mechanism for transmitting the business strategy expressed in the business model (Wikström et al., 2010). The definition of PDM from Gransberg, Koch, and Molenaar (2006) refers to the process through which a project is designed and performed by a client (i.e., owner) to concurrently achieve the desired outcomes and satisfy the needs of the users. This process traditionally includes a definition of the scope of the project; an organisation of designers, constructors, subcontractors, and consultants; a definition of design and construction phase sequences; execution and close out and operation start-up (Gransberg et al., 2006). In most of the cases, if one of these phases fails or is sub-optimal, the project performance can be severely affected with regard to the ‘triple constraint’ criteria – budget, schedule and quality. Additionally, the PDM helps to define the nature of the relationships between the parties involved in the project; to allocate the risks between them; and to identify contract terms (Nawi, Nifa, & Ahmed, 2014). Nevertheless, the most relevant concern about the project for the client and the other project stakeholders is the likelihood of achieving the long-term, strategic objectives expressed as economic, environmental and societal goals. To that end, PDM is often used to outline how project objectives can be achieved and is, therefore, a core component of value generation processes in projects (Aapaoja, Haapasalo, & Söderström, 2013; Hyvarinen, Huovila, & Porkka, 2012).

A value creation process supported by a selected PDM depends fundamentally on the activities and the core competencies and capabilities of the organisation (Bowman & Ambrosini, 2000; Harrison & Wicks, 2013; Lepak et al., 2007). To maximise value, however, it is also necessary to work with joint stakeholders (Freeman et al., 2010) through inter-organisational strategies oriented toward generating relational and mutual collaboration among parties (Kelly, 2007; Zajac & Olsen, 1993). From this standpoint, two value creation processes are conceptualised in this research. The first is based on a single organisation's activities and competencies, recognised as an *'independent'* or *'individual'* value creation process; and the second accords with interdependent and continuous interactive processes among parties, known as a '*co-created*' or *'shared'* value process (Gummerus, 2013).

2.3.1 Independent value creation process

The independent value creation process occurs when the focal firm creates the value and distributes it in the market, usually through the exchange of goods/services and money (Bowman & Ambrosini, 2000). This traditional process of value creation is often thought of as a series of activities performed by the firm (Vargo et al., 2008) that are independent of the activities or actions of other organisations, including the clients and potential users (Austin & Seitanidi, 2012; Grönroos & Voima, 2013; Gummerus, 2013). Transaction cost economics, resource-based view and agency theory, which are briefly reviewed in subsequent sections, form the theoretical foundations for conceptualising this individual process of creating value, as follows.

2.3.1.1 Transaction cost economics

Based on the transactional efficiency rents theory proclaimed by Coase (1937) where the efficient allocation of resources is fundamental to create and capture value, transaction cost economics (TCE) focuses on minimising the transaction costs of exchange (Williamson, 1985) and maximising profits to shareholders (Gummerus, 2013; Moran & Ghoshal, 1996; Patanakul & Shenhar, 2007; Pitelis & Vasilaros, 2010). From this perspective, sources of value creation are directly related to the transaction efficiency under an appropriate governance structure (Amit & Zott, 2001) for achieving flexible adaptation under contextual uncertainties (Williamson, 1985). TCE emphasises three fundamental elements: transaction costs, governance and adaptation (Williamson, 2005), all of which signify that coordinating transactions efficiently is the key to achieving continuity in contractual relations, thereby avoiding losses and divergences stemming from opportunistic behaviour by the parties (Williamson, 1985, 1998).

2.3.1.2 Resource-based view of the firm

Resource-based view (RBV) focuses on valuing the resources and capabilities of the firm. According to Barney (1991), RBV is the fundamental premise of an organisation intended to achieve competitive advantage through the exploitation of heterogeneous resources and competencies that constitute strategic capabilities that are difficult to imitate (i.e. firm's value creation). RBV emphasises value creation by applying those resources of the firm that are valuable for satisfying client needs at a cost lower than that of other companies, and by implementing strategies to enhance performance about efficiency and effectiveness (Bowman & Ambrosini, 2000; E. Wang & Wei, 2007). In this body of theory, heterogeneity refers to those firms with superior resources and capabilities that can compete in the market and earn economic rents (Peteraf, 1993). Therefore, creating value becomes strongly associated with an economic value defined as the ratio between the perceived benefits from a resource and its economic costs (Barney, 1991; Peteraf, 1993). The main sources of generating value based on this theory are valuable, rare, inimitable and non-substitutable firm resources (Amit & Zott, 2001; Barney, 1991), and the replicability and imitability of core competences and dynamic capabilities (Amit & Zott, 2001; Teece, Pisano, & Shuen, 1997).

2.3.1.3 Agency theory

Agency theory has its origin in the agency problem. This issue occurs when there are different goals, interests, and risk preferences between the parties, i.e., the client, called the principal, who delegates work to others, called the agent (Eisenhardt, 1989a; Ross, 1973). Moreover, "it is difficult or expensive for the principal to verify what the agent is actually doing" (Eisenhardt, 1989a, p. 58). Consequently, the agency theory focuses on reviewing the efficiency of the contract between the principal and the agent with regard to their assumptions about people, organisations and information (Eisenhardt, 1989a). The main mechanisms for value in this theory are the inclusion of incentive schemes in the contractual agreements with the agent, and the application of a direct outcome or behaviour control from the principal to maximise shareholder interests (L. Donaldson & Davis, 1991; Eisenhardt, 1989a; Jensen & Meckling, 1976).

Table 2.2 summarises the theories presented above with a brief description of the sources of value in each, to conceptualise the independent value creation process.

TCE, RBV and the agency theory present different views to explain how an organisation can create value under a dyadic relationship between the provider and the buyer. Nevertheless, they share a common standpoint – the firm's independence from other organisations – which refers to the independent value creation process to the generation of value by a single stakeholder. Typically, the focal firm has the resources, competences and capabilities to deliver what has been requested without the need to seek extensive help from outside the firm. In such cases, the product or service to be delivered is relatively simple, routine and straightforward, and within the firm's area of expertise.

Table 2.2: Theoretical foundations for the independent value creation process

Theory	Sources of value creation	Representative research
Transaction cost economics	▪ Transaction efficiency through a suitable contractual governance structure to secure the continuity of the relationship. ▪ Reduction of coordination costs and transaction risks. ▪ Efficient coordination by information exchange and communication. ▪ Avoidance of losses from opportunistic behaviour by parties through safeguards, enforceability, monitoring and control tasks.	(Amit & Zott, 2001; Coase, 1937; Drnevich & Croson, 2013; Williamson, 1985, 1998, 2005)
Resource-based view	▪ Firm's valuable, rare, inimitable and non-substitutable resources, core competences and dynamic capabilities. ▪ Ease of replicability (expanding internally). ▪ Difficulty of imitability (replication by competitors).	(Amit & Zott, 2001; Barney, 1991; Mahoney & Qian, 2013; Peteraf, 1993; Teece et al., 1997)
Agency theory	▪ Encouraging incentives for the agent that function in the best interest of the principal. ▪ Determining the optimal contractual governance mechanism (i.e., behaviour or outcome) between the principal and the agent. ▪ The principal has information to monitor and control agent behaviour and outcome. Thus the agent is likely to behave in the interest of the principal.	(L. Donaldson & Davis, 1991; Drnevich & Croson, 2013; Eisenhardt, 1989a; Hill & Jones, 1992; Jensen & Meckling, 1976)

2.3.2 Value co-creation process

Value co-creation is defined as the process of joint value creation based on interactions, active dialogue, and co-building experiences between the organisation with its clients (Grönroos & Voima, 2013; Gummerus, 2013; Ng & Smith, 2012; Prahalad & Ramaswamy, 2004) and other stakeholders (Rod et al., 2014; Roser et al., 2013). This collaborative process requires generating opportunities for co-production, integrating resources and applying individual competencies (Vargo et al., 2008) where the beneficiary determines the perception of what is received (Rod et al., 2014). Four theories support the process of value co-creation, namely: social exchange; relational view of the firm; relational contracting; and stakeholder theory. These theories are described in the following subsections.

2.3.2.1 Social exchange theory

Stemming from sociology and social psychology, social exchange theory (SET) is a frame of reference that analyses the flow of valued resources as a social process where longitudinal exchange relations and network structures are developed to aggregate value for the parties (Emerson, 1976). The interdependence between exchange parties (i.e. mutual efforts to achieve the outcomes) encompasses joint gains during the process of transaction over time through knowing the partners' preferences and shared interests (Zajac & Olsen, 1993) as well as reducing exchange risks such as opportunistic behaviour, thereby encouraging mutual collaboration (Cropanzano & Mitchell, 2005; Molm, 1994). Therefore, the largest source of value creation in SET is the parties' interdependence or relationship (i.e., series of interdependent exchanges) (Molm, 1994).

2.3.2.2 Relational view of the firm

The relational view of the firm stresses the relationship between organisations as the main focus for analysing potential sources of competitive advantage (Dyer & Singh, 1998). Based on the partnership and alliancing research literature, Dyer and Singh (1998, p. 662) declare that a relational rent refers to "a supernormal profit jointly generated in an exchange relationship that cannot be produced by either firm in isolation and can only be created through the joint idiosyncratic contributions of the specific alliance partners". This relational view demands potential sources of value creation (Amit & Zott, 2001). For example, relational-specific assets create relational rent when safeguards, such as the contract length, and the volume of transactions are both significant (Dyer, 1997; Dyer & Singh, 1998). Knowledge-exchange, the degree of compatibility in inter-organisational systems and processes, and the choice of effective governance for minimising transaction costs and maximising value creation initiatives also represent sources of value creation underpinned by this relational perspective (Dyer & Singh, 1998; Hamel, 1991).

2.3.2.3 Relational contracting

Relational contracts divulged by Macneil (1985) recognise informal agreements and unwritten codes that may significantly affect the behaviour of the parties in an inter-organisational relationship (Baker, Gibbons, & Murphy, 2002). In this sense, the contract has less prominence than the relationship itself, where relational norms such as trust, honesty, and accountability become critical to achieving the desired benefits (Colledge, 2005). Hence, these types of contracts, unlike discrete transactions, are more complex and of long-term duration, and require flexibility to be effective (Macneil, 1977). The long-term nature of relational contracting reduces the possibility of opportunistic behaviour between the parties because it includes mechanisms to share and reduce risks, consequently maintaining an ongoing relationship of mutual advantage (Bultler & Baysinger, 1983). Moreover, relational contracting helps the parties to use their knowledge in specific situations that may appear and adapts newly available information across the relationship (Baker et al., 2002). Mutual trust, commitment (i.e. win-win strategy) and exchange of knowledge and information to generate innovation for both parties are leading sources of value from relational contracting (Colledge, 2005).

2.3.2.4 Stakeholder theory

Stakeholder theory focuses on maximising benefits by establishing favourable relationships between interested parties (Freeman et al., 2010). Although traditionally short-term economic and financial goals have represented the main measure of the value of an organisation, value maximisation through maintaining close relationships with stakeholders to ensure their satisfaction can increase long-term returns (Harrison & Wicks, 2013; Jensen, 2001). Stakeholders (i.e. owners and investors, employees, clients and users, suppliers, local communities and government agencies) are a related group or individuals that contribute to create value because they may affect or be affected by the achievement of the goals of the firm (T. Donaldson & Preston, 1995; Freeman et al., 2010; Harrison & Wicks, 2013; Jensen, 2001; Lepak et al., 2007). From this perspective, firms should work toward managing stakeholder interests in order to reduce conflicts and related monetary losses (Harrison & Wicks, 2013). As declared by Freeman (2010), the performance of the firm is directly associated with the measure of the total value created by the firm through its products and activities, which represents the sum of the utility generated for each stakeholder in the firm. This theory supports value creation because strong and close interactions between interested parties generate opportunities to reduce conflicts and improve cooperation, consequently increasing the likelihood of creating value in the form of long-term benefits for the focal firm and its stakeholders (Freeman et al., 2010; Harrison & Wicks, 2013; Jensen, 2001).

Table 2.3 displays a summary of the theories that underpin the process of co-creating value, including a description of each theory as a source of value creation, and the relevant prior representative research.

Table 2.3: Theoretical foundations for value co-creation process

Theory	Sources of value creation	Representative research
Social exchange theory	▪ Interdependence between exchange parties for joint value maximisation. ▪ The development of trust, loyalty, mutual commitments and inter-organisational learning between exchange parties.	(Cook, Cheshire, Rice, & Nakagawa, 2013; Cropanzano & Mitchell, 2005; Emerson, 1976; Molm, 1994; Zajac & Olsen, 1993)
Relational view of the firm	▪ Relation-specific investments through a greater length of safeguards and volume of transactions. ▪ Inter-organisational knowledge-sharing routines by absorptive capacity and alignment of incentives. ▪ Complementary resources and capabilities based on prior relational experiences and inter-organisational compatibility of systems and processes. ▪ Effective governance selection oriented to self-enforcement governance (e.g. trust) rather than third-party enforcement governance (e.g. contractual agreement).	(Dyer, 1997; Dyer & Singh, 1998; Hamel, 1991)
Relational contracting	▪ The development of mutual trust and commitment in long-term inter-organisational relationships. ▪ Flexibility for adapting to new situations in complex environments.	(Baker et al., 2002; Bultler & Baysinger, 1983; Macneil, 1977, 1985)
Stakeholder theory	▪ Close relationships between interested parties. ▪ Reduction of conflicts and increase of cooperation with stakeholders through shared norms such as fairness and trust. ▪ Early stakeholder's engagement.	(T. Donaldson & Preston, 1995; Freeman, 1999; Freeman et al., 2010; Harrison & Wicks, 2013; Jensen, 2001)

Theories such as social exchange theory, relational view of the firm, relational contracting and stakeholder theory provide strong support for conceptualising value co-creation. As proclaimed by Prahalad and Ramaswamy (2004), co-creating value is the process in which clients and suppliers jointly create value, mainly through high-quality interactions above and beyond the traditional focus, where the generated value is inside the firm through its products, activities and competences (i.e. independent value creation). In the process of co-creation, the parties must seek one another's active participation beyond the regular arms-length type of relationship (Hammervoll, 2012; Nord, 2012). Accordingly, a relational approach underpinned by effective collaboration in terms of high resource complementarity, distinctive competences and strongly linked interests (Austin & Seitanidi, 2012), becomes a critical undertaking to face more complex and uncertain environments.

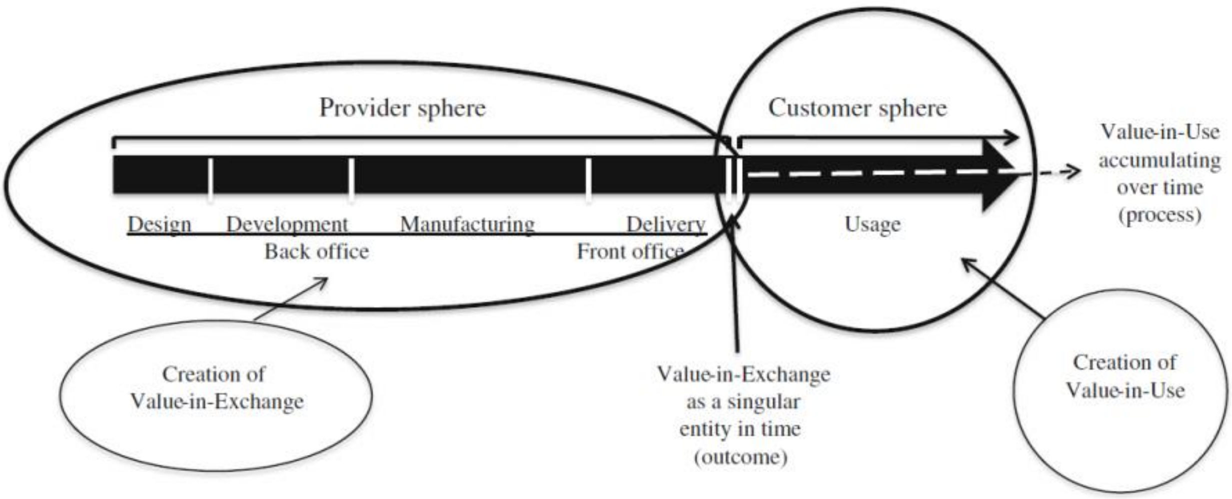
2.3.3 Complementarity of independent value creation and value co-creation

According to Vargo et al. (2008), value co-creation is related to the service-dominant logic while independent value creation follows the traditional perspective related to the good-dominant logic. This difference identifies clear distinctions between the view of independent value creation and co-creation processes (see main differences in Table 2.4).

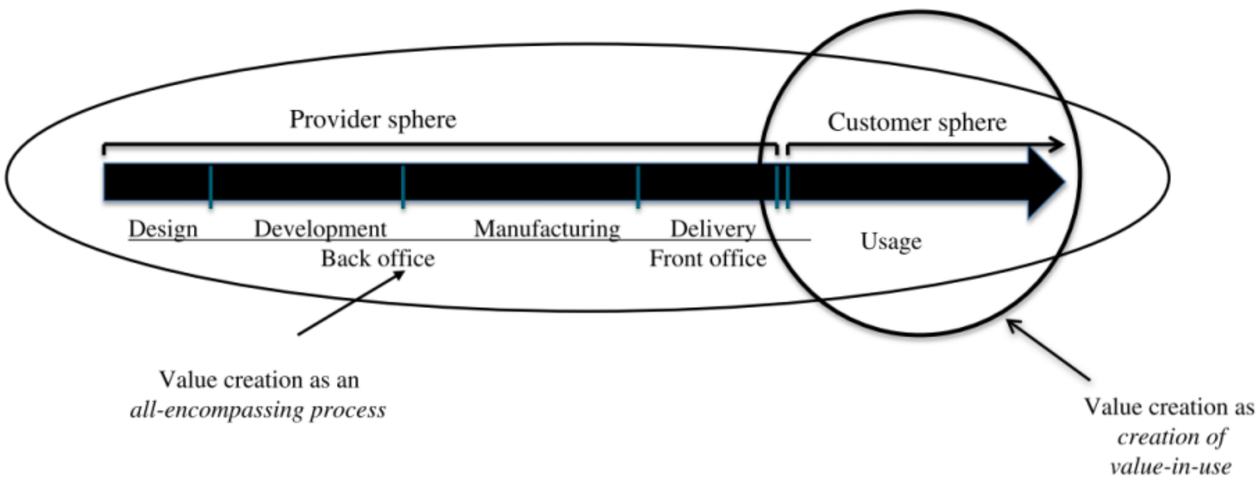
Table 2.4: Independent value creation process vs. value co-creation process
(Adapted from (Vargo et al., 2008))

	Independent value creation process	**Value co-creation process**
Value logic	Good-dominant	Service-dominant
Value driver	Value-in-exchange	Value-in-use
Creator of value	Firm (focal organisation)	Firm with its clients and stakeholders
Process of value	Firm creates value in goods; value is added by attributes, step by step toward the client	Firm proposes value, stakeholders and the firm co-create value by usage in time
Purpose of value	Increase wealth for the firm	Increase benefits for all stakeholders
Measurement of value	The amount of nominal value, price received in exchange	Stakeholder value measured regarding satisfaction
Resources used	Primarily operand resources, i.e. physical and goods resources	Primarily operant resources, i.e. knowledge, skills, competences, transferred between parties
Role of the firm	Produce and deliver value	Propose and co-create value
Role of goods	Units of output, operand resources that are embedded with value	Vehicle for operant resources enables access to benefits of firm and stakeholders
Role of clients	"Use up" and "destroy" value created by the firm (i.e. value capture)	Co-create value through their integration with the firm

Although the traditional market-oriented conception of value creation shows that independent value creation and value co-creation processes are antagonistic (Pitelis & Vasilaros, 2010; Prahalad & Ramaswamy, 2004), other researchers have underlined the complementarity between both (Grönroos & Voima, 2013; Gummerus, 2013). Grönroos and Voima (2013) contribute to understanding better the role, scope, locus and nature of creating value independently and co-creating value through the definition of three value creation spheres: one from the provider, the other from the client and, the last one from the joint action of the provider and the client. Figure 2.3 shows this conceptualisation of both value creation processes.



Independent value creation process



Value co-creation process

Figure 2.3: A representation of the value creation processes (Grönroos & Voima, 2013)

Thus, these value creation spheres emphasise the role of the provider and the client separately to create value. The provider's sphere is related to resources and processes facilitated by the supplier independently from the client for being used by the client or user (i.e. value-in-exchange); whereas the client's sphere is characterised by the added value (i.e. value-in-use) that the client may generate for itself without the provider intervention. Additionally, both, provider and client, have a pivotal role in generating value jointly during their interactions, viewing value creation as an encompassing process. Thus, a joint sphere between the provider and the customers may be established where both are co-producers of resources and processes by direct interactions (Grönroos & Voima, 2013).

Consequently, independent value creation and value co-creation can be understood as interrelated processes that co-exist within inter-organisational relationships (IOR). In line with this understanding, contemporary management literature takes the lead in defining the complementarity of both processes. Hence, from a systematic literature review of previous management and business research, 51 empirical studies about value creation and value co-creation are selected based on peer-reviewed publications from 1998 and summarised in Table 2.5. These publications are presented in chronological order to see the development of the concept of value creation in empirical research. Additionally, industry type, firm or project level, methodology approach, sample size, country or region, independent value creation factors, value co-creation factors, contributions to value creation literature and predominant theories are included. As presented, the majority of the studies (35 articles) highlight the complementarity of independent value creation and value co-creation through an empirical analysis of relationships among recognised theoretical factors of value creation (see italic and bold words). Following this evidence, this thesis conceptualises both processes as interconnected and inclusive for creating value at the firm level in accordance with the approach proposed by Grönroos and Voima (2013) and suggested by Winter and Szczepanek (2009) at the project level.

Table 2.5: Selected empirical research on factors in value creation processes

	Empirical Research	Industry/level	Methodology	Sample size and country/region	Independent value creation factors	Value co-creation factors	Contribution to value creation literature	Predominant theory
1	(Tsai & Ghoshal, 1998)	Manufacturing (electronic products)/ firm level	Quantitative (survey)/ Covariance SEM (LISREL and MRQAP)	15 business units (2 or 3 respondents each) /North America, Europe and Asia		Structural dimension: social ***interaction*** Relational dimension: ***trust*** and trustworthiness Cognitive dimension: shared vision ***Innovation***: Resource exchange and combination	Firms need to reallocate resources, to combine new resources, or to combine existing resources in new ways (social capital dimensions) to create value for an innovative product.	Social exchange/ network theory
2	(Amit & Zott, 2001)	Information technology/ firm level	Quantitative (multiple cases, questionnaire)/ cross-case comparisons	59 firms/ USA and Europe	Efficiency: search costs, selection range, ***symmetric information***, simplicity, speed, scale economies Complementarities: between products and services, between activities, between technologies Lock-in: switching costs, positive networks externalities Novelty: new transaction structures, transactional contents and participants		Value creation potential of e-businesses hinges on four interdependent dimensions: efficiency; complementarities; lock-in; and novelty. A firm's business model is an important locus of innovation and a crucial source of value creation for the firm and its suppliers, partners, and customers.	TCE, RBV, strategic networks
3	(Georges & Eggert, 2003)	Several industries/ firm level	Quantitative (survey)/ PLS	102 respondents/ France	***Coordination***: role formalisation, decision authority, transparency	Offer adjustment (innovative solutions): lateral ***interaction***, vertical interaction, buying consultation	Managers create value by coordinating the complex, customer-related processes and by improving the fit between the offer and the customer's needs.	TCE and relational view of the firm
4	(Stewart & Mohamed, 2004)	Construction/ project level	Quantitative (survey)/ Pearson correlation analysis	82 respondents/ Australia	Operational perspective: contract administration, progress claims, ***coordination and information exchange*** Benefits perspective Strategic competitiveness perspective Technology/system perspective		The interrelationships between the five perspectives (operational, benefits, user orientation, strategic competitiveness, and technology/system) of the framework exist, and they are significant. This process creates value from the project.	Not mentioned

Table 2.5: Selected empirical research on factors in value creation processes (continued)

	Empirical Research	Industry/level	Methodology	Sample size and country/region	Independent value creation factors	Value co-creation factors	Contribution to value creation literature	Predominant theory
5	(Tseng & Goo, 2005)	Manufacturing/ firm level	Quantitative (survey)/ Covariance SEM (LISREL)	81 respondents/ Taiwan (China)	Human capital: employee knowledge, workforce expertise, knowledge and attitude. Organisation capital: information systems, operation process and organisational culture.	Relationship capital: customer and supplier's ***relationships***, networking. ***Innovation capital***: development of new products through creativity.	Human capital, organisation capital, innovation capital and relationship capital are four constructs of intellectual capital. They impact significantly on value creation.	RBV
6	(Eggert, Ulaga, & Schultz, 2006)	Manufacturing/ firm level	Quantitative (survey)/ PLS and covariance SEM (LISREL)	421 respondents/ USA	Core offering: delivery performance, product quality Customer operations: know-how, time to market	Sourcing process: service support, personal ***interaction***	Customer-perceived value can be improved by increasing relationship benefits or decreasing relationship costs.	TCE, RBV and relational view of the firm
7	(Y. Liu, Tao, Li, & El-Ansary, 2007)	Manufacturing/ firm level	Quantitative (survey)/ Factor analysis and covariance SEM	251 respondents/ China	***Contract*** Contract ***control***	***Trust***: Honesty trust and benevolence trust ***Relational norms***	Trust enhances the direct value gained through the use of both contract and relational norms but hinders and promotes the indirect value acquired by the use of contract and relational norms respectively.	TCE, relational contracting
8	(E. Wang & Wei, 2007)	Manufacturing/ firm level	Quantitative (survey)/ PLS	150 respondents/ Taiwan (China)	Virtual integration: process order, exchange price and market ***information***, coordination (***task coordination***) Information visibility: manufacturing, transaction, planning, supplying, ***evaluation***	Relational governance: ***trust***, ***commitment***, coordination (i.e., ***collaborative work***), ***joint problem solving*** Supply chain offering flexibility (innovative process): flexibility, mutual interactions, adaptability	Inter-organisational governance and virtual integration can create value in the supply chain context.	TCE, RBV and relational view of the firm
9	(Fang et al., 2008)	Manufacturing (new product development)/ project level	Quantitative (survey)/ confirmatory factor analysis and covariance SEM (AMOS)	188 respondents/ USA	***Information sharing***: knowledge, changes, proprietary information (i.e. technical information) ***Coordination*** effectiveness	Customer participation: ***interactions*** during the production process	Customer participation affects value creation by improving the effectiveness of the product development process through enhancing information sharing and coordination.	TCE and social exchange theory

Table 2.5: Selected empirical research on factors in value creation processes (continued)

	Empirical Research	Industry/level	Methodology	Sample size and country/region	Independent value creation factors	Value co-creation factors	Contribution to value creation literature	Predominant theory
10	(Wagner & Lindemann, 2008)	Automotive, food, engineering and chemical industries/ firm level	Quantitative (survey)/ logistic regression analysis	142 respondents/ Germany	Value creation goals: cost reductions and lead time improvements	Relationship quality Motivation for ***collaboration*** ***Sharing principle*** and intention: equity, service success	Relationship qualities, motivation, goals of the relationship and the applied sharing principle are all influential in determining how value is shared.	Relational view of the firm
11	(Gil-Saura, Frasquet-Deltoro, & Cervera-Taulet, 2009)	Several industries/ firm level	Quantitative (survey)/ factor analysis and covariance SEM	276 respondents/ Spain		Relationship value ***Trust*** ***Commitment*** Satisfaction	Relationship value influences commitment, trust and satisfaction for creating value.	Relational view of the firm
12	(Y. Liu, Luo, & Liu, 2009)	Manufacturing/ firm level	Quantitative (survey)/ Exploratory and confirmatory factor analysis	225 dyadic relationships/ China	Transactional governance mechanisms: ***Contract***, transaction-specific investment	Relational governance mechanisms: ***relational norms, trust***	Transactional mechanisms are more effective in avoiding opportunism. Relational mechanisms are more powerful in improving relationship performance. This performance is higher when both work jointly.	TCE, social exchange theory
13	(Cheung, Myers, & Mentzer, 2010)	Manufacturing/ firm level	Quantitative (survey)/PLS	126 cross-border dyads/ several countries (Americas, Europe, Asia and Oceania)		Relationship learning: ***information exchange*** and knowledge ***integration*** Organisational fit: ***trust,*** complementary, compatibility	Contextualising inter-firm collaboration regarding relationship learning and value co-creation viewed by both buyers and sellers.	RBV, social exchange theory
14	(Wagner et al., 2010)	Manufacturing and services/ project level	Quantitative (survey)/PLS	183 respondents/ Germany and Switzerland	***Information exchange***: frequently, proprietary information, changes	Relational ***trust***: honesty, trustworthy, welfare Relational satisfaction	Value creation entails the total net value created in a collaborative effort among exchange partners.	Social exchange theory, equity theory
15	(Chen, Tsou, & Ching, 2011)	Information technology/ project level	Quantitative (survey)/PLS	157 respondents/ Taiwan (China)	Partner expertise	Partner match: ***prior history***, compatibility Affective ***commitment*** Co-production: ***collaboration*** ***Innovation*** orientation: new ideas, knowledge, methods and ways to solve problems	Co-production influences service innovation by the collaborative partner's compatibility and history of business relations, expertise and commitment. The innovation moderates the relationship between co-production and service.	RVB, relational contracting

Table 2.5: Selected empirical research on factors in value creation processes (continued)

	Empirical Research	Industry/level	Methodology	Sample size and country/region	Independent value creation factors	Value co-creation factors	Contribution to value creation literature	Predominant theory
16	(Hammervoll, 2011)	Seafood/ firm level	Quantitative (survey)/PLS	181 supply chain relationships/ Norway	Market governance: price mechanism Hierarchical governance: reward schemes ***Sharing of logistical information***	Relational governance: ***solidarity norm*** ***Sharing of strategic information***	A mutual desire to preserve the relationship induces contributions from partners and encourages value creation through partner-specific investments and implicit social norms.	TCE, agency theory, relational contracting
17	(Lau, 2011)	Manufacturing/ firm level	Quantitative (survey)/ Covariance SEM (AMOS)	251 respondents/ Hong Kong (China)	Product innovativeness Product modularity ***Internal coordination***	Supplier and customer involvement and ***interactions***	Modular design, innovation, and internal coordination are correlated with the provider and customer involvement for better new product performance.	RBV, relational view of the firm
18	(L. Li, 2011)	Manufacturing/ firm level	Quantitative (survey)/ confirmatory factor analysis, covariance SEM (LISREL)	403 respondents/ China	Cross-functional ***coordination*** capability: ***information sharing***	Technical application ***integration*** Business process integration ***Joint innovation*** competence	Internal coordination and innovation capabilities are required to support competency-based solutions and for affecting the upgraded relationship value.	RBV, relational view of the firm
19	(O'Cass & Ngo, 2011)	Manufacturing and services/ firm level	Quantitative (survey)/PLS	301 respondents/ Australia	Performance value Pricing value	Relationship building value Co-creation value	Value offering is the strategic value creation at the point of proposition delivered to customers by performance, pricing, relational and co-creation to achieve a relational advantage from customers.	TCE, RBV, relational view of the firm
20	(Zacharia, Nix, & Lusch, 2011)	Several industries/ firm level	Quantitative (survey)/ Covariance SEM	473 respondents/ USA	Organisational capabilities: absorptive capacity	Perceived ***interdependence*** ***Collaborative engagement*** Collaborative process competence	Absorptive capacity, collaborative process competence and level of engagement influence the operational and relational success of a collaboration effort.	RBV, relational view of the firm
21	(Eweje, Turner, & Müller, 2012)	Engineering and construction/ project level	Quantitative (survey)/ Analysis of variance (ANOVA)	69 respondents/ Several countries	***Controllability*** ***Information feed***		Control influences the scope and quality of information feed and later, the impact on the strategic value created by the project.	TCE, decision theory

Table 2.5: Selected empirical research on factors in value creation processes (continued)

	Empirical Research	Industry/level	Methodology	Sample size and country/region	Independent value creation factors	Value co-creation factors	Contribution to value creation literature	Predominant theory
22	(Hammervoll, 2012)	Seafood/ firm level	Quantitative (survey)/PLS	142 exchange relationships/ Norway	Market management: reliance on the legal system (written ***contracts*** and agreements) Hierarchical management: unilateral use of authority ***Information supply***: customer provides information to the supplier	Relational management: norms of joint conflict resolution Coaching problem solving: customer contributes to ***joint problem-solving*** effort ***Strategic knowledge sharing***: to ***engage in joint problem solving***	Inter-organisational management facilitates value creation in three different types of interactions in exchange relationships: unilateral learning, unilateral development, and bilateral learning.	TCE, RBV, social exchange theory, relational view of the firm
23	(Song, Su, Liu, & Wang, 2012)	Manufacturing/ firm level	Quantitative (survey)/ Covariance SEM (LISREL)	239 respondents/ China	Business relationship function: cost reduction, volume, quality, safeguard	Relationship quality: ***cooperation,*** adaptation, atmosphere	Business relationship has a direct and an indirect effect on buyer's performance by the mediating effect of relationship quality.	Relational view of the firm
24	(Toon, Robson, & Morgan, 2012)	Architecture, engineering and construction/ project level	Quantitative (survey)/ confirmatory factor analysis, covariance SEM	197 respondents/ UK	Asset-specific investment ***Technical information exchange***	***Trust***: goodwill trust and calculative trust Operational compatibility	At the operational level, the value in the relationship process is co-created by an iterative investment in specific assets. Also, the technical information exchange is a source of value for the relationship.	TCE, Relational Contracting
25	(Artemis Chang, Chih, Chew, & Pisarski, 2013)	Defence/ project level	Qualitative (case study: interviews)/ cross-case comparisons	15 executives of 3 megaprojects/ Australia		Stakeholder ***engagement*** Continuous ***interactions*** ***Knowledge exchange***	Customers and other stakeholders actively engage in the value creation process increasing the value created and captured during and post projects.	Stakeholder theory
26	(J. Hsu et al., 2013)	Information technology/ project level	Quantitative (survey)/PLS	103 pairs of respondents/ Taiwan (China)		Structural social capital: ***interactions*** Relational social capital: ***trust*** Cognitive social capital: ***shared understanding*** Coproduction: ***shared problem solving***, tolerance ***involvement in project governance***	Co-production has a significant influence on project outcomes, and social capital between user representatives and developers is also associated with user co-production.	Relational view of the firm, service-dominant logic

Table 2.5: Selected empirical research on factors in value creation processes (continued)

	Empirical Research	Industry/level	Methodology	Sample size and country/region	Independent value creation factors	Value co-creation factors	Contribution to value creation literature	Predominant theory
27	(Inemek & Matthyssens, 2013)	Manufacturing/ firm level	Quantitative (survey)/ Exploratory and confirmatory factor analysis, multiple regression analysis	189 respondents/ Turkey	Buyer assistance to quality improvement and cost reduction	Joint product development: supplier ***involvement***, joint development, teamwork Cooperative tie: ***cooperation, commitment, trust, problem-solving*** Supplier ***innovativeness***: new ideas, new methods, new technology	Inter-firm knowledge sharing routines, relation-specific investments, and governance mechanisms may promote supplier innovativeness by expanding the supplier's knowledge resources.	Relational view of the firm
28	(Keung & Shen, 2013)	Construction/ project level	Quantitative (survey)/ Analysis of variance (ANOVA)	119 respondents/ Hong Kong (China)	***Information exchange***: proprietary technical information Project communication system: meetings, channels, ***coordination*** activities Corporate culture: coordination, goal ***alignment***, corporate reputation	***Knowledge sharing for collaboration*** Learning capability in intra- and inter-organisational settings	The inter-firm network is an important mechanism for firms to develop and sustain their business. Five components (e.g. information exchange, project communication, etc.) are developed for measuring networking performance.	Social network theory
29	(Ng, Ding, & Yip, 2013)	Defence/ firm level	Qualitative (interviews) and quantitative (survey)/ confirmatory factor analysis and PLS	96 respondents/ UK	Partnering inputs: complementary competences, congruence of expectations Value-driven alignments: behavioural, ***information***, material Perceived ***control*** Empowerment		Behavioural and information alignments are necessary to achieve outcomes. However, material and equipment alignment does not have a significant effect. Perceived control and empowerment mediate the relationship between partnership inputs and value-driven alignments	TCE, RBV
30	(Stanko & Bonner, 2013)	Several industries/ firm level	Quantitative (survey)/ confirmatory factor analysis and covariance SEM	128 respondents/ USA	Knowledge redundancy Customer influence	***Relational embeddedness*** ***Interactivity*** Knowledge competence ***Innovativeness***	Relational embeddedness and interactivity are predictors of knowledge competence. While knowledge redundancy helps build knowledge competence which impacts on innovativeness.	Social exchange theory, relational view of the firm

Table 2.5: Selected empirical research on factors in value creation processes (continued)

	Empirical Research	Industry/level	Methodology	Sample size and country/region	Independent value creation factors	Value co-creation factors	Contribution to value creation literature	Predominant theory
31	(Yi & Gong, 2013)	Several industries/ firm level	Quantitative (survey)/ exploratory-confirmatory factor analysis and PLS	311 respondents/ South Korea		Customer participation behaviour: information seeking, ***information sharing***, responsible behaviour, personal ***interaction*** Customer citizenship behaviour: advocacy, helping, feedback, tolerance	Developing and validating a client value co-creation behaviour scale. The scale comprises two dimensions: customer participation behaviour and customer citizenship behaviour.	Relational view of the firm
32	(Hahn & Gold, 2014)	Manufacturing, financial services, food/ project level	Qualitative (multiple-case study - interviews)/ Content analysis	4 cases – 13 interviewees/ France, Germany and Switzerland	Partner identification: network, experience, position, evaluation capabilities	Synergy-sensitive resources: ***long-term commitment***, stable personal ties, partner capacity building Informal governance mechanisms: ***trust, commitment***, shared vision	Synergy-sensitive resources facilitate performance and long-term partnerships by establishing well-adapted and well-informed management practice and by creating a lock-in by informal governance mechanisms.	Relational view of the firm
33	(Hartmann, Roehrich, Frederiksen, & Davies, 2014)	Engineering and construction/ project level	Qualitative (longitudinal case study – interviews)/ Systematic combining analysis	2 cases (public organisations) – 34 interviewees/ UK and Netherlands	Contractual capabilities: write, negotiate, monitor and enforce ***contracts*** ***Control and monitoring*** systems	Relational capabilities: ***trust***, cognitive ***alignment*** ***Collaborative interaction***	In complex projects, the learning process cumulates the knowledge and experience in the client-supplier interaction accompanied by changing contractual and relational capabilities. This process is not initially motivated by the benefits of value co-creation but is politically driven.	TCE, RBV, relational view of the firm
34	(Miguel, Brito, Fernandes, Tescari, & Martins, 2014)	Personal care, cosmetics and food industries/ firm level	Quantitative (survey)/ Confirmatory factor analysis and covariance SEM	166 respondents/ Brazil	Asset specificity Complementary resources	***Knowledge sharing*** ***Relational governance*** mechanisms	Inter-firm relationships create value. Buyers and suppliers can benefit from collaborative relationships, but buyers appear to capture a larger share, forcing suppliers to seek new sources of value.	RBV, Relational view of the firm

Table 2.5: Selected empirical research on factors in value creation processes (continued)

	Empirical Research	Industry/level	Methodology	Sample size and country/region	Independent value creation factors	Value co-creation factors	Contribution to value creation literature	Predominant theory
35	(Polo Peña, Frías Jamilena, & Rodríguez Molina, 2014)	Tourism/ firm level	Qualitative (interviews) and quantitative (survey)/ covariance SEM	572 respondents/ Spain	Information and communication technology: ***information sharing***, communication, adoption	Value co-creation: business-to-costumer ***interactions***	Information technology capabilities have a direct effect on value co-creation and co-creation impacts on perceived value and loyalty.	RBV, Relational view of the firm
36	(Ranjan & Read, 2014)	Manufacturing and services/ firm level	Quantitative (survey)/PLS	458 respondents/ India and USA		Co-production: ***innovation***, equity (transparency, access ***alignment***, power sharing) and ***interaction*** (dialogue) Value-in-use: experience, ***relations*** (interdependence, ***engagement***, ***collaboration***) personalisation (unique, consumer orientation).	Value co-creation considers two dimensions, co-production and value-in-use. Knowledge, equity and interaction are part of co-production while experience, personalisation and relationship refer to value-in-use.	Relational view of the firm
37	(Rod et al., 2014)	Manufacturing and services/ firm level	Qualitative (interviews)/ critical discourse analytic approach	34 firms/ New Zealand, China and India	Transaction-based value: value is created by the firm and the value proposition is either accepted or declined by customers	Co-production of value: the customer is ***involved*** in the production process or service provision Value facilitation: organisations create opportunities to ***engage*** with their customers' value-generating processes	The network is more relevant to understanding the value co-creation process in dyadic inter-organisational relationships. There are three categories of value creation: co-production of value, value facilitation and transaction-based value	RBV, relational view of the firm, service-dominant logic
38	(S. Zhao et al., 2014)	Manufacturing (high-technology)/ firm level	Quantitative (survey)/ Factor analysis and covariance SEM	187 respondents/ China	***Technical information exchange*** Investor contribution, risk and dependence	Relationship-specific investment Coordination effectiveness (i.e. ***collaborative work***)	Relationship-specific investment influences on the value creation in cooperation arrangements.	TCE, RBV, relational view of the firm
39	(Kähkönen, Lintukangas, & Hallikas, 2015)	Several industries/ firm level	Quantitative (survey)/ Principal component analysis and ANOVA	165 respondents/ Finland		Supplier orientation: clear procedures, ***collaboration***, ***shared goals***, shared business process Buyer’s dependence: ***collaboration*** Early supplier ***involvement*** Inter-firm learning: joint planning, ***interactions***, ***knowledge sharing***	Value-creating activities of inter-firm learning and early supplier involvement increase buyer’s dependence, but a supplier orientation does not have similar effects.	Relational view of the firm

Table 2.5: Selected empirical research on factors in value creation processes (continued)

	Empirical Research	Industry/level	Methodology	Sample size and country/region	Independent value creation factors	Value co-creation factors	Contribution to value creation literature	Predominant theory
40	(Karpen, Bove, Lukas, & Zyphur, 2015)	Banking and automotive retail/ firm level	Quantitative (survey)/ Confirmatory factor analysis and PLS	301 banking respondents and 412 retail respondents/ Australia		Service-dominant orientation capabilities: ***relational interaction***, ethical interaction, individuated interaction, empowered interaction, concerted interaction, developmental interaction ***Trust*** Affective ***commitment***	Service-dominant orientation reinforces the relevance of valuable, rare, imperfectly imitable, and organisational conditions of resources and capabilities for permitting efficient and effective value creation (i.e. co-creation).	RBV, relational view of the firm Service-dominant logic
41	(Murphy, Arenas, & Batista, 2015)	Several industries/ firm level	Quantitative (survey)/ Exploratory and confirmatory factor analysis and covariance SEM (LISREL)	362 respondents/ Spain		Prior experience ***Alignment***: shared values, mission/strategy, ***interactions***	Prior experience and alignment affect value creation. Prior experience affects alignment regarding mission and strategy. Also, prior experience moderates the effect of alignment on value creation.	Social exchange theory
42	(Ralston, Blackhurst, Cantor, & Crum, 2015)	Several industries/ firm level	Quantitative (survey)/ Covariance SEM	220 respondents/ USA		Corporate strategic integration: strategy ***alignment***, shared goals Strategic customer integration: formal plan employee-customer ***interaction*** Strategic supplier integration: cost-quality improvements, ***information sharing***, early ***involvement***	Firms align their internal and external supply chain integration strategies with customers and suppliers. These inner and outer integration strategies affect the firm's ability to respond to customer demand, which then impacts operational and financial performance.	Organisational economics theory
43	(Andersen, 2016)	Several industries/ project level	Quantitative (survey)/ Exploratory factor analysis	180 respondents/ Norway	Project management's focus-task perspective: concentrate on carrying out the task, detailed plan, ***information exchange***, reporting, detailed ***control***	Project management's focus-organisational perspective: ***relationships***, ***involved*** parties, ***collaboration***, ***knowledge exchange***, socialisation	The task perspective means that project management focuses on delivering on time, within budget and with specified quality. The organisational perspective implies that the project manager's focus is to support value creation in the receiving organisation.	Not mentioned

Table 2.5: Selected empirical research on factors in value creation processes (continued)

	Empirical Research	Industry/level	Methodology	Sample size and country/region	Independent value creation factors	Value co-creation factors	Contribution to value creation literature	Predominant theory
44	(Clauss & Spieth, 2016)	Aviation industry/ firm level	Quantitative (survey)/ PLS	101 respondents/ Germany	***Transactional governance***: detailed specification ***Information transparency***, delivery speed, ***coordination***	Relational governance: loyalty, ***commitment*** (i.e. ***trust***) ***Joint product development*** Strategic ***innovation orientation***	Transactional governance is suited to foster buyer-supplier efficiency, and relational governance strengthens buyer-supplier effectiveness. The choice of a governance mechanism indirectly affects the innovation orientation.	TCE, social exchange theory
45	(Murthy et al., 2016)	Services/ firm level	Qualitative (case studies) and quantitative (survey)/ Exploratory factor analysis, Delphi technique and covariance SEM	32 interviewees and 256 respondents/ several countries		Strategic intent: dynamic value change, ***commitment*** Alliance relationship: ***innovation***, behavioural ***alignment, relational norms*** Collective capabilities Service actualisation: ***joint problem solving***, delivery excellence, communication Resource management: ***interaction***, complementary competences	The alliance relationship, strategic intent, service actualisation, and intrapreneurship are found to be significant for value co-creation.	Relational view of the firm
46	(Rodríguez, Giménez, & Arenas, 2016)	Manufacturing/ project level	Qualitative (cross-case study)/ Comparative analysis	6 cases – 18 interviewees/ Ecuador	Complementary resources: ***coordination***, ***exchanging information***, values	Structural social capital: ***trust***, communication channels, mutual ***understanding***, ***interactions*** Value logic ***alignment*** of strategies and goals Routines that support ***collaborative relationships***	The inter-organisational fit is an antecedent for the combination of resources for implementing activities that create value. Structural social capital enables its alignment with the profit-oriented behaviour of firms.	Relational view of the firm, social capital theory
47	(Panda, 2016)	Engineering and construction/ project level	Qualitative (case study)/ Systematic inductive reasoning approach	3 PPP projects – 26 interviewees/ India	***Contract*** administration: efficiency ***coordination***, performance ***monitoring***, risk reduction and ***control*** Organisational attributes: structure, system, style	***Trust*** and confidence: ***working together***, records, accountability, open communication	Contract administration causes value creation by relationship dynamics among project partners. These dynamics are an outcome of two elements: trust and confidence, and organisational attributes.	TCE, RBV, Agency theory, stakeholder theory

Table 2.5: Selected empirical research on factors in value creation processes (continued)

	Empirical Research	Industry/level	Methodology	Sample size and country/region	Independent value creation factors	Value co-creation factors	Contribution to value creation literature	Predominant theory
48	(Torvinen & Ulkuniemi, 2016)	Engineering, construction and maintaining/ project level	Qualitative (single-case study)/ Content analysis	Seven interviews and more than 50 PPP project documents/ Finland	Access: ***information exchange***, user training, user's independent value creation	Dialogue: ***interactions***, networking Risk assessment and reflexivity: user satisfaction measures, feedback, procurement know-how Transparency: ***trust***, personal ***relationships***, community ***involvement***	Value creation can be enhanced through actively engaging end users as co-creators of value in public procurement by interactive dialogue in the design phase. There are positive effects of end user's independent value creation and the sensation of involvement in the user's individual value experience.	Relational contracting
49	(Yao Li, Zhang, & Zheng, 2016)	High-tech industry/ firm level	Quantitative (survey)/ hierarchical regression analyses	276 respondents/ China	Portfolio management capability	Cognitive social capital: shared values, vision and goals Relational social capital: ***respect***, ***trust***, reciprocity Structural social capital: ***interactions*** ***Exploratory innovation***	Cognitive social capital affects exploratory innovation, whereas relational and structural social capital demonstrates an inverted U-shaped association with exploratory innovation. Portfolio management moderates the relationships between the dimensions of social capital and exploratory innovation.	Relational view of the firm, social capital theory
50	(Hjelmbrekke, Klakegg, & Lohne, 2017)	Engineering and construction/ project level	Qualitative (case study)/ comparative analysis and experts panel	Two projects, three workshops with 40 participants / Norway	Project governance: ***information exchange***, communication	Project governance: strategic ***alignment***, mutual dialogue (***interactions***)	The business model of the design team focuses on efficiency rather than on the client's strategic objectives. This situation entails a need for project governance.	Not mentioned
51	(Wu et al., 2017)	High-tech industry/ firm level	Quantitative (survey)/ confirmatory factor analysis	238 respondents/ China	Formal ***contracts*** Opportunistic behaviour	Specific investments for ***collaboration*** Relational ***trust*** Cooperative behaviour	Specific investments affect the formation of formal contracts and relational trust, and the relational trust influences the effect of specific investments on performance.	TCE, relational exchange theory

2.4 Drivers of value creation processes

A value creation driver is referred to as "any factor that enhances the total value created by a business" (Amit & Zott, 2001, p. 494). As shown by empirical research (see Table 2.5), governance strategy, mode of inter-organisational interaction and management foci represent value creation drivers that maximise the created or co-created value for all involved parties. Figure 2.3 displays a representation of these three elements.

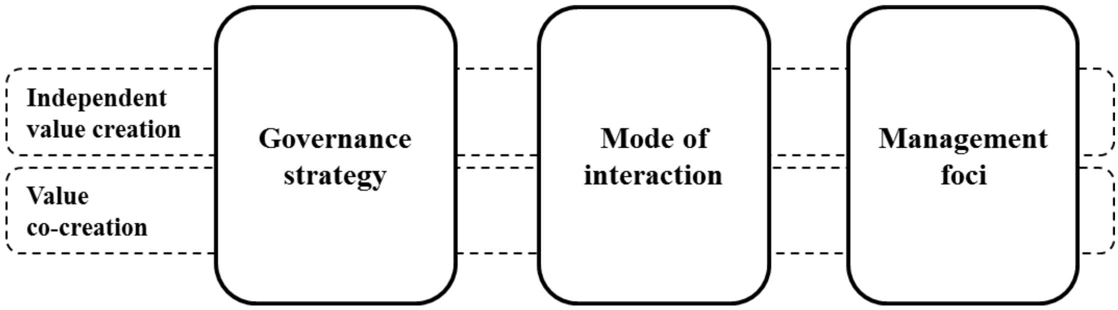


Figure 2.3: Drivers of value creation processes

2.4.1 Governance strategy

Governance has been identified in management and business literature as a key value creation driver at both firm level and project level (Clauss & Spieth, 2016; Hammervoll, 2011, 2012; Hartmann et al., 2014; Hjelmbrekke et al., 2017; J. Hsu et al., 2013; Y. Liu et al., 2009; Y. Liu et al., 2007; Miguel et al., 2014; E. Wang & Wei, 2007; Wu et al., 2017). According to the Organisation for Economic Co-operation and Development (OECD), governance involves a structure to reduce conflicts among different groups of stakeholders, as well as a framework to establish and achieve the objectives of the organisation (Demise, 2006). In other words, governance "constitutes the overall framework for management decisions in an organisation" (Müller, Zhai, Wang, & Shao, 2016, p. 959), including project-based organisations (Turner & Keegan, 2001).

As shown, management and organisation literature has described two main types of governance strategies, namely contractual and relational. A contractual governance strategy is based on formal contracts which commonly include specifications of promises, obligations and actions to solve disputes, as well as the responsibilities of the parties, procedures for monitoring delivered outcomes, and punishments in the case of noncompliance (Poppo & Zenger, 2002). This contract-based governance mechanism represents a platform to create value because it incorporates patterns of formal relationships between partners (Y. Liu et al., 2009). Additionally, suppliers and clients can reduce opportunistic behaviour and asymmetric information through defined controls and frequent monitoring (Roehrich & Lewis, 2010), as well as promoting trust, cooperation, and long-term win-win relationships by using strong legal enforceability (Zhou & Poppo, 2010). The mechanism here is based on forcing compliance so, for these reasons, contractual governance strategy aligns with an independent value creation process, as demonstrated in this empirical review.

In contrast, a relational governance strategy lays the foundation for close collaborations between parties (Jacobsson & Roth, 2014), incorporating different inter-organisational relationship mechanisms between stakeholders, such as trust, commitment, and cooperation (E. Wang & Wei, 2007), based on the norm of solidarity (Hammervoll, 2012) and fairness (Harrison & Wicks, 2013). According to Zajac and Olsen (1993), value maximisation can be achieved through the use of relational and inter-firm strategies characterised by formal collaborative arrangements between parties (e.g., joint venture and partnering). Moreover, this relational approach, which is based on trust and reliability, represents the principal mechanism of protection against opportunistic behaviours (Harrison & Wicks, 2013; Wagner et al., 2010), mainly within lower legal enforceability contexts (Zhou & Poppo, 2010). Consequently, this relational governance mechanism is directly associated with a value co-creation process.

2.4.2 Mode of interaction

The mode of interaction between the parties involved is also a fundamental element for generating value. Generally, interactions refer to physical, virtual or mental situations between suppliers and clients, or *vice-versa* with regard to influencing expected benefits

(Grönroos & Voima, 2013). Indeed, Ranjan and Read (2014) point out that interaction is a primary interface to co-produce an offering where the participation, dialogue, and sharing of information and knowledge are essential elements to solve issues and propose solutions to any inter-organisational relationship.

Different modes of interaction have been variously defined in the literature. For example, in a seminal work, Ring and Van de Ven (1992) designate four types of transactions between organisations, nominated as discrete market transactions; hierarchical managerial transactions; recurrent contracting transactions; and relational contracting transactions. Each type has different characteristics with regard to the status between parties, ranging from a limited, non-unique relationship between legally equal and free parties to an extensive, unique socially-embedded relationship between legally equal and free parties. Similarly, Brennan and Turnbull (1999) establish three dominant categories of interaction to explain adaptive behaviour in IOR: (1) transactional, where there is no policy to develop long-term partnership sources; (2) transitional, which includes transactional basis relationships but committed at the top management level; and (3) partnering, where firms are embedded in an organisational practice. Another prominent example was elucidated by Spekman, Kamauff, and Myhr (1998), wherein a supply chain management context, interactions are studied strategically, from the supplier of the supplier through to the client of the client. This level of interaction identifies four types of transactions that key supplier-client negotiations might transit: open-market, cooperation, coordination and collaboration. Open market negotiations are based on price and characterised by adversarial relationships. In the cooperation category, interactions are delineated by few supplies with long-term contract ties. Coordination is the next level of relational intensity where the parties engage in specified workflow and information linkages. Ultimately, collaboration refers to the degree of supply chain integration based mainly on joint planning and technology sharing, built on a foundation of trust and commitment.

In agreement with Spekman et al. (1998), this research adopts coordination and collaboration as the critical types of interaction in value creation. Coordination involves "the process of managing dependencies among activities and linking together different parts of an organisation to accomplish a collective set of tasks" (Andrew Chang & Shen, 2014, p. 1), which is aligned with a contractual governance mechanism and consequently with an independent value creation process. Collaboration is an evolving process where the parties work together actively and closely to achieve the desired outcomes (Bedwell et al., 2012), based on mutual trust and commitment. As such, it is closely connected to a relational governance strategy as a priority for the value co-creation process.

2.4.3 Management foci

The choice of management foci is also recognised as an essential element for governing value creation processes. Through the analysis of several organisations, Ghoshal et al. (1999) found evidence of two dominant approaches to the strategic management of any organisation. One approach is focused on monitoring and controlling how the organisation captures value (mainly economic value) from the products or services put on the market by the managers, with the intention of maximising shareholder returns by exploiting available economic options and resources as efficiently as possible (Ghoshal et al., 1999). Through transaction cost economics theory, Williamson (1985) points out that this logic of static efficiency requires exhaustive coordination of monitoring and controlling tasks in order to avoid opportunistic behaviour and asymmetric information from the other party in the relationship. Control in IORs refers to the mechanism that a controller uses to regulate the actions of controlees to achieve desired objectives (Tiwana, 2010). The independent value creation logic is closely related to this management focus.

Innovation orientation is currently featured as another important management focus. Ghoshal et al. (1999) argue that value is created collectively by continuous innovation through generating new resources and new ideas to maximise mutual benefits between the parties involved. In a relational environment of collaboration, innovating adds value because organisations with shared goals and practices support an effective process of value creation characterised by close communication, knowledge exchange, risks/gains sharing, and continuous learning and improvement (Austin & Seitanidi, 2012). This innovation capability is specifically referred to the organisation's capacity to transform knowledge and ideas into new products continuously, new processes or new systems, for the benefit of the firm and its stakeholders under an atmosphere of co-creation (Hamidi & Gharneh, 2017; Inemek & Matthyssens, 2013; Tanev et al., 2011). Thus, innovating can be seen to be closely related to co-creating value.

To conclude, key factors in each value creation processes include three defined drivers, namely governance strategy, mode of interaction and management foci, which are formalised from the empirical research analysis and shown in Tables 2.6 and 2.7.

Table 2.6: Factors in the independent value creation process

Element	Factor and definition	Reference
Governance strategy	**Contractual agreements** The formal mechanism that stipulates the rights and obligations of parties by defined rules, terms and procedures, explicitly stating states how future contingencies and conflicts will be addressed.	(Clauss & Spieth, 2016; Hammervoll, 2012; Hartmann et al., 2014; Y. Liu et al., 2009; Y. Liu et al., 2007; Panda, 2016; Wu et al., 2017)
Mode of interaction	**Coordination** The process for managing dependencies among activities and linking different parties to accomplish a common set of tasks and to facilitate the exchange of technical information.	(Andersen, 2016; Clauss & Spieth, 2016; Eweje et al., 2012; Fang et al., 2008; Georges & Eggert, 2003; Hammervoll, 2011, 2012; Hjelmbrekke et al., 2017; Keung & Shen, 2013; Lau, 2011; L. Li, 2011; Panda, 2016; Polo Peña et al., 2014; Rodríguez et al., 2016; Stewart & Mohamed, 2004; Toon et al., 2012; Torvinen & Ulkuniemi, 2016; Wagner et al., 2010; E. Wang & Wei, 2007; S. Zhao et al., 2014)
Management foci	**Monitoring & controlling** The process of securing that the objectives are reached as planned, including corresponding changes to the plan as required.	(Andersen, 2016; Eweje et al., 2012; Hartmann et al., 2014; Y. Liu et al., 2009; Ng et al., 2013; Panda, 2016)

Table 2.7: Factors in the value co-creation process

Element	Factor and definition	Reference
Governance strategy	**Relational engagement** Engage in active ***interactions*** with a set of ***relational norms*** so that the supplier applies its specialised professional skills, methods and expertise, while the client contributes to resources, needs and linked interests.	(A. Chang et al., 2013; Cheung et al., 2010; Eggert et al., 2006; Fang et al., 2008; Georges & Eggert, 2003; Gil-Saura et al., 2009; Hahn & Gold, 2014; Hartmann et al., 2014; Hjelmbrekke et al., 2017; J. Hsu et al., 2013; Inemek & Matthyssens, 2013; Kähkönen et al., 2015; Karpen et al., 2015; Lau, 2011; Yao Li et al., 2016; Y. Liu et al., 2009; Y. Liu et al., 2007; Murphy et al., 2015; Murthy et al., 2016; Panda, 2016; Polo Peña et al., 2014; Ralston et al., 2015; Ranjan & Read, 2014; Rod et al., 2014; Rodríguez et al., 2016; Stanko & Bonner, 2013; Toon et al., 2012; Torvinen & Ulkuniemi, 2016; Tsai & Ghoshal, 1998; Wagner et al., 2010; E. Wang & Wei, 2007; Wu et al., 2017; Zacharia et al., 2011)
Mode of interaction	**Collaboration** ***Work cooperatively*** in activities whereby two or more parties (e.g. clients and suppliers) actively ***share strategic information*** and ***jointly solve problems*** to achieve shared goals, reduce risks, share gains and pains by a rational and transparent interaction.	(Andersen, 2016; A. Chang et al., 2013; Chen et al., 2011; Cheung et al., 2010; Clauss & Spieth, 2016; Hammervoll, 2011, 2012; J. Hsu et al., 2013; Inemek & Matthyssens, 2013; Kähkönen et al., 2015; Keung & Shen, 2013; Miguel et al., 2014; Murthy et al., 2016; Panda, 2016; Song et al., 2012; Stanko & Bonner, 2013; Wagner & Lindemann, 2008; E. Wang & Wei, 2007; Wu et al., 2017; Zacharia et al., 2011; S. Zhao et al., 2014)
Management foci	**Innovating** Transform knowledge and ideas jointly for new products, new processes or new systems encouraging change, creativity and risk-taking where the parties have little or no prior experience, for their benefit and that of their stakeholders.	(Chen et al., 2011; Clauss & Spieth, 2016; Inemek & Matthyssens, 2013; L. Li, 2011; Yao Li et al., 2016; Murthy et al., 2016; Ranjan & Read, 2014; Stanko & Bonner, 2013; Tsai & Ghoshal, 1998; Tseng & Goo, 2005)

Figure 2.4 presents the factors of each value creation driver as discussed in previous subsections and the association with the value creation processes.

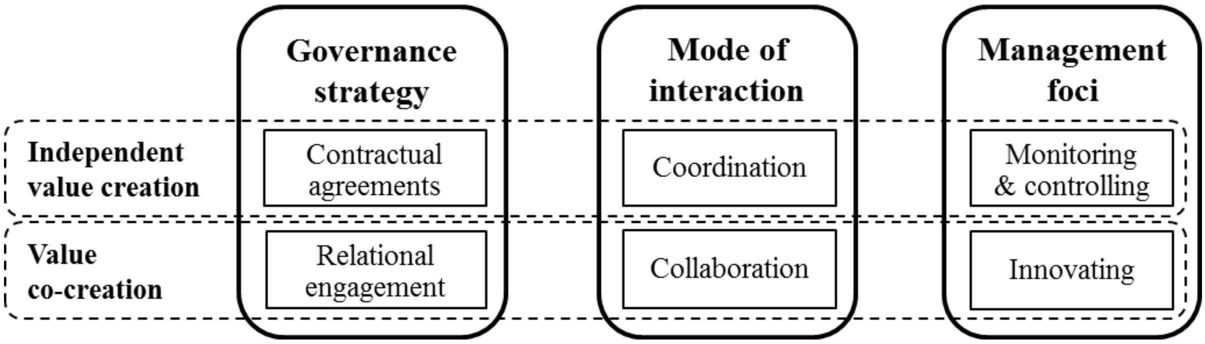


Figure 2.4: Factors in the value creation processes

2.5 Literature gaps and research questions

This review identifies two gaps in the literature that establish two research questions, as follows.

2.5.1 The effects of value creation processes on project value

This research conceptualises two basic value creation processes. First, the independent process involves delivery of the project by the focal organisation without the need for contributions from other project actors. Second, the co-creation process requires the collaborative delivery of the project outcome by the parties involved in the project based on their continuous interactions and innovations. Empirical research demonstrates that these two processes are currently considered to be complementary. For example, based on the analysis of 142 exchange relationships (supplier-buyer dyads), Hammervoll (2012) demonstrates that hierarchical or relational management governs value creation initiatives through different types of interactions between actors. Where a unilateral interdependence is emphasised, the main driver of value consists of the information supply supported by hierarchical management; however, if the interdependence is bilateral, a relational approach to information exchange is also fundamental, but with the addition of strategic knowledge sharing and joint problem-solving. Thus, although interactions are different conceptually, value creation orientations are applied in a similar manner. Correspondingly, Andersen (2016) compared two contrary perspectives of creating value at project level, referred to as task perspective and organisational perspective. The former is focused on the execution of defined tasks (i.e. independent creation) determined at the start in order to achieve the project outputs on time, within budget and of the specified quality. The latter refers to the delivery of a desirable development through strengthening the relationship between the base organisation and the project parties (i.e. co-creation) to fulfil the project purpose. Although both task and organisational management applications might differ, mostly in cases where uncertainty and complexity are relevant, project managers can apply both types jointly. Where task perspective is concerned with threats, organisational perspective pays more attention to opportunities.

Different methods of measuring the value created by an organisation for its shareholders have traditionally been based on Net Present Value (NPV) calculations such as Tobin's *Q*, Shareholder Value Analysis (SVA), Value-Based Management (VBM) and Economic Valued Added (EVA) (Charreaux & Desbrières, 2001; Patanakul & Shenhar, 2007; Tseng & Goo, 2005). Currently, however, a more holistic view of organisational value has been recognised (Lepak et al., 2007; Thomas & Mullaly, 2008) which explains value as a magnitude of realised benefits (Zwikael & Smyrk, 2012) measured through a set of non-financial indicators relating to innovation, quality, client relationships, management capabilities, technology, employee relationships, environmental and community issues, among others (Cuganesan, 2005). Normally the resulting value is divided into tangible benefits, i.e., results that can be quantified, and intangible benefits, results that are less quantifiable but "without resorting to excessive reliance on assumptions, approximations, and inferences" (Mullaly & Thomas, 2009, p. 129). This view, in contrast with the traditional shareholder-centred perspective, includes the benefits from and for all key stakeholders (Charreaux & Desbrières, 2001; Garriga, 2014).

Specifically, in projects, value has been widely associated with a quantitative evaluation of progress by the earned value management (EVM) technique (Browning, 2014; Crawford & Pollack, 2004; Patanakul, Iewwongcharoen, & Milosevic, 2010). The application of this technique, however, is sometimes dismissed because EVM only accounts for time, cost and scope (Browning, 2014) under a closed view of project performance based on the *triple constraint* paradigm (Lechler & Byrne, 2010). As previously discussed, a project is "supposed to create value for its stakeholders" (Browning, 2014, p. 1); therefore, project management should focus on a value paradigm intended to maximise value (i.e. outputs, outcomes, impacts) by identifying stakeholder needs and opportunities, while also reducing risks and uncertainties (Browning, 2014; Lechler & Byrne, 2010). To this end, project value has been understood as "the satisfaction of the project stakeholders on the explicit and implicit benefits generated from the project versus the tangible and intangible resources invested to achieve those benefits" (Patanakul & Shenhar, 2007, p. 2142). Satisfying a stakeholder's needs involves actions beyond delivering an outcome defined by the *triple constraint* criteria. Instead, the project contractor takes the initiative to identify ways of aggregating value for the client, while the client shares the gains or value additions and associated risks with the contractor. With that in mind, project value is traditionally represented by one or any combination of measurements such as project efficiency, project effectiveness, stakeholder satisfaction with emphasis on clients and shareholders, business and organisational success, future benefits, and additional dimensions of success linked to health, safety and environmental impacts (Eriksson & Westerberg, 2011; Lechler & Byrne, 2010; Patanakul & Shenhar, 2007; Serrador & Turner, 2014; Shenhar & Dvir, 2007).

Prior research literature establishes the effects of independent value creation and value co-creation processes on organisational value and project value.

Related to independent value creation, for example, Wagner et al. (2010) validate the idea that creating economic value represents total net value added by an inter-organisational effort among exchange parties. Creating value in this way has an adverse impact on project satisfaction when parties develop projects in competitive environments. Moreover, the exchange of information moderates the relationship between value creation and project satisfaction; this means that open and frequent information exchanges reduce the adverse effect of economic value creation on project satisfaction (Wagner et al., 2010). In contrast, S. Zhao et al. (2014) found in new product development projects that information exchange among parties for effective coordination improves the value creation performance as measured by achievement of expected goals, project economic returns, new products and new patents. In addition, the scope and quality of the information feed, and the sense of controllability by project managers, influence the strategic value created by the project with regard to value for partners, health, safety, security and environmental (HSSE) compliance, profitable asset performance and value to the host community (Eweje et al., 2012). Lastly, two case studies of engineering and construction projects (Hjelmbrekke et al., 2017) demonstrate that a lack of project governance routines mainly associated with coordination and monitoring exerts a negative impact on project performance and the potential for future success. Thus, defining the governance structure leads to strategic project outcomes; whereas the owner's failure to establish the governance frame to safeguard the project outcomes escalates the scope, overtaking the requirements of the project and the budget.

On the other hand, value co-creation enables performance at both the organisational and the project level. For example, in a new product value creation process, customer involvement increases the product performance (i.e. low cost, high innovation and high quality of the process and product) through enhanced information exchange and internal coordination between the supplier and the customers (Fang et al., 2008; Lau, 2011). Similarly, a collaborative process between firms (e.g. suppliers and clients) has a positive impact on operational value. This impact can be measured by lower costs; improved quality; better service; reduced lead time; better safety, environmental or regulatory performance. In addition, the relational value is shaped by an improved level of honesty, trust, open information sharing, and efficient and productive working relationship (Zacharia et al., 2011). Furthermore, co-production (i.e. co-creation) impacts service innovation and, in turn, project value (Chen et al., 2011). As explained by Chen et al. (2011), collaborative work, strategic information exchange and partners' contributions are significant factors for future project value connected with service improvements, generation of new markets and reduction of market risks. Correspondingly, J. Hsu et al. (2013) affirm that co-production characterised by communication openness, shared problem-solving and involvement in project governance is impacted by firm-user interactions, mutual trust and common understanding (i.e. knowledge and information sharing). Additionally, this co-creation process significantly affects project value as measured by product quality, client satisfaction and overall performance regarding budget, schedule and scope (J. Hsu et al., 2013). This view is likewise confirmed in two other research studies performed by A. Chang et al. (2013) and Murthy et al. (2016). The value co-creation process contributes to project success through the engagement of clients and other key stakeholders and the effective governing structures validated in three Australian defence mega projects (A. Chang et al., 2013). In addition, the information provided by 32 interviews and 256 completed questionnaires from IT project managers determines that value co-creation characterised by commitment, alignment, relational norms, innovation, joint-problem solving, continuous interactions and complementary competencies has a direct effect on strategic value, business value and transactional value (Murthy et al., 2016).

Current efforts have partially shown the effects on firm and project performance from the application of both independent value creation and co-creation together. Clauss and Spieth (2016) established that transactional and relational governance mechanisms exert different effects on the efficiency and effectiveness of relationships with suppliers. Whereas transactional governance is primarily suited to foster buyer-supplier efficiency (e.g. cost or lead time reduction), and where relational governance strengthens buyer-supplier effectiveness (e.g. product customisation or joint innovation). Additionally, the choice of a governance mechanism indirectly affects the suppliers' orientation to strategic innovation; specifically, buyer-supplier effectiveness stimulates an orientation toward strategic innovation, whereas high buyer-supplier efficiency leads to less orientation toward strategic innovation (Clauss & Spieth, 2016). Relatedly, by using 238 responses from project managers in Chinese cooperative innovation projects, Wu et al. (2017) analysed the effects on project performance from specific investments, governance mechanisms (i.e. formal contracts and relational trust) and behaviours. Their findings demonstrate that specific investments favour the formation of formal contracts, and relational trust significantly influences the effect of both mechanisms on performance.

Briefly, organisations rarely create value in isolation; governance mechanisms, mobilisation of heterogeneous resources and the following managerial attributes of exchange all interact to determine success in creating value (Ghosh & John, 1999). As corroborated by previous verifiable studies, different conceptual frameworks have been very useful in understanding how value creation processes work, and determining their particular effects on project value. Nevertheless, there is almost no empirical analysis investigation about the joint implications of these processes on project value defined as project management success and project success. Consequently, the first research question is defined as follows.

RQ1: *How do value creation processes (i.e. independent value creation and value co-creation) affect project value (i.e. project management success and project success)?*

2.5.2 The contingent effect of requirement uncertainty and project complexity

Completing a discussion of the effects of independent value creation and value co-creation processes on project value leads to a subsequent analysis of the contingency theory that proclaims that contextual conditions (also called moderators) affect the fit between organisational characteristics and performance (L. Donaldson, 2001). Many contingency factors have been analysed in prior management and business literature in different industries, levels and project contexts. Among the moderator factors at the firm-level, for example, are firm size, agency conflicts, environmental uncertainty, business strategy, competition within the industry, firm complexity, monitoring by board of directors (Elgharbawy & Abdel-Kader, 2013; Gordon, Loeb, & Tseng, 2009), and stakeholder role clarity (Beringer, Jonas, & Kock, 2013). At the project level, moderator factors that have been applied as contingent variables include moderators, such as supplier asset specificity and requirements certainty (Narayanan, Narasimhan, & Schoenherr, 2015); governance mechanisms (i.e. trust and control) and governance complexity (Müller et al., 2016); external turbulence (Voss & Kock, 2013); severity of contract enforcement (Quanji, Zhang, & Wang, 2017); joint collaborative planning (Hadaya & Cassivi, 2012); physical distance (Mesly, 2015); organisational environment and project team risks (S. Liu & Wang, 2016); project type, project uncertainty and contract type (Larsson, Eriksson, Olofsson, & Simonsson, 2015; Yang, Chen, & Wang, 2012); stakeholder support and project schedule (Eweje et al., 2012); collaborative climate and project characteristics (i.e. customisation, project value/size and time pressure) (Eriksson & Westerberg, 2011; Larsson et al., 2015); emergent properties (Zhu & Mostafavi, 2017); project stability, market diversity, hostility, external control and internal power (Van Donk & Molloy, 2008); quality of the vision/goals and team experience (Serrador & Pinto, 2015); and project complexity (Açikgöz, Günsel, Kuzey, & Seçgin, 2016; Geraldi, Maylor, & Williams, 2011; Larsson et al., 2015; S. Liu, 2015; Serrador & Pinto, 2015; Van Donk & Molloy, 2008; Zhu & Mostafavi, 2017).

In a comprehensive research study using 21 selected publications, Howell, Windahl, and Seidel (2010) identified uncertainty, project complexity, urgency, team empowerment and criticality as five original themes that encompass almost all the project contextual factors previously discussed. In addition, two contingencies have received special attention in the business and management literature: namely uncertainty and complexity (Eriksson & Westerberg, 2011; Hanisch & Wald, 2011; Padalkar & Gopinath, 2016; Shenhar & Dvir, 2007). The literature review considers three determinations – first, that complexity does not imply necessarily uncertainty, or *vice versa* (Tidd, 1997); second, that the lack of certainty in project requirements and project complexity can significantly affect the value proposition of a project (Lechler, Edington, & Gao, 2012); and third, that both contextual contingencies are recognised as critical to influencing organisational structure and management processes for innovation (Tidd, 2001). As a result, this research study has elected to include requirements uncertainty and complexity as moderators of the relationship between value creation processes and project value, interpreted as follows.

The first moderator, uncertainty, is recognised as the difference between the amount of information required for a decision and the amount of information available (Winch, 2010). Project requirements refer to the owner and users to establish the functionalities of the project deliverables that will provide the desired benefits (i.e. outcomes) (Turner, 2006a). If project requirements are unclear or frequently changing, the project requirements uncertainty is high. Thus, requirements uncertainty (RU) is the difference between the information required and the information available to specify the requirements to be fulfilled by the project. This variable has been broadly studied in information systems projects, particularly in the area of software development (Kossmann, 2013; J. Liu, Chen, Chen, & Sheu, 2011). There are two main subdimensions of RU, namely, requirements instability and requirements diversity (Jiang, Klein, Wu, & Liang, 2009). Requirements instability refers to the extent of changes that occur to the project requirements during the project, whereas requirements diversity represents the degree to which project stakeholder requirements differ from each other in the requirements to be met (Jiang et al., 2009; J. Liu et al., 2011).

The second moderator, complexity, involves project scope, project size, the number and variety of components, subtasks and interactions (Baccarini, 1996; Shenhar & Dvir, 2007). Complexity is also recognised as a source of uncertainty (Floricel, Michela, & Piperca, 2016). Project complexity has several dimensions, including structural, uncertainty, dynamic, pace and socio-political complexities (Geraldi et al., 2011), information, task, technological, organisational, environmental and goal complexities (Luo, He, Xie, Yang, & Wu, 2016). For other relevant examples, see Bakhshi, Ireland, and Gorod (2016), Geraldi et al. (2011), Lessard, Sakhrani, and Miller (2014), Luo et al. (2016). Floricel et al. (2016) and Brady and Davies (2014), all of which define two basic dimensions of project complexity (PC) – structural complexity and dynamic complexity. Whereas the former is associated with the arrangement of elements and subsystems into the whole project, the latter refers to the changing relationships between components in the project and between the project and its context over time (Brady & Davies, 2014).

Understanding complexity and uncertainty in the requirements of projects affect the decisions in practice to manage projects effectively (Geraldi et al., 2011), which strongly influences the method of creating value for project stakeholders.

The majority of project management literature agrees that when there are high levels of uncertainty and complexity, project delivery requires a more collaborative approach (i.e., value co-creation) to create a favorable impact on efficiency as measured by cost, time and scope, and achievement of the desired outcomes (Eriksson, 2014; Eriksson & Westerberg, 2011; Pesämaa et al., 2009; M. Rahman & Kumaraswamy, 2005). With small, simple, and standardised projects, which are associated with low levels of uncertainty and complexity, a transactional approach based on contract, coordination and monitor and control (i.e., independent value creation) would be sufficient to meet customer expectations (Eriksson & Westerberg, 2011). Nevertheless, Merrow (2011) found that collaborative relationships between owners and contractors, in alliance-type procurement methods, increase instability in project execution mainly when projects have high levels of requirements uncertainty. This situation motivated the owners to divide the delivery model into two separate parts, one for engineering and procurement, using a relational approach; and another for construction (Merrow, 2011), reverting to a traditional procurement method governed by a transactional approach based on cost-efficiency (Challender, Farrell, & Sherratt, 2014).

As a result, various discussions present contradictory recommendations about which value creation process is more suitable and successful for different requirements uncertainty and project complexity. Although in general PDM research advocates a relationship-based approach for project complexity and requirements uncertainty, most of the evidence relied upon is either anecdotal or based on case studies (Alam, Kabir, & Chaudhri, 2014; Caldwell, Roehrich, & Davies, 2009; Eriksson & Westerberg, 2011; Nord, 2012; Smyth, Lecoeuvre, & Vaesken, IN PRESS; Walker & Lloyd-Walker, 2013; Xue, Turner, Lecoeuvre, & Anbari, 2013). This type the evidence represents another gap that is empirically investigated in this study, as elucidated by the second research question.

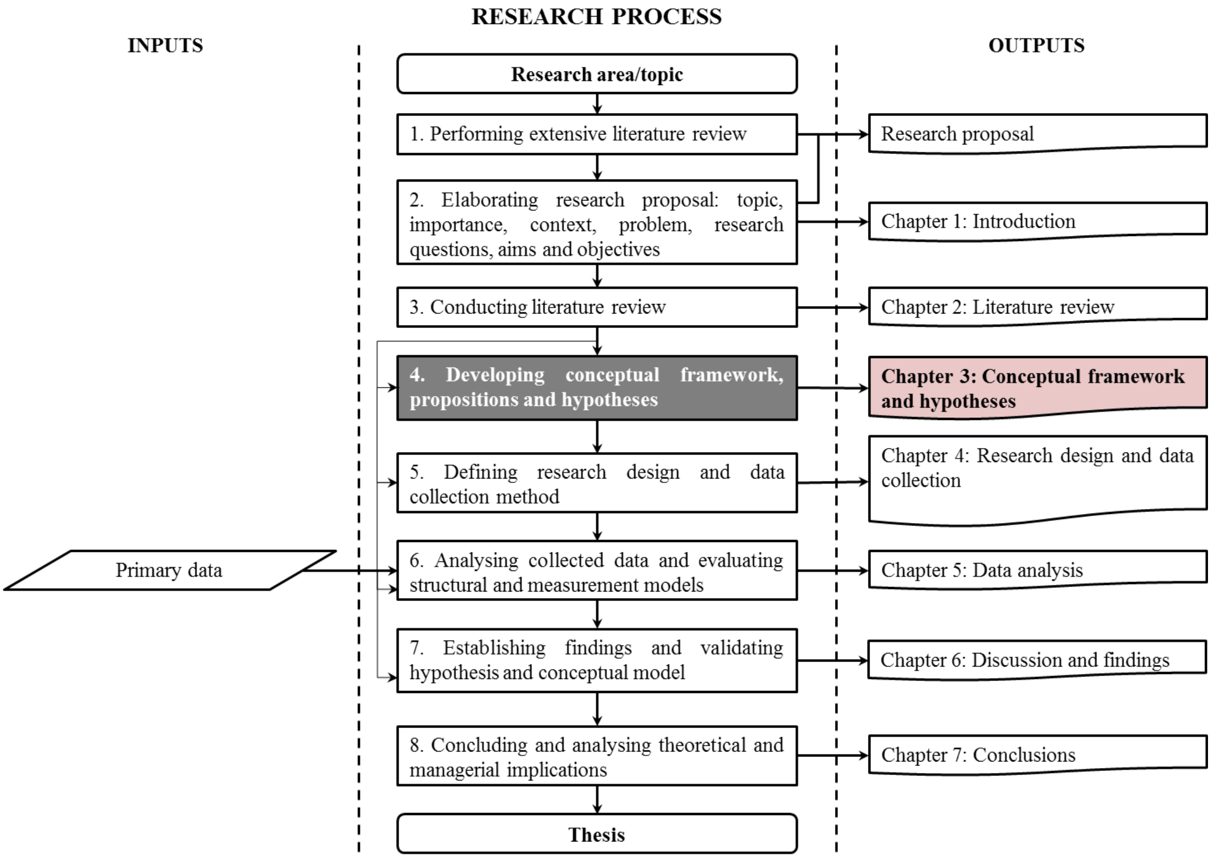
RQ2: *How do requirements uncertainty and project complexity moderate the relationship between value creation processes and project value?*

2.6 Summary

A review of relevant literature was presented in this Chapter. First, value concepts and logics (i.e. value chain, value shop and value network) are reviewed. Then, two distinct value creation processes are conceptualised: independent value creation and value co-creation. Subsequently, the underlining theories are examined, and three key components of value creation processes are explained and defined, namely governance strategy, mode of interaction, and management foci. Finally, literature gaps are identified, and research questions formulated.

Chapter 3: CONCEPTUAL FRAMEWORK AND HYPOTHESES

- Introduction
- The contingency theory and project management
- A contingent model of value creation in projects
- Conceptual framework and hypotheses development
- Summary



3.1 Introduction

This chapter proposes the conceptual framework and develops the research hypotheses for addressing the gaps identified in the literature review. Based on the contingency theory (Section 3.2), the proposed model examines the effects of project delivery model's (PDM's) value creation processes on project value, moderated by two critical project contextual factors, namely requirements uncertainty and project complexity. Section 3.3 begins with an explanation of both factors, followed by the proposal of a two-by-two matrix on the effects of value creation processes on project value, according to the level of requirements uncertainty and project. A hypothesised path model is then developed to describe the value creation processes as underlined by governance strategy, mode of interaction and management foci, and the corresponding impact on project value (Section 3.4).

3.2 The contingency theory and project management

A contingent approach recognises that organisations should be designed and managed in accordance with specific environmental conditions in order to effectively achieve high performance (L. Donaldson, 2001; Lawrence & Lorsch, 1967). Contingency (e.g., the environment, organisational size and organisational strategy) represents factors that "moderate the effect of an organisational characteristic on organisational performance" (L. Donaldson, 2001, p. 2). Thus, contingency theory usually refers to the existence of contextual variables that affect causal relationships between managerial and performance variables (Luthans & Stewart, 1977).

According to Luthans and Stewart (1977), environmental variables (also called contextual or contingent variables) form part of the ecosystem of an organisation. These factors, which are considered independent variables, affect the organisation but are not under the control of management. In management research, general environmental variables are directly related to cultural, social, technological, educational, legal, political, economic, ecological and demographic factors. Managerial variables, representing managerial actions or constructs, also form part of the ecosystem of an organisation. Together with resources, these managerial variables are performed for achieving the organisational objectives. Planning, organising, communicating, controlling, motivational techniques, leadership styles, decision-making models and information management are some examples of managerial variables. Performance variables are often used as the dependent variable in gauging performance levels; they represent the result of the intersection between environmental and managerial variables. Together, these three core variables – environmental, managerial, and performance – underpin the core contingency paradigm (L. Donaldson, 2001) exhibited in Figure 3.1. Applied to project management, this model postulates that if there is a good fit between project context (i.e., contextual variables) and project management (i.e., managerial variables), then project performance (i.e., performance variables) should be satisfactory. Conversely, if project performance is poor, then management must adapt to improve the fit between variables in order to enhance performance.

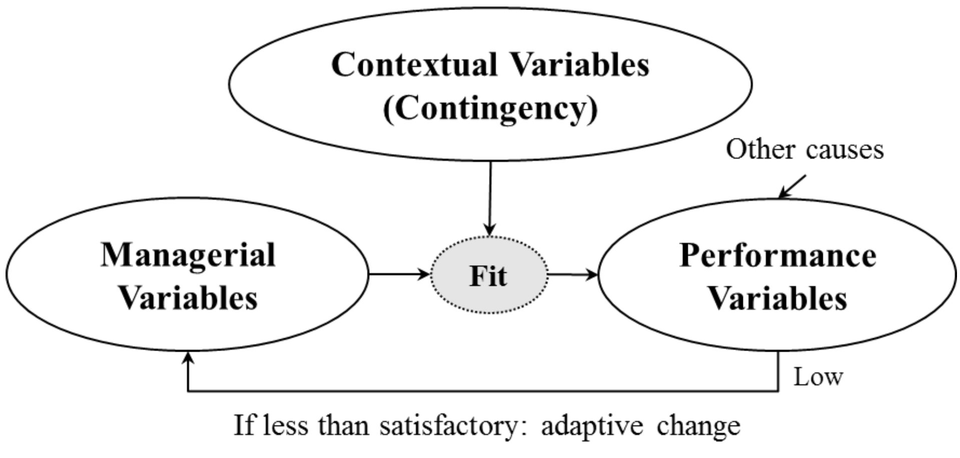


Figure 3.1: The contingent approach in project management
Adapted from (L. Donaldson, 2001)

Several scholars in project management research have adopted this contingency theory for three main reasons. First, to explain particular characteristics of the relationships between managerial variables within diverse project contexts to improve performance (Chih &

Zwikael, 2015; Jiang et al., 2009; Joslin & Müller, 2015; Y. Lin & Ho, 2013; Müller & Martinsuo, 2015; Sakka, Barki, & Côté, 2016). Second, to classify projects by contingencies rather than by industries (Brady & Davies, 2014; Dvir, Lipovetsky, Shenhar, & Tishler, 1998; Geraldi et al., 2011; Shenhar, Dvir, Lechler, & Poli, 2002). Third, to propose alternative project management approaches instead of the commonly applied 'plan-driven model' (Hanisch & Wald, 2011; Howell et al., 2010; Joslin & Müller, 2016; Mullaly & Thomas, 2009; Turner, Anbari, & Bredillet, 2013). Congruent with the first reason, this study considers a contingent model that includes requirements uncertainty and project complexity as moderators between value creation processes and project value. In line with the second reason, this study proposes four types of projects based on the level of requirements uncertainty and project complexity, rather than on the traditional classification based on size or industry.

3.3 A contingent model of value creation in projects

3.3.1 Project contextual variables

As reviewed in Chapter 2, uncertainty and complexity are two critical dimensions of project context (Shenhar & Dvir, 2007) that have been treated as contingency factors (Eriksson & Westerberg, 2011; Hanisch & Wald, 2014; Jiang et al., 2009; J. Liu et al., 2011; Luo et al., 2016; Padalkar & Gopinath, 2016).

In most cases, the two contextual factors have been analysed separately; however, some frameworks use a combination of uncertainty and complexity mainly for categorising projects (Geraldi et al., 2011; Shenhar & Dvir, 2007). For example, Tatikonda and Rosenthal (2000) quantitatively validate project complexity as a significant contributor of uncertainty (i.e., task uncertainty) in product development projects. Similarly, Pich, Loch, and De Meyer (2002) propose three project management strategies – instructionism, learning, and selectionism – based on the levels of uncertainty and complexity. Little (2005) establishes four categories of projects, based on the level of complexity and uncertainty – dogs, colts, cows, or bulls – that are used to maximise the business value of agile software development projects. Recently, Padalkar and Gopinath (2016) presented the argument that a deterministic view of uncertainty and complexity may not be enough to explain project outcomes; instead, they offer a semantic categorisation of both constructs.

Aligned to Turner's the goals and methods matrix (Turner, 2009), this research proposes to classify projects based on requirements uncertainty (RU) and project complexity (PC) as exhibited in Figure 3.2. Thus, RU and PC divide projects into four types, namely *certain simple, uncertain simple, certain complex and uncertain complex.* High or low requirements uncertainty is related to the extent of changes in project requirements throughout the project and represents the difference between the desired stakeholders' requirements and the requirements that are met. In the same way, project complexity is either high or low, according to the arrangement of components and subsystems into the whole project, and to what extent there are changes in the relationships between components in the project and between the project and its environment over time.

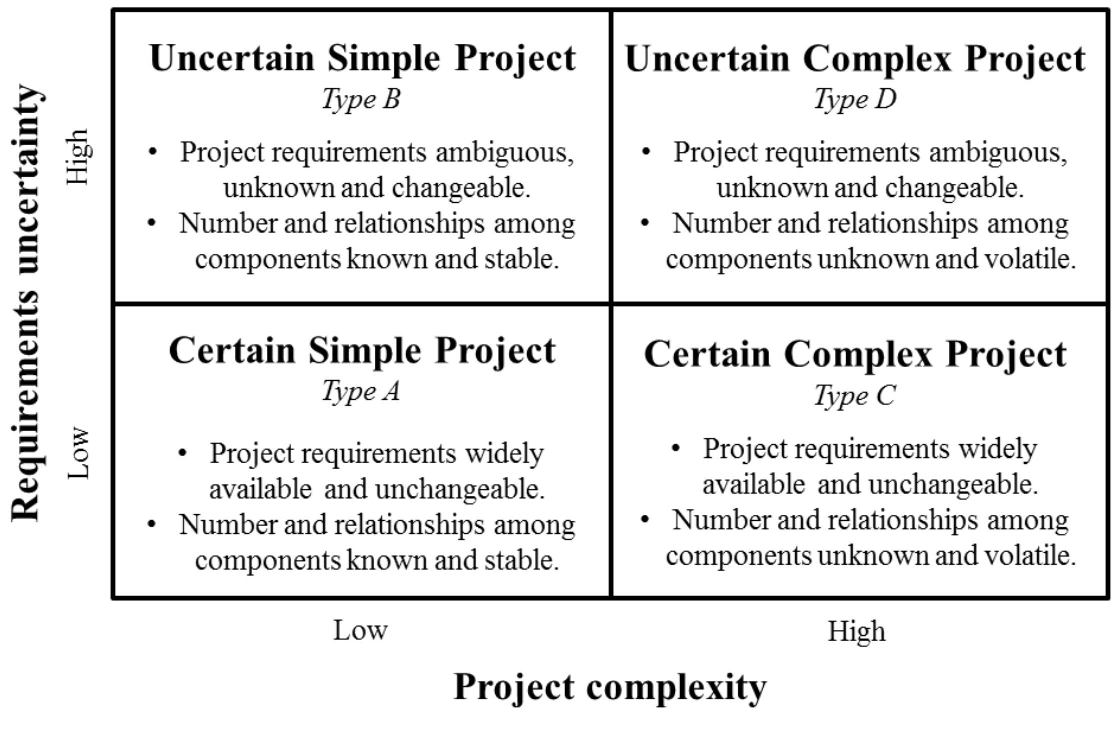


Figure 3.2: A contingent framework for value creation in projects

Accordingly, *certain simple (type A) projects* are those where the required information is available for all actors, thus avoiding differences between the detailed requirements and those that are finally achieved. All of the relationships between components are known and stable during the project. Within *uncertain simple (type B) projects*, all the interdependencies among elements and subsystems are known and steady over time, but the required information is ambiguous or unavailable, which results in changes in project requirements within the project. *Certain complex (type C) projects* are generally large in scope, where the number of components and their relationships may be unknown and volatile throughout the project, even though the project requirements are available and well-established. Finally, *uncertain complex (type D) projects* differ from the previous types because it is not possible to foresee all of the elements and interactions between the project and with its environment. In this type of project, it is difficult to determine the stakeholder requirements in advance, thus resulting in significant changes in requirements across the project.

3.3.2 Project managerial variables

Projects have been recognised as temporary organisations and social entities (Söderlund, 2004). To create value by using projects, an owner typically starts by selecting a project delivery model (PDM). A PDM defines the nature of the relationships between the parties involved in the project, to allocate the risks between the parties and identify the terms of the contract (Nawi et al., 2014). The major concern of the client and other stakeholders is whether or not the project will achieve the long-term, strategic objectives expressed as economic, environmental and societal goals. Thus, the PDM is often used to outline how project objectives can be attained and is therefore considered a core component of generating value in projects (Aapaoja et al., 2013; Hyvarinen et al., 2012). This holistic view of the PDM’s value creation process must remain throughout the project, ranging from the front-end (idea, selection, definition, financing) to the back-end (renovation, operation and maintenance) (Abi-Karam, 2006) to achieve the desired project outcomes.

Understanding the value drivers of a PDM can significantly affect the value created and added from the project for the owner (Ahola et al., 2008) and other stakeholders (Aapaoja et al., 2013). As found in the literature review (see Chapter 2), two main value creation processes (i.e., independent and co-creation) underpin three key components for creating project value; namely, governance strategy, mode of interaction and management foci (see Figure 3.3).

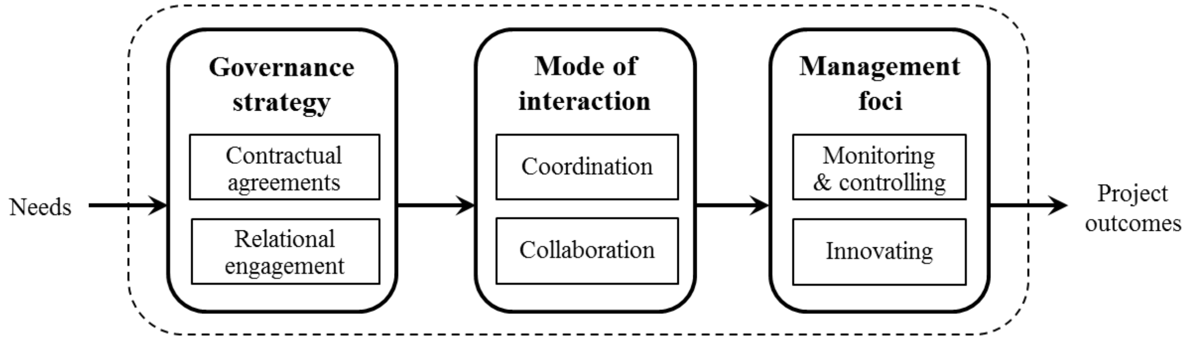


Figure 3.3: The value creation process in projects

3.3.2.1 Governance strategy

Project governance provides the structure for involving a set of relationships between stakeholders in the project and for determining objectives as well as the means for achieving and monitoring those objectives (Turner, 2006b). As previously discussed, project management literature highlights two governance mechanisms: contractual governance and relational governance. In contractual governance, parties coordinate project tasks by sharing technical information to deliver the project outcomes specified in the contract. In contrast, in relational governance , parties bound by common interests collaborate strategically to deliver the project, i.e., work together to explore alternative design choices and solve problems jointly in an effort to add value.

While some studies find contractual and relational governance strategies to be substitutive (e.g. Dyer and Singh (1998), Ghoshal and Moran (1996), Larson (1992)), other researchers empirically demonstrate that they are complementary rather than mutually exclusive (e.g. Y. Liu et al. (2009), Poppo and Zenger (2002), Z. Zhang, Wan, Jia, and Gu (2009)). This research adopts the interrelated view of contractual and relational governance for analysing the impact on the mode of interaction between parties in projects.

3.3.2.2 Mode of interaction

Following the dominant logic of the project governance strategy, two modes of interaction between the client and contractors are considered: coordination and collaboration.

In a contractual governance strategy, project tasks are coordinated through the exchange of technical information to deliver the project outputs specified in the contract; each contractor independently provides the deliverables specified in the contract. In this context, coordinative relationships between parties are essential to integrate planning and information sharing in order to control progress and understand the task requirements (Loebbecke, Van Fenema, & Powell, 2016; Walker & Lloyd-Walker, 2013).

In contrast, the dominant logic of the relational-based approach affirms that by looking after each other’s interests and even sharing gains and pain. The parties bound by shared interests strategically far beyond simple technical levels of coordination to deliver the project, by collaborating to explore alternative design choices and to solve problems in an effort to add value (Aarikka-Stenroos & Jaakkola, 2012). A value creation process demands collaboration among parties (i.e., client, designer and contractor) who share their resource complementarity, distinctive competencies and linked interests (Austin & Seitanidi, 2012). Hence, collaborative work refers to the joint activities of two or more parties who are actively and reciprocally solving complex problems, exchanging necessary and critical information, achieving shared goals, reducing risks, and sharing gains and pains (Aarikka-Stenroos & Jaakkola, 2012; Bedwell et al., 2012; Cheung et al., 2010; Gulati, Wohlgezogen, &

Zhelyazkov, 2012; Hadaya & Cassivi, 2012; Prahalad & Ramaswamy, 2004; Vargo et al., 2008; E. Wang & Wei, 2007).

3.3.2.3 Management foci

Having decided how the key stakeholders should interact (i.e., coordination or collaboration), the choice between adopting the appropriate project control approach and doing things differently (i.e., innovating) is a crucial one to accomplish project objectives and increase project value.

As enshrined in the PMBoK(R) Guide, the project control focus is to monitor and control by tracking, reviewing, and regulating the progress or performance of the project, with the purpose of identifying and initiating any necessary changes in the project plan (PMI, 2013). This approach comprises a formal mechanism associated with legal documents for enabling the control processes and the decision-making surrounding key issues, such as resource allocation (Zwikael & Smyrk, 2015), where coordination is the predominant mode of interactions between parties (Pala, Edum-Fotwe, Ruikar, Doughty, & Peters, 2014).

In contrast, project control can be exercised innovatively (Matinheikki, Artto, Peltokorpi, & Rajala, 2015; Prahalad & Ramaswamy, 2004). Innovating refers to implementing operation methods that are different from the normally established processes of operation carried out in similar circumstances to achieve the desired outcomes (Jean, Kim, & Sinkovics, 2012). For example, in a design and construction (D&C) project, there is little incentive for the contractor to give priority to benefits from the operating phase; however, in a public private partnership (PPP) project, there are significant incentives for integrating the design and construction phases with the operating phase to increase efficiency and add value (Ahola et al., 2008; Caldwell et al., 2009).

3.3.3 Project performance variables

The concept of performance and its measurement has been discussed in diverse contexts (Lechler, Gao, & Edington, 2013). Traditionally, project success is mainly assessed through examining time, budget and scope (i.e., based on 'triple constraint') (Shenhar & Dvir, 2007), although sometimes the assessment is expanded to include client satisfaction (Serrador & Turner, 2014), environmental impacts, and work environment (mainly regarding health & safety) (Eriksson & Westerberg, 2011). These conceptualisations of performance fail to capture the impact on the project business objectives (Serrador & Turner, 2014; Shenhar & Dvir, 2007; Turner & Zolin, 2012). The benefits that flow from those impacts can be measured only during the operation stage (Turner & Zolin, 2012), which are necessary factors for an assessment of project performance and recognised as part of the 'project value'.

Project benefits are measurable outcomes that meet stakeholder needs (Patanakul & Shenhar, 2007), or the addition of value produced by accomplishing the project results desired by stakeholders (e.g. owner, user, contractor, sub-contractors, suppliers, regulatory agencies, society) (Zwikael & Smyrk, 2012). Value determination in this research is measured as the difference between the benefits received by a stakeholder and the sacrifices made by the stakeholder (Ahola et al., 2008; Kliniotou, 2004; Möller, 2006; Voss, 2012). Satisfying stakeholder needs involves more than the delivery of what was specified in the project requirements, or what is prescribed in the 'triple constraint' view; it also includes initiatives for project contractors to identify ways of adding value for the client, while the owner and the contractor share the gains or value additions as well as the associated risks.

Project value can be measured by determining project efficiency (i.e., cost, time and scope) and project effectiveness (i.e., impact on client and users, business success and preparation for the future) (Miller & Lessard, 2000; Shenhar & Dvir, 2007; Turner & Zolin, 2012). As previously mentioned, project evaluation has been predominantly based on assessing efficiency (A. Chang et al., 2013; Lechler et al., 2013; Patanakul & Shenhar, 2007;

Shenhar & Dvir, 2007); however, there are cases where project efficiency considerations dissipate in comparison with the long-term value of project benefits. The Sydney Opera House, for example, is an excellent illustration of a case with entirely negative project efficiency that yielded exceptional long-term value (i.e., effectiveness) (Zwikael & Smyrk, 2012). Thus, project effectiveness also refers to the extent to which desired project outcomes or objectives can be achieved (Xue et al., 2013; Zwikael & Smyrk, 2012). Effectiveness must often be judged in the months or years after the project is finished when the overall long-term benefits can be better appraised (Turner & Zolin, 2012). In contrast to the typical emphasis given to the efficiency of project delivery, Miller and Lessard (2000, p. 15) state that "effective projects create value for all parties… and can generally survive their own inefficiencies (cost overruns, late completion, or early operational problems), but ineffective projects cannot compensate for their failures by efficient construction".

This research defines project value as including not only project efficiency but also "the satisfaction of the project stakeholders on the explicit and implicit benefits generated from the project versus the tangible and intangible resources invested to achieve those benefits" (Patanakul & Shenhar, 2007, p. 2142). As shown later in Table 4.1, project performance (i.e., project value) includes two dimensions – first, project management success that considers both project efficiency and the impact on the client; and second, project success as defined by organisational and business success and preparing for the future.

3.4 Conceptual framework and hypotheses development

Keeping in mind that the objectives of this research are to investigate the relationship between the effects of value creation processes (i.e., independent and co-creation) on project value, and the moderating effect of requirements uncertainty and project complexity on this relationship, the following section develops the conceptual framework to be validated by using survey data.

The conceptual model comprises eight main hypotheses which explain the relationships between the constructs previously mentioned, which are developed in Figure 3.4.

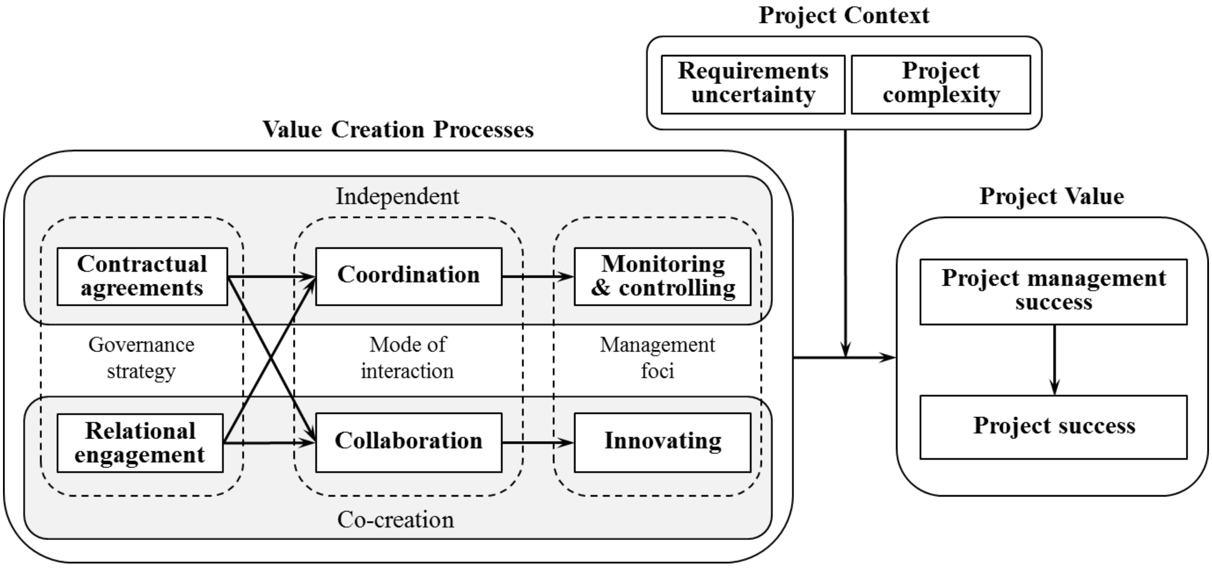


Figure 3.4: The conceptual model of this research

3.4.1 The influence of governance strategy on the mode of interaction

3.4.1.1 Contractual agreements and coordination and collaboration

An independent value creation process motivates organisations to concentrate on protecting the transactions governed by contracts. Contracts contain promises and obligations of the parties and particular actions (Macneil, 1977). In projects, contracts are typically divided into project phases or tasks, and they set out the scope and performance criteria for the designer, the contractor and other parties (i.e., dyadic contracts), as in engineering and construction projects (Lavikka, Smeds, Jaatinen, & Wagner, 2015). Because there is limited potential for synergy between the parties, contracts can be relied on to effectively govern the transactions (Williamson, 1985). These contractual agreements also include clauses that define the modes of intertwining technical information for planning and controlling (Loebbecke et al., 2016); in other words, they support a procedural coordination based on an efficient information flow to provide feedback between parties and to adjust delivery performance (Lavikka et al., 2015). Additionally, contract documents, such as clauses, drawings, and specifications, represent a major method of coordination in that they specify the parties' rights and obligations to be fulfilled throughout the project (Andrew Chang & Shen, 2014) that are commonly defined before the work begins on the project. Therefore, this research presents the hypothesis that:

H1a: *Contractual agreements have a positive impact on coordination when managing projects.*

In addition to the perspective of contracts as written documents to prevent potential disputes between parties, they can also be recognised as tools for generating business cooperation (Siedel & Haapio, 2010). A contract is considered to be a collaborative tool because it includes procedures and instructions, and functions as a dynamic instrument for supporting contingencies (J. Kujala, Nystén-Haarala, & Nuottila, 2015). Poppo and Zenger (2002, p. 708) argue that “well-specified contracts may actually promote more cooperative, long-term, trusting exchange relationships”. Contractual agreements may add value to the project through the use of the contracting process, especially when the benefits of this process are analysed through the collaborative relationships ex-post, compared to those undertaken ex-ante (Carson, Madhok, & Wu, 2006). This ability to add value can be seen in capital projects where the selection of the type of contract (ex-ante) has a significant ex-post impact on the collaboration between the client and the contractor (Suprapto, Bakker, Mooi, & Hertogh, 2015). Thus, this research investigates the following hypothesis:

H1b: *Contractual agreements have a positive impact on collaboration when managing projects.*

3.4.1.2 Relational engagement and coordination and collaboration

Relational engagement is defined as a governance strategy where the parties engage in active dialog and interactions under a set of relational norms, so that the parties (i.e., contractor and the client) work together to achieve project objectives by contributing resources, specialised skills, expertise and scoping (Aarikka-Stenroos & Jaakkola, 2012; Grönroos, 2011; Nord, 2012; Prahalad & Ramaswamy, 2004; Ranjan & Read, 2014). This commitment represents a platform that lays the foundation for effective coordination and close collaboration between the parties (Jacobsson & Roth, 2014). Although coordination and collaboration are distinct types of relationships (Bedwell et al., 2012; Söderlund, 2011), they are complementary facets that can present different challenges and risks during the project (Gulati et al., 2012). For example, coordination between parties is necessary to execute collaborative actions (Lavikka et al., 2015). Coordination is related to short-term relationships that involve limited personal interactions with an emphasis on planning and controlling; while collaboration represents long-term, interdependent and intertwined relationships with a focus on reciprocity (Jacobsson & Roth, 2014).

Relational governance mechanisms such as trust, shared norms, fairness and a ‘no blame culture’ enable mutual positive reinforcement for coordination and collaboration. On coordination, a relationally engaged environment motivates an exchange of information and the alignment of interests (Gulati et al., 2012). Effective information exchange in the form of permanent communications allows the actors to transfer information pertinent to critical tasks, procedures, and other relevant data (S. Zhao et al., 2014), and to adequately establish distinct modes of interaction to align their tasks with project goals (J. Hsu, Shih, Chiang, & Liu, 2012). Consequently, this research explores the following hypothesis:

H2a: *Relational engagement has a positive impact on coordination when managing projects.*

On collaboration, the engaging context of co-creation supports project stakeholders to work together pro-actively and closely to achieve project outcomes (Bedwell et al., 2012). Thus, during both the design and the execution stages, relational engagement based on capable interactions and good relational norms, facilitates collaborative work and joint problem-solving between parties to generate innovative solutions (Aarikka-Stenroos &

Jaakkola, 2012; Eriksson & Westerberg, 2011; Lavikka et al., 2015). Therefore, this research hypothesises that:

H2b: *Relational engagement has a positive impact on collaboration when managing projects.*

3.4.2 The influence of the mode of interaction on the management foci

3.4.2.1 Coordination and monitoring & controlling

Coordination is the process of managing dependencies between activities to facilitate the exchange of technical information and to monitor and control the tasks and the progress of the project (Pala et al., 2014). This view of coordination is largely based on the transactional view of formal governance mechanisms (i.e., contractual agreements) that serve as safeguards to prevent potential opportunistic behaviours in inter-organisational relationships (Dekker, 2004).

From an independent value creation perspective, parties share resources, define tasks and agree to coordinate labour across organisational boundaries in order to ensure outcomes (Borys & Jemison, 1989). In other words, coordination is associated with formal control modes (i.e., outcome and behaviour control). The outcome control mode is established by coordinating interdependent tasks between parties to monitor the achievement of performance targets (Das & Teng, 1998; Dekker, 2004). In those (not uncommon) situations where inter-organisational relationships are marked by differences in goals and performance ambiguity, behavioural monitoring mechanisms are required in order to achieve desirable behaviours (Das & Teng, 1998). Thus, as S. Liu (2015) argues, a behaviour control mode such as ex-ante, with specific and appropriate guidelines and procedures, will articulate the desired conduct with a focus on coordination and interaction between partners to share technical information and knowledge; to reduce project errors and revisions; and to effectively implement project tasks. Accordingly, this research proposes the hypothesis:

H3: *Coordination has a positive impact on monitoring and controlling when managing projects.*

3.4.2.2 Collaboration and innovating

A co-creation perspective of value creation demands a high level of collaboration between parties (e.g., client and contractor) in sharing complementary resources, distinctive competencies and linked interests in order to innovate (Austin & Seitanidi, 2012). For example, in the engineering and construction industry, the contractors apply their professional skills, methods and expertise to solve problems for the client. While the owner, drawing from personal knowledge in the business domain, clarifies the needs, defines the problem and scrutinises the design and the solutions through close interactions with the contractors (Austin & Seitanidi, 2012; Nord, 2012). Thus, this process of co-creation enables project actors to enhance this exchange of strategic information, engage in joint decision-making, exhibit greater openness to learn from each other, and demonstrate a willingness to apply new ideas to improve performance (Nix & Zacharia, 2014). That is, a collaborative environment facilitates innovation that is often necessary for complex and uncertain projects to co-create value through solving technical difficulties and management challenges jointly (Matinheikki et al., 2015; Prahalad & Ramaswamy, 2004). As Barlow (2000, p. 979) asseverates, "there is indeed considerable evidence […] that collaborative relationships help to promote the product and process innovation" related to project management success and benefits realisation. Hence, this research postulates the hypothesis that:

H4: *Collaboration has a positive impact on innovating when managing projects.*

3.4.3 The influence of management foci on project value

3.4.3.1 Monitoring & controlling and project management success and project success

According to Nidumolu (1995, p. 196), through coordination, project managers can obtain an enhanced understanding of the project that leads to better estimates of project management success which means that managerial control (i.e., monitoring behaviours or outcomes) can provide “the necessary feedback to managers in assessing the likely performance outcomes from the project”. Outcome control is related to the definition and monitoring of the desired goals for the project (Jaworski, 1988); while behavioural control includes specific rules and procedures that must be followed to ensure appropriate behaviour when working to deliver outcomes (Kirsch, 1997). As an example, Gopal and Gosain (2010) demonstrated empirically through an investigation of 96 Indian IT/IS projects that outcome and behaviour control modes have a significant impact on the efficiency and the effectiveness of a project. Similarly, after analysing data from 128 IS projects of a variety of industries, S. Liu (2015) points out that outcome and behaviour controls have a positive effect on the success of projects. Demonstrably, the relationship between project controlling and the project value has been widely studied, resulting in the conclusion that there is a significant association between the factors. Therefore, this research hypothesises that:

H5a: *Monitoring & controlling has a positive impact on project management success.*

H5b: *Monitoring & controlling has a positive impact on project success.*

3.4.3.2 Innovating and project management success and project success

Innovation relies mainly on the collaborative partners' compatibility and their history of business interactions, affective relational engagement, and expertise (Chen et al., 2011). Dulaimi, Nepal, and Park (2005, p. 566) define, innovating as the “generation, development and implementation of ideas that are new to an organisation, and that has practical or commercial benefits”. This definition encompasses the adoption of innovations for the majority of projects as involving into improvements, modifications, or line extensions of existing products or services. Innovation is arguably initiated to address challenges, opportunities and problems encountered at work in order to meet the objectives of the project or to improve performance (Dulaimi et al., 2005). In complex and uncertain contexts, this perception of change and creativity is encouraged to include risk-taking into new ideas in a co-creation process of innovation where the partners have little or no previous experience (Svetlik, Stavrou-Costea, & Lin, 2007). The adoption of innovations throughout the project must aim to assure a higher likelihood of meeting project objectives or outcomes such as cost reduction, increase in profit margins, productivity improvement, early project completion, and other long-term benefits. Hence, project innovativeness (i.e., the capacity for innovation from the project) represents a means of achieving better project management performance and consequently having a positive impact on the final product (Toole, 2001). For example, in engineering and construction projects, early stakeholder involvement in innovating can be fundamental to mitigate project risks and future disputes that can arise from design and building differences through constructability, and to sharing knowledge and learning from and for contractor and stakeholders, thus improving performance in terms of operability and maintainability of the project (Aapaoja et al., 2013; Walker & Lloyd-Walker, 2013). In consequence, a collaborative environment for value creation motivates continuous interactions that are conducive to solving complex problems through the duration of the project, and that encourage innovative solutions to achieve the project outcomes (Ramaswamy, 2009). For these reasons, this research predicts that:

H6a: *Innovating has a positive impact on project management success.*

H6b: *Innovating has a positive impact on project success.*

3.4.4 The influence of project management success on the success of the project

Project management success and project success have been previously associated by several project management researchers in their studies (Alsudiri, Al-Karaghouli, & Eldabi, 2013; Cooke-Davies, 2002; De Wit, 1988; Salazar-Aramayo, Rodrigues-da-Silveira, Rodrigues-de-Almeida, & De Castro-Dantas, 2013; Zwikael & Smyrk, 2012). The first is directly related to project management performance where cost, time and quality can be measured during the life of the project (Cooke-Davies, 2002) through achievement of the specified outputs or deliverables. The second is evaluated by the project outcomes only when the project is completed (Salazar-Aramayo et al., 2013); this means that success of the project is measured against the overall objectives of the project (Cooke-Davies, 2002). Traditionally, the project management team is directed toward completing the project in accordance with the 'triple constraint' criteria (i.e., budget, schedule and scope), because the project management technique focuses on achieving specific short-term outputs (Munns & Bjeirmi, 1996). When the focus changes to satisfying long-term strategic project objectives (i.e., outcomes or project benefits), it becomes critical to achieving consistently successful projects (Alsudiri et al., 2013; Cooke-Davies, 2002). Project management success and project success are often misunderstood. As explained by Munns and Bjeirmi (1996), a successful project can be accomplished almost without successful project management, although successful project management can indeed help to achieve the project objectives. In other words, "good project management can contribute towards project success but is unlikely to be able to prevent project failure" (De Wit, 1988, p. 165). Consequently, this research postulates that:

H7: *Project management success impacts positively on project success.*

3.4.5 The moderating effect of requirements uncertainty and project complexity

In the contingent project management literature, characteristics such as project uncertainty (Nidumolu, 1995) and project complexity (Tyssen, Wald, & Heidenreich, 2014) have been identified as contextual variables that moderate project performance. Requirements uncertainty, in particular, reflects the extent of changes that occur in the project requirements and the degree to which project stakeholder requirements differ from each other in the requirements to be met (Jiang et al., 2009; J. Liu et al., 2011). Whereas project complexity pertains to the arrangement of elements and subsystems into the whole project, and the changing relationships between components in the project and between the project and its context over time (Brady & Davies, 2014).

It is much more challenging to create value through the lifecycle of a project where there is a high level of requirement uncertainty and project complexity than when the levels of those variables are low. Where there is a high level of uncertainty and complexity, collaborative client-contractor relationships support effective project delivery and are thereby conducive to maximising project performance (Eriksson & Westerberg, 2011; Pesämaa et al., 2009; M. Rahman & Kumaraswamy, 2005). In contrast, for small, straightforward and routine projects which have low levels of requirement uncertainty (Eriksson & Westerberg, 2011) and complexity, the need for close collaboration between stakeholders is less imperative. These types of projects are characterised by a clear definition of the requirements and of the relationships between parties, both of which are usually included in the contract. The contract then serves as a basis for planning and coordinating the project and for controlling the outputs without the need for close and continuous interaction between the parties. Based on the satisficing principle (Simon, 1956), decision-makers select the first option that meets a given need or the option that seems to address most needs rather than the 'optimal' solution. Ultimately, as Ning and Ling (2015) point out when the project context becomes complex or uncertain, a stronger demand arises for collaborative project partnership adaptation. Consequently, value creation based on relational engagement, collaboration and innovating are essential for adding value for the stakeholders, as well as for efficient delivery of projects with high complexity and uncertainty (Caldwell et al., 2009; Hartmann et al., 2014; A. Liu, Fellows, & Chan, 2014; Nord, 2012). Therefore, this research hypothesises that:

H8: *Requirements uncertainty and project complexity moderate the effect of the value creation processes on project value.*

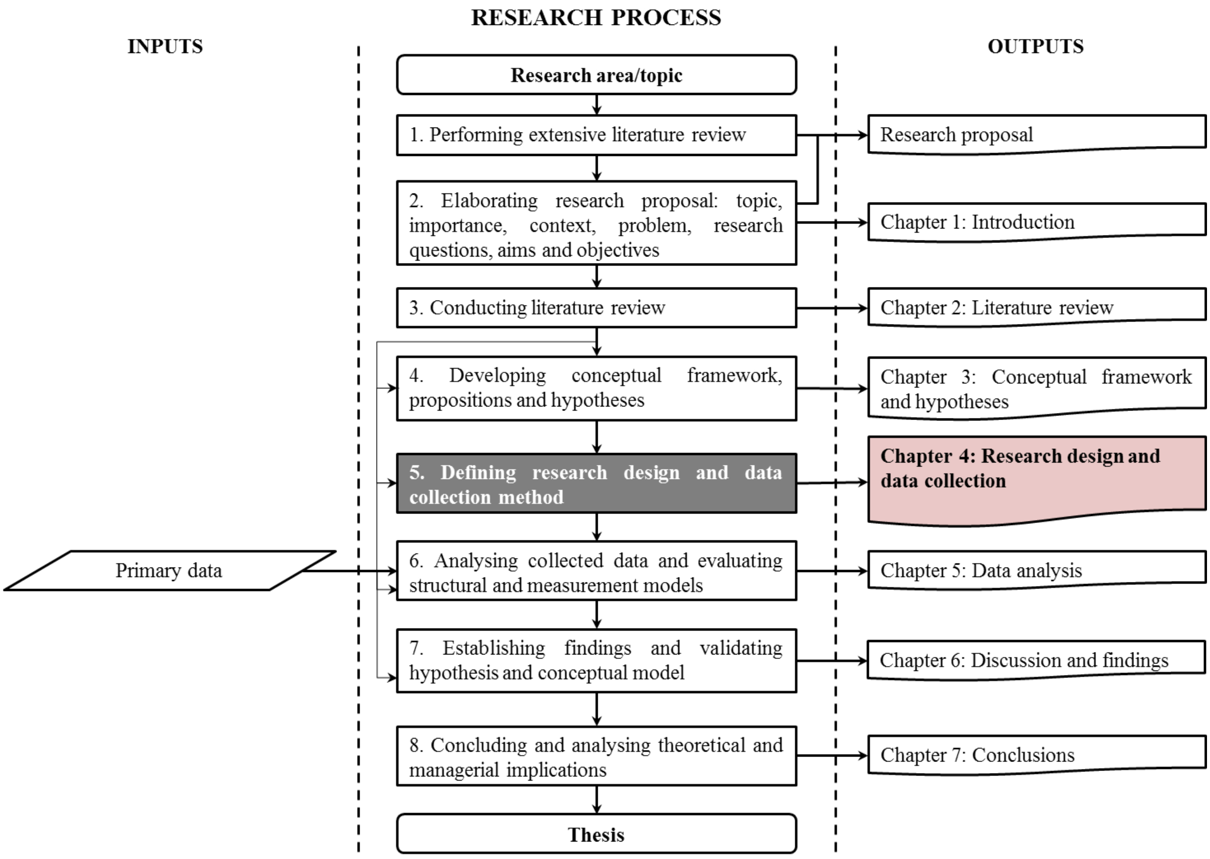
3.5 Summary

This chapter shows the proposed contingent model for value creation in projects and explains the three components of this model (i.e., contextual, managerial and performance variables). Requirements uncertainty and project complexity are two relevant contextual variables for project management used to establish four types of projects, namely, certain simple, uncertain simple, certain complex, and uncertain complex. A conceptual model that includes seven main hypotheses that examine the relationships between value creation processes (i.e., independent and co-creation) and project value is also developed. The chapter concludes by presenting an additional hypothesis that considers the moderating effect of requirements uncertainty and project complexity on the relationship between value creation processes and project value.

Chapter 4: RESEARCH DESIGN AND DATA COLLECTION

Introduction

- Research process
- Research design
- Data collection method
- Time horizon of research design
- Research design elements
- Data analysis method
- Summary



4.1 Introduction

This chapter describes the research design, data collection, and data analysis techniques employed in this research, beginning with a description of the research process undertaken in this study (Section 4.2), followed by a definition of the research design (Section 4.3), and the justification for selecting the appropriate method for data collection (Section 4.4). A discussion of the sampling frame (Section 4.5) and the structured questionnaire survey, including definitions and details of its implementation process, is then presented (Section 4.6). The last section (4.7) highlights the method of data analysis.

4.2 Research process

Empirical research is the predominant mode to social sciences that represents a systematic and rigorous approach to building or verify theory "based on real-world observations or experiment" (Flynn, Sakakibara, Schroeder, Bates, & Flynn, 1990, p. 251). As Babbie (2010) states, the two essential pillars of social science are logic and observation. These two components are related to three major aspects of sciences, namely theory, data collection, and data analysis. Theory links with the logical aspect to provide rational explanations of the world, data collection with observations and, data analysis with patterns in those observations to compare among the logically expected and the observed (Babbie, 2010).

In general terms, there are three approaches proposed for theory development in scientific research: (1) deductive, (2) inductive, and (3) abductive (Saunders, Lewis, & Thornhill, 2016). The deductive approach starts with a theoretical foundation based on the extant academic literature, followed by data collection and analysis to evaluate propositions and hypotheses related to that theory. Conversely, the inductive approach starts by gathering and analysing data to explore the phenomenon, followed by generating a theory in the form of a conceptual framework. The abductive approach consists of collecting data to study a phenomenon, identifying themes and explaining patterns, thereby creating a new theory or modifying an existing one, which is then finally tested through additional data collection and analysis (Saunders et al., 2016).

Although deductive and inductive approaches are traditionally considered to be opposite, there is no rigid separation between them other than a difference in flow, wherein the deductive approach moves from theory to data, as opposed to the inductive approach which proceeds from data to theory. The abductive approach combines the characteristics of deduction and induction (Saunders et al., 2016). According to Saunders et al. (2016), either deduction, induction or abduction become dominant as a result of the emphasis on the research and the nature of the research topic. Deduction is more appropriate when there is a wealth of literature about the research topic that can support a conceptual framework and define the hypotheses. Induction is best suited for a relatively new research topic with little supportive literature, which makes it reasonable to express conceptual themes from data collection and analysis. Abduction is suggested when the existing literature does not fully cover the research topic.

As discussed in previous chapters, the project management context has the benefit of theoretically rich literature with regard to the relationship between value creation processes (i.e., independent creation and co-creation) and project value. Accordingly, this PhD research adopts a deductive approach for evaluating the theory. In addition, this study is time-limited, the thesis completion is risky, and the audience (i.e., project managers) are “familiar and more likely to put faith in the conclusions emanating from this approach” (Saunders et al., 2016, p. 149). Therefore, a deductive approach forms the basis of the research process.

Adapted from the systematic empirical research proposed by Flynn et al. (1990), the research process for this study has four main steps: theoretical foundation; research design, data collection method and implementation; data analysis and results; discussion and conclusion. Figure 4.1 provides an overview of the process used in this thesis.

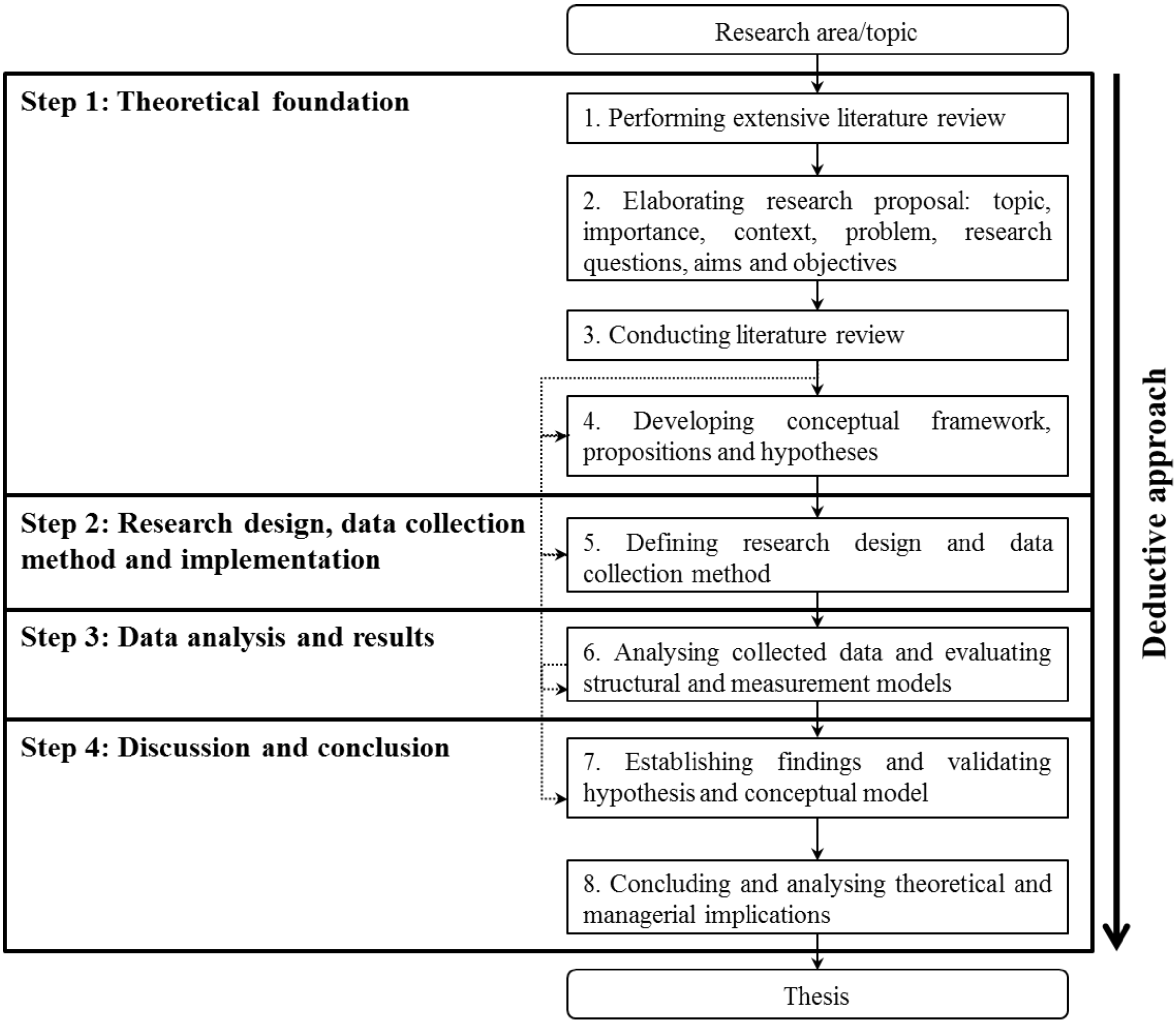


Figure 4.1: The research process

The first step incorporates a comprehensive review of the extant literature and includes insights from transaction cost economics (TCE) theory, relational-based view theories, and contingency theory in project management research, with the purpose of establishing a conceptual framework and formulating hypotheses. The second step focuses on designing and implementing the research approach in order to answer the research questions. This step also includes the selection of data analysis techniques. The third step implements the data analysis to demonstrate the reliability and validity of constructs and to evaluate the conceptual model. The last step provides validation of the proposed hypotheses, conclusions, relevant findings, and theoretical and managerial implications for future research.

4.3 Research design

As explained by Anderson (2010, p. 343), the research design is the plan where the researcher provides "the underlying structure to integrate all elements of quantitative (or qualitative or both) study so that the results are credible, free from bias, and maximally generalisable."

Saunders et al. (2016) establish that quantitative research is commonly associated with deduction mainly when data is used for testing theory. In contrast, qualitative research design is commonly performed by applying an inductive approach, when the focus is on developing theories. In this induction process, the aim is to generate richer theory based on gathered data. Nevertheless, the qualitative approach can also be applied to theory testing (Yin, 2013). Finally, a mixed methods research, which combines quantitative and qualitative research, can be conducted by using deduction, induction or abduction. For example, quantitative or qualitative research can work for testing theoretical propositions, followed by further quantitative or qualitative research for building a better theoretical understanding (Saunders et al., 2016).

The chosen research design establishes how the research question(s) will be answered (Dainty, 2008; Saunders et al., 2016). Research can be categorised into two broad types, experimental and non-experimental. Experimental design is powerful for inferring causal relationships (Anderson, 2010). However, conducting experiments requires the ability to control experimental subjects, which is not always practical. For example, it is not realistic to 'control' how project stakeholders collaborate in order to infer the effect of stakeholder collaboration on project outcomes. Instead, it is more realistic to adopt non-experimental designs which accepts what happens with the project as they are and infers relationships between constructs based on observations (Anderson, 2010). Without the ability to manipulate values of constructs, the ability of the latter to infer causal relationships is limited.

There are different research strategies for each type of research design. These strategies serve as a methodological link between the research philosophy and the choice of methods for collecting and analysing data (Saunders et al., 2016). The following review helps to define the research strategies and justifies the choice of the strategy for use in this study.

4.3.1 Experimental research

An experiment is a mode of observation where researchers attempt to prove causal relationships between variables under controlled conditions (Babbie, 2010). The purpose of this type of research is to investigate the probability of a change in an independent variable causing a change in another, dependent variable (Saunders et al., 2016). An experiment is normally performed in a laboratory rather than in the field (Saunders et al., 2016); however, social researchers are increasingly using the World Wide Web as an effective vehicle for conducting experiments (Babbie, 2010). Experimental research takes place in a setting particularly created for the investigation of a phenomenon, where the researcher has control over the independent variable(s) and subsequent measurement of the impact of the manipulation on the dependent variable(s) (Boudreau, Gefen, & Straub, 2001).

According to Saunders et al. (2016, p. 181), a consequence of using laboratory-based experiments is that generalising the findings "to all organisations is likely to be lower for a field-(organisation-) based experiment". Additionally, laboratory-based experiments often improve internal validity, but they make it more difficult to establish external validity. Although field experiments can obtain more realistic results than laboratory settings, they are performed in a natural environment where researchers have only limited or no control over experimental parameters, and thus reduced validity to establish causality (Flynn et al., 1990).

Preparing an experimental setting in which to examine the unexpected effects between project delivery model's value creation processes and project value is very costly and unrealistic. Additionally, the complexities involved in the management of projects and client-contractor relationships require a real-life investigation rather than an experiment, for which reason experimental research was not selected for this study.

4.3.2 Non-experimental research

As opposed to experimental studies, non-experimental research does not allow the researcher to manipulate independent variables or to control the causal effects of other confounding variables (i.e., those that can potentially undermine the inferences drawn between the independent and dependent variables) (Boudreau et al., 2001). Case study and survey are two common research strategies in non-experimental studies (Flynn et al., 1990).

4.3.2.1 Case study

Case study is defined as "an empirical inquiry that investigates a contemporary phenomenon (the case) in depth and within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident" (Yin, 2013, p. 13). Case study advantages include the opportunity to combine different types of data collection methods, such as archives and documents, interviews, questionnaires, and observations; and, the possibility of acquiring qualitative, quantitative, or both types of evidence (Eisenhardt, 1989b). In addition, Yin (2013) classifies four types of case study research strategies. Type 1, a single-case (holistic) design, represents a critical, unusual, common, revelatory, or longitudinal purpose. Type 2, a single-case (embedded) design, incorporates some subunits of analysis in the same case. Type 3 consists of a multiple-case (holistic) design, and type 4 incorporates a multiple-case (embedded) design.

Although case study research has been available extensively for over 50 years, it is criticised with regard to the difficulty of generalising the findings to different contexts (Flynn et al., 1990), and the related lack of robust and theoretical contributions to knowledge (Saunders et al., 2016). Nevertheless, case study provides depth, high conceptual validity, a good understanding of context, process, and causal relationships about the phenomenon; and fosters the proposal of new hypotheses and new research questions (Flyvbjerg, 2011).

The characteristics of case studies indicate that in the context of this research, it would not be easy to generalise the findings on project value creation processes and the corresponding influence on project value through a case study, which would also be too costly and time-consuming. In addition, large sample size would be necessary to represent the whole population in order to validate the findings for similar types of projects and to answer the proposed research questions. For these reasons, case study has not been selected for this research.

4.3.2.2 Survey

The survey is the most commonly used research strategy in the social sciences (Babbie, 2010; Flynn et al., 1990), and particularly in business and management research (Saunders et al., 2016), including construction management research (Dainty, 2008). Survey strategy is specifically referred to as a deductive approach used for exploratory and descriptive research (Saunders et al., 2016). The survey uses a sample of respondents for gathering original data to infer information about the population in a cost-effective way for a short period of time (Babbie, 2010). It also provides answers to research questions about what, who, where, how much, and how many (Saunders et al., 2016; Yin, 2013).

Using survey is advantageous when the purpose of the research is to delineate "the incidence or prevalence of a phenomenon or when it is to be predictive of certain outcomes" (Yin, 2013, p. 6). In other words, when the focus of the research is to generalise findings to an entire population, a survey of a broad cross-section is the appropriate approach (Flynn et al., 1990). The researcher has control over the research process when applying the survey strategy. In fact, if the sample is representative of the population through careful design and pilot testing of the data collection method, and ensures an acceptable response rate, the research findings can be statistically validated for the whole population (Saunders et al., 2016). Despite these advantages, survey research strategy has some limitations, such as systematic bias, non-response rate, a social desirability response and missing data (Babbie, 2010; Flynn et al., 1990).

In view of these advantages and limitations, this study adopts a survey strategy. The purpose is to investigate the contingent effects of value creation processes on project value. Survey research is suitable for a quantitative (deductive) approach, and the outcomes can be generalised by testing the hypothesis. Threats to validity associated with the survey research design are presented in detail in the instrument implementation section (4.6.2).

4.4 Data collection method

Once the survey research strategy is selected, the next step is to identify the most appropriate data collection method for the research design and the cost-time limitations of this PhD research. Accordingly, brief descriptions of each representative data collection technique, as well as the justification for choosing a questionnaire as the data collection method, are presented as follows.

4.4.1 Archival and documentary research

Archival and documentary research is based on the analysis of available historical and archival information from different categories of documents such as communications, individual records, organisational and government sources, and media sources (Saunders et al., 2016). The documents used for investigating are often applied as secondary data (Saunders et al., 2016). The historical archive data analysis method is often used with a single or multiple case study research design, but is sometimes also applied in combination with survey or panel study (Flynn et al., 1990), with the rationale of triangulating aggregate collected data to ensure the reliability of the data (Saunders et al., 2016).

In this thesis, the archival and documentary research data collection method was not adopted because of either detailed archival and documentary data about the history of relationships between client and contractors, nor the outcomes in projects in Chile were available to the public.

4.4.2 Participant observation

Participant observation is another type of data collection method where the researcher takes part in the activities of the research subjects and becomes a member of the team, organisation or community (Saunders et al., 2016). This participation can be categorised into four types, namely complete participant, complete observer, observer-as-participant, and participant-as-observer. The choice of one of these categories basically depends on the research questions. Participant observation is convenient for social research where the research question is related to exploring the dynamics of situations (Saunders et al., 2016). Participant observation is also very useful for theory development and hypothesis formulation (Flynn et al., 1990); consequently, it is suitable for qualitative (inductive) research (Babbie, 2010) that uses either the case study or panel study research strategy (Flynn et al., 1990).

Since this study adopts survey to gather data; participant observation is not a convenience choice.

4.4.3 Interviews

Saunders et al. (2016, p. 388) define the research interview as a "purposeful conversation between two or more people requiring the interviewer to establish rapport, to ask concise and unambiguous questions and to listen attentively". The interview is one of the most frequently applied techniques in engineering and construction management research case studies (Dainty, 2008). There are three basic types of interviews – structured, semi-structured, and unstructured or in-depth – that differ in levels of formality and structure (Saunders et al., 2016). For structured interviews (or quantitative research interviews) the researcher uses a script based on a set of specified questions that are asked as written and each response is recorded on a pre-code. In contrast, semi-structured and in-depth interviews are non-standardised. In semi-structured interviews, the researcher uses a list of possible questions and related themes that can be either omitted or added to if necessary, depending on the course of the conversation, to assure satisfactory data collection. The responses are recorded by audio recordings and note taking. The third type of interview, unstructured or in-depth, uses an informal process wherein the researcher works from his or her clear and thorough understanding of the topic, without relying on a list of predefined questions. Audio recording and note taking are also necessary for this type of interview process.

Interviewing is a preferred technique for qualitative (inductive) research where complicated research subjects require deep analysis to clarify questions or the terminologies used (Babbie, 2010). This face-to-face conversation method can generate more confidence for the researcher with regard to response rate, response bias and missing values in the data collected (Saunders et al., 2016). In addition, interviews are also effective to confirm that the interviewee fully understands the context of the questions; that allows the researcher to refine the questions if it is necessary to do so to elicit the deepest answer(s) (Babbie, 2010).

Despite the benefits from the flexibility and applicability of this method in social science research, there are also disadvantages, mainly associated with semi-structured and in-depth interviews, beginning with higher costs and longer time requirements than those relating to other techniques. For example, persuading individuals to agree to be interviewed can sometimes be difficult; and detailed transcriptions are necessary for coding and finding patterns in the data to develop or to test the hypotheses (Flynn et al., 1990). Secondly, the interview is a very good choice used in case study research strategy to apply where there are a limited number of cases and individuals. Owing to these disadvantages and the use of survey, the interview is not an appropriate option for this study.

4.4.4 Questionnaires

Flynn et al. (1990, p. 259) identify the questionnaire as “the most common method used in survey research” that represents a favoured data collection technique in business and management research (Saunders et al., 2016), as well as engineering and construction project management (Dainty, 2008). Saunders et al. (2016) defines questionnaires as a data collection technique consisting of a predetermined instrument specifically designed to obtain original data, to which all respondents answer the same set of ordered and predefined questions; such as the self-completed questionnaire (e.g., online, postal, delivery and collection), and the interviewer-completed questionnaire (e.g., telephone, face-to-face) (Babbie, 2010).

Self-completed questionnaires represent the cheaper and quicker option because the researcher does not necessarily have to be present at the site (Babbie, 2010), and are therefore a recommended choice when the research has a limited schedule and budget (Saunders et al., 2016). For instance, the time and cost of collecting data from geographically dispersed samples can be drastically reduced by using self-administered questionnaires, particularly online-based, that can capture and automatically save the data without the possibility of increasing method bias that arises in cases that transfer data by hand (Saunders et al., 2016).

A self-administered questionnaire is the preferred choice of data collection method for this study. In the first place, questionnaires are strongly linked to survey research strategies and quantitative (deductive) research design. Second, survey questionnaires represent the most appropriate method to cross-national studies like this one (i.e., data gathered from project managers in Chile). Third, there is a solid body of knowledge about value creation processes that provides sophisticated definitions and validated measures of key constructs. Finally, this method addresses the restrictions in time and cost relevant to this doctoral research.

4.5 Time horizon of the research design

As highlighted by Babbie (2010), there are two options to the on-time dimension of the research approach – cross-sectional studies and longitudinal studies. The cross-sectional study investigates a particular phenomenon in a single point of time, whereas the longitudinal study investigates changes and developments that occur over a period of time (Saunders et al., 2016).

According to Babbie (2010), longitudinal studies usually include participant observations and in-depth interviews and are related to qualitative research more than to quantitative study. For example, it is more difficult to accomplish longitudinal studies for quantitative research such as large-scale surveys (Babbie, 2010) because of the considerable demands related to time and financial resources. For this reason, cross-sectional studies are often employed, with a survey research strategy, to describe the significance of a phenomenon or to explain the impact exerted by related factors (Saunders et al., 2016). As stated by Rindfleisch, Malter, Ganesan, and Moorman (2008, p. 276), a cross-sectional study is suitable when the researcher needs to "examine concrete, and externally oriented constructs, sample highly educated respondents, employ a diverse array of measurement formats and scales" and remain "strongly rooted in theory." A cross-sectional study is also the best option for data collection from a large and geographically dispersed group of subjects (O'Sullivan, Rassel, & Berner, 2008).

Since a longitudinal study that uses a large number of samples of projects demands resources and time far beyond those available for this PhD research, a cross-sectional study is a practical and realistic choice.

4.6 Other research design considerations

The Chilean engineering and construction industries are selected as the research case to survey for three reasons: (1) According to the World Economic Forum (2015) in the Global Competitiveness Report 2015-2016, Chile is the top Latin American performer (35th of 140 countries), and its stage of development is transitioning from an efficiency-driven to an innovation-driven economy. (2) Over the last decades, social and economic developments have led to Chile becoming the country with the highest GDP per capita in Latin America; and the first South American member of the Organisation for Economic Co-operation and Development (OECD, 2016). (3) Chile is the home country of this author who has a close connection with local industries, so factors of convenience and familiarity provide two more reasons for choosing the Chilean engineering and construction industries as the survey target (Yin, 2013).

Units of analysis in previous project management literature are diverse (Artto et al., 2011). For example, a project as the business entity is considered the unit of analysis when the research is about the management of a project. When the research is concerned with the management of a project-based firm, the unit of analysis changes to the firm or a portfolio of projects. For research relating to the management of a project network and business network, a suitable unit of analysis is then a network of companies and their relationships. Similarly, for other selected engineering and construction project management studies, the unit of analysis can be the transaction, the project, the supply chain and the network or the embedded relationships (Bygballe et al., 2013). Ultimately, projects, recognised as a collection of economic transactions and social interactions, are a preferred unit of analysis in project management research (some examples are Kolltveit, Karlsen, and Grønhaug (2007); Miranda and Kavan (2005); Turner and Keegan (2001); Winch (2001)). In accordance with the research purpose of this investigation, 'completed project' is the unit of analysis.

4.6.1 Description of participants

4.6.1.1 Sampling procedure

Sampling refers to the process of selecting a subgroup or a part of a larger population for data collection in order to answer the research questions and achieve the research objectives (Saunders et al., 2016). Sampling methods are categorised into two main types, probability (or representative) sampling and non-probability sampling. According to Saunders et al. (2016, p. 275), probability sampling refers to the method which "the chance, or probability, of each case being selected from the target population, is known and is usually equal for all cases". In contrast, non-probability sampling refers to the unknown probability of each case. The former type is related to surveys or experiments where the research objectives are addressed statistically, and the characteristics of the population are inferred from the sample. The later type pertains to case studies where it is not possible to make those statistical inferences (Saunders et al., 2016).

This study applies a probability sampling by following the four stages of procedure suggested by Saunders et al. (2016), delineated as (1) identifying sampling frame (2) deciding on sample size (3) choosing the sampling technique and the sample and (4) checking what the sample is representative of in the target population.

First, the sampling frame consists of the entire list of elements of a target population from which a sample is selected (Babbie, 2010). In this case, for gathering data on completed projects, project managers were considered to be the best-informed participants from whom to select a sample. Project managers take on leadership roles that are critical to the success of a project, such as transferring knowledge and information, making decisions, formulating strategy and planning and controlling (Alsudiri et al., 2013; Eweje et al., 2012; Sakka et al., 2016); in addition, their work focuses mostly on project delivery and outcome.

Second, to establish a suitable sample, this study contacted one globally recognised association in project management, i.e., the Project Management Institute (PMI®) in Chile. PMI® is a professional membership organisation that disseminates and develops project management discipline through professional certifications, global standards, academic research, training and education (PMI, 2016). Many of the activities of this organisation take place in chapters located in more than 80 countries, and it maintains almost 500,000 active members and volunteers. The database from PMI® Antofagasta Potential Chapter that provides personal details about its members was used to distribute the questionnaire via Email. From that databank, 362 project managers were selected as the target sample for sampling.

As recommended by Dillman, Smyth, and Christian (2014), the minimum sample size for this study was determined by the following formula:

$$n = \frac{(z^2 * p\% * q\%)}{e\%^2} \qquad \text{[Equation 4.1]}$$

Where, n is the minimum sample size required; $p\%$ is the proportion belonging to the specified category (in this case, project manager); $q\%$ is the percentage not belonging to the specified category (i.e., $q\% = 1 – p\%$); z is the z-score or critical value for the desired level of confidence; and, $e\%$ is the required margin of sampling error.

According to Saunders et al. (2016, p. 280), researchers commonly “work to a 95 percent level of certainty”, a value which is also appropriate in management research. Given that the sampling frame contains accurate and complete information on project managers, this study applies a margin of error of 5% (i.e., 95% level of confidence) and 90% and 10% for belonging and not belonging to the specified category, respectively. As a result, the minimum desired sample size for this research consists of 139 returns.

The next step is to select the adequate sampling technique for collecting a representative sample, from two basic technique choices – simple random and systematic random (Babbie, 2010). Simple random sampling is the selection of units to comprise a sampling frame by randomly using computers or random number tables. The systematic random technique involves the selection of units at regular intervals, from a target population where the first unit is typically chosen randomly (Babbie, 2010). Additionally, there are three other techniques which represent a modification or a multistage application of the previous methods, that can also apply. As developed by Saunders et al. (2016), stratified random sampling represents a simple random where the sampling frame is divided into two or more categories according to one or more attributes. Cluster sampling is similar to stratified random but requires the target population to be split into distinct clusters before sampling. Multistage sampling is applied when the complexity of constructing an accurate and complete sampling frame requires carrying out one or more stages of sampling that also include random sampling.

Following the recommendations found in Saunders et al. (2016), this study uses a simple random sampling technique, as appropriate when there is an accurate, readily available sampling frame in electronic format (as described previously); and equally appropriate with a data collection method that consisted of a web-based questionnaire for a geographically dispersed area.

Finally, the selected sample must be representative of the target population. Calculating the representativeness of the samples involves checking the statistically significant difference in the responses between proportions of respondents to questions sufficiently broad to maintain confidentiality, for example, questions about age, the level of education, designation or job title, and years of experience (Saunders et al., 2016). Additionally, for assessing the possibility of a related bias (known as nonresponse bias), it facilitates a comparison of data from early and late respondents, as suggested by Armstrong and Overton (1977). In this research, however, the calculation of sample representativeness shows no significant difference among groups of respondents; therefore, non-response bias is not a major issue (see details in Section 4.6.4.2).

4.6.1.2 Research design requirements

In this investigation, a self-administered questionnaire is used to gather data for analysis (as justified in Section 4.4.4). The design of the questionnaire depends on how the questionnaire will be delivered, returned or collected, and the characteristics of the respondents (Saunders et al., 2016). The target population consists of individuals (i.e., project managers) with access to the Internet, who are often contacted by Email; the sample size was large (i.e., 139 observations as a minimum) and geographically dispersed (i.e., cross-national study); and the respondents' answers had to remain uncontained or unchanged to increase the reliability of the data. For these reasons, the best design form for this study is a web-based questionnaire, as opposed to a postal, telephone, or face-to-face option.

The questionnaire is “a document containing questions and other types of items designed to solicit information appropriate for analysis” (Babbie, 2010, p. 256), where the items are defined prior to data collection (Saunders et al., 2016). In empirical research such as this study, the theory constitutes the foundation for designing the questionnaire (i.e., for defining the relevant questions) in order to achieve the research objectives. In other words, the questionnaire is designed to develop or to test a set of variables (i.e., concepts or constructs) and their relationships (i.e., hypotheses) that comprise a resulting theory (Flynn et al., 1990). Accordingly, as presented in previous chapters, the basis for the construction of the questionnaire used in this research includes a detailed literature review (see Chapter 2) and hypothesised conceptual framework (see Chapter 3) about value creation processes and their effects on project value under uncertain and complex project contexts (explained in detail in Section 4.6.1.3).

Another important consideration is construct measurement. Measurement is defined as the process for quantifying a variable accurately through following a group of rules (Hair, Hult, Ringle, & Sarstedt, 2016). In some cases, these rules are easy to define and standardise (e.g., for variables such as age or gender); but for other variables that are not directly observable, known as latent variables or constructs (such as satisfaction or collaboration), the rules can be complex, abstract and not so obvious. As Netemeyer, Bearden, and Sharma (2003) point out, latent (unobservable) variables require multiple items or indicators (such as scale or index) in order to make an objective assessment. Scaling indicates that the (reflective) measurements are reflected on the latent variable, whereas indexing demonstrates that the (formative) measurements entirely mould or form the latent variable. This research evaluates all of the first-order constructs through multiple reflective indicators (see Section 4.6.1.3); this improves the accuracy of the measured constructs, the capture of all of their different attributes, and reduces measurement error (Hair et al., 2016). Furthermore, given that this study conceptualises the latent variables of interest and related theories based on an extant literature review, the multi-item scales are adapted from previous empirical investigations (Netemeyer et al., 2003).

Finally, this study utilises a six-point Likert scale, for four main reasons. First, the Likert scale is suitable when a researcher needs to obtain a defined position on certain issues from the respondents (Flynn et al., 1990). Second, it has better scale reliability and validity than other scales with higher scale points (Dillman et al., 2014). Third, it is one of the most common coding styles used in business and management research, along with five-point and seven-point scales (Saunders et al., 2016). Fourth and final, a Likert scale provides a symmetrical and equidistant measure to assess variables, which represents a critical issue in the application of multivariate analysis (Hair et al., 2016), an essential characteristic of this PhD research.

4.6.1.3 Questionnaire construction

The self-administered questionnaire is organised into five sections. Section one contains five questions about specific attributes of the latest finished project that the respondent worked on or participated in; and attributes such as the type of project, total planned budget, total planned duration, people involved and time pressure. The project type was a nominal scale composed of engineering and construction; information system and technology; business processes or organisational or administrative change; new product development or manufacturing; service, maintenance or equipment/system installation; and research and development. The total planned budget was an ordinal variable defined as either less than AU$1 million, between AU$1 and AU$9.9 million, between AU$10 and AU$99.9 million, between AU$100 and AU$999.9 and more than AU$1000 million. Similarly, the order for total planned duration was either less than six months, between 6 and 12 months, between 13 and 24 months, between 25 and 36 months, between 37 and 48 months, and more than 48 months. Another measurement of project size was the number of people involved, an ordinal scale composed of less than 20, between 20 and 99, between 100 and 249, between

250 and 499, between 500 and 999, and more than 1000. Finally, the perceived time pressure, adapted from Nepal, Park, and Son (2006), was an ordinal variable characterised by one of these four choices – not at all, normal, high, and very high/critical.

Section two, the longest section, includes statements related to the PDM's value creation processes. Specifically for governance strategies, Conceptual Agreements (CA) was used as a first-order latent variable measured by five indicators. Three relevant items (i.e., the contract as governed by the client-contractor relationship; the contract as contained obligations and rights; and contractor operations that do not require contractual reference) are adopted from Y. Liu et al. (2009), and two items (i.e., contingencies included in the contract and the resolution of conflicts through the contract) from Z. Zhang et al. (2009). Relational Engagement (RE) is a second-order formative construct shaped by the Quality of Interactions (QI) and Relational Norms (RN). Two indicators to measure QI (i.e., interactions that produced novel insights and interactions that displayed a sound strategic understanding) are derived from Grayson and Ambler (1999), and one indicator (i.e., partners' proactive role in the interaction) is taken from Ranjan and Read (2014). RN referred to as the degree of reciprocal values between the client and the contractor, is operationalised through five indicators proposed by Suprapto, Bakker, Mooi, et al. (2015) (i.e., honesty; enthusiasm for achieving project objectives; reliability and trust; best effort; and a no-blame culture).

Considering the degree of interaction, Coordination (CO) is defined as a first-order construct composed of and measured by seven items. Two items, as presented in E. Wang and Wei (2007), relate to work activities that fit well together, and routines that are well defined. Another item, from Georges and Eggert (2003), pertains to whether or not decisions are well coordinated; another item measures whether the parties linked together to achieve project objectives; and yet another item, adapted from Hammervoll (2012) evaluates the quality of the exchanged technical information. The two last items, taken from Fang et al.

(2008), assess whether or not the information that was shared between parties was proper and frequent, and whether it included changes during the project.

Collaboration (CL) is a second-order formative construct formed by Strategic Information Exchange (SIE), Collaborative Work (CW), and Joint Problem-Solving (JPS). In accordance with Cheung et al. (2010), SIE is operationalised by four items (i.e., shared information on successful and unsuccessful experiences; user's needs and behaviours; organisations' strategies and policies; and, financial performance and organisational know-how). CW is measured through three indicators proposed by Fang et al. (2008), i.e., parties working together in a project tailored to common needs; exploiting unique opportunities, and looking for new ways to do business jointly. Lastly, JPS is quantified by four indicators, two of which are adapted from E. Wang and Wei (2007) (finding proper solutions, and suggestions from clients). Another item, the prompt sharing of information to solve problems that arise, was proposed by Cheung et al. (2010). The last indicator is a new item concerned with reducing risks and sharing gains and pains.

For the management foci, two first-order constructs are defined: Monitoring & Controlling (MC) and Innovating (IN). MC was assessed by five items from Kirsch, Ko, and Haney (2010) (i.e., using several sources of objective data; engaging in frequent discussions about the project progress; time monitoring and controlling; budget monitoring and controlling; and client requirement monitoring and controlling). MC also includes two new questions to measure – whether project tasks were efficiently monitored and controlled, and whether the contractor applied mechanisms for the identification and resolution of project issues. IN is operationalised by five indicators from Svetlik et al. (2007) that involve how the parties tried out new ideas, looked for new ways of doing things, were creative in their operating methods and took risks, and whether innovation was resisted across the project.

The third section encompasses two first-order latent variables to evaluate the project context: Requirements Uncertainty (RU) and Project Complexity (PC). RU is measured through six items proposed by J. Liu et al. (2011) and Jiang et al. (2009) that reflect the instability and diversity of project requirements. PC is shaped by four indicators adopted from Tyssen et al. (2014) and four from Suprapto, Bakker, and Mooi (2015) that evaluate the degree of structural and dynamic complexity (Brady & Davies, 2014) in the project.

All indicators included in Section 2 and 3 of the questionnaire are ordinal closed-ended questions rated on a six-point Likert bipolar scale (1=Fully disagree, 2=Disagree, 3=Partially disagree, 4=Partially agree, 5=Agree and 6=Fully agree). The questionnaire also includes the option designated as “unsure or don’t know”. As Saunders et al. (2016, p. 458) point out, “this inclusion of a neutral point allows the respondent to ‘sit on the fence’ by ticking in the middle ‘not sure’ category when considering an implicitly negative statement”.

Section 4 includes 18 items to evaluate project value (PV). All indicators are taken from Shenhar and Dvir (2007). PV is defined by two high-order constructs, Project Management Success (PMS) and Project Success (PSU). PMS comprises Project Efficiency (PE) and Impact on the Client (IC). PE is measured by three indicators related to the ‘triple constraint’ criterion (i.e., on budget, on time and in scope). IC is evaluated by five indicators associated with project quality, namely, performance improvement, client satisfaction, meeting client requirements, product/service use, and coming back for future work. PSU covers Organisational and Business Success (OS) and Preparing for the Future (PF). OS is quantified by four items – economic business success, profitability, return on investment and direct organisation performance. PF includes six indicators related to future benefits from the project, such as contribution to future projects; additional new products or services; generation of new markets; development of new technologies; application of new business processes; and improvements in managerial capabilities.

In contrast with previous indicators presented in Section 2 and 3, all items in this section are rated on a seven-point Likert unipolar scale (from 1=Not at all to 7=To a great extent). Although these questions are also ordinal variables, the change of scale represents an attempt to eliminate or minimise the method variance error by using procedural remedies, in agreement with the suggestions of Podsakoff, MacKenzie, Lee, and Podsakoff (2003). Thus, this research methodologically separates the measures of the predictor variables (i.e., PDM's value creation processes) and a criterion variable (i.e., project value). Table 4.1 shows a summary of the latent variables, indicators, and sources that were used in this study.

Table 4.1: Summary of research constructs and indicators

Constructs and indicators	Source
Contractual Agreements (CA): first-order latent variable	
CA1. The client-contractor relationship was primarily governed by written contracts.	(Y. Liu et al., 2009)
CA2. The client and the project contractor made contractual agreements where they detailed both parties' rights and obligations.	
CA3. During the project, the project contractor completed tasks for the client that did not have to be expressed contractually or formally. *(Reverse coded)*	
CA4. Each party considered the contingencies that might emerge in the future at best and provided an exhaustive explanation in the contract.	(Z. Zhang et al., 2009)
CA5. The client and the project contractor permanently referred to the contract to resolve disputes and conflicts between them during the project.	
Relational Engagement (RE): second-order latent variable	
Quality of Interactions (QI): first-order latent variable	
QI1. The interactions between both parties produced novel insights.	(Grayson & Ambler, 1999)
QI2. Both parties displayed a sound strategic understanding of each other in their interactions.	
QI3. Both parties played a proactive role during the interaction.	(Ranjan & Read, 2014)
Relational Norms (RN): first-order latent variable	
RN1. Both parties were intentionally open and honest in their interactions.	(Suprapto, Bakker, Mooi, et al., 2015)
RN2. Both parties were enthusiastic in achieving the project objectives.	
RN3. Both parties felt confident that the other party was reliable and trustworthy.	
RN4. Both parties believed the other party provide its best efforts.	
RN5. Both parties adopted a 'no blame culture' whenever problems arose.	
Coordination (CO):first-order latent variable	
CO1. The different job and work activities between the project contractor and the client fit together very well.	(E. Wang & Wei, 2007)
CO2. The routines between the project contractor and the client were well established during the project.	
CO3. The decisions were well coordinated between both parties.	(Georges & Eggert, 2003)
CO4. Both parties linked together to achieve the project objectives.	(New item)
CO5. Both parties provided the technical information needed by the other.	(Hammervoll, 2012)
CO6. Proprietary technical information was exchanged between both parties frequently.	(Fang et al., 2008)
CO7. Both parties were expected to keep the other party informed of changes that could affect the project.	

Table 4.1: Summary of research constructs and indicators (continued)

Constructs and indicators	**Source**
Collaboration (CL): second-order latent variable	
Strategic Information Exchange (SIE): first-order latent variable	
SIE1. Both parties shared information on successful and unsuccessful experiences with deliverables that were exchanged in the relationship.	(Cheung et al., 2010)
SIE2. Both parties exchanged information related to changes in the users' needs, preferences, and behaviour.	
SIE3. Both parties exchanged sensitive information, such as financial performance and organisational know-how.	
SIE4. Both parties exchanged information that is sensitive to them, such as financial performance and organisational know-how.	
Collaborative Work (CW): first-order latent variable	
CW1. Both parties worked effectively on a joint project tailored to joint needs.	(Fang et al., 2008)
CW2. Both parties worked together effectively to exploit unique opportunities.	
CW3. Both parties were always looking for synergistic ways to do business together.	
Joint Problem Solving (JPS): first-order latent variable	
JPS1. When conflicts arose, both parties found a proper solution jointly.	(E. Wang & Wei, 2007)
JPS2. When the project contractor's performance did not match the client's expectation, the client helped or provided suggestions.	
JPS3. Both parties exchanged information as soon as any unexpected problems arise.	(Cheung et al., 2010)
JPS4. Both parties worked closely to reduce risks, sharing gains and pains throughout the project.	(New item)
Monitoring & Controlling (MC): first-order latent variable	
MC1. The project contractor had several sources of objective data that indicated how well the project was meeting the goals.	(Kirsch et al., 2010)
MC2. The project contractor frequently discussed progress toward the project objectives with the client.	
MC3. The project contractor monitored and controlled whether the project (or deliverable) was completed on time.	
MC4. The project contractor monitored and controlled whether the project (or deliverable) was completed within budget.	
MC5. The project contractor monitored and controlled whether the project (or deliverable) was satisfying the client's requirements.	
MC6. The project contractor monitored and controlled whether the project tasks were being performed efficiently.	(New items)
MC7. The project contractor applied mechanisms for the identification and resolution of project issues requiring corrective actions	
Innovating (IN): first-order latent variable	
IN1. Both parties collaboratively and frequently tried out new ideas for the project.	(Svetlik et al., 2007)
IN2. Both parties collaboratively and frequently sought new ways of doing things for the project.	
IN3. During the project, both parties were creative in operating methods.	
IN4. During the project, both parties put much value on taking risks even when failure was a possibility.	
IN5. During the project, innovation was perceived by any party as too risky and was resisted. (*Reverse coded)*	
Requirements Uncertainty (RU):first-order latent variable	
RU1. Project requirements fluctuated quite a bit in later phases. *(Reverse coded)*	(Jiang et al., 2009); (J. Liu et al., 2011)
RU2. Project requirements identified at the beginning were quite different from those at the end.	

Table 4.1: Summary of research constructs and indicators (continued)

Constructs and indicators	Source
RU3. Project requirements are expected to fluctuate quite a bit in the future. *(Reverse coded)* RU4. Users/stakeholders of the project often differed between themselves in the requirements to be met. RU5. Much effort had to be spent in reconciling the requirements of various users/stakeholders of the project. RU6. It was difficult to customise the project output to one set of users/stakeholders without reducing support to other users/stakeholders.	(Jiang et al., 2009); (J. Liu et al., 2011)
Project Complexity (PC): first-order latent variable	
PC1. The project had a high degree of task novelty. PC2. The project had a high degree of complexity concerning content. PC3. The project had a high degree of complexity concerning interdisciplinary participants and specialities. PC4. The project was characterised by high risk and uncertainty.	(Tyssen et al., 2014)
PC5. The country's regulations and politics were challenging. PC6. The market situation (e.g. exchange rate) was highly unstable. PC7. The project site (location) was challenging or difficult to access. PC8. The pressure from external stakeholders was high.	(Suprapto, Bakker, & Mooi, 2015)
Project Value (PV)	
Project Management Success (PMS): second-order latent variable	
Project Efficiency (PE): first-order latent variable	
PE1. The project was completed within or below budget. PE2. The project was completed on time or earlier. PE3. The project had minor changes.	(Shenhar & Dvir, 2007)
Impact on the Client (IC): first-order latent variable	
IC1. The product (or deliverable) improved the client's performance. IC2. The client was satisfied. IC3. The product (or deliverable) met the client's requirements. IC4. The client is using the product (or deliverable). IC5. The client came/will come back for future work.	(Shenhar & Dvir, 2007)
Project Success (PSU): second-order latent variable	
Organisational and Business Success (OS): first-order latent variable	
OS1. The project was an economic business success for the contractor. OS2. The project increased the contractor's profitability. OS3. The project has a positive return on investment. OS4. The project contributed to the contractor's direct performance.	(Shenhar & Dvir, 2007)
Preparing for the Future (PF): first-order latent variable	
PF1. The project outcome contributed/will contribute to future projects. PF2. The project led/will lead to additional new products. PF3. The project helped/will help to create new markets. PF4. The project created new technologies for future use. PF5. The project contributed to new business processes/models. PF6. The project developed better managerial capabilities.	(Shenhar & Dvir, 2007)
Project Size (PS): first-order latent variable – control variable	
PS1. What size was the project, in terms of the total planned budget (in millions of AU$)? PS2. What size was the project, in terms of the total planned duration (in months)? PS3. What size was the project, in terms of the number of people involved?	

In Section 5, there are four questions that provided information about respondents. Two enquiries were nominal variables (i.e., designation/job title and highest level of education), and the other two were ordinal variables (i.e., age and years of experience in projects).

The last section of the questionnaire evoked general comments from the respondents. The questionnaire is presented entirely in Appendix B.

4.6.2 Reliability and validity of the instrument

In simple words, a questionnaire is reliable when the construct indicators can replicate the same results consistently, and it is valid when the indicators provide to be true measures of the concepts they were intended to measure (Flynn et al., 1990). As "reliability is a necessary condition of validity" (Hair et al., 2016, p. 108), both must be addressed by the questions (i.e., indicators or items) in the questionnaire. One recognised way to ensure the inclusion of reliable and valid questions is to systematically consider the four stages proposed by Foddy (1993), as follows: (1) The researcher knows the data requirements and designs the question; (2) The respondent decodes the question as the researcher intended it to be decoded; (3) The respondent answers the question; (4) The researcher decodes the answer as the respondent intended it to be decoded. Several measurements have been established to assess this process, to determine the reliability and the validity of the questionnaire: internal consistency reliability; indicator reliability; content validity; criterion-related validity; construct validity; convergent validity; and discriminant validity (Saunders et al., 2016). Table 4.2 shows a summary and a brief description of these. Additionally, the scores of construct reliability and validity are presented as part of data analysis in Chapter 5.

Table 4.2: Reliability and validity measures

Measure	Criterion	Description	Score	Source
Internal consistency reliability	Cronbach's alpha (α)	Measures the coherence of the responses across a subgroup of the questions related to a particular concept that is measuring the correlations of the observed indicator variables.	α >0.7 Values must not be lower than 0.6	(Hair et al., 2016; Saunders et al., 2016)
	Composite reliability (CR)	In contrast with α, CR takes into account the different outer loadings of the indicator variables for each concept. It measures the degree to which the indicator variables load simultaneously when the construct increases.	CR >0.7 Values must not be lower than 0.6	(Hair et al., 2016; Urbach & Ahlemann, 2010)
Indicator reliability	Indicator loadings	Evaluates how much of the observed indicator variables variance is explained by the corresponding latent variable or construct.	Values significant at the 5% and >0.7	(Chin, 1998; Hair et al., 2016; Urbach & Ahlemann, 2010)
Content validity	Judgement by experts	Is a subjective measure to evaluate if the questions (i.e., indicator variables) provide adequate coverage of the research questions. Delphi method is a technique to assess content validity.	-	(Flynn et al., 1990; Saunders et al., 2016)
Criterion-related validity	Validity coefficient	Measures the capacity of the observed indicator variables to predict the latent variable accurately through correlations.	-	(Flynn et al., 1990; Saunders et al., 2016)
Construct validity	Unidimensionality (U)	Assesses whether the set of questions (indicator variables) are appropriate to evaluate the latent variables or construct. Factor analysis can be used to calculate the construct validity of the indicators.	Factors with Eigenvalue >1.0 U>0.6 (high) U<0.4 (low)	(Flynn et al., 1990; Saunders et al., 2016; Urbach & Ahlemann, 2010)
Convergent validity	Average variance extracted (AVE)	Estimates how much an observed indicator variable correlates positively with alternative indicator variables of the same latent variable. That is the amount of variance that the construct captures from its indicators about the amount due to measurement error.	AVE>0.5	(Chin, 1998; Hair et al., 2016; Urbach & Ahlemann, 2010)
Discriminant validity	Fornell-Larcker criterion	Refers to whether a latent variable is truly distinct from other latent variables into the model. In other words, if the construct is unique and captures phenomena not represented in other constructs included in the same theoretical framework.	The AVE of each construct must be higher than the construct's highest squared correlation with any other construct.	(Chin, 1998; Hair et al., 2016; Urbach & Ahlemann, 2010)

Given that the reliability and validity of the designed questionnaire are measured after data collection, the quality of the instrument depends mainly on the clarity of the questions, the structure, and the rigour of pilot testing (Saunders et al., 2016). In this research, the indicator variables are adapted from prior validated empirical studies maintaining the type, wording and length, as presented in the literature review (see Chapter 2) and previous Section 4.6.1.3.

Following sections focus on the translation procedure, pilot testing study and ethical considerations necessary for securing a reliable and valid data collection instrument.

4.6.2.1 Translation procedure

One of the most common issues in constructing a questionnaire is the possibility of translating the instrument into other languages to perform cross-national studies (Presser et al., 2004; Young & Javalgi, 2007). An appropriate procedure for translation is fundamental to ensure that the questions convey the same meaning for all respondents in different localities. Usunier (1998) indicates four approaches to translation; namely, direct translation, parallel translation, back-translation, and mixed techniques. Each approach has its own advantages and disadvantages. For example, even though the direct translation option is the easiest one to implement and the least expensive, it can lead to inconsistencies between the source and the target of the questionnaire. Similarly, parallel translation (i.e., two or more independent translations used to compare and create the final version) can result in proper wording, but cannot satisfactorily guarantee the lexical, idiomatic and experiential meanings. A back-translation approach that translates from the source questionnaire to the target questionnaire and back again to the source questionnaire requires two translators (one for each language), which can be a bit troublesome but can discover more inconsistency. Lastly, a mixed-techniques translation uses double parallel back-translation to generate two new target questionnaires for comparison. Although this process achieves a better match between the initial and the final questionnaires, it is a costly approach that implies the possibility of creating changes in the source questionnaire (Usunier, 1998).

This cross-national research considers a back-translation approach to ensure the equivalence between the questionnaires of origin (English) and target (Spanish). Thus, following the procedure proposed by Young and Javalgi (2007), an English version of the questionnaire was first developed, then translated into Spanish by one translator and translated back into English by another translator. The English back-translated questionnaire was compared to the original English version to check the clarity and specificity of each question. Finally, certain items in the Spanish version were re-worded to improve the accuracy of the translation. Appendix C shows the Spanish translated questionnaire.

4.6.2.2 Pilot testing

A carefully designed questionnaire must be pilot tested to ensure that gathered data can effectively address the research questions before delivering the questionnaire to the sampling frame (Saunders et al., 2016).

Following Bell (2014), a set of seven criteria are addressed during pilot testing including the time required to complete; the clarity of both instructions and questions; the omission of any major topic; the difficulty in answering; the clarity of survey layout; and general comments.

A group of volunteers were asked by Email to participate in this pilot study. In total, 33 invitations were sent out to two different groups of people, 15 for completion of the English version and 18 for the Spanish version. The participants included project managers, university professors and lecturers in project management, and PhD students in project management from the University of Sydney and other universities in different countries, e.g., Australia, United Kingdom, Indonesia, Iran, Thailand and New Zealand. A total of 23 completed questionnaire responses are received (11 from the English participants and 12 from the Spanish participants).

All 100% of participants selected ‘almost agree’ or ‘agree’ with the clarity of instructions; 83% found no unclear or ambiguous questions; and, more than 90% recognised the layout as adequate. Based on these results, comments were addressed, and minor modifications were made.

4.6.2.3 Ethical considerations

The final approval of the questionnaire and associated documents (i.e., a participant information statement, a participant consent form and guidelines) was ratified by the University of Sydney on September 29, 2015, with reference number 2015/759 (see human ethics approval letter in Appendix D)

4.6.3 Data collection procedure

A web-based, self-administered questionnaire was designed to collect data for this study. The data collection starts with the distribution of the questionnaire. To do so, the questionnaire and complementary information (i.e., participant information statement, participant consent form and guidelines) are transformed to *‘Google Web Forms’* and hosted in ‘*Google Drive’*, generating a hyperlink to the inquiry website. That procedure is followed by the first contact with potential respondents through an Emailed personalised invitation to complete the questionnaire, providing a detailed explanation of the research.

The potential respondent was asked to tick the consent form before answering the questionnaire, in order to present clear explanations of voluntary participation and the option to leave the survey at any time. Reminders were sent after one week and again after three weeks following the first message, as a means to complete data collection in six weeks (between November 4 and December 15, 2015) to correspond with the recommendations proposed by Saunders et al. (2016).

4.6.4 Data management

4.6.4.1 Respondents and the projects

Invitations were sent out to 362 project managers included in the sampling frame, 168 valid completed questionnaires were received (i.e., the sample size N=168). All the replies were saved automatically in *'Google Drive'*. Only the aggregate results from the data that was gathered are published. The participants are not individually identifiable in publications, ensuring their anonymity. The data will be destroyed after five years.

The achieved response rate is 46%, which represents a very good response rate for a Web-based survey (Saunders et al., 2016).

Tables 4.3 and 4.4 show the profiles of the participants and the surveyed projects. With regard to profile, the majority of the respondents (74.4%) are project top managers, and 54.2% have more than ten years of experience working on projects. Half of the respondents (50%) are more than 40 years old, and 85.7% possess a master degree, mainly in project management or business administration. All these characteristics of the participants support a feeling of confidence toward their significant knowledge of and extensive experience with management issues.

Table 4.3: Summary of respondent profiles

Profile items	Categories	Frequency	Percentage
Designation/job title	Project top managers (e.g., executive manager, senior manager, project director, contract manager)	125	74.4
	Project middle managers (e.g., project engineer, project planning and controlling manager, project technical manager)	43	25.6
Project experience (years)	Under 10	77	45.8
	Between 10 to 19	65	38.7
	Between 20 to 29	20	11.9
	Over 30	6	3.6
Age (years)	Under 30	6	3.6
	Between 30 and 39	78	46.4
	Between 40 and 49	55	32.7
	Between 50 and 59	26	15.5
	Over 60	3	1.8
Level of education	Bachelor/Professional	24	14.3
	Master degree	144	85.7

Table 4.4: Summary of project profiles

Profile items	Categories	Frequency	Percentage
Type of project	Engineering and construction	120	71.4
	Information systems and technology	23	13.7
	Service (consulting, financial, transport, retail, tourism, health, education)	9	5.3
	Business processes/organizational change/ administrative	7	4.2
	Maintenance / equipment or system installation	5	3.0
	Research and development (R&D)	3	1.8
	New product development/manufacturing	0	0.0
	Other	1	0.6
Total planned budget (millions of AU$)	Less than 1	26	15.5
	Between 1 and 9.9	59	35.1
	Between 10 and 99.9	44	26.2
	Between 100 and 999.9	17	10.1
	More than 1000	22	13.1
Total planned duration (in months)	Less than 6	16	9.5
	Between 6 and 12	67	39.9
	Between 13 and 24	50	29.8
	Between 25 and 36	16	9.5
	Between 37 and 48	7	4.2
	More than 48	12	7.1
People involved	Less than 20	28	16.7
	Between 20 and 99	59	35.1
	Between 100 and 249	35	20.8
	Between 250 and 499	18	10.7
	Between 500 and 999	6	3.6
	More than 1000	22	13.1
Perceived time pressure	Not at all	0	0.0
	Normal	48	28.6
	High	80	47.6
	Very high/critical	40	23.8

The majority of the completed projects surveyed are associated with engineering and construction (71.4%) and IT (13.7%). The planned budget varied with 50% exceeding AU$ 10 million. Similarly, nearly 70% of the projects surveyed have a planned duration of over six months and under two years. The respondents answered that the perceived time pressure in the projects was high and very high (or critical) in 71.4% of projects.

4.6.4.2 Non-response bias

As explained in Section 4.6.1.1, to rule out the possibility of non-response bias, this research adopts the approach recommended by Armstrong and Overton (1977), where the behaviour of late respondents can be considered similar to non-respondent behaviour because it is necessary to make a considerable effort to stimulate participation. The Mann-Whitney U-Test (Mann & Whitney, 1947) is then conducted to analyse the difference in means between the two respondent groups; in this case, the first third (i.e., early responses) and the last third (i.e., late responses) of the data by utilising *IBM SPSS Statistics 24*. Early responses were coded 1 (N=56), while late responses were coded 3 (N=56).

This research uses the Mann-Whitney U-Test for three main reasons highlighted by Nachar (2008). First, this test is non-parametric, which means that it does not depend on assumptions about the data distribution of the target population (i.e., data normality is not necessary). Second, it is one of the most powerful tests to determine statistically significant results to reject a false null hypothesis. Third, this test is commonly applied when the indicator variables are ordinal with a less accurate scale.

Table 4.5 exhibits the results of the U-Test to two ordinal variables – age and years of experience in projects – revealing non-significant differences (>0.05) among the means of early and late respondents. The results demonstrate that non-response bias is not an issue of concern in this study.

Table 4.5: Mann-Whitney U-Test results

Variable	Response date	N	Mean rank	Sum of ranks	T-Statistics[a]		
					U-Test	Z	Sig. (2-tailed)
Age	1	56	59.10	3309.50	1422.500	-0.906	0.365 *(n.s.)*
	3	56	53.90	3018.50			
	Total	112					
Project experience	1	56	56.62	3170.50	1561.500	-0.041	0.967 *(n.s.)*
	3	56	56.38	3157.50			
	Total	112					

Note: n.s. equal non-significant
[a]Grouping variable: response date.

4.7 Data analysis method

Following implementation of the data collection method, the next step is to select a suitable method to analyse the data collected. This section explains in detail the different statistical methods available to multivariate analysis and the reason for choosing partial least squares structural equation modelling (PLS-SEM) for this study.

4.7.1 Multivariate analysis

In social sciences research, there are two types of possible relationships between variables, namely bivariate and multivariate. According to Babbie (2010), the former is a mere association among two variables, while the latter represents the simultaneous relationships between multiple variables. In this research, an appropriate multivariate analysis is preferable because of the increased development in applying complex models with several variables and different types of relationships between them to obtain a better explanation of the reality (Hair et al., 2016).

Two generations of statistical techniques can be applied to multivariate analysis. First-generation techniques – such as cluster analysis, exploratory factor analysis and multidimensional scaling for exploratory research; and analysis of variance, multiple regression and confirmatory factor analysis for confirmatory studies – have been broadly used in the social sciences (Chin, 1998; Hair et al., 2016). As explained by Hair et al. (2016), confirmatory research is primarily geared toward testing the hypothesis of existing theories, whereas exploratory research is mainly related to predicting the relationships between variables when there is not much prior knowledge, or where it is necessary to improve existing concepts by using new approaches. On the other hand, structural equation modelling (SEM) represents the second-generation techniques also implemented in business and management disciplines to test and estimate causal relationships between multiple latent independent and dependent variables (Urbach & Ahlemann, 2010). SEM-based methods deal with two perspectives, one oriented to prediction, and another to the configuration of theoretical models where there are latent variables inferred indirectly from multiple observed items (indicators or manifest variables) (Chin, 1998).

The advantage of SEM over first-generation techniques stems from the "greater flexibility that the researcher has for the interplay of theory and data." (Chin, 1998, p. 296). Specifically, second-generation methods can improve three main limitations of first-generation methods by the factors described by Haenlein and Kaplan (2004): (1) the postulation of a simple model structure; (2) the assumption that all variables are observable; and (3) the supposition that all variables are measured without error. First, the relationship between one dependent and one independent variable (i.e., simple model structure) is unrealistic and can lead to relatively artificial and inconsequential findings (Haenlein & Kaplan, 2004). Moreover, first-generation methods can be unsuitable when researchers want to investigate complex models, for example, ones that include the mediating or moderating effects (Baron & Kenny, 1986). Second, Babbie (2010) defines observable variables as concepts that can be observed simply and directly, such as sex, colour, and height; while certain characteristics or attributes of concepts such as satisfaction, performance, or collaboration, are not directly observable; they require indirect observation in order to be measured. Consequently, first-generation methods can fail to analyse latent variables defined by manifest (i.e., observable) variables. Finally, the limitation of first-generation methods work in assuming that all variables in the model are quantified without error, is not applicable to reality because an observed score of a variable is always the sum of three parts: a true score of the variable, random error, and systematic error (Haenlein & Kaplan, 2004). Random error is usually generated by the sequence of questions included in a questionnaire or by respondent fatigue (Dillman et al., 2014). Systematic error (i.e., common method bias) refers to the variance that originates from the measurement method, rather than from the construct of interest (Podsakoff et al., 2003). All these factors discussed herein demonstrate that first-generation methods are inaccurate in this case.

SEM techniques improve over these limitations. SEM allows the researcher to investigate relationships between multiple independent (or exogenous) and dependent (or endogenous) constructs simultaneously (Chin, 1998; Hair et al., 2016). Additionally, as constructs (i.e., latent variables) are not directly measured, SEM enables the use of single or multiple observable and empirically measurable indicator variables (i.e., manifest variables or items) for estimating reflective or formative constructs (Hair et al., 2016; Urbach & Ahlemann, 2010). Finally, SEM includes error terms to represent the unexplained variance when the relationships among exogenous and endogenous latent variables are estimated (Chin, 1998; Haenlein & Kaplan, 2004; Hair et al., 2016). Therefore, this research implements SEM methods to analyse collected data for the purpose of achieving the research objectives.

4.7.2 Structural equation model (SEM) methods

A structural equation model (SEM) is formally defined by the combination of two sets of linear equations that support different sub-models: the measurement model and the structural model (Henseler, Hubona, & Ray, 2016; Urbach & Ahlemann, 2010). The measurement model (or outer model) establishes the relationship between a latent variable and its observed manifest variables, while the structural model (or inner model) specifies the relationships between latent variables (Henseler et al., 2016). A simple example of SEM is shown in Figure 4.2. This model contains one exogenous (ξ_i) and two endogenous variables (η_i). Several observed manifest variables (x_i and y_i) operationalise each latent variable. Path coefficients are all relationships between variables. Thus, there are path coefficients among exogenous and endogenous latent variables (γ_i), between endogenous latent variables (β_i); and among latent variables and their indicators (λ_i). The unexplained variance in the path coefficients estimation is represented by error terms. Error terms for each item are labelled ε_i in measurement models, while δ_i for endogenous constructs in the structural model.

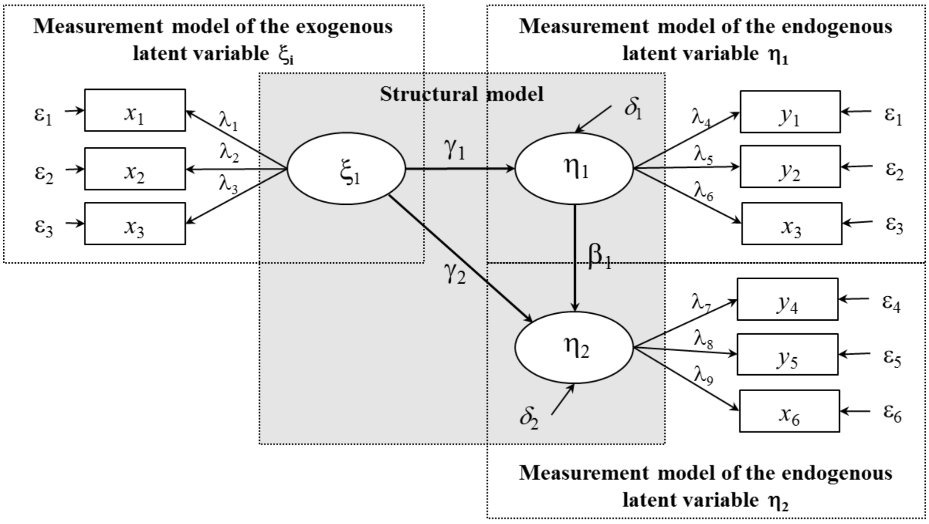


Figure 4.2: Example of a structural equation model

Within SEM, the relationships between variables are usually assumed as linear (Henseler et al., 2016). In a case where these relationships fit the data, the hypothesised model represents a causal structure that can be considered statistically significant (Urbach & Ahlemann, 2010). Justifiably, the determination of the size and significance of the path coefficients is the target of quantitative research based on empirical data (Henseler et al., 2016).

Scholars have defined two types of SEM: covariance-based SEM and variance-based SEM (also known as partial least squares, PLS-SEM) (Chin, 1998; Haenlein & Kaplan, 2004; Hair et al., 2016; Henseler et al., 2016; Urbach & Ahlemann, 2010). Thus, covariance-based SEM is used primarily to confirm or reject hypothesised relationships through an empirical covariance matrix (Hair et al., 2016) by "using a maximum likelihood function to minimise the difference between the sample covariance and those predicted by the theoretical model" (Chin, 1998, p. 297). In contrast, PLS-SEM is applied to estimate construct relationships, usually in exploratory studies where the theory is only slightly developed or needs improvement (Haenlein & Kaplan, 2004; Hair et al., 2016). This approach seeks to minimise the variance of all endogenous variables (both latent and manifest) instead of determining the covariation (Chin, 1998; Urbach & Ahlemann, 2010).

A comprehensible comparison between covariance-based SEM and PLS-SEM adapted from Urbach and Ahlemann (2010) is presented in Table 4.6.

Table 4.6: Comparison between SEM methods[a]

	Covariance-based SEM	**Variance-based SEM (PLS)**
Objective	Parameter-oriented	Prediction-oriented
Approach	Minimising the difference between the sample covariance	Minimising the variance of all endogenous variables
Assumption	Parametric (normal distribution and independent observations)	Nonparametric (non-normal distribution and predictor specification)
Parameter estimates	Consistent	Consistent as indicators and sample size increase (consistency at large)
Latent variable scores	Indeterminate	Explicitly estimated
Relationship modes between latent variables and its manifest variables	Typically only with reflective indicators	Can be modelled in either formative or relative mode
Implications	Optimal for parameter accuracy	Optimal for prediction accuracy
Model complexity	Small to moderate complexity	Large complexity (a large number of constructs and indicators)
Sample size	Ideally based on power analysis of the specific model. Minimal recommendations range from 200 to 800 observations.	Power analysis based on the portion of the model with the largest number of predictors. Minimal recommendations range from 30 to 100 observations
Type of optimisation	Globally iterative	Locally iterative
Significance tests	Available	Only using simulations (e.g., bootstrapping)
Availability of global Goodness of Fit (GoF) metrics	Available	Currently being developed and discussed

[a] Adapted from Urbach and Ahlemann (2010)

Chin (1998) denotes that PLS may be a valid alternative choice to estimate conceptual models rather than covariance-based methods when the researcher faces issues characterised by any of the following features:

- The research topic is relatively new, and measurement models need to be improved;
- The model is complex with a large number of latent and manifest variables;
- The model includes different modes of measuring latent variables (i.e., formative and reflective measurement models);
- The sample size is small, and the normal distribution is not met;

- Prediction is more relevant than the estimation of parameters (testing theory).

Contrary to this rationale, it is important to recognise some limitations of PLS-SEM that have been highlighted by several researchers such as Guide & Ketokivi, 2015; Rönkkö, McIntosh, Antonakis & Edwards, 2016; Sarstedt et al, 2016. For example, Rönkkö et al (2016) establish methodological problems of PLS-SEM related to inconsintent and biased estimation, capitalization of chance, problems in model testing and assessing measurement quality. They also discuss the certain to apply PLS-SEM to cases where there are non-normal data; small sample size; prediction or explanation; and, reflective and formative measurements. All those problems have generated a diminution of the reputation of the method. However, recent propositions as presented by Sarstedt et al (2016) show that PLS-SEM may be applied "practically no bias when estimating data from a composite model population, regardless of whether the measurement models are reflective or formative" (p. 4008); but they argue that future investigation should explore the interplay between measurement specifications, population type, and PLS's estimation modes.

In consequence, this exploratory study has a complex theoretical framework configured with high-order constructs, and a large number of indicators (see model developed in Section 3.4 and constructs in Table 4.1). The sample size (N=168) is relatively small, and the data distribution of some variables is non-normal (see details in Section 5.3.3). Moreover, the research objective is oriented more toward prediction than for confirmation of the theory. In view of these considerations, PLS-SEM approach was selected as the preferred method for performing the data analysis.

4.7.3 PLS-SEM in project management research

For supporting the decision of applying PLS-SEM in this research, a review of the motivation to use this approach in the project management field was realised. First, to ensure high quality of the literature, this review was focussed on peer-reviewed publications, specifically journal papers. The search criteria included three main parameters, namely the period of publication, key terms, and ranking criterion, were used in accessing Scopus and Web of Sciences databases. The term of publication for the review was since 2000 because the application of PLS-SEM in a project management context is relatively new. Search terms were defined a priori as “PLS OR partial least squares AND project management”. This review included academic articles from high-ranked journals within project management literature and other publications related to business and management discipline.

As evidenced, prior empirical studies in project management have progressively used the PLS-SEM approach since 2000, with greater frequency in the last six years. This research selected 108 publications which are summarised in Appendix E. More than 50% of these studies (exactly 55) are published directly in project management journals (i.e., International Journal of Project Management (IJPM), Project Management Journal (PMJ), International Journal of Project Organisation of Management and International Journal of Information Systems and Project Management (IJISPM)). This body of research was developed in different countries and project contexts, but particularly on the information system and technology (IS/IT) projects and engineering and construction projects, which represent 76.8% of the cases (see Tables E.1, E.2 and E.3 in Appendix E). The median of the sample size for these selected cases was 118 observations, while the total mean was 151.3. Finally, several motivations for the use of PLS-SEM in project management are highlighted. The most cited reasons are (1) small sample size (2) complex structural and measurements models (3) non-normal data (4) exploratory research. Table 4.7 shows a summary of these motivations.

Table 4.7: Motivations to choose PLS-SEM in project management research

Motivation	Frequency	%
Small sample size	58	27.4
Complex models: formative/reflective models, higher-order or hierarchical constructs, number of indicators (one or many) or mediating and moderating effects	56	26.4
Non-normal distribution data	38	17.9
Exploratory research: the theory is relatively new or in development	29	13.7
Explanation of all observed measure variance (prediction)	21	9.9
Reducing measurement error	5	2.4
Controlling multi-collinearity	3	1.4
Applied in previous studies	2	0.9
Total	**212**	**100.0**

4.7.5 Choosing a suitable software to apply PLS-SEM

Various software packages have been developed to perform statistical analysis using PLS-SEM. The review discussed in the previous section of 108 PLS-SEM studies in project management research indicates the prevalence of two tools as the ones used most often. *SmartPLS* (Ringle, Wende, & Becker, 2015) was applied to 53.4% of the studies, and *PLS-Graph* (Chin, 2001) in 32.3%. Other PLS path modelling software has been used as well, such as *LVPLS*, *PLS-GUI*, *VisualPLS* and *SPAD-PLS* (Temme, Kreis, & Hildebrandt, 2010), although the usage proportion is much lower. Considering that the popularity of PLS-SEM application has increased, certain packages to statistical programming environments like *R programming language* have been recently proposed such as *plspm* (Sanchez, 2013).

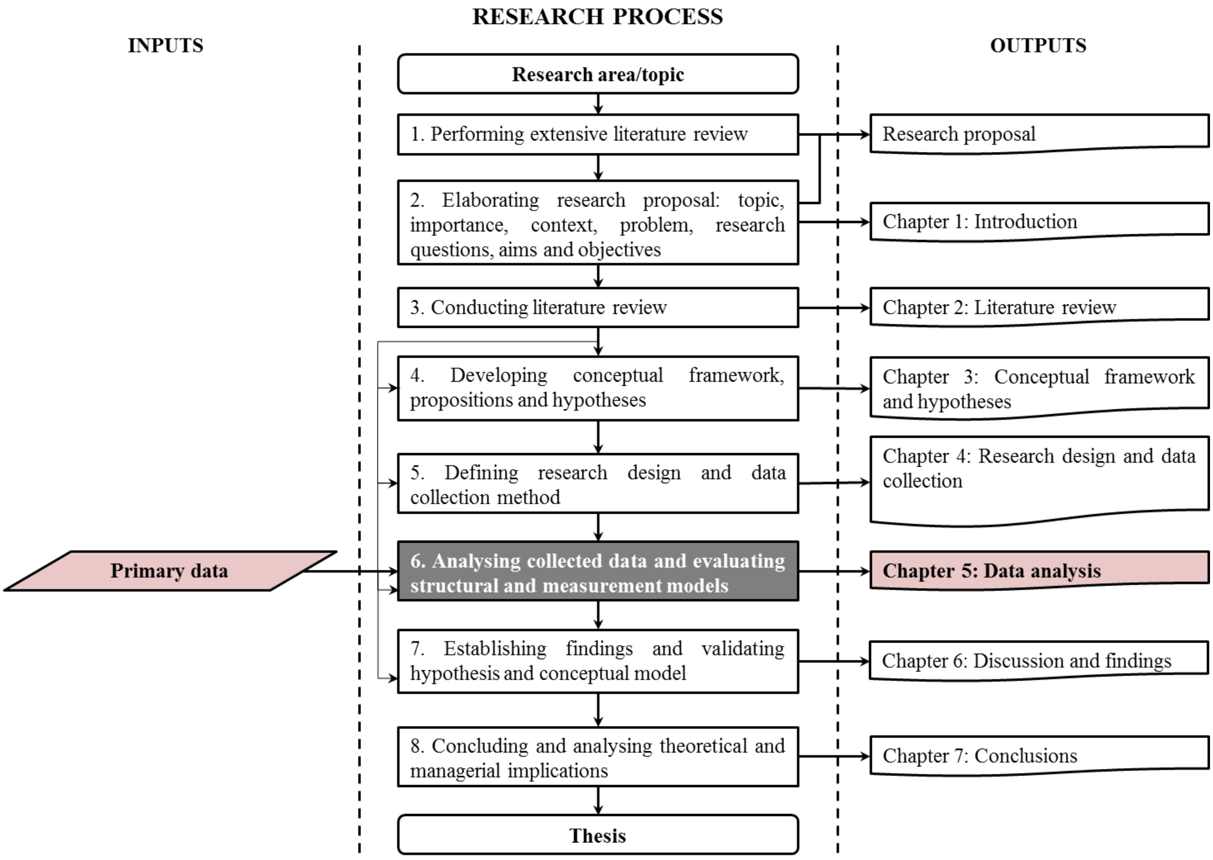
This PhD research chooses SmartPLS as the main tool to perform the data analysis for validating the proposed conceptual model. SmartPLS is selected because of its user-friendliness, mainly to support the estimation of interaction (i.e., moderating) effects and effective export options (Temme et al., 2010). It also offers an associated book (Hair et al., 2016) to help as a guide for employing systematic procedures to assess measurement and structural models through clear examples, which results in a much more reliable application. Moreover, it is undergoing constant improvements (the latest release is SmartPLS 3.2.6) that aggregate more testing tools and new features. As previously mentioned, there is widespread use of SmartPLS in project management literature.

4.8 Summary

This chapter describes the research design for this thesis. Based on a quantitative deductive approach, the research design consists of a survey strategy that includes a self-administered Web-based cross-sectional survey. The sample is composed of project management professionals in Chilean engineering and construction industries. This chapter also discusses the sampling procedure, questionnaire construction, reliability and validity measures of the instrument, and other important considerations such as translation, ethics approval and pilot testing. Finally, the data management is explained, and the data analysis method (i.e., PLS-SEM) justified.

Chapter 5: DATA ANALYSIS

- Introduction
- Defining the structural model
- Defining the measurement model
- Assessing the measurement models
- Assessing the structural model
- Moderation analysis
- Summary



5.1 Introduction

The previous chapter explains the choice of PLS-SEM as the preferred method to analyse the gathered data in this study. This chapter presents the definition of the PLS-SEM structural model and measurement models (Section 5.2), followed by a discussion of the main considerations connected with data preparation, such as missing values, outliers and data distribution (Section 5.3). The results of measurement models (Section 5.4) and structural model assessments (Section 5.5) are then submitted, with a moderation analysis of project context (i.e. requirements uncertainty and project complexity) on the relationship between value creation processes and project value (Section 5.6).

5.2 Defining structural and measurement models

Hair et al. (2016) have proposed one of the most recent and systematic guidelines for the application of the PLS-SEM approach. As explained in section 4.7.2, the first two stages of the application are related to specifying the structural model and its corresponding measurement models in PLS-SEM path modelling.

In SEM methods, the use of a structural model (also known as the inner model) establishes the relationships between latent variables (Henseler et al., 2016), to carefully define the two most important aspects that require identification – the sequence and the relationships between constructs (Hair et al., 2016). These aspects represent the hypotheses and the theory that will be tested. In contrast, the measurement models (also known as outer models) represent the relationship of each latent variable included in the structural model and its corresponding indicator variables (Hair et al., 2016).

Measurement models can incorporate two different approaches to demonstrate the causality between the construct and its indicators, known as reflective and formative measurements (Jarvis, MacKenzie, & Podsakoff, 2003). According to the critical review performed by Jarvis et al. (2003), a reflective model indicates that the direction of causality is from the construct to the measures, which is consequently where these measurements are expected to be correlated. In this case, if one indicator is dropped, there is no alteration in the meaning of the construct. Moreover, this principal factor model takes into account the measurement error at the indicator level; and according to its nature, item scores do not adequately represent the whole construct. Conversely, a formative model shows a direction of causality from the indicator to the construct, in which case there are no reasons to expect that the measures are correlated. The meaning of the construct can change when at least one of the indicators is retired. Additionally, this composite latent variable model includes measurement error at the construct level and consequently does not represent the whole construct as a reflective model. Figure 5.1 graphically demonstrates the difference between reflective and formative measurement models.

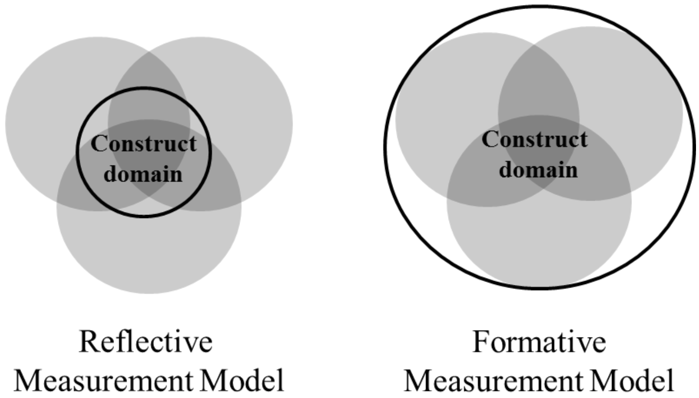


Figure 5.1: Simple representation of measurement models (Hair et al., 2016)

It is fundamental to establish whether construct indicators are reflective or formative in order to reduce measurement model misspecification. Jarvis et al. (2003) present evidence demonstrating that measurement misspecification generates bias in relationships estimates, thus seriously affecting the theoretical conclusions drawn from that model. This error is especially critical when a formative model is included or mistakenly seen as reflective. Consequently, Jarvis and his colleagues (2003) propose a set of decision-making rules to determine whether a construct is reflective or formative accurately. Table 5.1 shows a summary of the proposed criterion for this judgment.

Table 5.1: Criterion for defining formative or reflective constructs[a]

Criterion	Reflective model	Formative model
Direction of causality from construct to measure implied by the conceptual definition	From construct to items	From items to construct
Are the indicators (a) defining characteristics or (b) manifestations of the construct?	Manifestations	Characteristics
Would changes in the indicator cause variations in the construct or not?	No	Yes
Would changes in the construct cause variations in the indicators?	Yes	No
Interchangeability of the indicators	Indicators should be interchangeable	Indicators need not be interchangeable
Should the indicators have the same or similar content? Do the indicators share a common theme?	Yes	No
Would drop one of the indicators alter the conceptual domain of the construct?	No	Yes
Covariation among the indicators	Indicators are expected to covary with each other	Not necessary for indicators to covary with each other
Should a change in one of the indicators be associated with variations in the other indicators?	Yes	Not necessarily
Nomological net of the construct indicators	Should not differ	May differ
Are the indicators expected to have the same antecedents and consequences?	Yes	No

[a] Adapted from Jarvis et al. (2003)

PLS-SEM can be used with advanced and complex models, such as higher-order latent variables; accordingly, their lower-order constructs can also be included as reflective or formative measurement models. For example, a second-order construct is measured by a group of reflective or formative first-order constructs defined according to the level of theoretical abstraction used by the researcher (Becker, Klein, & Wetzels, 2012; Jarvis et al., 2003; Ringle, Sarstedt, & Straub, 2012). In PLS-SEM literature, four possible combinations have been recognised to measure second-order latent variables (Becker et al., 2012; Hair et al., 2016; Jarvis et al., 2003; Ringle et al., 2012). Type I is reflective first-order, reflective second-order model. Type II is reflective first-order, formative second-order model. Type III is formative first-order, reflective second-order model. Type IV is formative first-order, formative second-order model. Figure 5.2 illustrates these four types of measurement models, to provide a better understanding of higher-order constructs.

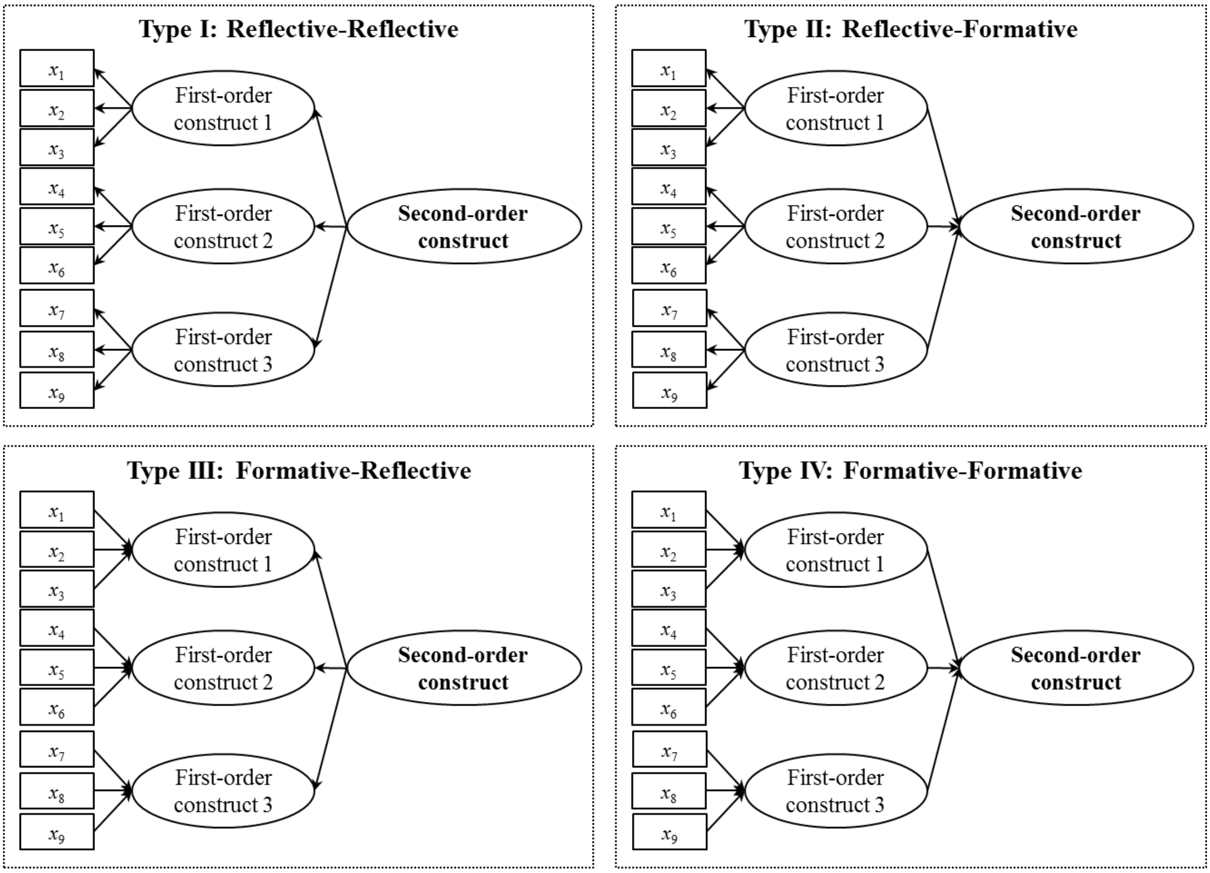


Figure 5.2: Types of second-order constructs

The selection of the appropriate type of high-order and lower-order constructs is "based on a priori established theoretical/conceptual considerations" (Hair et al., 2016, p. 282) along with the use of the guidelines detailed in Table 5.1.

As developed in the conceptual framework (see Figure 3.4) and the questionnaire construction (see Table 4.1), this study models the following constructs within the structural model: contractual agreements (CA), coordination (CO), monitoring & controlling (MC), relational engagement (RE), collaboration (CL), innovating (IN), project management success (PMS) and, project success (PSU). This proposed structural model includes higher-order latent variables to achieve parsimony and reduce model complexity according to the recommendations of Hair et al. (2016). Thus, RE is established as a second-order construct consisting of two reflective latent variables: quality of interactions (QI) and relational norms (RN). Similarly, strategic information exchange (SIE), collaborative work (CW) and joint problem solving (JPS) represent reflective first-order constructs for CL, also a second-order construct; and PMS and PSU are also modelled as second-order constructs. PMS is shaped by project efficiency (PE) and impact on the client (IC), whereas PSU is defined by organisational and business success (OS) and preparing for the future (PF). Thus, those four second-order latent variables (i.e., RE, CL, PMS and PSU) are all type I (reflective-reflective). All lower-order constructs are also assessed by reflective indicators. The detailed structural model and measurement models are presented in Figure 5.3.

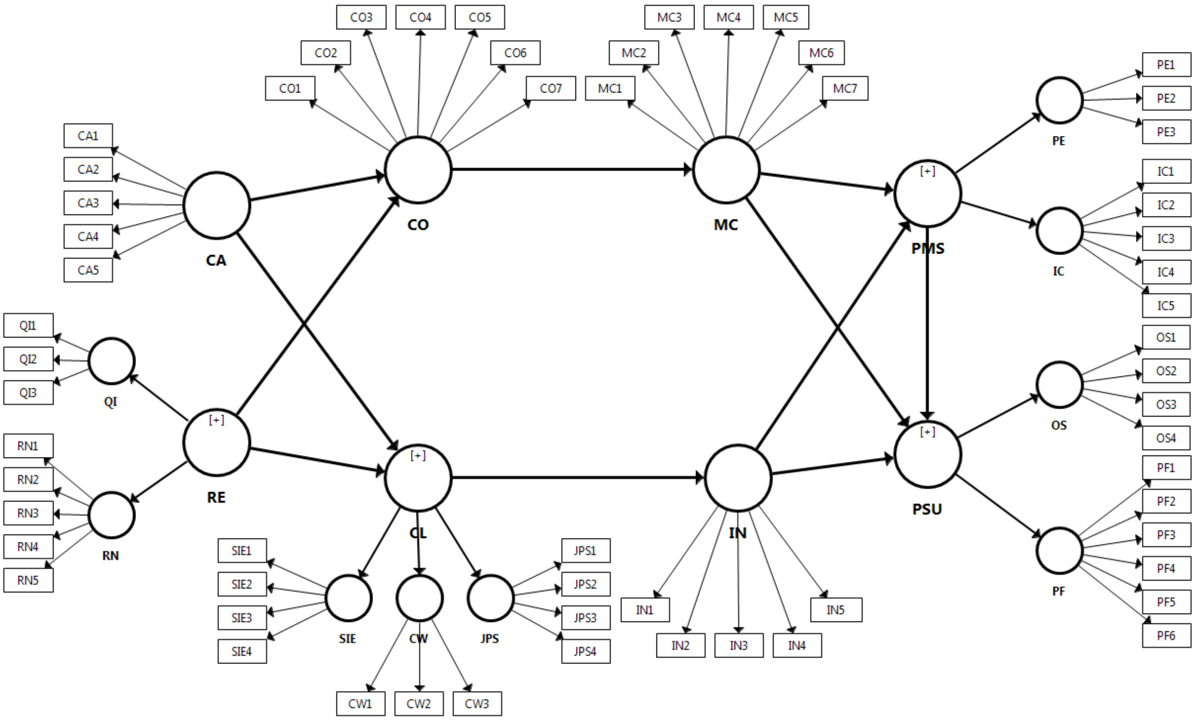


Figure 5.3: Initial structural and measurement models

5.3 Descriptive statistics and data preparation

Once the structural and measurement models are determined, the next stage is to examine the primary data collected through the questionnaire survey, which was automatically entered in a dataset, before performing the appropriate statistical analysis. Descriptive statistics for this dataset are produced using IBM SPSS 24; the scores are presented in Table 5.2.

Table 5.2: Descriptive statistics of variables included in this research

Variable	Item	N	Min.	Max.	Mean		Std. Deviation	Median	Variance	Skewness	Excess Kurtosis
					Statistic	Std. error					
CA	CA1	168	1	6	5.083	0.082	1.069	5.000	1.143	-1.150	1.097
	CA2	168	2	6	5.196	0.066	0.857	5.000	0.734	-0.969	0.674
	CA3	167	1	6	3.395	0.123	1.587	3.000	2.518	0.327	-1.201
	CA4	167	1	6	3.868	0.108	1.399	4.000	1.958	-0.323	-0.668
	CA5	166	1	6	4.464	0.100	1.292	5.000	1.668	-0.765	-0.124
CO	CO1	168	2	6	4.518	0.071	0.922	5.000	0.850	-0.517	0.253
	CO2	168	1	6	4.702	0.071	0.919	5.000	0.845	-0.870	1.490
	CO3	168	2	6	4.601	0.077	1.004	5.000	1.008	-0.821	0.562
	CO4	168	1	6	4.964	0.067	0.875	5.000	0.765	-1.180	2.802
	CO5	168	2	6	4.940	0.065	0.846	5.000	0.715	-0.548	0.108
	CO6	164	2	6	4.622	0.079	1.017	5.000	1.034	-0.709	0.341
	CO7	168	2	6	4.625	0.075	0.971	5.000	0.942	-0.497	-0.089
MC	MC1	167	1	6	4.665	0.073	0.948	5.000	0.899	-1.170	2.246
	MC2	168	1	6	5.071	0.069	0.900	5.000	0.809	-1.241	2.693
	MC3	168	2	6	5.042	0.073	0.950	5.000	0.902	-0.932	0.813
	MC4	168	1	6	5.089	0.072	0.934	5.000	0.872	-1.251	2.494
	MC5	168	2	6	4.851	0.076	0.983	5.000	0.966	-0.999	1.114
	MC6	168	1	6	4.661	0.084	1.082	5.000	1.172	-0.952	1.174
	MC7	168	2	6	4.661	0.080	1.043	5.000	1.088	-0.820	0.391
QI	QI1	168	2	6	4.339	0.085	1.099	4.000	1.208	-0.406	-0.313
	QI2	167	1	6	4.455	0.087	1.129	5.000	1.274	-0.562	-0.001
	QI3	168	1	6	4.649	0.078	1.010	5.000	1.020	-0.838	1.068
RN	RN1	168	1	6	4.631	0.085	1.103	5.000	1.216	-0.934	0.989
	RN2	168	1	6	5.161	0.068	0.878	5.000	0.770	-1.503	3.772
	RN3	168	1	6	4.673	0.087	1.129	5.000	1.275	-1.068	1.660
	RN4	168	1	6	4.571	0.081	1.047	5.000	1.097	-0.746	0.745
	RN5	167	1	6	4.078	0.104	1.349	4.000	1.819	-0.561	-0.333
CW	CW1	168	1	6	4.536	0.084	1.083	5.000	1.172	-0.766	0.562
	CW2	168	1	6	4.524	0.084	1.094	5.000	1.197	-0.769	0.535
	CW3	166	1	6	4.428	0.094	1.208	5.000	1.458	-0.769	0.299
JPS	JPS1	168	1	6	4.696	0.074	0.965	5.000	0.931	-1.137	2.262
	JPS2	167	1	6	4.647	0.087	1.120	5.000	1.254	-1.038	1.127
	JPS3	168	2	6	4.667	0.076	0.989	5.000	0.978	-0.604	0.232
	JPS4	165	1	6	4.212	0.089	1.147	4.000	1.314	-0.499	-0.099
SIE	SIE1	167	1	6	4.521	0.085	1.102	5.000	1.215	-0.709	0.258
	SIE2	165	1	6	4.497	0.085	1.091	5.000	1.191	-0.890	0.840
	SIE3	163	1	6	4.202	0.102	1.297	4.000	1.681	-0.556	-0.262
	SIE4	159	1	6	3.792	0.105	1.327	4.000	1.760	-0.286	-0.627
IN	IN1	167	1	6	4.377	0.089	1.144	5.000	1.309	-0.855	0.872
	IN2	166	1	6	4.470	0.081	1.048	5.000	1.099	-0.878	0.959
	IN3	165	1	6	4.376	0.088	1.128	4.000	1.273	-0.834	0.910
	IN4	168	1	6	3.655	0.098	1.267	4.000	1.605	-0.201	-0.710
	IN5	164	1	6	3.134	0.100	1.275	3.000	1.626	0.410	-0.490
PE	PE1	168	1	7	5.071	0.148	1.919	6.000	3.683	-0.957	-0.286
	PE2	168	1	7	4.446	0.154	1.999	5.000	3.997	-0.473	-1.035
	PE3	168	1	7	4.429	0.137	1.770	5.000	3.133	-0.304	-0.980
IC	IC1	168	1	7	5.476	0.121	1.571	6.000	2.466	-1.218	0.933
	IC2	168	1	7	5.690	0.115	1.496	6.000	2.239	-1.736	2.880
	IC3	168	1	7	5.946	0.100	1.301	6.000	1.692	-1.734	2.904
	IC4	168	1	7	6.232	0.109	1.418	7.000	2.012	-2.419	5.611
	IC5	168	1	7	5.696	0.113	1.467	6.000	2.153	-1.349	1.372
OS	OS1	168	1	7	5.458	0.129	1.674	6.000	2.801	-1.397	1.278
	OS2	168	1	7	5.339	0.128	1.655	6.000	2.740	-1.284	1.041
	OS3	168	1	7	5.625	0.110	1.430	6.000	2.044	-1.580	2.594
	OS4	168	1	7	5.530	0.113	1.468	6.000	2.155	-1.467	1.992

Table 5.2: Descriptive statistics of variables included in this research (continued)

Variable	Item	N	Min.	Max.	Mean Statistic	Mean Std. error	Std. Deviation	Median	Variance	Skewness	Kurtosis
PF	PF1	168	1	7	6.006	0.091	1.176	6.000	1.383	-1.777	3.766
	PF2	168	1	7	4.994	0.139	1.806	6.000	3.263	-0.873	-0.238
	PF3	168	1	7	4.429	0.161	2.084	5.000	4.342	-0.448	-1.089
	PF4	168	1	7	3.940	0.159	2.067	4.000	4.272	-0.084	-1.423
	PF5	168	1	7	4.262	0.152	1.971	5.000	3.883	-0.385	-1.137
	PF6	168	1	7	4.714	0.136	1.765	5.000	3.115	-0.608	-0.587

Descriptive scores provide information concerning the distribution of continuous variables. For example, the mean and median values for the majority of variables are not close, which implies that the distribution of these variables is not symmetrical. Moreover, skewness values remote from zero indicate an asymmetrical distribution and kurtosis values below zero show that distributions are relatively flat; in other words, there are too many cases in the extremes. Thus, skewness and kurtosis scores demonstrate that many variables in this research have a non-normal distribution. Normality assessment is presented in Section 5.3.3. Other issues related to data, such as missing data and detection of outliers, are previously examined.

5.3.1 Missing data

Missing data issues are common in social science research when a respondent "either purposely or inadvertently fails to answer one or more questions" (Hair et al., 2016, p. 56). There are four specific reasons for missing data in questionnaire surveys, as identified by Saunders et al. (2016): (1) The data were not required from the respondent. (2) The respondent refused to answer the question (i.e. non-response). (3) The respondent did not know the answer or did not give an opinion. (4) The respondent missed responding to the question by mistake, or his/her response was not clear.

In consideration of the advantages of self-administered questionnaires as described in Section 4.4.4, the web-based questionnaire for this study was carefully designed with the intention of reducing the possibility of missing data. For this reason, the questionnaire does not include filter questions to skip sections. All the respondents are obligated to answer every question because each item is labelled as obligatory, and the respondent cannot progress to a new survey section until all the questions are answered. In addition, the questionnaire includes a ‘not sure/not know’ answer to address any potential issues related to unclear questions or to the refusal to answer.

Missing values represented a low value per indicator. The worst case showed only one indicator (SIE4) with 5.4% missing values, and most of the items had less than 2%. Hence, missing values in this investigation are adequately addressed through the mean value replacement recommended by Hair et al. (2016). Likewise, there is no major issue regarding possible bias, as demonstrated by Mann-Whitney U-Test results presented in Section 4.6.4.2.

5.3.2 Outliers

Outliers are defined as part of the collected data that “differ totally from all the other observations and they can influence results substantially” (Sarstedt & Mooi, 2014, p. 93). Of the several methods that can be used to detect extreme values in the dataset, univariate and bivariate graphs and statistics are commonly applied (Sarstedt & Mooi, 2014). Histograms, boxplots, stem-and-leaf plots, and scatter plots are examples of tools for this detection.

IBM SPSS 24 was used for drawing box plots and identifying outliers in each indicator variable (i.e. univariate outlier detection analysis). The analysis demonstrates the existence of extreme outliers. Nevertheless, because all of the variables were ordinal scales from 1=fully disagree to 6=fully agree, unusual erroneous scores did not arise. As expressed by Hair et al. (2016), high or low values are exceptionally part of the reality, then there are no reasons to believe that these values are wrong. This research retains all the defined outliers from the analysis, in line with the instructions in Sarstedt and Mooi (2014). Subsequently applying IBM SPSS 24, scatter plots were also used to establish the presence of outliers between each construct relationship specified in the structural model (i.e. bivariate detection analysis). In this case, “observations that fall markedly outside the range of the other observations will show as isolated points in the scatterplot” (Sarstedt & Mooi, 2014, p. 95). Thus, a few outliers for specific paths were removed, as shown in Table 5.3. This decision was made after evaluating the influence of the results by comparing them between, before, and after deletion. The results were not substantially affected.

Table 5.3: Outliers and corresponding path

Removed observation	Path in the structural model
65	IN –» PMS; IN –» PSU
111	CA –» CO; CA –» CL; MC –» PMS; MC –» PSU
158	IN –» PMS; IN –» PSU

5.3.3 Data distribution

As previously mentioned in Section 4.7.2, PLS-SEM is a nonparametric method that seeks to minimise the variance of all endogenous variables (Urbach & Ahlemann, 2010). Consequently, the method does not require the normal distribution of data, as in the case of covariance-based SEM method (Hair et al., 2016). Nonetheless, it is necessary to check the data to validate that they are either not close to normal (to be sure that data are non-normal) or are extremely non-normal (to avoid inflating standard errors of the parameter significances) (Hair et al., 2016). As a result, statistical methods have been proposed to evaluate normality, such as the eyeball test, the Kolmogorov-Smirnov test and the Shapiro-Wilk test; but the methods have yielded unreliable and incompatible results for the same data or with different sample sizes (Kim, 2013). Kim (2013) argues that the Z-test is the proper normality test, based on skewness and kurtosis values, to estimate normal distributions in working with small, medium, and large sample sizes. Z-scores, also called critical values, are obtained by dividing the skewness values or excess kurtosis values by the corresponding standard errors.

Conforming with Kim (2013), the criteria to determine whether the data have a normal distribution according to sample size is established as follows. First, for small samples ($n<50$), if Z-score for skewness or kurtosis is higher than 1.96 or -1.96, then the null hypothesis is rejected, and sample distribution is established as non-normal. Second, for medium-sized samples (50<n<300), the sample distribution will be considered non-normal when absolute Z-score to skewness or kurtosis is higher than 3.29. Finally, for large samples (n>300), if the absolute critical value of skewness is greater than 2 or the absolute critical value of excess kurtosis is greater than 7, then the hypothesis will be rejected, and the sample will have a non-normal distribution. Table 5.4 presents critical values for skewness and kurtosis as well as non-normality distribution variables. Demonstrably, since this research includes a significant number of non-normal variables, a nonparametric data analysis approach such as PLS-SEM should be applied to evaluate the developed conceptual model.

Table 5.4: Normality test using skewness and kurtosis

Variable	Item	N	Skewness	Std. Error	Z-score $_{skewness}$	Kurtosis	Std. Error	Z-score $_{kurtosis}$
CA	**CA1**	167	-1.143	0.188	**6.082**	1.082	0.374	2.895
	CA2	167	-0.962	0.188	**5.120**	0.665	0.374	1.779
	CA3	166	0.337	0.188	1.787	-1.184	0.375	3.159
	CA4	166	-0.323	0.188	1.713	-0.661	0.375	1.765
	CA5	165	-0.756	0.189	**4.003**	-0.143	0.376	0.380
CO	CO1	168	-0.517	0.187	2.760	0.253	0.373	0.679
	CO2	168	-0.870	0.187	**4.647**	1.490	0.373	**4.001**
	CO3	168	-0.821	0.187	**4.382**	0.562	0.373	1.508
	CO4	168	-1.180	0.187	**6.298**	2.802	0.373	**7.520**
	CO5	168	-0.548	0.187	2.924	0.108	0.373	0.289
	CO6	164	-0.709	0.190	**3.738**	0.341	0.377	0.904
	CO7	168	-0.497	0.187	2.656	-0.089	0.373	0.240
MC	**MC1**	166	-1.199	0.188	**6.362**	2.407	0.375	**6.425**
	MC2	167	-1.176	0.188	**6.257**	2.685	0.374	**7.186**
	MC3	167	-0.926	0.188	**4.928**	0.808	0.374	2.162
	MC4	167	-1.201	0.188	**6.394**	2.519	0.374	**6.742**
	MC5	167	-0.971	0.188	**5.170**	1.128	0.374	3.018
	MC6	167	-0.860	0.188	**4.579**	0.934	0.374	2.501
	MC7	167	-0.809	0.188	**4.306**	0.423	0.374	1.133
QI	QI1	168	-0.406	0.187	2.166	-0.313	0.373	0.841
	QI2	167	-0.562	0.188	2.989	-0.001	0.374	0.003
	QI3	168	-0.838	0.187	**4.472**	1.068	0.373	2.867
RN	**RN1**	168	-0.934	0.187	**4.985**	0.989	0.373	2.656
	RN2	168	-1.503	0.187	**8.024**	3.772	0.373	**10.125**
	RN3	168	-1.068	0.187	**5.703**	1.660	0.373	**4.456**
	RN4	168	-0.746	0.187	**3.981**	0.745	0.373	2.001
	RN5	167	-0.561	0.188	2.984	-0.333	0.374	0.892
CW	**CW1**	168	-0.766	0.187	**4.090**	0.562	0.373	1.510
	CW2	168	-0.769	0.187	**4.107**	0.535	0.373	1.436
	CW3	166	-0.769	0.188	**4.081**	0.299	0.375	0.797
JPS	**JPS1**	168	-1.137	0.187	**6.072**	2.262	0.373	**6.071**
	JPS2	167	-1.038	0.188	**5.524**	1.127	0.374	3.016
	JPS3	168	-0.604	0.187	3.226	0.232	0.373	0.622
	JPS4	165	-0.499	0.189	2.639	-0.099	0.376	0.263

Table 5.4: Normality test using skewness and kurtosis (continued)

Variable	Item[a]	N	Skewness	Std. Error	$Z\text{-score}_{Skewness}$[b]	Kurtosis	Std. Error	$Z\text{-score}_{Kurtosis}$[b]
SIE	**SIE1**	167	-0.709	0.188	**3.776**	0.258	0.374	0.691
	SIE2	165	-0.890	0.189	**4.710**	0.840	0.376	2.235
	SIE3	163	-0.556	0.190	2.922	-0.262	0.378	0.693
	SIE4	159	-0.286	0.192	1.488	-0.627	0.383	1.638
IN	**IN1**	165	-0.849	0.189	**4.495**	0.840	0.376	2.234
	IN2	164	-0.875	0.190	**4.618**	0.931	0.377	2.471
	IN3	163	-0.845	0.190	**4.445**	0.950	0.378	2.512
	IN4	166	-0.202	0.188	1.074	-0.705	0.375	1.882
	IN5	162	0.411	0.191	2.155	-0.489	0.379	1.291
PE	**PE1**	168	-0.957	0.187	**5.106**	-0.286	0.373	0.768
	PE2	168	-0.473	0.187	2.526	-1.035	0.373	2.779
	PE3	168	-0.304	0.187	1.621	-0.980	0.373	2.630
IC	**IC1**	168	-1.218	0.187	**6.502**	0.933	0.373	2.503
	IC2	168	-1.736	0.187	**9.269**	2.880	0.373	**7.732**
	IC3	168	-1.734	0.187	**9.256**	2.904	0.373	**7.794**
	IC4	168	-2.419	0.187	**12.915**	5.611	0.373	**15.062**
	IC5	168	-1.349	0.187	**7.199**	1.372	0.373	**3.683**
OS	**OS1**	168	-1.397	0.187	**7.457**	1.278	0.373	**3.430**
	OS2	168	-1.284	0.187	**6.856**	1.041	0.373	2.794
	OS3	168	-1.580	0.187	**8.436**	2.594	0.373	**6.963**
	OS4	168	-1.467	0.187	**7.833**	1.992	0.373	**5.346**
PF	**PF1**	168	-1.777	0.187	**9.488**	3.766	0.373	**10.109**
	PF2	168	-0.873	0.187	**4.660**	-0.238	0.373	0.639
	PF3	168	-0.448	0.187	2.394	-1.089	0.373	2.923
	PF4	168	-0.084	0.187	0.449	-1.423	0.373	**3.819**
	PF5	168	-0.385	0.187	2.057	-1.137	0.373	3.053
	PF6	168	-0.608	0.187	3.248	-0.587	0.373	1.575

Note: [a] Indicators marked by bold type have a non-normal distribution. [b] Scores marked by bold type are greater than 3.29.

5.4 Assessing the measurement models

After data preparation, the next step is to evaluate the defined measurement (outer) models regarding the reliability and validity of the indicator variables. Because all of the lower-order constructs are specified as reflective constructs, the measurement models are assessed according to the following criteria (Chin, 1998; Hair et al., 2016; Urbach & Ahlemann, 2010): unidimensionality (by exploratory factor analysis), internal consistency reliability (by Cronbach's alpha and composite reliability), indicator reliability (by indicator loadings), convergent validity (by average variance extracted – AVE) and discriminant validity (by Fornell-Larcker criterion and heterotrait-monotrait ratio – HTMT). A brief description of each criterion for the evaluation of the validity and reliability of the reflective measurement models is previously summarised in Table 4.2.

5.4.1 Unidimensionality

Factor analysis is used to calculate the construct validity of the indicators (Urbach & Ahlemann, 2010). According to Field (2013), this technique identifies clusters or factors within a group of variables, and is often applied for three main reasons: (1) to understand the structure of a set of variables; (2) to design a questionnaire that measures a latent variable; and (3) to reduce a data set to a more manageable group of factors or components while retaining as much of the original information as possible (Gerbing & Anderson, 1988). Factor analysis may also be used to solve collinearity issues between variables (Field, 2013; Sarstedt & Mooi, 2014).

Within SEM-based methods such as PLS-SEM, exploratory factor analysis serves as a statistical technique that can evaluate “how well-observed variables relate to factors and what the relationships between factors are” (Sarstedt & Mooi, 2014, p. 236). Hence, this study performs exploratory factor analysis for each group of observed variables included in the major elements of value creation processes (i.e., governance strategy, degree of interaction and management foci) and project value, to validate if “each defined indicator loads with a high coefficient on ‘only’ one factor and this factor is the same for all indicators that are supposed to measure it” (Urbach & Ahlemann, 2010, p. 19).

Only factors with an Eigenvalue higher than 1.0 and indicators with unidimensionality scores higher than 0.3 and factor loadings higher than 0.4 are considered in this research, following the recommendations of Gerbing and Anderson (1988) and Field (2013). Tables 5.5, 5.6, 5.7 and 5.8 show the scores of the unidimensionality for each set of indicators using IBM SPSS 24 software. Additionally, exploratory factor analysis was performed for the elements of value creation processes (i.e., governance strategy, the mode of interaction and management foci) and project value. PMS was analysed separately from PSU because the prior literature has broadly defined their principal factors like cost, time, scope (i.e., project efficiency) and quality (i.e., impact on the client). Full results are presented in Table 5.5, 5.6, 5.7 and 5.8.

Table 5.5: Unidimensionality and exploratory factor analysis for governance strategy

Item	**Unidimensionality**			**Loadings**[a]	
	Initial	**Extraction**		**Factor 1**	**Factor 2**
CA1	1.000	0.560		0.075	**0.745**
CA2	1.000	0.567		0.257	**0.708**
~~**CA3**~~	1.000	~~**0.262**~~		-0.180	**0.479**
CA4	1.000	0.412		0.319	**0.557**
CA5	1.000	0.584		-0.022	**0.764**
QI1	1.000	0.530		**0.712**	0.153
QI2	1.000	0.670		**0.768**	0.281
QI3	1.000	0.752		**0.839**	0.220
RN1	1.000	0.804		**0.896**	-0.041
RN2	1.000	0.629		**0.793**	0.002
RN3	1.000	0.755		**0.867**	-0.058
RN4	1.000	0.770		**0.877**	-0.030
RN5	1.000	0.608		**0.774**	0.094
▫ The chi-square statistic is 1246.237 on 78 degrees of freedom.			Eigenvalue	5.739	2.164
			% of variance	44.145	16.647
▫ The ***p-value is 0.000			Cumulative % of variance	44.145	**60.792**

Note: Extraction method: principal component analysis
[a] Rotated component matrix. Rotation method: Varimax with Kaiser normalisation; Rotation converged in 3 iterations.

Table 5.6: Unidimensionality and exploratory factor analysis for mode of interaction

Item	**Unidimensionality**			**Loadings**[a]	
	Initial	**Extraction**		**Factor 1**	**Factor 2**
CO1	1.000	0.539		0.308	**0.666**
CO2	1.000	0.555		0.139	**0.732**
CO3	1.000	0.650		0.333	**0.735**
CO4	1.000	0.572		0.458	**0.602**
CO5	1.000	0.497		0.162	**0.686**
~~**CO6**~~	1.000	~~**0.279**~~		0.092	**0.520**
CO7	1.000	0.435		0.390	**0.531**
CW1	1.000	0.706		**0.719**	0.434
CW2	1.000	0.659		**0.711**	0.392
CW3	1.000	0.699		**0.762**	0.344
JPS1	1.000	0.640		**0.720**	0.349
JPS2	1.000	0.428		**0.583**	0.296
JPS3	1.000	0.597		**0.634**	0.442
JPS4	1.000	0.700		**0.764**	0.340
SIE1	1.000	0.616		**0.745**	0.247
SIE2	1.000	0.616		**0.750**	0.230
SIE3	1.000	0.469		**0.681**	0.068
SIE4	1.000	0.526		**0.722**	0.071
▫ The chi-square statistic is 1645.112 on 153 degrees of freedom.			Eigenvalue	8.722	1.461
			% of variance	48.455	8.117
▫ The ***p-value is 0.000			Cumulative % of variance	48.455	**56.572**

Note: Extraction method: principal component analysis
[a] Rotated component matrix. Rotation method: Varimax with Kaiser normalisation; Rotation converged in 3 iterations.

Table 5.7: Unidimensionality and exploratory factor analysis for management foci

Item	Unidimensionality			Loadings[a]	
	Initial	Extraction		Factor 1	Factor 2
MC1	1.000	0.529		**0.666**	0.294
MC2	1.000	0.633		**0.772**	0.194
MC3	1.000	0.652		**0.805**	0.063
MC4	1.000	0.680		**0.820**	0.086
MC5	1.000	0.725		**0.843**	0.114
MC6	1.000	0.684		**0.790**	0.243
MC7	1.000	0.513		**0.678**	0.231
IN1	1.000	0.728		0.291	**0.802**
IN2	1.000	0.784		0.312	**0.829**
IN3	1.000	0.767		0.295	**0.825**
IN4	1.000	0.400		0.089	**0.626**
~~**IN5**~~	1.000	~~**0.103**~~		~~-0.011~~	~~0.320~~
▫ The chi-square statistic is 978.146 on 66 degrees of freedom.			Eigenvalue	5.491	1.706
			% of variance	45.755	14.214
▫ The ***p-value is 0.000			Cumulative % of variance	45.755	**59.969**

Note: Extraction method: principal component analysis
[a] Rotated component matrix. Rotation method: Varimax with Kaiser normalisation; Rotation converged in 3 iterations.

Table 5.8: Unidimensionality and exploratory factor analysis for project value

Item	Unidimensionality			Loadings[a]	
	Initial	Extraction		Factor 1	Factor 2
PE1	1.000	0.526		**0.725**	-
PE2	1.000	0.428		**0.654**	-
PE3	1.000	0.331		**0.575**	-
IC1	1.000	0.589		**0.767**	-
IC2	1.000	0.820		**0.905**	-
IC3	1.000	0.786		**0.886**	-
IC4	1.000	0.372		**0.610**	-
IC5	1.000	0.553		**0.743**	-
▫ The chi-square statistic is 684.043 on 28 degrees of freedom.			Eigenvalue	4.403	0.000
			% of variance	55.034	0.000
The ***p-value is 0.000			Cumulative % of variance	55.034	**55.034**
OS1	1.000	0.841		**0.914**	0.083
OS2	1.000	0.827		**0.903**	0.106
OS3	1.000	0.686		**0.811**	0.171
OS4	1.000	0.690		**0.820**	0.129
PF1	1.000	0.461		0.305	**0.606**
PF2	1.000	0.472		0.266	**0.634**
PF3	1.000	0.491		0.158	**0.682**
PF4	1.000	0.606		-0.020	**0.778**
PF5	1.000	0.712		0.061	**0.841**
PF6	1.000	0.496		0.277	**0.648**
▫ The chi-square statistic is 892.864 on 45 degrees of freedom.			Eigenvalue	4.299	1.982
			% of variance	42.992	19.823
▫ The ***p-value is 0.000			Cumulative % of variance	42.992	**62.815**

Note: Extraction method: principal component analysis
[a] Rotated component matrix. Rotation method: Varimax with Kaiser normalisation; Rotation converged in 3 iterations.

As discussed above, several exploratory factor analyses were conducted on each group of the indicator variables related to governance strategy, the mode of interaction, management foci and project value, through principal component analysis as the extraction method with orthogonal rotation (i.e. varimax) to enhance the interpretability of the results (Sarstedt & Mooi, 2014). First, the results demonstrate statistical significance at 0.1% for each analysis, supporting the construct factorability. Second, according to the developed conceptual framework (see figure 3.4), exploratory factor analyses validate the key factors of each element of the value creation processes through Eigenvalues higher than 1. Thus, governance strategy is shaped by two factors – contractual agreements (CA) and relational engagement (RE) – with an explained variance of 60.79%. Similarly, the mode of interaction also has two main factors, coordination (CO) and collaboration (CL), that represent 56.57% of the variance; and management foci is established by monitoring & control (MC) and innovating (IN) that explain 59.97% of the variance.

Project management success (PMS) is unexpectedly factorised by only one factor that explains 55.03% of the total variance. On the other hand, project success (PSU) is defined by two factors, as expected, that explain 62.82% of the variance. These two factors are organisational and business success (OS), and preparing for the future (PF). In this research, indicators of project management success (PMS) represent the project value of immediately delivered project outcomes, while OS and PF are kept to indicate the impact of the project value over months and years (Turner & Zolin, 2012).

Finally, three indicator variables, namely CA3, CO6 and IN5, have a unidimensionality score lower than 0.3 (0.262, 0.279 and 0.103, respectively), and were removed because this situation fails to secure a satisfactory representation of a measurement within a set of indicators that can be used to predict the construct (Gerbing & Anderson, 1988). Figure 5.4 exhibits the structural and measurement models of the conceptual framework after the removal of the indicators, and the item restructuring of the project management success construct.

Once factor analysis is performed, it is necessary to check the reliability of each set of indicators. Reliability means to what extent the group of indicator variables consistently reflects the latent variable that it is measuring (Field, 2013). The next sections detail the reliability criteria (i.e. internal consistency reliability and indicator reliability) with regard to PLS-SEM, and the results obtained from SmartPLS 3 software (Ringle et al., 2015).

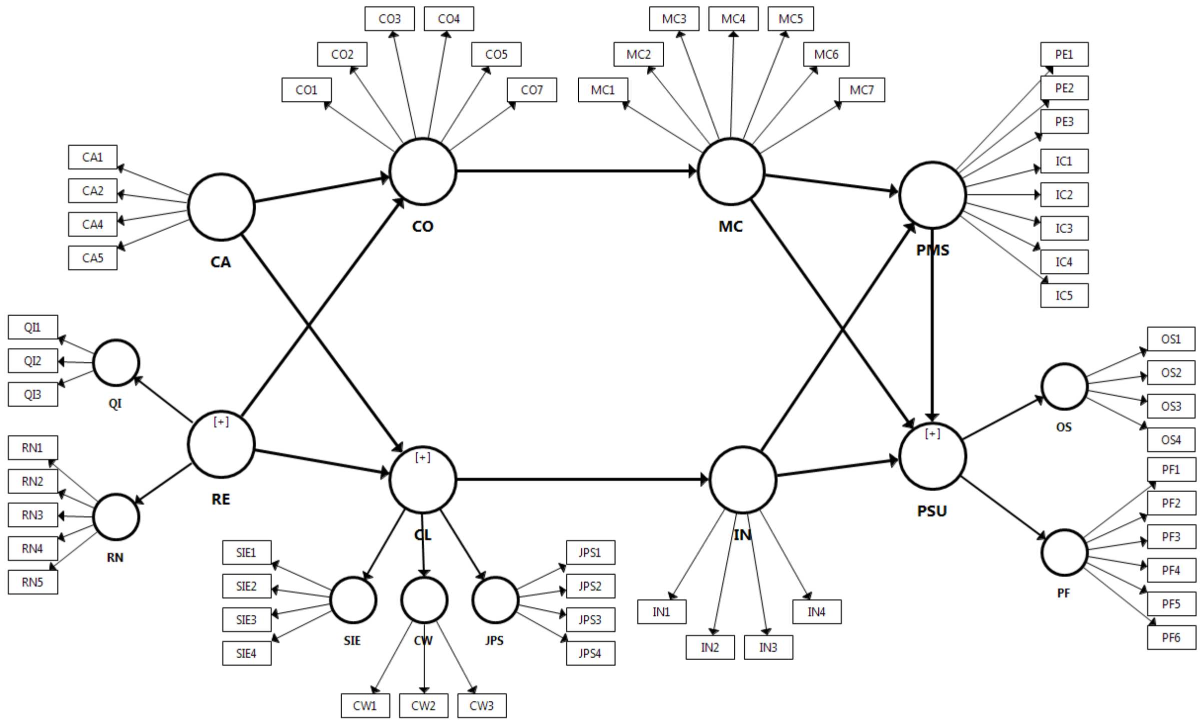


Figure 5.4: Structural and measurement models after factor analysis

5.4.2 Internal consistency reliability

Two measures commonly accepted to assess reliability in measurement models in PLS-SEM are Cronbach's alpha (α) and composite reliability (CR). The former has been traditionally used to evaluate internal consistency reliability which measures the coherence of a set of the observed variables related to a particular latent variable through correlations (Hair et al., 2016). Whereas the latter is a more appropriate measure of reliability (Hair et al., 2016) because it mitigates the conservative scores obtained from Cronbach's alpha through the calculation of the degree to which the indicators load simultaneously when the latent variable increases (Urbach & Ahlemann, 2010). However, as composite reliability tends to overestimate the internal consistency reliability (Hair et al., 2016), this research considered both criteria to assess the proposed measurement models.

The formula to calculate Cronbach's α is defined as follows (Hair et al., 2016):

$$\alpha = \left(\frac{M}{M-1}\right) . \left(1 - \frac{\sum_{i=1}^{M} S_i^2}{S_t^2}\right) \quad \text{[Equation 5.1]}$$

Where, S_i^2 is the variance of the indicator variable i of a specific construct, measured with *M* indicators; and, S_t^2 is the variance of the sum of all *M* indicators of that construct.

On the other hand, CR can be measured by the following formula (Hair et al., 2016):

$$CR = \frac{\left(\sum_{i=1}^{M} l_i\right)^2}{\left(\sum_{i=1}^{M} l_i\right)^2 + \sum_{i=1}^{M} var(e_i)} \quad \text{[Equation 5.2]}$$

Where, l_i is the standardised outer loading of the indicator variable i of the specific construct measured with *M* indicators; the measurement error of each indicator variable i is e_i; and, $var(e_i)$ refers to the variance of the measurement error (i.e. $1 - l_i^2$).

Cronbach's α and CR scores range from 0 (completely unreliable) to 1 (completely reliable), where high values represent a greater degree of reliability (Hair et al., 2016). Proposed threshold score above 0.700 is enough for exploratory research, while 0.800 or 0.900 is required for more advanced stages of research (i.e. confirmatory research) (Nunnally & Bernstein, 1994), but scores should not be lower than 0.600 which would show a lack of internal consistency reliability (Urbach & Ahlemann, 2010). Additionally, large numbers above 0.950 denote that "indicator variables are measuring the same phenomenon" (Hair et al., 2016, p. 112), in other words, there is a redundancy of items and a potential common method bias (Urbach & Ahlemann, 2010). Table 5.9 shows α and CR scores for each construct included in the path model. Values below 0.700 and above 0.950 were checked. All scores were included in this range, demonstrating good internal consistency reliability. Therefore no items were removed.

5.4.3 Indicator reliability

Indicator reliability is measured through indicator loadings that refer to how much of the reflective indicator variance is explained by the corresponding construct (Urbach & Ahlemann, 2010). As Chin (1998) postulates, a construct must explain at least 50% of the variance of each indicator, i.e. indicator loadings higher than 0.707 and significant at least at the 5% level. The significance of indicator loadings can be calculated by using resampling methods such as bootstrapping (Urbach & Ahlemann, 2010).

Indicator loading scores are also shown in Table 5.9. All values are significant at 0.1% (bootstrapping routine with 5000 subsamples, bias-corrected and accelerated bootstrap and no sign changes option), and the majority are greater than 0.700. Nevertheless, indicators such as CA5, CO5, IN4, PE2, PE3, IC4, PF1, PF3 and PF4 did not achieve the proposed threshold value. The procedure used with regard to removing or not removing these indicators is detailed in the next section.

Table 5.9: Initial results summary of measurement models assessment

Construct	Item	Outer loading[a] > 0.700	α > 0.700	CR > 0.700	AVE > 0.500
Contractual agreements (CA)	CA1	0.706	0.714	0.818	0.530
	CA2	0.811			
	CA4	0.742			
	CA5	**0.645**			
Coordination (CO)	CO1	0.738	0.835	0.879	0.549
	CO2	0.727			
	CO3	0.810			
	CO4	0.804			
	CO5	**0.645**			
	CO7	0.708			
Monitoring & controlling (MC)	MC1	0.737	0.899	0.920	0.623
	MC2	0.792			
	MC3	0.786			
	MC4	0.802			
	MC5	0.838			
	MC6	0.834			
	MC7	0.728			
Relational engagement (RE)			*0.931*	*0.944*	*0.677*
Quality of interactions (QI)	QI1	0.852	0.855	0.912	0.775
	QI2	0.907			
	QI3	0.882			
Relational norms (RN)	RN1	0.897	0.916	0.937	0.750
	RN2	0.808			
	RN3	0.907			
	RN4	0.911			
	RN5	0.800			

Table 5.9: Initial results summary of measurement models assessment (continued)

Construct	Item	Outer loading[a] > 0.700	α > 0.700	CR > 0.700	AVE > 0.500
Collaboration (CL)			*0.930*	*0.941*	*0.595*
Strategic information exchange (SIE)	SIE1	0.850	0.823	0.883	0.653
	SIE2	0.837			
	SIE3	0.762			
	SIE4	0.780			
Collaborative work (CW)	CW1	0.916	0.898	0.936	0.830
	CW2	0.919			
	CW3	0.899			
Joint problem solving (JPS)	JPS1	0.869	0.849	0.898	0.689
	JPS2	0.770			
	JPS3	0.848			
	JPS4	0.830			
Innovating (IN)	IN1	0.877	0.835	0.893	0.679
	IN2	0.889			
	IN3	0.879			
	IN4	**0.621**			
Project management success (PMS)	PE1	0.724	0.878	0.904	0.549
	PE2	**0.656**			
	PE3	**0.535**			
	IC1	0.770			
	IC2	0.911			
	IC3	0.888			
	IC4	**0.597**			
	IC5	0.764			
Project success (PSU)			*0.848*	*0.879*	***0.430***
Organisational and business success (OS)	OS1	0.934	0.905	0.934	0.781
	OS2	0.932			
	OS3	0.830			
	OS4	0.833			
Preparing for the future (PF)	PF1	**0.634**	0.783	0.846	**0.478**
	PF2	0.717			
	PF3	**0.695**			
	PF4	**0.638**			
	PF5	0.742			
	PF6	0.717			

Note: α=Cronbach's alpha; CR=Composite reliability; AVE=average variance extracted. [a] All outer loadings are significant at 0.1 level. [b] Acceptable score for exploratory studies (Urbach & Ahlemann, 2010)

5.4.4 Convergent validity

Convergent validity estimates to what extent an indicator variable correlates positively with alternative indicators of the same construct (Chin, 1998; Hair et al., 2016). The average variance extracted (AVE) is a criterion that is frequently used to assess convergent validity. AVE represents "the amount of variance that the latent variable captures from its indicators relative to the amount due to measurement error" (Urbach & Ahlemann, 2010, p. 19). The following formula is applied to calculate AVE (Hair et al., 2016):

$$AVE = \left(\frac{\sum_{i=1}^{M} l_i^2}{M}\right) \qquad \text{[Equation 5.3]}$$

Where, l_i is the standardised outer loading of the indicator variable i of the specific construct measured with *M* indicators.

According to Chin (1998), Fornell and Larcker suggest that the AVE score should be greater than 0.5, which means that 50% or more of the variance of the indicator variables should be explained. If AVE is less than 0.5, then the measurement error is relatively higher than the indicator variance explained by the corresponding latent variable, which demonstrates a lack of convergent validity (Hair et al., 2016). AVE preliminary scores shown in Table 5.9 reveal that all constructs achieve AVE scores higher than 0.5, except for PF.

As outer loadings below 0.707 are often found within social science studies, researchers should carefully analyse the impact on the composite reliability and convergent validity of the construct when any indicator is removed (Hair et al., 2016). Thus, Hair et al. (2016) propose a compressible guideline to address that issue (see Figure 5.5).

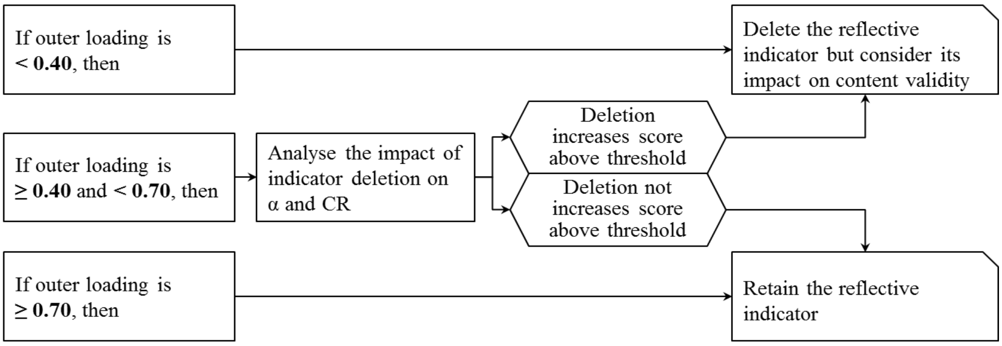


Figure 5.5: Hair et al. (2016) outer loading relevance guideline

Following this recommendation, Table 5.10 summarises the indicator variables deleted or retained and the reason for each action.

Table 5.10: Summary of indicator deletion and retention

Item	Deleted or retained	Reason
CA5	Retained	Deletion does not increase α and CR scores above the threshold.
CO5	Retained	Deletion does not increase α and CR scores above the threshold.
IN4	Retained	Deletion does not increase α and CR scores above the threshold.
PE2	Retained	Deletion does not increase α and CR scores above the threshold.
PE3	**Deleted**	Deletion increases α and CR score above the threshold.
IC4	**Deleted**	Deletion increases α and CR score above the threshold.
PF1	Retained	Deletion does not increase α and CR scores above the threshold.
PF3	**Deleted**	Deletion increases α and CR score above the threshold.
PF4	**Deleted**	Deletion increases α and CR score above the threshold.
PF5	**Deleted**	Deletion increases α and CR score above the threshold.

Figure 5.6 and Table 5.11 exhibit the validated measurement models and related scores of construct outer loadings, internal consistency reliability (i.e. α and CR) and content validity (i.e. AVE) after the deletion of PE3, IC4, PF3, PF4 and PF5.

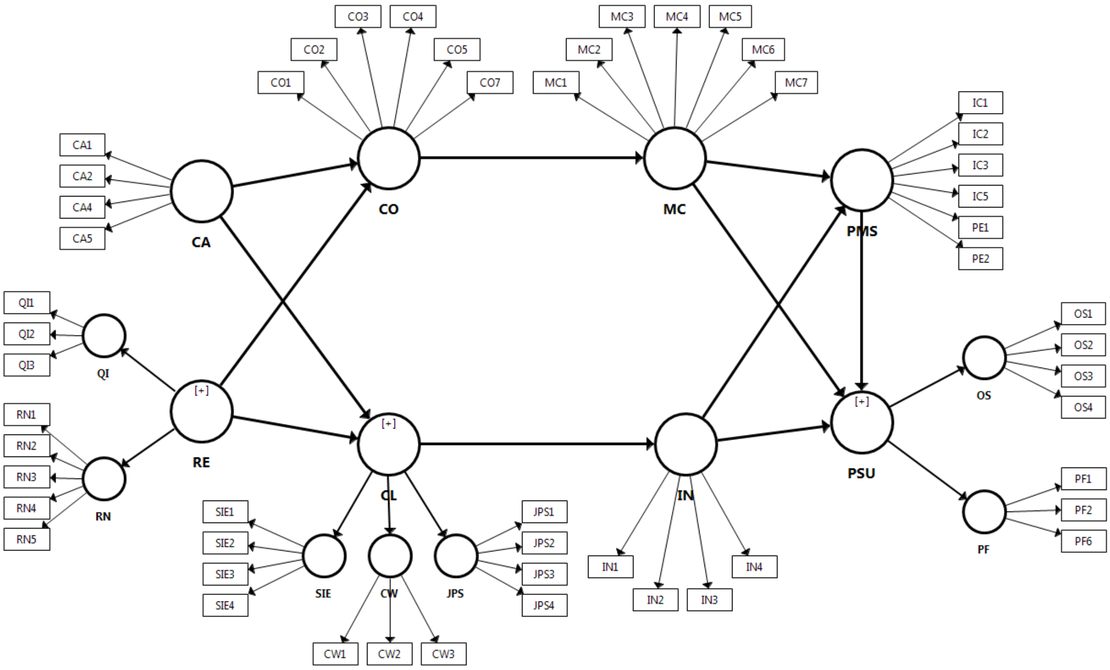


Figure 5.6: Validated measurement models

Table 5.11: Summary of final results of measurement model assessment

Construct	Item	Outer loading[a] > 0.700	α > 0.700	CR > 0.700	AVE > 0.500
Contractual agreements (CA)	CA1	0.706	0.714	0.818	0.530
	CA2	0.811			
	CA4	0.742			
	CA5	0.645			
Coordination (CO)	CO1	0.738	0.835	0.879	0.549
	CO2	0.727			
	CO3	0.810			
	CO4	0.804			
	CO5	0.645			
	CO7	0.708			
Monitoring & controlling (MC)	MC1	0.737	0.899	0.920	0.623
	MC2	0.792			
	MC3	0.787			
	MC4	0.802			
	MC5	0.837			
	MC6	0.834			
	MC7	0.728			
Relational engagement (RE)			*0.931*	*0.944*	*0.677*
Quality of interactions (QI)	QI1	0.852	0.855	0.912	0.775
	QI2	0.907			
	QI3	0.882			
Relational norms (RN)	RN1	0.897	0.916	0.937	0.750
	RN2	0.808			
	RN3	0.907			
	RN4	0.911			
	RN5	0.800			

Table 5.11: Final results summary of measurement models assessment (continued)

Construct	Item	Outer loading[a]	α	CR	AVE
Collaboration (CL)			*0.930*	*0.941*	*0.595*
Strategic information exchange (SIE)	SIE1	0.850	0.823	0.883	0.653
	SIE2	0.837			
	SIE3	0.762			
	SIE4	0.780			
Collaborative work (CW)	CW1	0.916	0.898	0.936	0.830
	CW2	0.919			
	CW3	0.899			
Joint problem solving (JPS)	JPS1	0.869	0.849	0.898	0.689
	JPS2	0.770			
	JPS3	0.848			
	JPS4	0.830			
Innovating (IN)	IN1	0.877	0.835	0.893	0.679
	IN2	0.889			
	IN3	0.879			
	IN4	0.621			
Project management success (PMS)	PE1	0.738	0.882	0.912	0.635
	PE2	0.666			
	IC1	0.774			
	IC2	0.916			
	IC3	0.886			
	IC5	0.775			
Project success (PSU)			*0.852*	*0.890*	*0.546*
Organisational and business success (OS)	OS1	0.934	0.905	0.934	0.781
	OS2	0.932			
	OS3	0.830			
	OS4	0.832			
Preparing for the future (PF)	PF1	0.827	0.631[b]	0.800	0.573
	PF2	0.724			
	PF6	0.715			

Note: α=Cronbach's alpha; CR=Composite reliability; AVE=average variance extracted. [a] All outer loadings are significant at 0.001 level. [b] Acceptable score for exploratory studies.

5.4.5 Discriminant validity

Discriminant validity refers to the degree to which each latent variable differs from other latent variables in the model; in other words, a latent variable must share more variance with its indicators than with any other latent variable (Urbach & Ahlemann, 2010). Traditionally, the Fornell-Larcker criterion is recommended as the dominant standard for determining discriminant validity; this test compares the AVE scores of the constructs and the square of the correlations between the latent variables. If AVE scores are greater than the square of the correlations, then more variance is shared among the construct and its set of indicators than with another different set of indicators (Chin, 1998).

Table 5.12 presents the correlation and AVE scores from SmartPLS 3 (Ringle et al., 2015) and demonstrates that the root squares of AVEs (values in bold type on the diagonal) were higher than the correlation of the same construct with other constructs (values below the diagonal). All of the analysed latent variables achieve discriminant validity.

Table 5.12: Construct correlations and discriminant validity (Fornell-Larcker criterion)

	CA	CO	MC	QI	RN	SIE	CW	JPS	IN	PMS	OS	PF
CA	**0.728**											
CO	0.443	**0.741**										
MC	0.304	0.633	**0.789**									
QI	0.409	0.666	0.618	**0.881**								
RN	0.244	0.686	0.632	0.772	**0.866**							
SIE	0.345	0.576	0.527	0.664	0.630	**0.808**						
CW	0.326	0.672	0.602	0.781	0.808	0.710	**0.911**					
JPS	0.416	0.697	0.584	0.741	0.780	0.726	0.813	**0.830**				
IN	0.264	0.531	0.510	0.699	0.638	0.655	0.753	0.692	**0.824**			
PMS	0.295	0.583	0.487	0.507	0.542	0.380	0.506	0.512	0.436	**0.797**		
OS	0.147	0.355	0.368	0.353	0.380	0.288	0.345	0.336	0.338	0.642	**0.884**	
PF	0.257	0.421	0.447	0.425	0.400	0.401	0.428	0.416	0.516	0.618	0.533	**0.757**

Note: Scores in bold type on the diagonal are the square root of AVE values; Scores below the diagonal are correlations.

Because the predominant traditional tests such as the Fornell-Larcker criterion do not provide reliable estimates of the lack of discriminant validity, the heterotrait-monotrait ratio (HTMT) has been recently proposed as a new approach (Henseler, Ringle, & Sarstedt, 2015). The HTMT of the correlations is technically "an estimate of what the true correlation between two constructs would be if they were perfectly measured" (Hair et al., 2016). The HTMT ratio is calculated from the average of the indicator correlations across constructs measuring different phenomena (i.e. heterotrait-heteromethod correlations) divided by the geometric mean of the indicator correlations within the same construct (i.e. monotrait-heteromethod correlations) (Henseler et al., 2015). This real correlation, also called disattenuated correlations between two constructs, indicates a lack of discriminant validity if the value is close to 1 (Hair et al., 2016). Henseler et al. (2015) establish a threshold HTMT value of 0.90 to constructs that are conceptually quite similar (i.e. HTMT scores above 0.90 represent a lack of discriminant validity); however, as PLS-SEM assumes a nonnormal distribution, only a bootstrapping procedure can be useful to estimate the HTMT statistic.

Hence, although a bootstrapping confidence interval containing the value 1 indicates a lack of discriminant validity, if one is out of this range, then both analysed constructs are empirically and conceptually different (Henseler et al., 2015).

Table 5.13 shows HTMT value for each construct, obtained directly from SmartPLS 3 (Ringle et al., 2015). All HTMT scores are below 0.900 except for CW-JPS correlation. This result suggests an apparent lack of discriminant validity between those constructs. Nonetheless, Table 5.14 presents certain intervals for all HTMT correlations, none of which include 1. Consequently, it is possible to support the view that all latent variables in this model have discriminant validity, confirming the results of the Fornell-Larcker criterion test.

Table 5.13: Heterotrait-monotrait (HTMT) ratio scores

	CA	CO	MC	QI	RN	SIE	CW	JPS	IN	PMS	OS	PF
CA												
CO	0.554											
MC	0.361	0.713										
QI	0.476	0.777	0.695									
RN	0.286	0.775	0.692	0.867								
SIE	0.419	0.682	0.609	0.784	0.726							
CW	0.359	0.767	0.664	0.889	0.892	0.819						
JPS	0.511	0.811	0.657	0.860	0.877	0.854	**0.925**					
IN	0.288	0.622	0.576	0.821	0.729	0.785	0.866	0.814				
PMS	0.349	0.669	0.545	0.581	0.605	0.440	0.571	0.592	0.510			
OS	0.187	0.404	0.405	0.402	0.415	0.326	0.381	0.382	0.394	0.721		
PF	0.382	0.540	0.574	0.568	0.511	0.537	0.553	0.550	0.694	0.789	0.686	

Note: Bolded HTMT scores represent lack of discriminant validity

Table 5.14: Confidence intervals for HTMT

	Original Sample	Sample Mean	Bias	Confidence intervals 2.50%	97.50%	HTMT confidence intervals do not include 1
CO –» CA	0.554	0.560	0.006	0.398	0.700	Yes
CW –» CA	0.359	0.373	0.014	0.229	0.494	Yes
CW –» CO	0.767	0.766	-0.001	0.666	0.848	Yes
IN –» CA	0.288	0.328	0.040	0.160	0.385	Yes
IN –» CO	0.622	0.624	0.001	0.476	0.738	Yes
IN –» CW	0.866	0.866	0.000	0.778	0.933	Yes
JPS –» CA	0.511	0.513	0.002	0.345	0.663	Yes
JPS –» CO	0.811	0.809	-0.002	0.708	0.888	Yes
JPS –» CW	0.925	0.925	0.000	0.854	0.980	Yes
JPS –» IN	0.814	0.816	0.001	0.716	0.891	Yes
MC –» CA	0.361	0.374	0.012	0.207	0.498	Yes
MC –» CO	0.713	0.711	-0.002	0.590	0.809	Yes
MC –» CW	0.664	0.663	-0.002	0.540	0.766	Yes
MC –» IN	0.576	0.579	0.003	0.439	0.703	Yes
MC –» JPS	0.657	0.656	-0.001	0.508	0.777	Yes
OS –» CA	0.187	0.206	0.019	0.088	0.331	Yes

Table 5.14: Confidence intervals for HTMT (continued)

	Original Sample	Sample Mean	Bias	Confidence intervals 2.50%	97.50%	HTMT confidence intervals do not include 1
OS –» CO	0.404	0.406	0.002	0.219	0.577	Yes
OS –» CW	0.381	0.377	-0.005	0.205	0.538	Yes
OS –» IN	0.394	0.395	0.001	0.261	0.521	Yes
OS –» JPS	0.382	0.378	-0.004	0.200	0.546	Yes
OS –» MC	0.405	0.400	-0.005	0.232	0.571	Yes
PF –» CA	0.382	0.403	0.021	0.205	0.533	Yes
PF –» CO	0.540	0.548	0.008	0.347	0.716	Yes
PF –» CW	0.553	0.552	-0.001	0.357	0.729	Yes
PF –» IN	0.694	0.697	0.003	0.531	0.828	Yes
PF –» JPS	0.550	0.551	0.001	0.374	0.713	Yes
PF –» MC	0.574	0.576	0.002	0.391	0.739	Yes
PF –» OS	0.686	0.685	-0.001	0.476	0.867	Yes
PMS –» CA	0.349	0.364	0.015	0.213	0.499	Yes
PMS –» CO	0.669	0.667	-0.002	0.529	0.783	Yes
PMS –» CW	0.571	0.568	-0.003	0.412	0.710	Yes
PMS –» IN	0.510	0.509	-0.001	0.346	0.653	Yes
PMS –» JPS	0.592	0.588	-0.004	0.440	0.728	Yes
PMS –» MC	0.545	0.541	-0.004	0.384	0.676	Yes
PMS –» OS	0.721	0.716	-0.005	0.579	0.834	Yes
PMS –» PF	0.789	0.789	0.000	0.617	0.954	Yes
QI –» CA	0.476	0.479	0.003	0.341	0.597	Yes
QI –» CO	0.777	0.776	-0.001	0.672	0.868	Yes
QI –» CW	0.889	0.888	-0.001	0.810	0.950	Yes
QI –» IN	0.821	0.821	0.000	0.717	0.906	Yes
QI –» JPS	0.860	0.860	0.000	0.787	0.913	Yes
QI –» MC	0.695	0.693	-0.001	0.568	0.794	Yes
QI –» OS	0.402	0.398	-0.004	0.217	0.558	Yes
QI –» PF	0.568	0.567	0.000	0.341	0.756	Yes
QI –» PMS	0.581	0.579	-0.002	0.413	0.714	Yes
RN –» CA	0.286	0.304	0.018	0.172	0.393	Yes
RN –» CO	0.775	0.775	0.000	0.670	0.869	Yes
RN –» CW	0.892	0.891	-0.001	0.821	0.949	Yes
RN –» IN	0.729	0.730	0.001	0.610	0.824	Yes
RN –» JPS	0.877	0.877	0.000	0.811	0.930	Yes
RN –» MC	0.692	0.690	-0.002	0.554	0.793	Yes
RN –» OS	0.415	0.413	-0.002	0.229	0.574	Yes
RN –» PF	0.511	0.512	0.001	0.307	0.708	Yes
RN –» PMS	0.605	0.603	-0.002	0.447	0.731	Yes
RN –» QI	0.867	0.865	-0.002	0.784	0.927	Yes
SIE –» CA	0.419	0.425	0.006	0.253	0.589	Yes
SIE –» CO	0.682	0.681	-0.001	0.547	0.787	Yes
SIE –» CW	0.819	0.819	0.000	0.714	0.895	Yes
SIE –» IN	0.785	0.787	0.002	0.624	0.899	Yes
SIE –» JPS	0.854	0.855	0.002	0.772	0.920	Yes
SIE –» MC	0.609	0.608	-0.002	0.466	0.735	Yes
SIE –» OS	0.326	0.326	0.000	0.165	0.496	Yes
SIE –» PF	0.537	0.540	0.003	0.334	0.722	Yes
SIE –» PMS	0.440	0.439	-0.001	0.268	0.601	Yes
SIE –» QI	0.784	0.782	-0.002	0.679	0.874	Yes
SIE –» RN	0.726	0.725	-0.001	0.619	0.821	Yes

Note: Bootstrapping routine was applied to 4000 subsamples, assuming a 95% degree of confidence

5.5 Assessing the structural model

Having confirmed that the indicator variable measures are reliable and valid, the structural model must be evaluated next. PLS-SEM literature recognises two main approaches for estimating hierarchical latent variable models as proposed in this research, namely, a repeated indicator approach and a two-stage approach (Becker et al., 2012; Hair et al., 2016; Hair, Ringle, & Sarstedt, 2013). According to Becker et al. (2012), the repeated indicator approach consists of assigning all the observed variables from lower-order constructs to a higher-order construct. In other words, the indicators are repeated; once for the first-order construct and then again for the second-order construct. This approach can be easily applied to hierarchical models with three or more orders, as presented empirically by Wetzels, Odekerken-Schroder, and Van Oppen (2009). The repeated indicator approach should be used when the model is reflective-reflective (type A) and reflective-formative (type B) because it provides more precise estimates of the parameters (i.e. less biased) and more reliable higher-order construct values (Becker et al., 2012).

In contrast, when formative-formative and reflective-formative higher-order latent variables are modelled, the repeated indicator approach presents issues mainly related to the higher-order variance which is explained by all lower-order constructs; consequently, the coefficient of determination R^2 is approximately 1.0 (Hair et al., 2016), which results in slight and nonsignificant path coefficients (Ringle et al., 2012). The two-stage approach separates the analysis into two parts. In the first stage, the repeated indicators approach is applied to estimate the lower-order constructs scores that are used in the second stage as indicators of the higher-order constructs to assess the structural model (Ringle et al., 2012). As Hair et al. (2016, p. 283) emphasise, “the two-stage high-order model analysis can then identify significant path relationships that may not otherwise be found”.

Since the structural model of this research presented in Figure 5.6 includes only reflective-reflective higher-order constructs (i.e. RE, CL and PSU), the model was then evaluated by the repeated indicator approach. Before proffering the structural model analysis, two threats to the research should be carefully examined – namely, common method bias and multicollinearity issues – both of which are evaluated in the following section.

5.5.1 Common method bias

Common method bias is a frequent problem potentially originating from datasets in social and behavioural research that refers to "the variance that is attributable to the measurement method rather than the constructs the measures represent" (Podsakoff et al., 2003, p. 879). This systematic error variance can adversely affect empirical results, generating misleading findings and conclusions (Podsakoff et al., 2003). More specifically, common method bias can be critical when self-administered questionnaires gather data from respondents that answer all the dependent and independent variables at the same time (Podsakoff & Organ, 1986), as is the case in this research, resulting in the possibility of originating false correlations between variables, leading to misunderstandings and even wrong conclusions (S. Chang, Van Witteloostuijn, & Eden, 2010). According to Podsakoff et al. (2003) and summarised by S. Chang et al. (2010), there are two types of remedies that can address common method bias and are often proposed in business and social research; they are known as ex-ante and ex-post remedies.

Ex-ante remedies are directly focused on including procedural treatments during the design stage of the research (e.g. questionnaire construction) (S. Chang et al., 2010). This study applies several remedies at the research design stage, in accordance with the recommendations of Podsakoff et al. (2003), as follows: (1) Respondents are assured of the anonymity and confidentiality of the study, and advised that there are no right or wrong answers and that they must answer as honestly as possible. (2) Questions were examined during the questionnaire construction phase to ensure that ambiguous, vague and unfamiliar terms were removed and that each question, as well as the entire questionnaire design, was as concise as possible; this treatment was then validated through pilot testing. (3) As mentioned in Section 4.6.1.3, the scales for predictor variables and criterion variables were different, establishing a methodological separation between the two.

Ex-post remedies refer to statistical diagnostics that can be applied after the data has been collected (S. Chang et al., 2010). Two ex-post tests are performed in this research to examine the potential common method variance in the collected data. The first, Harman's single factor test, is the most often used statistical technique to determine if the majority of the covariance among the measures can be explained by a single factor through factor analysis without rotation (Podsakoff et al., 2003). In this case, the presence of one general factor indicates common method variance.

From IBM SPSS 24 calculations, Table 5.15 shows that a single factor explains a variance of 38.93%. Because this score does not represent the majority of the explained variance for the model, there is, therefore, no evidence of the occurrence of common method bias in this research.

Second, simple reporting of Harman's single factor test is insufficient to prove common method variance (S. Chang et al., 2010) because in this trial it is unlikely that a single factor can fit the data, and there is no compressible and acceptable value of explained variance to determine the presence of common method error (Podsakoff et al., 2003). For this reason, Podsakoff et al. (2003) argue that the common latent factor (CLF) represents a more reliable test, since it adds a CLF that contains all the construct indicators of the conceptual model and calculates each indicator variances substantively explained by its construct and by the method (Liang, Saraf, Hu, & Xue, 2007; Podsakoff et al., 2003).

Figure 5.7 exhibits the PLS path model for assessing common method bias following the guidelines presented by Liang et al. (2007). Thus, CLF represents the common method factor that is associated with each single indicator variable of reflective constructs.

Table 5.15: Harman's single factor test scores

Component	Initial Eigenvalues			Extraction sums of squared loadings		
	Total	**% of variance**	**Cumulative %**	**Total**	**% of variance**	**Cumulative %**
1	20.631	38.927	38.927	20.631	38.927	38.927
2	3.770	7.114	46.040			
3	2.613	4.930	50.970			
4	2.505	4.727	55.697			
5	1.734	3.272	58.969			
6	1.588	2.996	61.965			
7	1.212	2.286	64.251			
8	1.142	2.155	66.407			
9	1.120	2.114	68.521			
10	1.026	1.935	70.456			
11	0.926	1.748	72.204			
12	0.902	1.703	73.907			
13	0.839	1.584	75.490			
14	0.803	1.515	77.006			
15	0.785	1.480	78.486			
16	0.713	1.344	79.830			
17	0.691	1.303	81.133			
18	0.636	1.199	82.332			
19	0.614	1.158	83.490			
20	0.572	1.080	84.570			
21	0.542	1.022	85.592			
22	0.495	0.933	86.526			
23	0.486	0.917	87.443			
24	0.452	0.853	88.296			
25	0.442	0.834	89.130			
26	0.426	0.804	89.934			
27	0.410	0.775	90.708			
28	0.377	0.711	91.419			
29	0.349	0.658	92.077			
30	0.340	0.641	92.718			
31	0.303	0.572	93.291			
32	0.296	0.558	93.849			
33	0.280	0.529	94.378			
34	0.271	0.510	94.888			
35	0.253	0.477	95.365			
36	0.238	0.449	95.815			
37	0.228	0.431	96.246			
38	0.215	0.405	96.651			
39	0.177	0.334	96.985			
40	0.170	0.321	97.306			
41	0.164	0.309	97.615			
42	0.159	0.300	97.915			
43	0.151	0.284	98.199			
44	0.137	0.258	98.457			
45	0.129	0.243	98.700			
46	0.119	0.224	98.924			
47	0.112	0.211	99.135			
48	0.107	0.203	99.338			
49	0.090	0.169	99.507			
50	0.084	0.158	99.665			
51	0.071	0.135	99.800			
52	0.058	0.109	99.908			
53	0.049	0.092	100.000			

Note: Extraction method was principal component analysis. Unrotated.

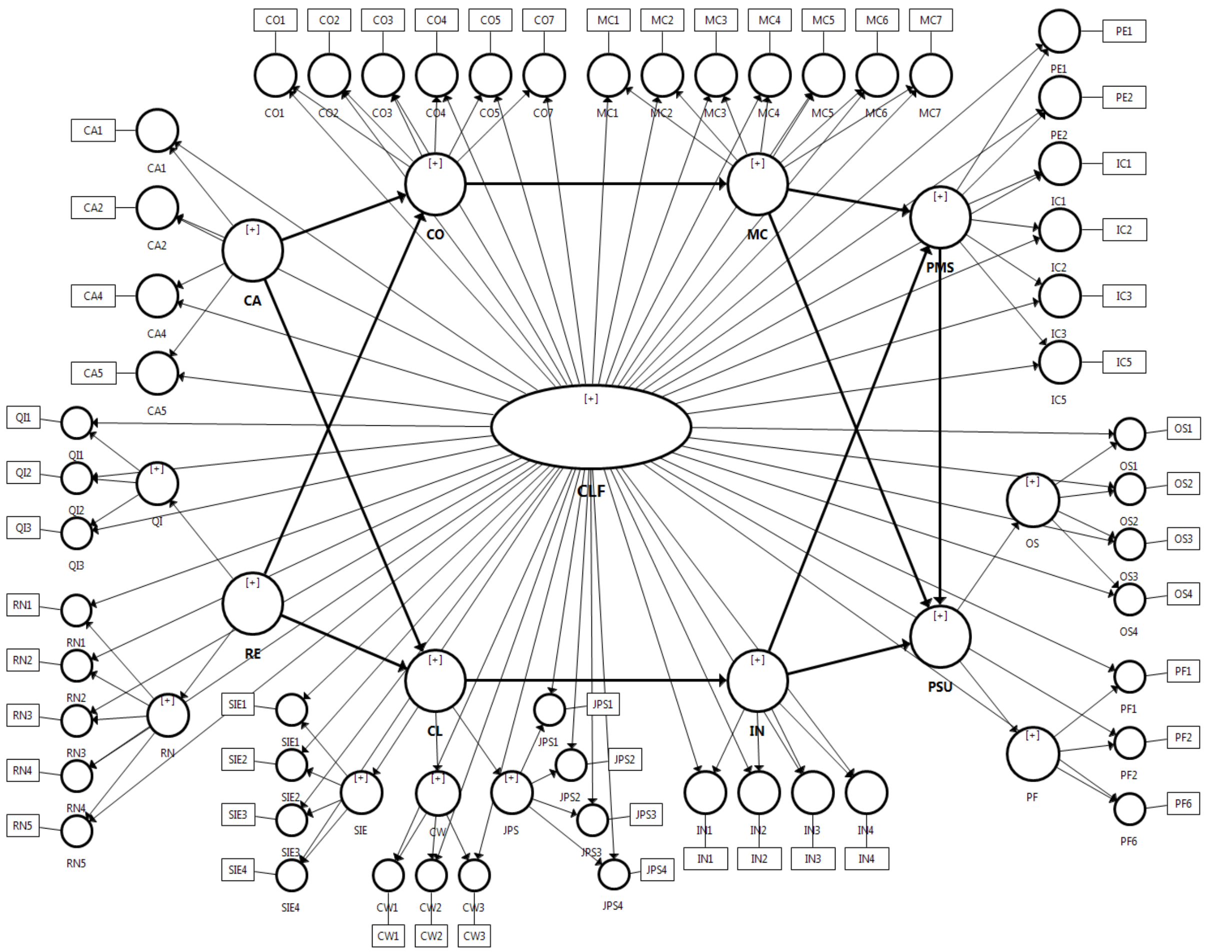


Figure 5.7: The PLS model for assessing common method bias

To determine whether or not common method bias is relevant, L. Williams, Edwards, and Vandenberg (2003) recommend the use of two criteria: (1) comparing the variances (i.e. squared values of factor loadings) of each indicator explained by its substantive construct and the method factor; and (2) evaluating the statistical significance of factor loadings to each indicator and the CLF. When the substantive factor loadings are considerably higher than CLF loadings, and CFL loadings are non-significant, common method bias is not a relevant issue.

As presented in Table 5.16, scores obtained from SmartPLS 3 (Ringle et al., 2015) demonstrate that the average of substantively explained variance is 0.676, and the mean of method variance is 0.018 (i.e. 37.6 times greater). Moreover, most of the CLF loadings are non-significant. Demonstrably, this study is not greatly influenced by common method bias.

Table 5.16: Common latent factor (CLF) test scores

Construct	Item	Substantive factor loading (R1)	$R1^2$	CFL loading (R2)	$R2^2$
CA	CA1	0.792***	0.627	-0.092	0.008
	CA2	0.764***	0.584	0.059	0.003
	CA4	0.612***	0.375	0.160	0.026
	CA5	0.768***	0.590	-0.133	0.018
CO	CO1	0.605***	0.366	0.158	0.025
	CO2	0.865***	0.748	-0.156	0.024
	CO3	0.779***	0.607	0.040	0.002
	CO4	0.666***	0.444	0.160	0.026
	CO5	0.902***	0.814	-0.291	0.085
	CO7	0.672***	0.452	0.031	0.001
MC	MC1	0.542***	0.294	0.232	0.054
	MC2	0.834***	0.696	-0.050	0.003
	MC3	0.914***	0.835	-0.158	0.025
	MC4	0.922***	0.850	-0.145	0.021
	MC5	0.891***	0.794	-0.060	0.004
	MC6	0.765***	0.585	0.086	0.007
	MC7	0.633***	0.401	0.117	0.014
QI	QI1	1.068***	1.141	-0.245	0.060
	QI2	0.903***	0.815	0.008	0.000
	QI3	0.681***	0.464	0.225	0.051
RN	RN1	0.810***	0.656	0.098	0.010
	RN2	0.876***	0.767	-0.080	0.006
	RN3	1.089***	1.186	-0.207	0.043
	RN4	0.948***	0.899	-0.041	0.002
	RN5	0.580***	0.336	0.252	0.064
SIE	SIE1	0.785***	0.616	0.073	0.005
	SIE2	0.743***	0.552	0.109	0.012
	SIE3	0.858***	0.736	-0.109	0.012
	SIE4	0.857***	0.734	-0.089	0.008
CW	CW1	0.852***	0.726	0.074	0.005
	CW2	0.978***	0.956	-0.065	0.004
	CW3	0.905***	0.819	-0.009	0.000
JPS	JPS1	0.783***	0.613	0.100	0.010
	JPS2	1.039***	1.080	-0.301	0.091
	JPS3	0.900***	0.810	-0.058	0.003
	JPS4	0.621***	0.386	0.230	0.053
IN	IN1	0.886***	0.785	-0.011	0.000
	IN2	0.902***	0.814	-0.012	0.000
	IN3	0.845***	0.714	0.044	0.002
	IN4	0.637***	0.406	-0.030	0.001
PMS	PE1	0.754***	0.569	-0.017	0.000
	PE2	0.628***	0.394	0.055	0.003
	IC1	0.790***	0.624	-0.019	0.000
	IC2	0.964***	0.929	-0.065	0.004
	IC3	0.926***	0.857	-0.052	0.003
	IC5	0.675***	0.456	0.123	0.015
OS	OS1	0.979***	0.958	-0.079	0.006
	OS2	1.000***	1.000	-0.121	0.015
	OS3	0.789***	0.623	0.068	0.005
	OS4	0.749***	0.561	0.154	0.024
PF	PF1	0.678***	0.460	0.192	0.037
	PF2	0.861***	0.741	-0.185	0.034
	PF6	0.748***	0.560	-0.030	0.001
	Average	**0.812**	**0.676**	**-0.001**	**0.018**

Note: Significance calculation was by bootstrapping routine with 500 subsamples, assuming a certain level of confidence 95%. Critical t-values for a two-tailed test are 1.96* (confidence level = 5%), 2.58** (confidence level = 1%), and 3.29*** (confidence level = 0.1%).

5.5.2 Multicollinearity

Collinearity is defined as “a data issue that arises if two independent variables are highly correlated” (Sarstedt & Mooi, 2014, p. 198). In general, collinearity exists when one variable has a perfect linear correlation with another, generating bias in the path coefficients (Hair et al., 2016). This issue has recently become relatively easy to detect through the tolerance (TOL) and variance inflation factor (VIF). The VIF is the reciprocal value of TOL (Sarstedt & Mooi, 2014). TOL refers to the quantity of variance of an indicator that cannot be explained by the other indicators in a specified construct (Hair et al., 2016). Conversely, VIF measures to what extent an indicator variance is explained by the other construct indicators, to determine the extent of the redundancy of the indicator information (Urbach & Ahlemann, 2010). Thus, when TOL is less than 0.2 (or reciprocally VIF greater than 5.0), multicollinearity is seen as a potential problem (Hair et al., 2016).

Multicollinearity assessment among the structural model constructs yielded VIF scores shown in Table 5.17, which are clearly below the critical value of 5. These results from SmartPLS 3 (Ringle et al., 2015) indicate that multicollinearity was not an issue in this study.

Table 5.17: Results of multicollinearity test (VIF scores)

	CA	CO	MC	RE	CL	IN	PMS	PSU
CA		1.119			1.119			
CO			1.000					
MC							1.350	1.529
RE		1.119			1.119			
CL						1.000		
IN							1.350	1.441
PMS								1.399
PSU								

5.5.3 Relevance of the significant path coefficients

The next step in the process of structural model assessment consists of evaluating the appropriateness of path coefficient estimates. Path coefficients represent the strength of the hypothesised relationships between the latent variables with regard to their algebraic sign, magnitude and significance (Urbach & Ahlemann, 2010). According to Hair et al. (2016), the standardised values of path coefficients between +1 (i.e. strong positive correlation) and -1 (i.e. strong negative correlation) are usually statistically significant. In contrast, scores near zero refer to weaker relationships and are commonly non-significant.

Given that PLS-SEM is a nonparametric method, the significance level is calculated by resampling techniques such as bootstrapping (Efron & Tibshirani, 1994). This data-based simulation method for statistical inference is applied by drawing a large number of the bootstrap samples from the original sample, with a replacement process where each time a sample is drawn randomly from the sampling population, it is returned before the next sample is drawn (Efron & Tibshirani, 1994; Field, 2013). The number of bootstrap samples should be greater or at least equal than the sampling size; however, as a general rule, 5000 is the number of samples suggested to evaluate the significance of path coefficients (Hair et al., 2016).

According to Hair et al. (2016), the statistical relevance of the path coefficients can be established by different means. The most commonly used method is a comparison between an observed t-value and the critical value (i.e. value where the coefficient is statistically significant at a certain error probability). Critical values for two-tailed tests have 1.96, 2.58 and 3.29 to 5%, 1%, and 0.1% significance level, respectively. Recently, certain bootstrap intervals are frequently used to define whether path coefficients are significantly different from zero. These certain intervals are calculated from the standard errors produced by bootstrapping routine under a certain level of confidence, usually 95%. When certain intervals of a hypothesised relationship between latent variables do not contain zero, the hypothesis is rejected, and a significant association can be assumed. In the structural model assessment for this research, all scores were obtained from SmartPLS 3 software (Ringle et al., 2015) by applying the bootstrapping method to 5000 subsamples, bias-corrected and accelerated (BCA) and with no signal changes option. Table 5.18 demonstrates that all path coefficients of the structural model are significant, except MC –» PSU.

Table 5.18: Relevance of path coefficients

Path	Original Sample	Sample Mean	Standard Deviation	t-values	p-values	Confidence intervals 2.50%	97.50%
CA –» CO	0.234***	0.238	0.067	3.476	0.001	0.095	0.359
CA –» CL	0.134**	0.136	0.046	2.907	0.004	0.043	0.220
CO –» MC	0.633***	0.636	0.051	12.466	0.000	0.518	0.720
MC –» PMS	0.358***	0.360	0.091	3.950	0.000	0.167	0.523
MC –» PSU	0.071	0.067	0.076	0.933	0.351	-0.077	0.219
RE –» CO	0.643***	0.639	0.058	11.174	0.000	0.521	0.747
RE –» CL	0.813***	0.809	0.030	26.678	0.000	0.752	0.869
CL –» IN	0.767***	0.768	0.037	20.534	0.000	0.683	0.831
IN –» PMS	0.254**	0.253	0.094	2.712	0.007	0.070	0.444
IN –» PSU	0.144*	0.148	0.066	2.194	0.028	0.015	0.275
PMS –» PSU	0.618***	0.615	0.070	8.809	0.000	0.457	0.738

Note: Significance was calculated through bootstrapping routine with 5000 subsamples, assuming a certain level of confidence 95%. Critical t-values for a two-tailed test are 1.96* (confidence level = 5%), 2.58** (confidence level = 1%), and 3.29*** (confidence level = 0.1%).

5.5.4 Coefficient of determination (R^2)

The predictive accuracy of a structural model is evaluated by the coefficient of determination, the R^2 value. In general terms, R^2 value refers to the quantity of explained variance in the endogenous constructs from all linked exogenous constructs (Hair et al., 2016). The values must be sufficiently high for the model to have a minimum level of explanatory power (Urbach & Ahlemann, 2010). Thus, the R^2 value fluctuates between 0 and 1, where higher R^2 scores are assigned greater levels of predictive accuracy. Hence, values around 0.67 are considered substantial, while values around 0.33 and 0.19 are regarded as moderate and weak, respectively (Chin, 1998).

In this investigation, the R^2 values were obtained from SmartPLS 3 software (Ringle et al., 2015) as displayed in Table 5.19. The results demonstrate that all R^2 values are significant, at least at the 1% level. The predictive accuracy level of this structural model is substantial for CL, moderate for CO, MC, IN, and PSU, and weak for PMS. In general, these values are adequate for predicting accuracy between specified latent variables.

Table 5.19: Coefficient of determination (R^2)

	Original Sample	Sample Mean	Standard Deviation	t-values	p-values	Confidence intervals 2.50%	97.50%	Predictive accuracy
CO	0.566***	0.574	0.057	9.995	0.000	0.435	0.662	Moderate
MC	0.401***	0.406	0.064	6.274	0.000	0.272	0.520	Moderate
CL	0.749***	0.751	0.035	21.451	0.000	0.671	0.810	Substantial
IN	0.589***	0.591	0.057	10.347	0.000	0.458	0.688	Moderate
PMS	0.285***	0.298	0.066	4.348	0.000	0.154	0.404	Weak
PSU	0.539**	0.546	0.073	7.425	0.000	0.376	0.666	Moderate

Note: Significance was calculated through bootstrapping routine with 5000 subsamples, assuming a certain level of confidence 95%. Critical t-values for a two-tailed test are 1.96* (confidence level = 5%), 2.58** (confidence level = 1%), and 3.29*** (confidence level = 0.1%).

5.5.5 Effect size (f^2)

Although in this case all R^2 scores indicate a moderate or substantial level of predictive accuracy, “selecting a model solely based on the R^2 value is not a good approach” (Hair et al., 2016, p. 199), because merely adding other non-significant constructs to explain an endogenous construct is enough to increase the level of predictive accuracy. Therefore, this study analyses the change in the R^2 value of an endogenous construct once a particular exogenous construct is excluded, thus assessing whether an exogenous construct has a substantial impact on an endogenous construct. This impact is called the effect size (f^2) (Cohen, 1992; Urbach & Ahlemann, 2010). For quantifying the effect size f^2, Chin (1998) proposes the following formula:

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}} \qquad \text{[Equation 5.4]}$$

Where, $R^2_{included}$ and $R^2_{excluded}$ are the coefficient of determination R^2 calculated on the dependent construct when the predictor construct is used or omitted in the structural model, respectively.

The f^2 values of 0.02, 0.15, and 0.35 indicate an exogenous construct has a small, medium or large effect, respectively, on an endogenous construct (Chin, 1998; Cohen, 1992) and values under 0.02 indicate that there is no effect (Hair et al., 2016). The f^2 score results from SmartPLS 3 (Ringle et al., 2015) are summarised in Table 5.20. All values have different levels of effect. RE –» CO, RE –» CL, CO –» MC, CL –» IN and PMS –» PSU paths have a large effect. CA –» CO, CA –» CL, MC –» PMS, IN –» PMS and IN –» PSU paths have a small effect. Finally, MC –» PSU path has no effect.

Table 5.20: Effect size (f^2) scores

	CA	CO	MC	RE	CL	IN	PMS	PSU
CA		0.113 (S)			0.064 (S)			
CO			0.669 (L)					
MC							0.132 (S)	0.007 (N/E)
RE		0.850 (L)			2.351 (L)			
CL						1.430 (L)		
IN							0.067 (S)	0.031 (S)
PMS								0.593 (L)
PSU								

Note: S=small effect, M=medium effect, L=large effect, N/E=no effect

5.5.6 Predictive relevance (Q^2)

The Q^2 value refers to the measurement of the predictive relevance of a set of indicator variables; that is, it determines whether the structural model accurately predicts the data points of indicators in reflective endogenous variables (Hair et al., 2016). The Q^2 is calculated through a blindfolding procedure. This iterative method systematically assumes that a group of observations are missing from the sample size, and then the original model parameters are applied to predict the omitted values (Urbach & Ahlemann, 2010). Q^2 values greater than zero indicate that the exogenous latent variables have predictive relevance for the endogenous latent variables (Chin, 1998).

This study applies the cross-validated redundancy approach to obtain Q^2 values because it defines the path model estimates from the structural model focused on the antecedent (exogenous and endogenous) constructs and from the measurement models targeted on endogenous constructs for data prediction, as suggested by Hair et al. (2016). Using SmartPLS 3 (Ringle et al., 2015), the Q^2 scores for all six endogenous constructs are presented in Table 5.21, which evidence that values are notably above zero, thus supporting the satisfactory predictive relevance of the model.

Table 5.21: Predictive relevance (Q^2) scores

	SSO	SSE	Q^2 (=1-SSE/SSO)
CA	672.000	672.000	
CO	1008.000	712.519	0.293
MC	1176.000	903.732	0.232
RE	1344.000	1344.000	
CL	1848.000	1058.957	0.427
IN	672.000	414.669	0.383
PMS	1008.000	838.155	0.168
PSU	1176.000	857.910	0.270

Note: Blindfolding routine for omission distance equal 10.

SSO=sum of the squared observations, SEE=sum of the squared predicted errors.

5.5.7 Effect size of predictive relevance (q^2)

Similarly to the use of effect size f^2 for assessing the impact of R^2 predictive accuracy, the effect size of predictive relevance may be estimated using q^2 value. This score shows the contribution of an exogenous construct on the predictive relevance of an endogenous construct (Hair et al., 2016). Considering the criteria proposed by Cohen (1992), q^2 values of 0.02, 0.15, and 0.35 indicate that an exogenous construct has either a small, medium or large predictive relevance effect on an endogenous construct, respectively.

Given that SmartPLS 3 software does not directly provide the q^2 values, these are calculated manually using equation 5.5.

$$q^2 = \frac{Q^2_{incluided} - Q^2_{excluided}}{1 - Q^2_{incluided}} \qquad \text{[Equation 5.5]}$$

Thus, the $Q^2_{incluided}$ scores are taken from the previous blindfolding performed to calculate Q^2 (see Table 5.22), whereas $Q^2_{excluided}$ scores are also obtained from the blindfolding routine, but after the deletion of each specific endogenous construct predecessor. Table 5.22 summarises the q^2 values for all the relationships in the structural model. Results confirm that in the majority of the cases the effect of predictive relevance can be determined as either small, medium or large; however, CA –» CL, MC –» PSU and IN –» PSU paths demonstrate no effects on predictive relevance.

Table 5.22: Effect size of predictive relevance (q^2) scores

	CA	CO	MC	RE	CL	IN	PMS	PSU
CA		0.035 (S)			0.016 (N/E)			
CO			0.302 (M)					
MC							0.066 (S)	0.000 (N/E)
RE		0.270 (M)			0.588 (L)			
CL						0.621 (L)		
IN							0.032 (S)	0.008 (N/E)
PMS								0.190 (M)
PSU								

Note: S=small effect, M=medium effect, L=large effect, N/E=no effect

5.5.8 Statistical power

The power of a statistical test of a null hypothesis (H_o) is "the probability that the H_o will be rejected when it is false, that means the probability to obtain statistically significant results" (Cohen, 1992, p. 98). Cohen (1992) argues that it is useful to assess the statistical power analysis of completed research because this exploits the mathematical relationship between four variables in statistical inference: power; the significance level; the sample size; and the population size effect. Thus, the determination of statistical power in empirical studies to detect a hypothesised effect size given the sample size and the significance level is advisable. Therefore, G*Power 3.1.9.2 is applied to evaluate the post hoc statistical power (Faul, Erdfelder, Lang, & Buchner, 2007) in this research.

The results exhibited in Figure 5.8 demonstrate that statistical power of 91.6% was achieved considering the sample size of 168, the significance level at 0.05 and the effect size of 0.067 (i.e. the least f^2 value obtained from IN –» PSU path as presented in Table 5.20). This power of more than 75% warrants an appropriate quality of the results for either accepting or rejecting the proposed hypotheses, as highlighted by Cohen (1992) and Faul et al. (2007).

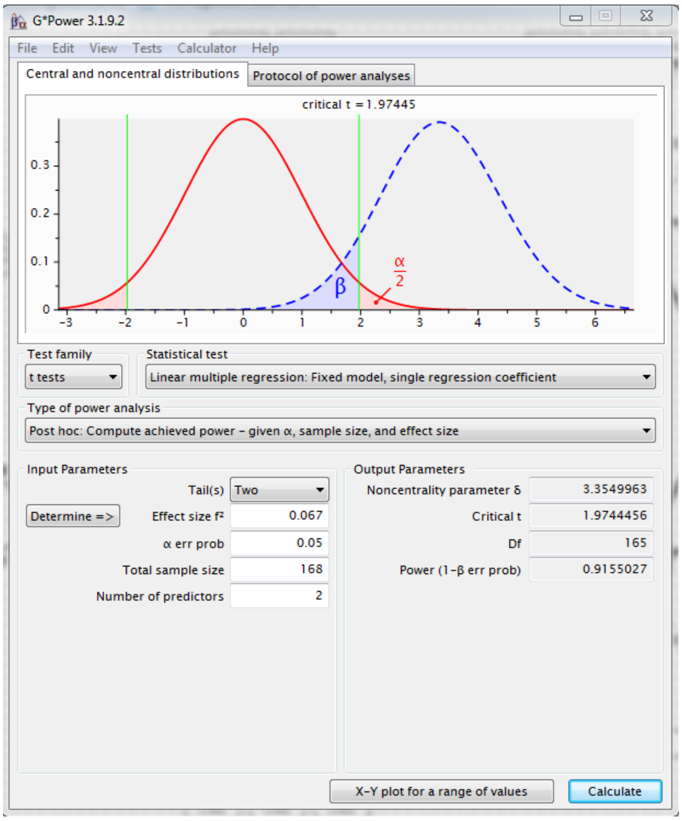


Figure 5.8: Post hoc statistical power analysis

In the light of these outcomes, the validated structural model is shown in Figure 5.9. Hypothesis testing results are summarised and discussed in Chapter 6.

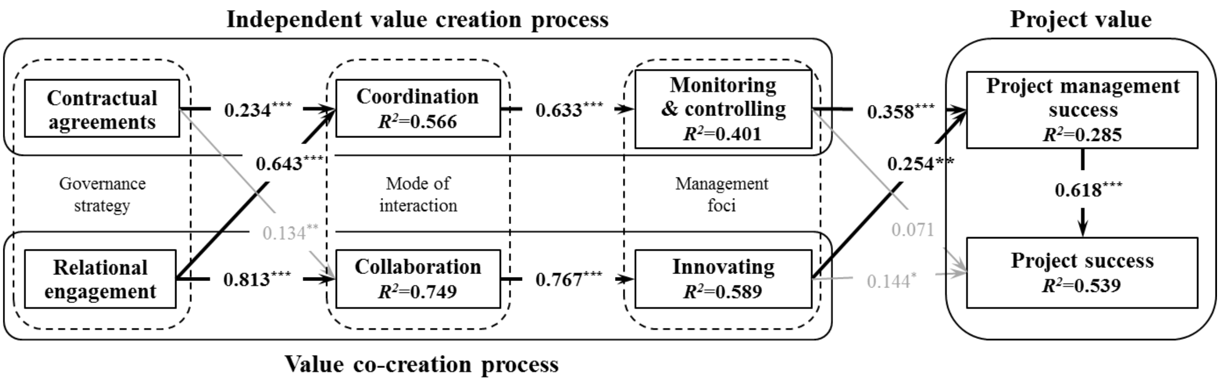


Figure 5.9: Validated structural model

In addition to the assessment of the structural and measurements models, the moderating effects of requirements uncertainty (RU) and project complexity (PC) on the relationship of value creation processes and project value were separately analysed, as recommended by Hair et al. (2013); the results are presented in the next section.

5.6 Moderation analysis

In this research, another fundamental element to evaluate consists of the moderating effects of requirements uncertainty and project complexity (i.e. moderator variables) on the relationship between value creation processes (i.e. independent or predictor or exogenous variable) and project value (i.e. dependent or outcome or endogenous variable). As declared by Baron and Kenny (1986), moderating effects (also called interaction effects) are produced by a third variable that impacts on the magnitude or the direction of a relationship between an exogenous and an endogenous latent variable. Venkatraman (1989) presents a mathematical function of moderation as follows:

$$Y = f(X, Z, X.Z) \qquad \text{[Equation 5.6]}$$

Where Z represents the moderator variable to the relationship between two other variables, X the independent variable and Y the dependent variable, and it is a function of the level of Z. X.Z reflects the common effect (or interaction term) of X and Z (see Figure 5.10).

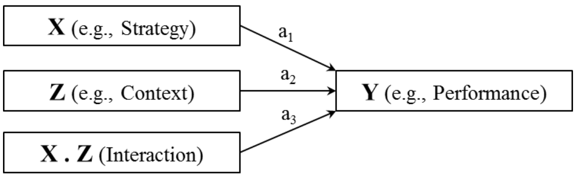


Figure 5.10: A representation of moderation (Venkatraman, 1989)

Henseler and Fassott (2010) refer to moderation representation as a product term approach. Thus, the function shown in Equation 5.6 can be presented as follows:

$$Y = \text{a} + \text{a1}.X + \text{a2}.Z + \text{a3}.X.Z \qquad \text{[Equation 5.7]}$$

Moderator variables can be categorised into two types, i.e., categorical and continuous (Hair et al., 2016). Categorical moderators, such as gender, are discrete, dummy coded (i.e., 0 or 1) and usually dichotomous; however, they can only represent more than two groups, for example, the social class variable. Conversely, continuous moderators such as customer income or project size can affect the relationship between latent variables across a continuum.

In other words, construct relationships changes (e.g., to stronger or weaker relationships) according to the level of presence (i.e. higher or lower) of the moderator variable (Hair et al., 2016).

As discussed by Henseler and Fassott (2010), when the independent variable and the moderator are continuous, a product term approach becomes necessary in order to evaluate the moderating effect. In contrast, when either the independent variable or the moderator is categorical, a group comparisons approach provides an appropriate alternative to assess the moderating effects. In spite of this, depending on the particular research question, researchers sometimes dichotomise a continuous moderator variable in a categorical moderator variable (Henseler & Fassott, 2010). That is, the scaled variable is transformed into a grouping variable by dividing the construct into two or more value categories, for example, by using means or medians (Venkatraman, 1989). Thus, median split represents a popular technique for dichotomising continuous variables where observations with moderator values higher than the median are sorted into a group, whereas observations with moderator values lower than the median are included in another group. Comparing the differences between model parameters in both groups are used to interpret the moderating effects in this case (Henseler & Fassott, 2010).

With the above information in mind, this study applies the median split method to divide the observations into four groups according to the different project types proposed and summarised in Figure 3.2; certain simple (type A) projects, uncertain simple (type B) projects, certain complex (type C) projects and uncertain complex (type D) projects.

5.6.1 Factor analysis of moderator variables

The two moderator latent variables included in the conceptual framework (i.e. requirements uncertainty-RU and project complexity-PC) are evaluated regarding their unidimensionality to secure the interpretability of the subsequent analyses. Thus, scores of unidimensionality (see Table 5.23) are taken from the exploratory factor analysis performed with IBM SPSS Statistics 24. According to these results, the RU1, RU3, PC6 and PC7 indicator variables were removed because they might not be a reliable measurement within the group of indicators that predict the construct.

Table 5.23: Summary of exploratory factor analysis of moderator variables (N=168)

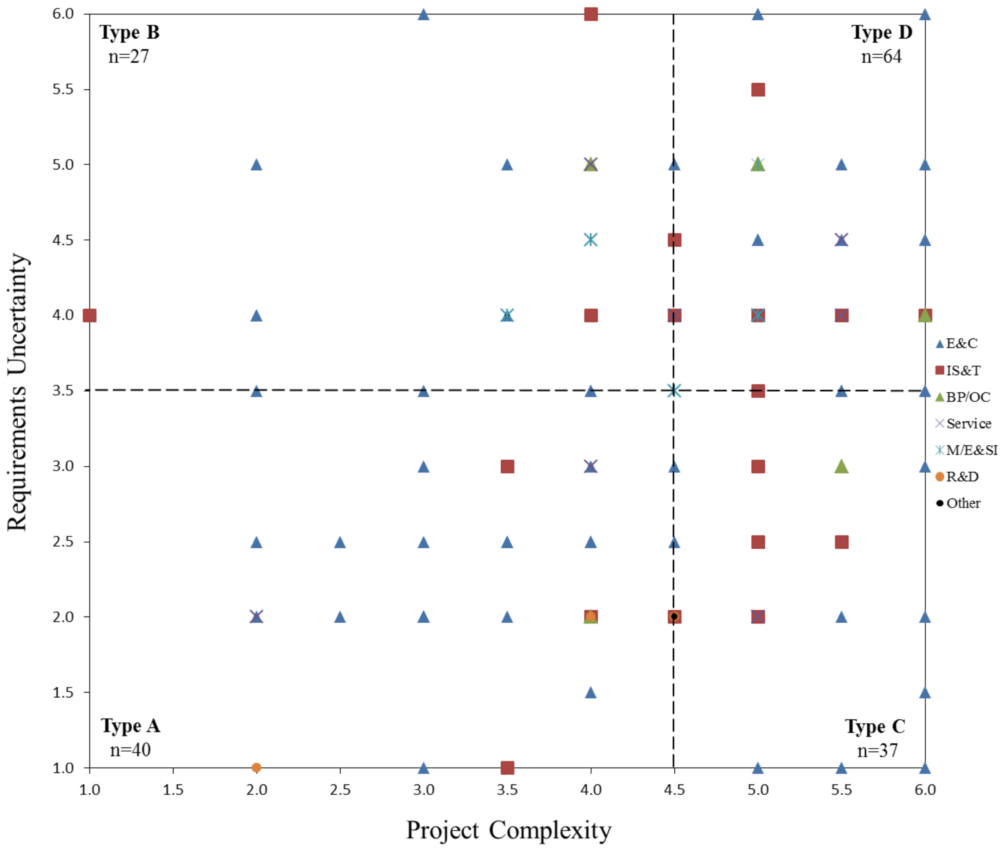
Item	**Unidimensionality**			**Loadings[a]**	
	Initial	**Extraction**		**Factor 1**	**Factor 2**
~~RU1~~	1.000	**~~0.038~~**		~~-0.071~~	~~0.111~~
RU2	1.000	0.585		0.206	**0.736**
~~RU3~~	1.000	**~~0.204~~**		-0.126	**0.434**
RU4	1.000	0.678		0.210	**0.796**
RU5	1.000	0.632		0.237	**0.759**
RU6	1.000	0.651		0.156	**0.792**
PC1	1.000	0.417		**0.638**	-0.104
PC2	1.000	0.609		**0.767**	-0.145
PC3	1.000	0.649		**0.795**	-0.132
PC4	1.000	0.439		**0.644**	0.156
PC5	1.000	0.319		**0.552**	0.120
~~PC6~~	1.000	**~~0.235~~**		**0.455**	0.166
~~PC7~~	1.000	**~~0.222~~**		**0.463**	0.088
PC8	1.000	0.336		**0.565**	0.129
▫ The chi-square statistic is 628.032 on 91 degrees of freedom.			Eigenvalue	3.691	2.323
			% of variance	26.368	16.596
▫ The ***p-value is 0.000			Cumulative % of variance	26.368	**42.964**

Note: Extraction method: principal component analysis
[a] Rotated component matrix. Rotation method: Varimax with Kaiser normalisation; Rotation converged in 3 iterations.

5.6.2 Data segmentation

Subsequent to factor analysis, the dataset is segmented according to the average of the median of RU and PC. For each observation, the medians of RU and PC are calculated for each observation, then the results of the mean of the medians for RU and PC are 3.5 and 4.5 (on a scale from 1 to 6), respectively. RU is considered high in projects with a median of at least 3.5 (i.e. scores between 3.5 and 6.0). Values lower than 3.5 represent projects with low RU. In contrast, projects with high PC are those in which the median is either equal to, or greater than 4.5 (i.e. values between 4.5 and 6.0), and PC is defined as low in projects where the median is lower than 4.5. In this way, the sample size for each type of project is 40 for certain simple (type A) projects; 27 for uncertain simple (type B) projects; 37 for certain complex (type C) projects; and 64 for uncertain complex (type D) projects.

Figure 5.11 shows the sample size for each group of projects according to the perceived level of RU and PC. The particular type of project, as related to industry or field, is also presented. This representation implies that industries have projects with different levels of RU and PC and that their categorisation does not depend on the size relating to cost or time. Table 5.24 displays the number and percentage of each type of project in this sample.



Legend: E&C=Engineering & Construction; IS&T=Information Systems & Technology; BP/OC=Business Processes/ Organizational Change; M/E&SI=Maintenance/Equipment & System Installation; R&D=Research & Development

Figure 5.11: Data split according to four proposed types of projects

Table 5.24: Summary of types of projects: industry or field and frequency

Industry or Field	Type of project A	B	C	D	Total
Engineering & construction	29 (24.2%)	20 (16.7%)	27 (22.5%)	44 (36.7%)	120
Information systems & technology	6 (26.1%)	0 (0.0%)	8 (34.8%)	9 (39.1%)	23
Business processes/organizational change	1 (14.3%)	2 (28.6%)	0 (0.0%)	4 (57.1%)	7
Service	2 (22.2%)	3 (33.3%)	0 (0.0%)	4 (44.4%)	9
Maintenance/equipment & system installation	1 (20.0%)	1 (20.0%)	2 (40.0%)	1 (20.0%)	5
Research & development	1 (33.3%)	0 (0.0%)	0 (0.0%)	2 (66.7%)	3
Other	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	1
Total	40 (23.8%)	27 (16.1%)	37 (22.0%)	64 (38.1%)	168

5.6.3 Estimation of measurement and structural models for each group

Once the observations are classified, the direct effects for each group are then estimated separately (Henseler & Fassott, 2010) following the same procedures and tests applied in previous sections. The subsections that follow include the results of the measurement models and the structural model assessments for each type of proposed project.

5.6.3.1 Certain simple (type A) projects

Tables 5.25 and 5.26 present the evaluation of the measurement models (i.e. consistency reliability, indicator reliability, convergent validity and discriminant validity).

Table 5.25: Measurement model assessment for type A projects

Construct	**Item**	**Loading[a] > 0.700**	**α > 0.700**	**CR > 0.700**	**AVE > 0.500**
CA	CA1	0.746	0.720	0.844	0.644
	CA2	0.878			
	CA4	0.777			
CO	CO1	0.710	0.808	0.876	0.642
	CO2	0.868			
	CO3	0.912			
	CO4	0.693			
MC	MC1	0.663	0.859	0.895	0.588
	MC2	0.764			
	MC3	0.743			
	MC5	0.856			
	MC6	0.861			
	MC7	0.692			
RE			*0.903*	*0.924*	*0.636*
QI	QI1	0.821	0.830	0.899	0.748
	QI2	0.927			
	QI3	0.843			
RN	RN1	0.852	0.912	0.938	0.791
	RN2	0.871			
	RN3	0.918			
	RN4	0.916			
CL			*0.929*	*0.940*	*0.612*
SIE	SIE1	0.836	0.832	0.888	0.665
	SIE2	0.781			
	SIE3	0.808			
	SIE4	0.835			
CW	CW1	0.876	0.875	0.923	0.801
	CW2	0.892			
	CW3	0.915			
JPS	JPS1	0.860	0.800	0.883	0.716
	JPS3	0.893			
	JPS4	0.783			

Table 5.25: Measurement models assessment for type A projects (continued)

Construct	Item	Loading[a] > 0.700	α > 0.700	CR > 0.700	AVE > 0.500
IN	IN1	0.927	0.883	0.928	0.811
	IN2	0.858			
	IN3	0.915			
PMS	PE1	0.878	0.868	0.911	0.721
	PE2	0.662			
	IC2	0.922			
	IC3	0.910			
PSU			*0.840*	*0.883*	*0.540*
OS	OS1	0.943	0.922	0.945	0.813
	OS2	0.911			
	OS3	0.817			
	OS4	0.930			
PF	PF1	0.851	0.673[b]	0.813	0.593
	PF2	0.691			
	PF3	0.759			

Note: α=Cronbach's alpha; CR=Composite reliability; AVE=average variance extracted.
[a] All outer loadings are significant at 0.1 level. [b] Acceptable score for exploratory studies.

Table 5.26: Correlations and discriminant validity for type A projects

	CA	CO	MC	QI	RN	SIE	CW	JPS	IN	PMS	OS	PF
CA	**0.802**											
CO	0.416	**0.801**										
MC	0.341	0.662	**0.767**									
QI	0.328	0.656	0.729	**0.865**								
RN	0.242	0.682	0.681	0.636	**0.889**							
SIE	0.212	0.559	0.438	0.664	0.619	**0.816**						
CW	0.088	0.606	0.571	0.615	0.780	0.723	**0.895**					
JPS	0.314	0.773	0.680	0.746	0.826	0.791	0.817	**0.846**				
IN	0.078	0.406	0.379	0.548	0.411	0.611	0.684	0.582	**0.901**			
PMS	0.354	0.637	0.544	0.466	0.534	0.149	0.397	0.457	0.114	**0.849**		
OS	0.272	0.660	0.473	0.502	0.508	0.337	0.389	0.471	0.297	0.768	**0.902**	
PF	0.081	0.411	0.273	0.382	0.145	0.281	0.323	0.299	0.422	0.48	0.442	**0.770**

Note: Scores in bold type on the diagonal are the square root of AVE values; Scores below the diagonal are correlations.

Additionally, the structural model was assessed by the relevance of the path coefficients (Table 5.27), the coefficient of determination R^2 (Table 5.28), the effect size f^2 (Table 5.29) and predictive relevance Q^2 with the corresponding effect size q^2 (Table 5.30).

Table 5.27: Relevance of path coefficients for type A projects

Path	Original Sample	Sample Mean	Standard Deviation	t-values	p-values
CA –» CO	0.210	0.247	0.117	1.792	0.073
CA –» CL	-0.044	-0.035	0.111	0.399	0.690
CO –» MC	0.662^{***}	0.673	0.095	6.946	0.000
MC –» PMS	0.585^{*}	0.560	0.234	2.505	0.012
MC –» PSU	-0.012	-0.021	0.133	0.090	0.929
RE –» CO	0.676^{***}	0.654	0.104	6.524	0.000
RE –» CL	0.863^{***}	0.865	0.041	20.897	0.000
CL –» IN	0.680^{***}	0.680	0.095	7.186	0.000
IN –» PMS	-0.108	-0.073	0.168	0.642	0.521
IN –» PSU	0.306^{***}	0.309	0.092	3.314	0.001
PMS –» PSU	0.677^{***}	0.676	0.152	4.456	0.000

Note: Significance was calculated through bootstrapping routine with 5000 subsamples, assuming a certain level of confidence of 95%. Critical t-values for a two-tailed test are 1.96* (confidence level = 5%), 2.58** (confidence level = 1%), and 3.29*** (confidence level = 0.1%).

Table 5.28: Coefficient of determination (R^2) for type A projects

	R^2	Predictive accuracy
CO	0.587	Moderate
MC	0.438	Moderate
CL	0.724	Substantial
IN	0.462	Moderate
PMS	0.306	Weak-Moderate
PSU	0.588	Moderate

Table 5.29: Effect size (f^2) on endogenous constructs for type A projects

	CA	CO	MC	RE	CL	IN	PMS	PSU
CA		0.097 (S)			0.007 (N/E)			
CO			0.778 (L)					
MC							0.423 (L)	0.000 (N/E)
RE		1.005 (L)			2.448 (L)			
CL						0.860 (L)		
IN							0.014 (N/E)	0.192 (M)
PMS								0.770 (L)
PSU								

Note: S=small effect, M=medium effect, L=large effect, N/E=no effect

Table 5.30: Predictive relevance (Q^2) and the effect size (q^2) for type A projects

	Q^2	CA	CO	MC	RE	CL	IN	PMS	PSU
CA	-		0.021 (S)			-0.025 (N/E)			
CO	0.322			0.209 (M)					
MC	0.173							0.071 (S)	-0.021 (N/E)
RE	-		0.381 (L)			0.716 (L)			
CL	0.411						0.546 (L)		
IN	0.353							-0.034 (N/E)	0.030 (S)
PMS	0.061								0.220 (M)
PSU	0.236								

Note: Blindfolding routine for omission distance equal 10. S=small effect, M=medium effect, L=large effect, N/E=no effect

Additionally, the post hoc statistical power was calculated to a sample size n=40, the smallest effect size (i.e. f^2=0.192) and significance level at 5% as shown in Figure 5.12.

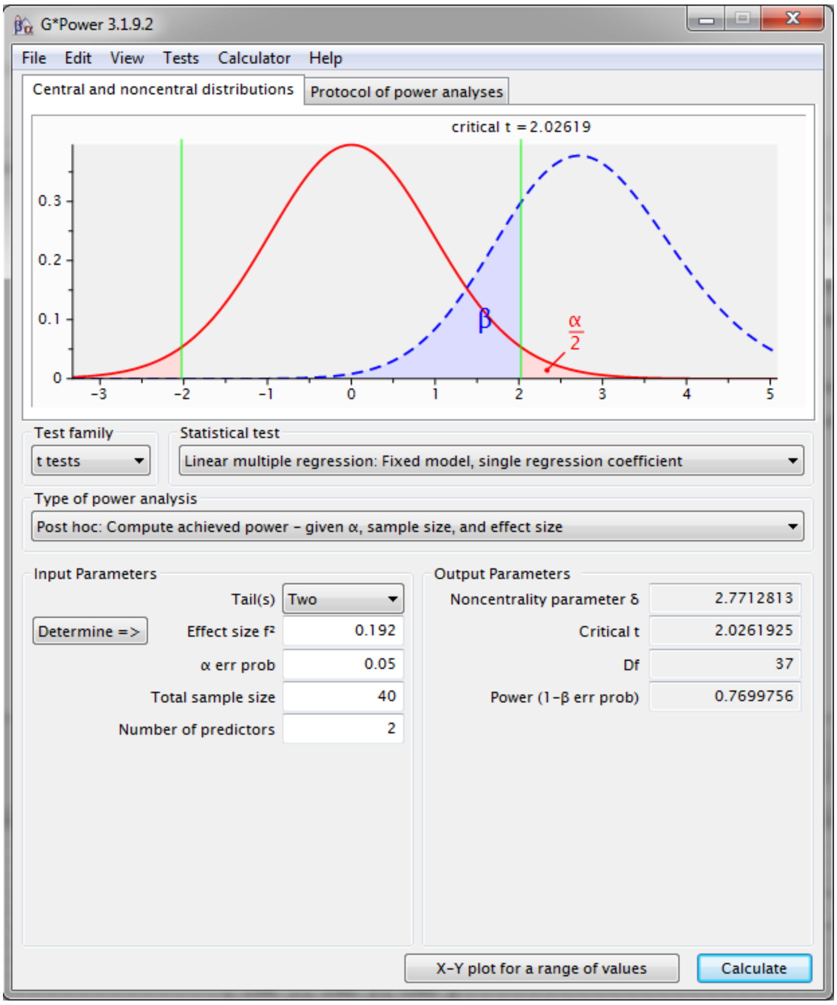


Figure 5.12: Post hoc statistical power analysis of type A projects

Finally, the validated model for certain simple (type A) projects is presented in Figure 5.13. The results establish that relational engagement–coordination–monitor & control path has a significant impact on project management success; and that relational engagement drives collaboration, which in turn impacts innovating to affect project success further.

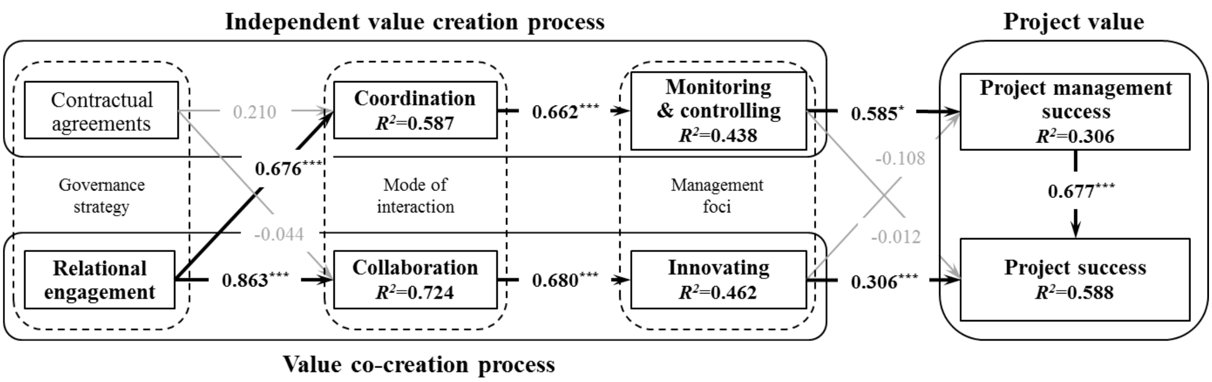


Figure 5.13: A validated model to certain simple (type A) projects

5.6.3.2 Uncertain simple (type B) projects

Similar to the data from the previous group, reliability and validity scores of the indicator variables and constructs of type B projects are displayed in Tables 5.31 and Table 5.32. Measures related to structural model assessment such as path coefficients, R^2, f^2, Q^2 and q^2 are summarised in Tables 5.33, 5.34, 5.35 and 5.36.

Table 5.31: Measurement model assessment for type B projects

Construct	Item	Loading[a]	α	CR	AVE
CA	CA2	0.863	0.659[b]	0.854	0.746
	CA4	0.864			
CO	CO1	0.772	0.834	0.889	0.668
	CO3	0.841			
	CO4	0.809			
	CO5	0.843			
MC	MC1	0.715	0.882	0.907	0.583
	MC2	0.718			
	MC3	0.806			
	MC4	0.850			
	MC5	0.706			
	MC6	0.796			
	MC7	0.743			
RE			*0.859*	*0.893*	*0.546*
QI	QI1	0.829	0.789	0.876	0.703
	QI2	0.881			
	QI3	0.804			
RN	RN1	0.869	0.863	0.908	0.711
	RN3	0.849			
	RN4	0.898			
	RN5	0.749			
CL			*0.857*	*0.890*	*0.505*
SIE	SIE1	0.946	0.863	0.936	0.879
	SIE2	0.930			
CW	CW1	0.921	0.899	0.937	0.833
	CW2	0.940			
	CW3	0.875			
JPS	JPS1	0.786	0.660[b]	0.814	0.594
	JPS2	0.709			
	JPS4	0.813			
IN	IN1	0.702	0.781	0.876	0.706
	IN2	0.905			
	IN3	0.895			
PMS	PE1	0.589	0.828	0.878	0.554
	PE2	0.539			
	IC2	0.875			
	IC3	0.867			
	IC4	0.822			
	IC5	0.703			
PSU			*0.822*	*0.870*	*0.537*
OS	OS3	0.956	0.909	0.956	0.916
	OS4	0.958			
PF	PF1	0.688	0.718	0.821	0.535
	PF3	0.729			
	PF5	0.769			
	PF6	0.737			

Note: α=Cronbach's alpha; CR=Composite reliability; AVE=average variance extracted.
[a] All outer loadings are significant at 0.01 level. [b] Acceptable score for exploratory studies (Hair et al., 2016).

Table 5.32: Correlations and discriminant validity for type B projects

	CA	CO	MC	QI	RN	SIE	CW	JPS	IN	PMS	OS	PF
CA	**0.863**											
CO	-0.016	**0.817**										
MC	0.081	0.420	**0.764**									
QI	0.361	0.607	0.460	**0.839**								
RN	0.174	0.571	0.244	0.535	**0.843**							
SIE	0.123	0.261	0.042	0.357	0.384	**0.938**						
CW	0.366	0.381	0.361	0.644	0.633	0.307	**0.912**					
JPS	0.310	0.482	0.168	0.616	0.566	0.700	0.538	**0.771**				
IN	0.084	0.320	0.537	0.367	0.439	0.405	0.475	0.503	**0.839**			
PMS	-0.001	0.189	0.458	0.188	0.187	0.292	0.265	0.380	0.560	**0.744**		
OS	-0.058	0.220	0.329	0.131	0.245	0.311	0.207	0.411	0.340	0.645	**0.957**	
PF	0.194	0.172	0.141	0.242	0.214	0.294	0.438	0.560	0.476	0.662	0.663	**0.732**

Note: Scores in bold type on the diagonal are the square root of AVE values; Scores below the diagonal are correlations.

Table 5.33: Relevance of path coefficients for type B projects

Path	Original Sample	Sample Mean	Standard deviation	t-values	p-values
CA –» CO	-0.230	-0.220	0.158	1.452	0.147
CA –» CL	0.130	0.139	0.145	0.894	0.371
CO –» MC	0.420*	0.419	0.213	1.968	0.049
MC –» PMS	0.221	0.276	0.173	1.277	0.202
MC –» PSU	-0.139	-0.105	0.204	0.680	0.497
RE –» CO	0.734***	0.744	0.124	5.909	0.000
RE –» CL	0.733***	0.709	0.125	5.848	0.000
CL –» IN	0.567*	0.575	0.221	2.566	0.010
IN –» PMS	0.441**	0.444	0.163	2.716	0.007
IN –» PSU	0.129	0.173	0.184	0.702	0.483
PMS –» PSU	0.713***	0.658	0.199	3.580	0.000

Note: Significance was calculated using bootstrapping routine with 5000 subsamples, assuming a certain level of confidence 95%. Critical t-values for a two-tailed test are 1.96* (confidence level = 5%), 2.58** (confidence level = 1%), and 3.29*** (confidence level = 0.1%).

Table 5.34: Coefficient of determination (R^2) for type B projects

	R^2	Predictive accuracy
CO	0.493	Moderate
MC	0.176	Not predictive accuracy
CL	0.609	Moderate
IN	0.322	Moderate
PMS	0.349	Moderate
PSU	0.538	Moderate

Table 5.35: Effect size (f^2) on endogenous constructs for type B projects

	CA	CO	MC	RE	CL	IN	PMS	PSU
CA		0.095 (S)			0.039 (S)			
CO			0.214 (M)					
MC							0.054 (S)	0.028 (S)
RE		0.973 (L)			1.256 (L)			
CL						0.475 (L)		
IN							0.213 (M)	0.021 (S)
PMS								0.716 (L)
PSU								

Note: S=small effect, M=medium effect, L=large effect, N/E=no effect

Table 5.36: Predictive relevance (Q^2) and the effect size (q^2) for type B projects

	Q^2	CA	CO	MC	RE	CL	IN	PMS	PSU
CA	-		0.018 (N/E)			0.000 (N/E)			
CO	0.283			0.089 (S)					
MC	0.082							0.008 (N/E)	-0.003 (N/E)
RE	-		0.450 (L)			0.276 (M)			
CL	0.243						0.208 (M)		
IN	0.172							0.059 (S)	0.000 (N/E)
PMS	0.129								0.183 (M)
PSU	0.211								

Note: Blindfolding routine for omission distance equal 5. S=small effect, M=medium effect, L=large effect, N/E=no effect

The post hoc statistical power is calculated to a sample size n=27, the smallest effect size to an endogenous variable (i.e. f^2=0.213) and significance level at 5% as shown in Figure 5.14. Additionally, Figure 5.15 presents the validated model to uncertain simple (type B) projects. As shown, the path defined by relational engagement, collaboration and innovating (RE–»CO–»IN) has a significant impact on project management success, which in turn affects project success.

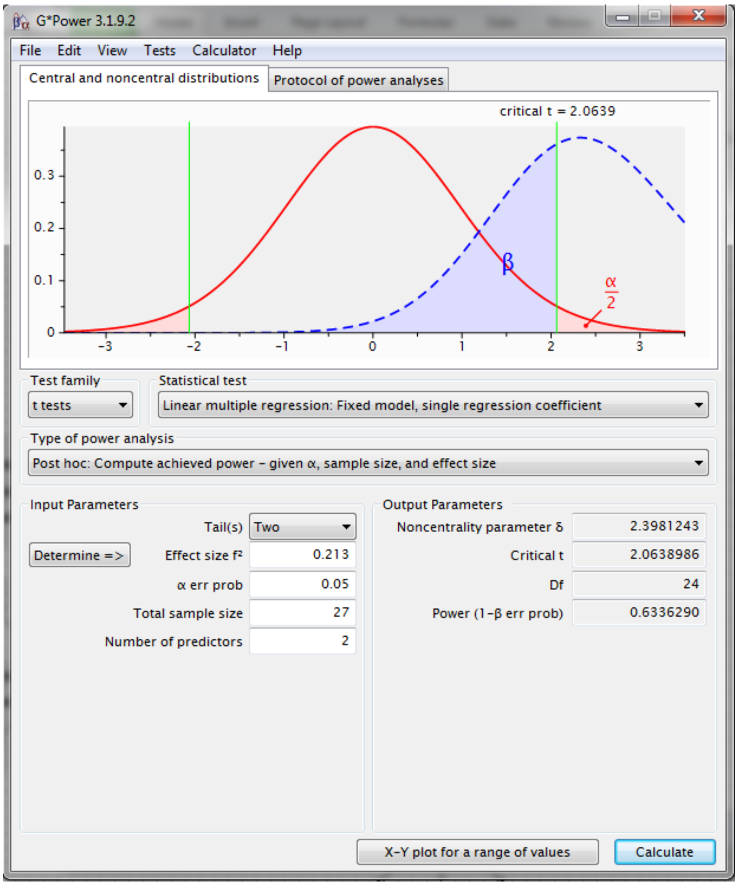


Figure 5.14: Post hoc statistical power analysis of type B projects

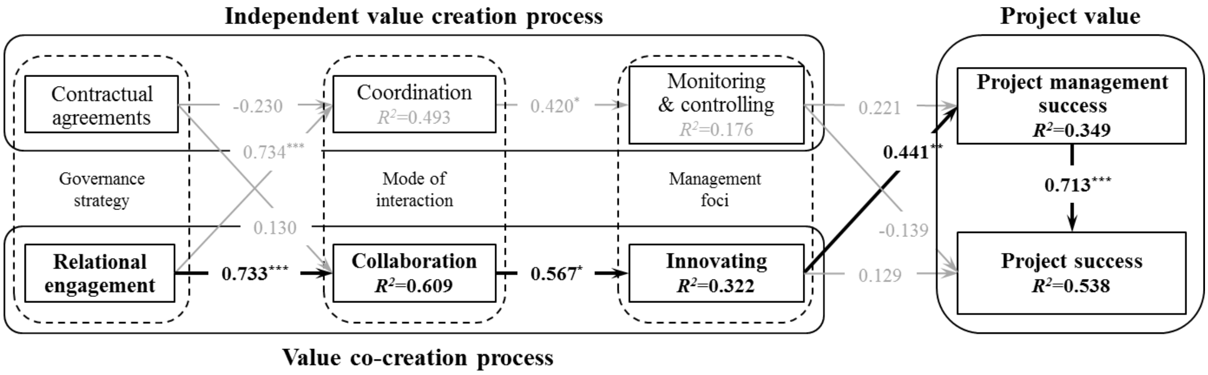


Figure 5.15: A validated model for uncertain simple (type B) projects

5.6.3.3 Certain complex (type C) projects

Results of measurement models for this kind of project are presented in Tables 5.37 and 5.38. Also, scores related to the structural model estimation are included in Tables 5.39, 5.40, 5.41 and 5.42, as follows.

Table 5.37: Measurement model assessment for type C projects

Construct	Item	Loading[a] > 0.700	α > 0.700	CR > 0.700	AVE > 0.500
CA	CA4	1.000	1.000	1.000	1.000
CO	CO1	0.706	0.828	0.879	0.593
	CO2	0.751			
	CO3	0.830			
	CO4	0.799			
	CO7	0.758			
MC	MC1	0.717	0.851	0.894	0.629
	MC2	0.762			
	MC5	0.882			
	MC6	0.877			
	MC7	0.710			
RE			*0.943*	*0.955*	*0.449*
QI	QI1	0.915	0.782	0.902	0.821
	QI2	0.897			
RN	RN1	0.892	0.928	0.949	0.822
	RN2	0.889			
	RN3	0.939			
	RN4	0.907			
CL			*0.942*	*0.952*	*0.688*
SIE	SIE1	0.915	0.851	0.910	0.773
	SIE2	0.944			
	SIE4	0.770			
CW	CW1	0.968	0.934	0.968	0.938
	CW2	0.969			
JPS	JPS1	0.860	0.907	0.935	0.783
	JPS2	0.838			
	JPS3	0.895			
	JPS4	0.942			

Table 5.37: Measurement model assessment for type C projects (continued)

Construct	Item	Loading[a]	α	CR	AVE
IN	IN1	0.899	0.847	0.899	0.695
	IN2	0.909			
	IN3	0.882			
	IN4	0.606			
PMS	PE1	0.795	0.888	0.915	0.643
	PE2	0.814			
	IC1	0.769			
	IC2	0.885			
	IC3	0.749			
	IC5	0.792			
PSU			*0.703*	*0.821*	*0.544*
OS	OS1	0.980	0.963	0.982	0.964
	OS2	0.984			
PF	PF2	0.873	0.616[b]	0.910	0.773
	PF5	0.825			

Note: α=Cronbach's alpha; CR=Composite reliability; AVE=average variance extracted.
[a] All outer loadings are significant at 0.01 level.
[b] Acceptable score for exploratory studies (Hair et al., 2016).

Table 5.38: Correlations and discriminant validity for type C projects

	CA	CO	MC	QI	RN	SIE	CW	JPS	IN	PMS	OS	PF
CA	**1.000**											
CO	0.609	**0.770**										
MC	0.565	0.645	**0.793**									
QI	0.487	0.712	0.543	**0.906**								
RN	0.430	0.749	0.473	0.885	**0.907**							
SIE	0.483	0.768	0.606	0.649	0.588	**0.879**						
CW	0.463	0.729	0.584	0.817	0.806	0.756	**0.968**					
JPS	0.443	0.689	0.456	0.692	0.772	0.744	0.794	**0.885**				
IN	0.581	0.717	0.451	0.666	0.717	0.734	0.784	0.785	**0.834**			
PMS	0.614	0.560	0.541	0.455	0.496	0.524	0.506	0.452	0.565	**0.802**		
OS	0.219	0.048	0.078	0.045	0.136	-0.062	0.127	-0.013	0.231	0.476	**0.982**	
PF	0.290	0.303	0.331	0.197	0.215	0.380	0.323	0.309	0.475	0.473	0.264	**0.850**

Note: Scores in bold type on the diagonal are the square root of AVE values; Scores below the diagonal are correlations.

Table 5.39: Relevance of path coefficients for type C projects

Path	Original Sample	Sample Mean	Standard deviation	t-values	p-values
CA –» CO	0.328*	0.330	0.128	2.573	0.010
CA –» CL	0.161	0.153	0.100	1.609	0.108
CO –» MC	0.645***	0.676	0.065	9.892	0.000
MC –» PMS	0.360*	0.376	0.146	2.465	0.014
MC –» PSU	-0.167	-0.164	0.184	0.909	0.363
RE –» CO	0.607***	0.608	0.130	4.681	0.000
RE –» CL	0.733***	0.735	0.075	9.758	0.000
CL –» IN	0.837***	0.839	0.061	13.774	0.000
IN –» PMS	0.402*	0.380	0.200	2.014	0.044
IN –» PSU	0.147	0.137	0.226	0.650	0.516
PMS –» PSU	0.598*	0.581	0.269	2.226	0.026

Note: Significance was calculated by using a bootstrapping routine with 5000 subsamples, assuming a certain level of confidence 95%. Critical t-values for a two-tailed test are 1.96* (confidence level = 5%), 2.58** (confidence level = 1%), and 3.29*** (confidence level = 0.1%).

Table 5.40: Coefficient of determination (R^2) for type C projects

	R^2	Predictive accuracy
CO	0.660	Substantial
MC	0.416	Moderate
CL	0.672	Substantial
IN	0.701	Substantial
PMS	0.422	Moderate
PSU	0.376	Moderate

Table 5.41: Effect size (f^2) on endogenous constructs for type C projects

	CA	CO	MC	RE	CL	IN	PMS	PSU
CA		0.249 (M)			0.062 (S)			
CO			0.711 (L)					
MC							0.178 (M)	0.030 (S)
RE		0.851 (L)			1.288 (L)			
CL						2.344 (L)		
IN							0.223 (M)	0.023 (S)
PMS								0.332 (M)
PSU								

Note: S=small effect, M=medium effect, L=large effect, N/E=no effect

Table 5.42: Predictive relevance (Q^2) and the effect size (q^2) for type C projects

	Q^2	CA	CO	MC	RE	CL	IN	PMS	PSU
CA	-		0.066 (S)			0.020 (S)			
CO	0.348			0.299 (M)					
MC	0.230							0.065 (S)	0.001 (N/E)
RE	-		0.230 (M)			0.442 (L)			
CL	0.410						0.805 (L)		
IN	0.446							0.089 (S)	-0.012 (N/E)
PMS	0.227								0.110 (S)
PSU	0.156								

Note: Blindfolding routine for omission distance equal 10.
S=small effect, M=medium effect, L=large effect, N/E=no effect

Additionally, the statistical power of this model was quantified considering the sample size n=37, significance level at 5% and the least value of effect size for a significant path (f^2=0.178) (see Figure 5.16). Also, Figure 5.17 details the validated model for certain complex (type C) projects. In this case, all paths of value creation processes are significant to collaboration except contractual agreements. Also, monitoring & controlling as well as innovating influence project management success (PMS) significantly, and this, in turn, has a direct impact on project success (PSU).

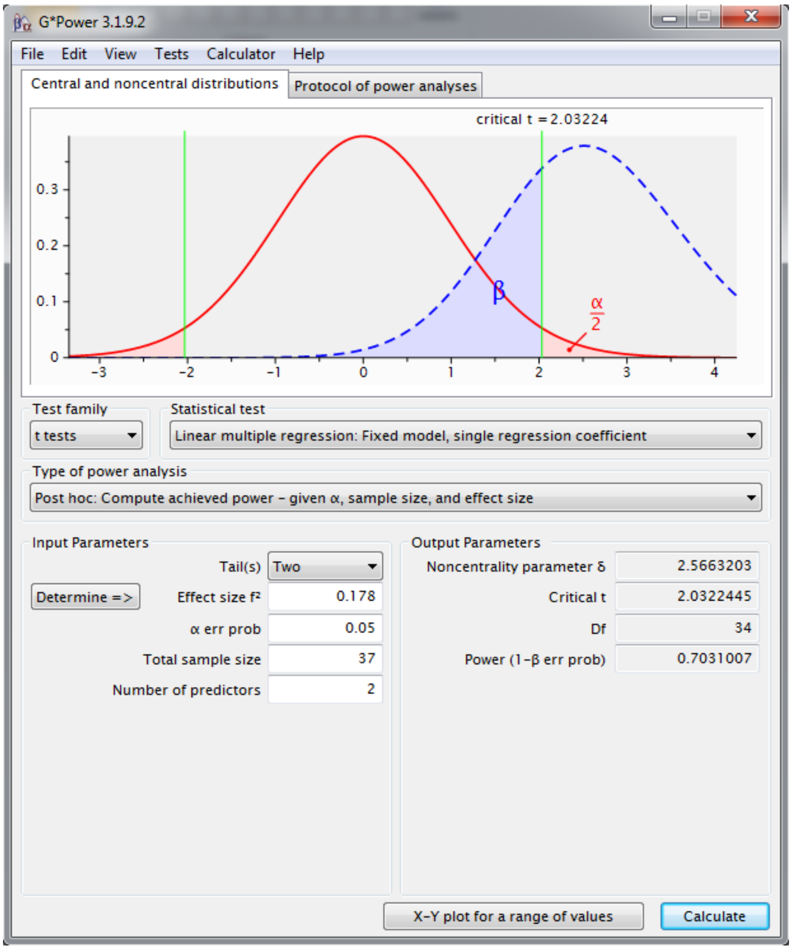


Figure 5.16: Post hoc statistical power analysis of type C projects

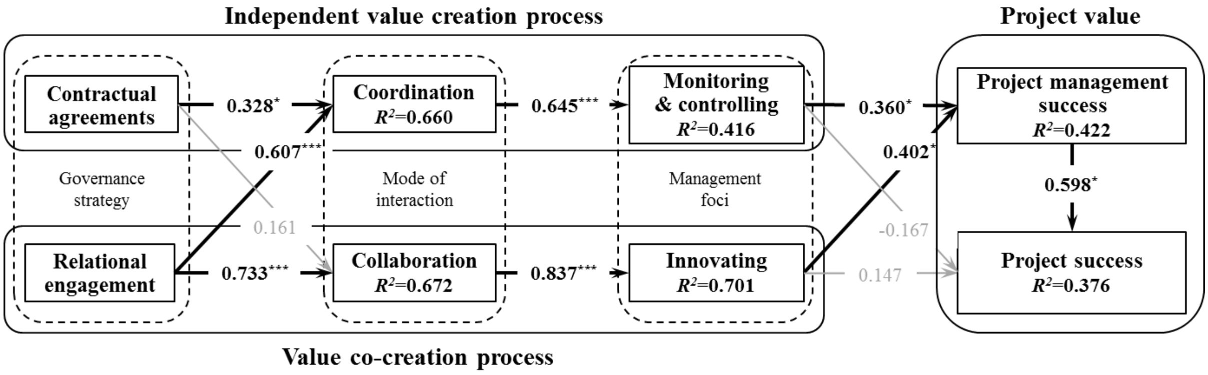


Figure 5.17: A validated model of certain complex (type C) projects

5.6.3.4 Uncertain complex (type D) projects

As in previous scenarios, the measurement models are evaluated by internal consistency reliability (Cronbach's alpha and composite reliability), indicator reliability (outer loadings relevance) and convergent validity (AVE) (see Table 5.43) and discriminant validity (Fornell-

Larcker criterion) (see Table 5.44). Also, Tables 5.45, 5.46, 5.47 and 5.48 exhibit the results of the significance and relevance of path coefficients, R^2, the effect size f^2, Q^2 and the effect size q^2, respectively.

Table 5.43: Measurement model assessment for type D projects

Construct	Item	Loading[a] > 0.700	α > 0.700	CR > 0.700	AVE > 0.500
CA	CA1	0.839	0.773	0.868	0.687
	CA2	0.868			
	CA5	0.777			
CO	CO1	0.755	0.857	0.894	0.584
	CO2	0.703			
	CO3	0.780			
	CO4	0.842			
	CO5	0.712			
	CO7	0.785			
MC	MC1	0.790	0.929	0.943	0.702
	MC2	0.830			
	MC3	0.834			
	MC4	0.888			
	MC5	0.861			
	MC6	0.864			
	MC7	0.793			
RE			*0.944*	*0.954*	*0.721*
QI	QI1	0.892	0.892	0.933	0.822
	QI2	0.922			
	QI3	0.905			
RN	RN1	0.907	0.925	0.944	0.773
	RN2	0.813			
	RN3	0.915			
	RN4	0.932			
	RN5	0.821			
CL			*0.935*	*0.946*	*0.638*
SIE	SIE1	0.865	0.815	0.878	0.643
	SIE2	0.854			
	SIE3	0.746			
	SIE4	0.733			
CW	CW1	0.926	0.903	0.939	0.837
	CW2	0.922			
	CW3	0.897			
JPS	JPS1	0.889	0.846	0.907	0.764
	JPS3	0.874			
	JPS4	0.859			
IN	IN1	0.901	0.863	0.909	0.718
	IN2	0.920			
	IN3	0.883			
	IN4	0.659			
PMS	PE1	0.707	0.907	0.930	0.692
	PE2	0.650			
	IC1	0.899			
	IC2	0.954			
	IC3	0.937			
	IC5	0.794			

Table 5.43: Measurement model assessment for type D projects (continued)

Construct	Item	Loading[a]	α	CR	AVE
PSU			*0.886*	*0.907*	*0.500*
OS	OS1	0.937	0.911	0.938	0.793
	OS2	0.944			
	OS3	0.814			
	OS4	0.861			
PF	PF1	0.754	0.829	0.874	0.537
	PF2	0.773			
	PF3	0.715			
	PF4	0.697			
	PF5	0.719			
	PF6	0.737			

Note: α=Cronbach's alpha; CR=Composite reliability; AVE=average variance extracted. [a] All outer loadings are significant at 0.01 level.

Table 5.44: Correlations and discriminant validity for type D projects

	CA	CO	MC	QI	RN	SIE	CW	JPS	IN	PMS	OS	PF
CA	**0.829**											
CO	0.560	**0.764**										
MC	0.258	0.690	**0.838**									
QI	0.361	0.660	0.680	**0.907**								
RN	0.250	0.659	0.763	0.817	**0.879**							
SIE	0.276	0.609	0.676	0.697	0.733	**0.802**						
CW	0.321	0.693	0.718	0.865	0.835	0.784	**0.915**					
JPS	0.388	0.704	0.748	0.765	0.821	0.751	0.866	**0.874**				
IN	0.215	0.565	0.623	0.790	0.737	0.635	0.810	0.712	**0.847**			
PMS	0.324	0.643	0.542	0.627	0.605	0.500	0.622	0.575	0.528	**0.832**		
OS	0.267	0.469	0.436	0.421	0.400	0.376	0.416	0.352	0.348	0.694	**0.890**	
PF	0.278	0.470	0.483	0.498	0.511	0.457	0.468	0.409	0.525	0.678	0.576	**0.733**

Note: Scores in bold type on the diagonal are the square root of AVE values; Scores below the diagonal are correlations.

Table 5.45: Relevance of path coefficients for type D projects

Path	Original Sample	Sample Mean	Standard deviation	t-values	p-values
CA –» CO	0.385***	0.387	0.110	3.496	0.000
CA –» CL	0.086	0.087	0.060	1.443	0.149
CO –» MC	0.690***	0.691	0.079	8.723	0.000
MC –» PMS	0.348*	0.346	0.144	2.412	0.016
MC –» PSU	0.112	0.123	0.130	0.861	0.389
RE –» CO	0.573***	0.568	0.094	6.092	0.000
RE –» CL	0.862***	0.859	0.041	20.929	0.000
CL –» IN	0.776***	0.783	0.057	13.515	0.000
IN –» PMS	0.311*	0.319	0.147	2.115	0.034
IN –» PSU	0.068	0.067	0.099	0.685	0.493
PMS –» PSU	0.685***	0.666	0.103	6.669	0.000

Note: Significance was calculated by using a bootstrapping routine with 5000 subsamples, assuming a certain level of confidence 95%. Critical t-values for a two-tailed test are 1.96* (confidence level = 5%), 2.58** (confidence level = 1%), and 3.29*** (confidence level = 0.1%).

Table 5.46: Coefficient of determination (R^2) for type D projects

	R^2	**Predictive accuracy**
CO	0.611	Moderate
MC	0.475	Moderate
CL	0.797	Substantial
IN	0.602	Moderate
PMS	0.353	Moderate
PSU	0.627	Moderate

Table 5.47: Effect size (f^2) on endogenous constructs for type D projects

	CA	**CO**	**MC**	**RE**	**CL**	**IN**	**PMS**	**PSU**
CA		0.345 (L)			0.033 (S)			
CO			0.906 (L)					
MC							0.114 (S)	0.018 (N/E)
RE		0.766 (L)			3.316 (L)			
CL						1.514 (L)		
IN							0.092 (S)	0.007 (N/E)
PMS								0.815 (L)
PSU								

Note: S=small effect, M=medium effect, L=large effect, N/E=no effect

Table 5.48: Predictive relevance (Q^2) and the effect size (q^2) for type D projects

	Q^2	**CA**	**CO**	**MC**	**RE**	**CL**	**IN**	**PMS**	**PSU**
CA	-		0.109 (S)			0.004 (N/E)			
CO	0.329			0.439 (L)					
MC	0.305							0.058 (S)	0.000 (N/E)
RE	-		0.234 (M)			0.774 (L)			
CL	0.477						0.664 (L)		
IN	0.399							0.048 (S)	0.000 (N/E)
PMS	0.224								0.199 (M)
PSU	0.282								

Note: Blindfolding routine for omission distance equal 10.
S=small effect, M=medium effect, L=large effect, N/E=no effect

The post hoc statistical power analysis of this model is determined by using the significance level at 0.05, a sample size n=64 and the least effect size equal to 0.092 (see Figure 5.18). In this case, the statistical power is 66.58%. Although this value is lower than 70%, it is nevertheless considered sufficient to estimate the parameters.

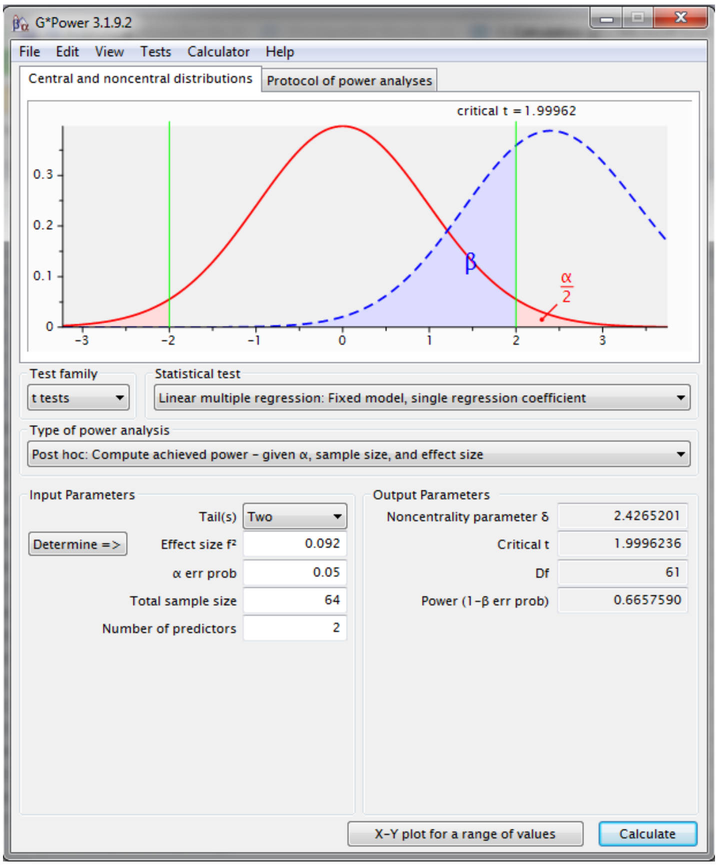


Figure 5.18: Post hoc statistical power analysis for type D projects

The validated model for uncertain complex (type D) projects is exhibited in Figure 5.19. In this case, both governance mechanisms (i.e. contractual and relational) become significant to influence coordination and collaboration, respectively. Additionally, coordination impacts on monitoring & controlling, which positively affects project management success (PMS), while collaboration impacts on innovating which also affects PMS. Lastly, PMS is significantly associated with project success.

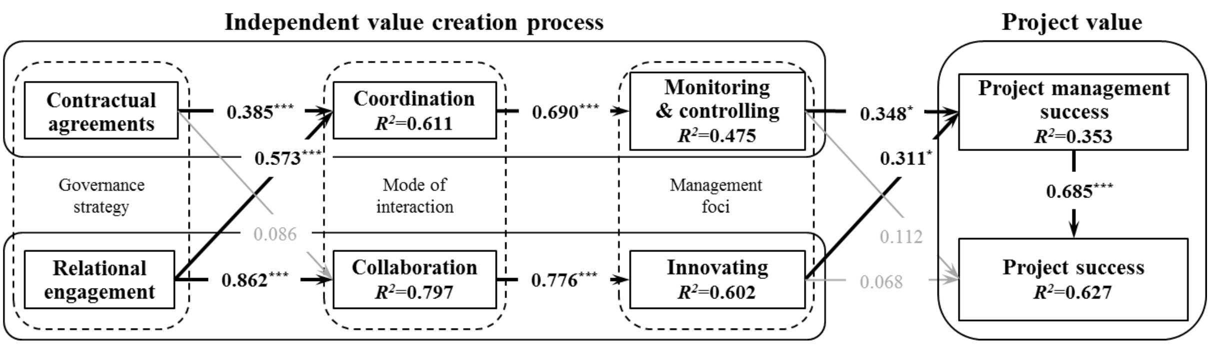


Figure 5.19: A validated model for uncertain complex (type D) projects

5.6.4 Multi-group analysis

As mentioned above, differences in the model parameters (i.e. path coefficients) among the established data groups are interpreted as moderating effects (Henseler & Fassott, 2010); however, the heterogeneity of data groups and significance in the differences must be estimated by multi-group analysis to ensure an accurate conclusion (Sarstedt, Henseler, & Ringle, 2011).

Several methods are applied in this research for multi-group analysis in PLS-SEM environment, beginning with a parametric approach introduced by Keil et al. (2000) that involves estimating model parameters for each group separately, and use of a bootstrapping routine to estimate the standard errors as input to a parametric test. Secondly, a distribution-free data permutation procedure proposed by Chin and Dibbern (2010) is carried out which compares the observed parameter differences between groups, and those between groups randomly set from the data. Thirdly, a nonparametric approach or PLS-MGA developed by Henseler (2012) analyses the differences between group-specific bootstrap estimates and each bootstrap sample. Finally, an alternative non-parametric approach called an omnibus test of group differences (OTG), defined by Sarstedt et al. (2011), is applied to compare the parameter estimates and bootstrap confidence intervals to each pair of groups. In this last method, if a path coefficient estimate of group one falls into the confidence interval of group two or vice versa (i.e., a path coefficient estimate of group two is in the confidence interval of group one), the absence of significant differences among groups is assumed. In reverse, where there is no coincidence (i.e., parameter estimate of group one or two is out of confidence interval of group two or one, respectively), group-specific path relationships are found to be significantly different at a certain level (generally 95%).

Advantages and drawbacks have been pointed out relating to each method (Sarstedt et al., 2011). For example, the parametric approach yields higher t-values and is the most liberal with regard to the procedures than the permutation method. PLS-MGA method is more conservative and produces lower significant differences when comparing results between multi-group tests. In view of these points, this research selects a nonparametric approach OTG to define the significance of the parameter differences between groups. This decision, supported by Sarstedt et al. (2011), is made because the approach does not require any distributional assumption; it can handle relatively small sample sizes; is a more conservative approach with a lower probability for having Type II errors (i.e. incorrectly retaining a false null hypothesis); and lastly, the bootstrap outputs are easily obtained from the prevailing PLS-SEM software, such as SmartPLS.

Following the procedure proposed by Sarstedt et al. (2011), PLS path modelling algorithm is re-run for each group as presented in previous sections, preserving all the common criteria to evaluate measurement and structural models (Hair et al., 2016). The results are summarised in Table 5.49. In addition, using SmartPLS 3 (Ringle et al., 2015), bias-corrected bootstrapping at 95% confidence level is applied to each scenario to obtain the confidence intervals. Path coefficient estimates of each group (Table 5.50) are then checked to establish whether or not they fall into the other group-specific confidence interval range.

Table 5.49: Summary of measurement and structural model results for each group

	Project Type	**A**	**B**	**C**	**D**
	Cases (n)	40	27	37	64
Composite reliability and convergent validity					
CA	CR	0.844	0.854	1.000	0.868
	AVE	0.644	0.746	1.000	0.687
RE	CR	0.924	0.893	0.949	0.954
	AVE	0.636	0.546	0.822	0.721
CO	CR	0.876	0.889	0.879	0.894
	AVE	0.642	0.668	0.593	0.584
CL	CR	0.940	0.890	0.952	0.946
	AVE	0.612	0.505	0.688	0.638
MC	CR	0.895	0.907	0.894	0.943
	AVE	0.588	0.583	0.629	0.702
IN	CR	0.928	0.876	0.899	0.909
	AVE	0.811	0.706	0.695	0.718
PMS	CR	0.911	0.876	0.915	0.930
	AVE	0.721	0.554	0.643	0.692
PSU	CR	0.883	0.870	0.821	0.907
	AVE	0.540	0.537	0.544	0.500

Table 5.49: Summary of measurement and structural model results for each group (continued)

Project Type	A	B	C	D
Path coefficients and R^2 scores				
CA –» CO	0.210	-0.230	0.328*	0.385***
CA –» CL	-0.044	0.130	0.161	0.086
CO –» MC	0.662***	0.420*	0.645***	0.690***
MC –» PMS	0.585*	0.221	0.360*	0.348*
MC –» PSU	-0.012	-0.139	-0.167	0.112
RE –» CO	0.676***	0.734***	0.607***	0.573***
RE –» CL	0.863***	0.733***	0.733***	0.862***
CL –» IN	0.680***	0.567*	0.837***	0.776***
IN –» PMS	-0.108	0.441**	0.402*	0.311*
IN –» PSU	0.306***	0.129	0.147	0.068
PMS –» PSU	0.677***	0.713***	0.598*	0.685***
R^2_{CO}	0.587	0.493	0.660	0.611
R^2_{MC}	0.438	0.176	0.416	0.475
R^2_{CL}	0.724	0.609	0.672	0.797
R^2_{IN}	0.462	0.322	0.701	0.602
R^2_{PMS}	0.306	0.349	0.422	0.353
R^2_{PSU}	0.588	0.538	0.376	0.627

Note: Significance was calculated by using a bootstrapping routine with 5000 subsamples, assuming a certain level of confidence at 95%. Critical t-values for a two-tailed test are 1.96* (confidence level = 5%), 2.58** (confidence level = 1%), and 3.29*** (confidence level = 0.1%).

Table 5.50: Bias-corrected confidence intervals and multi-group comparison results

Path	Bias-corrected 95% confidence intervals				Comparison	Significance
	A	B	C	D		
CA–»CO	[-0.171,0.394]	[-0.504,0.153]	[0.074,0.592]	[0.154,0.577]	**A vs. B**	**Yes**
					A vs. C	No
					A vs. D	No
					B vs. C	**Yes**
					B vs. D	**Yes**
					C vs. D	No
CA–»CL	[-0.289,0.137]	[-0.150,0.407]	[-0.024,0.367]	[-0.030,0.207]	A vs. B	No
					A vs. C	**Yes**
					A vs. D	**Yes**
					B vs. C	No
					B vs. D	No
					C vs. D	No
CO–»MC	[0.445,0.806]	[-0.532,0.624]	[0.458,0.738]	[0.501,0.807]	**A vs. B**	**Yes**
					A vs. C	No
					A vs. D	No
					B vs. C	**Yes**
					B vs. D	**Yes**
					C vs. D	No
MC–» PMS	[-0.158,0.842]	[-0.554,0.464]	[-0.101,0.569]	[0.060,0.624]	**A vs. B**	**Yes**
					A vs. C	**Yes**
					A vs. D	No
					B vs. C	No
					B vs. D	No
					C vs. D	No

Table 5.50: Bias-corrected confidence intervals and multi-group comparison results (continued)

Path	Bias-corrected 95% confidence intervals				Comparison	Significance
	A	B	C	D		
MC–» PSU	[-0.306,0.235]	[-0.560,0.262]	[-0.487,0.231]	[-0.145,0.359]	A vs. B	No
					A vs. C	No
					A vs. D	No
					B vs. C	No
					B vs. D	No
					C vs. D	**Yes**
RE–»CO	[0.451,0.838]	[0.420,0.914]	[0.277,0.797]	[0.374,0.735]	A vs. B	No
					A vs. C	No
					A vs. D	No
					B vs. C	No
					B vs. D	No
					C vs. D	No
RE–»CL	[0.756,0.927]	[0.411,0.878]	[0.555,0.860]	[0.764,0.928]	**A vs. B**	**Yes**
					A vs. C	**Yes**
					A vs. D	No
					B vs. C	No
					B vs. D	**Yes**
					C vs. D	**Yes**
CL–»IN	[0.432,0.825]	[-0.124,0.846]	[0.659,0.914]	[0.639,0.866]	A vs. B	No
					A vs. C	**Yes**
					A vs. D	No
					B vs. C	**Yes**
					B vs. D	**Yes**
					C vs. D	No
IN–»PMS	[-0.387,0.258]	[0.043,0.710]	[-0.026,0.749]	[0.002,0.575]	**A vs. B**	**Yes**
					A vs. C	**Yes**
					A vs. D	**Yes**
					B vs. C	No
					B vs. D	No
					C vs. D	No
IN–»PSU	[0.136,0.507]	[-0.306,0.430]	[-0.285,0.607]	[-0.091,0.298]	**A vs. B**	**Yes**
					A vs. C	No
					A vs. D	**Yes**
					B vs. C	No
					B vs. D	No
					C vs. D	No
PMS–» PSU	[0.374,0.945]	[0.243,0.976]	[-0.237,0.927]	[0.447,0.838]	A vs. B	No
					A vs. C	No
					A vs. D	No
					B vs. C	No
					B vs. D	No
					C vs. D	No

Note: Significance was calculated by using a bootstrapping routine with 5000 subsamples, assuming a degree of confidence at 95%. 'Yes' denotes a significant difference at 0.05 (in bold type); 'No' denotes a nonsignificant difference at 0.05.

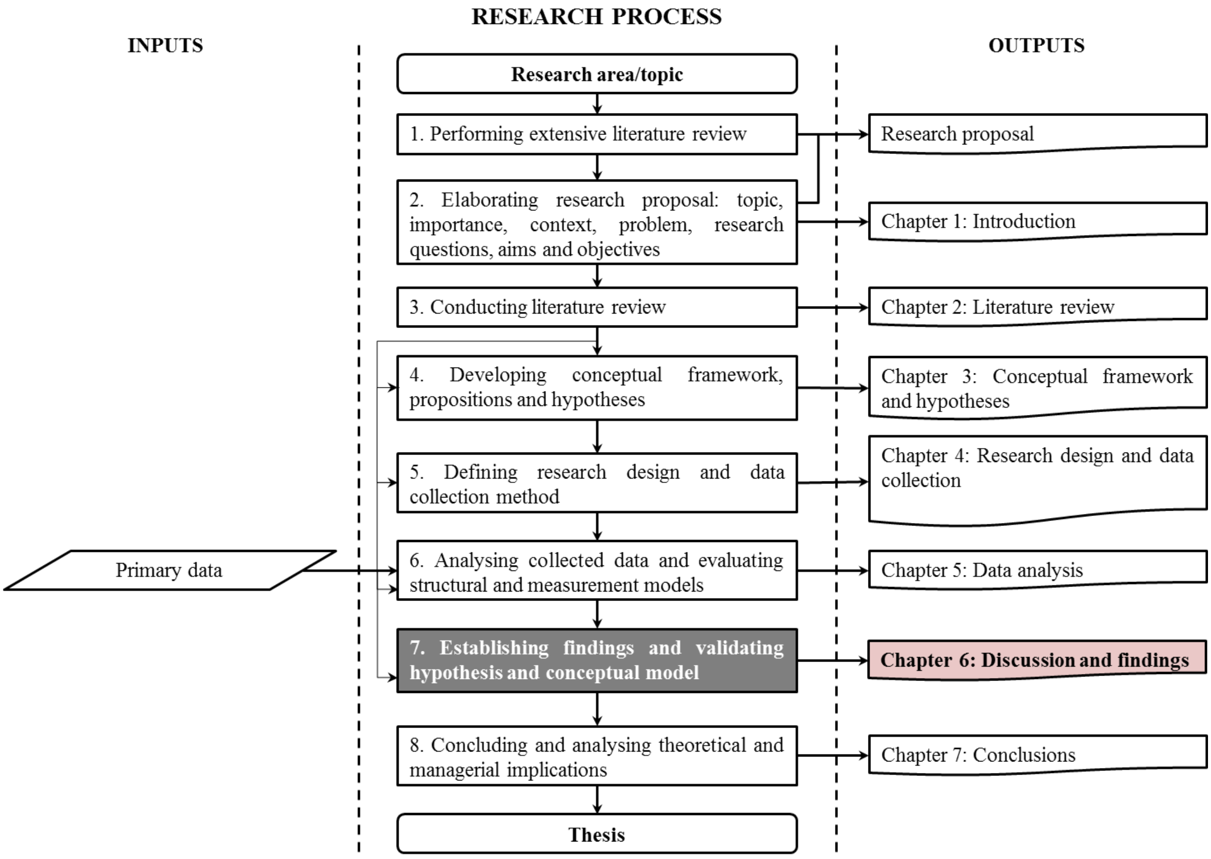
As presented, several path coefficients of each type of project fell out of the confidence interval range of the other group; therefore the group data sets were statistically different in the context of this study. This outcome supports the decision to split the gathered data into two groups, based on levels of requirements uncertainty and project complexity.

5.7 Summary

This chapter starts with a definition of the structural and measurement models associated with the conceptual framework and the previously developed hypotheses. The PLS path structural model includes three second-order latent variables (i.e. RE, CL and PSU) and five first-order latent variables (i.e. CA, CO, MC, IN and PMS). Each construct is measured through observed indicator variables that were defined during the construction of the questionnaire. Prior to assessment, descriptive statistics and data preparation are performed to examine possible threats to the originally collected data, such as missing data, the presence of outliers and data distribution. All measurement models are evaluated according to the established criteria for demonstrating the reliability and validity of the indicators. Weak items are deleted, and validated measurement models are defined. Afterwards, prior to evaluation of the structural model, common method bias and multicollinearity are investigated, found to be non-relevant to this research, and consequently discarded. Subsequently, path coefficients relevance, predictive accuracy, effect size, predictive relevance and its related effect size, and statistical power are all obtained through the use of SmartPLS and G*Power. As a result, hypothesised relationships are tested, and the validated structural model is presented. Finally, the moderating effect of the value creation processes to the project value is analysed in detail in four scenarios, according to different levels of RU and PC. These results demonstrate that the four scenarios were statistically different in this research, supporting the separate study of the contingent effect of value creation processes on project value.

Chapter 6: DISCUSSION AND FINDINGS

- Introduction
- Hypotheses testing results and discussion of the structural model analysis
- Hypotheses testing results and discussion of the moderation analysis
- Research findings
- Summary



6.1 Introduction

In this chapter, the research hypotheses are examined to determine if they are supported or rejected (Sections 6.2 and 6.3), followed by a discussion and explanation of the corresponding findings from the results presented in the previous chapter (section 6.4).

6.2 Hypotheses testing results and discussion of the structural model analysis

As mentioned in Chapter 5 (see Section 5.5.3), a significance test for measuring the relevance of path coefficients included in the structural model is performed for examining all proposed hypotheses, except the results on H8 which is directly related to the moderation analysis shown in Section 6.3. Next, Table 6.1 summarises the hypotheses, path coefficients, the significance, R^2 coefficients, the effect size f^2, the effect size of the predictive relevance q^2, for each path relationship, and determines whether or not each hypothesis is supported.

Table 6.1: Summary of hypothesis testing results

Hypothesis	Path	Coefficient	R^2	f^2	q^2	Inference
H1a: Contractual agreements have a positive impact on coordination.	CA –» CO	0.234^{***}	0.566	0.113 (S)	0.035 (S)	Supported
H1b: Contractual agreements have a positive impact on collaboration.	CA –» CL	0.134^{**}	0.749	0.064 (S)	0.016 (N/E)	Not supported
H2a: Relational engagement has a positive impact on coordination.	RE –» CO	0.643^{***}	0.566	0.850 (L)	0.270 (M)	Supported
H2b: Relational engagement has a positive impact on collaboration.	RE –» CL	0.813^{***}	0.749	2.351 (L)	0.588 (L)	Supported
H3: Coordination has a positive impact on monitoring & controlling.	CO –» MC	0.633^{***}	0.401	0.669 (L)	0.302 (M)	Supported
H4: Collaboration has a positive impact on innovating.	CL –» IN	0.767^{***}	0.589	1.430 (L)	0.621 (L)	Supported
H5a: Monitoring & controlling has a positive impact on project management success.	MC –» PMS	0.358^{***}	0.285	0.132 (S)	0.066 (S)	Supported
H5b: Monitoring & controlling has a positive impact on project success.	MC –» PSU	0.071	0.539	0.007 (N/E)	0.000 (N/E)	Not supported
H6a: Innovating has a positive impact on project management success.	IN –» PMS	0.254^{**}	0.285	0.067 (S)	0.032 (S)	Supported
H6b: Innovating has a positive impact on project success.	IN –» PSU	0.144^{*}	0.539	0.031 (S)	0.008 (N/E)	Not supported
H7: Project management success has a positive impact on project success.	PMS –» PSU	0.618^{***}	0.539	0.593 (L)	0.190 (M)	Supported

Note: Significance was calculated using a bootstrapping routine with 5000 subsamples, assuming a degree of confidence at 95%.Critical t-values for a two-tailed test are 1.96* (confidence level = 5%), 2.58** (confidence level = 1%), and 3.29*** (confidence level = 0.1%). S=small effect, M=medium effect, L=large effect, N/E=no effect

6.2.1 The effect of contractual agreements on coordination and collaboration

Hypotheses 1a and 1b postulate the positive influence from contractual agreements on coordination and collaboration. As depicted in Table 6.1, structural model assessment results only support H1a (i.e. contract agreements have an impact on coordination). Although the significance of the path coefficient and effect size f^2score is satisfactory, the q^2 value of formal contract on collaboration is lower than 0.02; therefore H1b is rejected. The findings can imply that a formal contract is more likely to lead to coordination than to collaboration between the interested parties in a project (e.g. contractor and owner). Related to H1a, this finding is consistent with that of Andrew Chang and Shen (2014) and Lavikka et al. (2015), who recognise that formal contracts define efficient methods for sharing technical information and specifying the rights and obligations of the parties during the project. As H1b is not supported, this result contradicts previous findings of the effect of formal contracts on collaboration (e.g. J. Kujala et al. (2015)), though it is also consistent with the findings of other recent studies (e.g. Wu et al. (2017)). This difference might be related to current contractual practices in Chile, where formal contracts are generally used as institutional enforcements for preventing and solving conflicts, rather than as a collaborative tool for governing the project based on trust and commitment among parties.

6.2.2 The effect of relational engagement on coordination and collaboration

Hypotheses 2a and 2b predict that relational engagement underpinned by a favourable quality of interactions and relational norms has a significant effect on coordination and collaboration. As presented above, both path coefficients are significant (p-value<0.001) and have a large effect size according to predictive accuracy and predictive relevance scores ($f^2>0.35$ and $q^2>0.35$). Therefore, both H2a and H2b are supported. These findings are in line with previous research that finds that continued interactions, trust and shared norms motivate the exchange of information to coordinate critical tasks (Y. Wang, Chen, Fu, & Zhang, 2017;

S. Zhao et al., 2014), and facilitate collaborative working and joint problem-solving that leads to innovative solutions (Aarikka-Stenroos & Jaakkola, 2012; Lavikka et al., 2015).

6.2.3 The effect of coordination on monitoring and controlling

Hypothesis 3 postulates that there is a positive impact from coordination on monitoring and controlling. The results confirm this positive association, as the path coefficient is significant (p-value<0.001) and the effect sizes measured by f^2 and q^2 scores are large and medium, respectively. This evidence is consistent with previous research (e.g. Dekker (2004)) and reaffirms the essential role played by task coordination in the formal control of projects within the TCE framework.

6.2.4 The effect of collaboration on innovating

Hypothesis 4 recognises the positive association between collaboration and innovating, as demonstrated in previous studies (e.g. Austin and Seitanidi (2012); Matinheikki, Artto, Peltokorpi, and Rajala (2016)). The results in Table 6.1 show that collaboration strongly affects innovating (β=0.767; p-value<0.001; f^2=1.430; q^2=0.621), thus supporting H4.

6.2.5 The effect of monitoring and controlling on project value

The conceptual framework posits the significant impacts of monitoring and controlling on project management success (H5a) and project success (H5b), respectively. The results show that H5a is supported (β=0.358, p-value<0.001, f^2=0.132; and q^2=0.066) and H5b is rejected (β=0.071, p-value>0.05; f^2 and q^2 are weak i.e., <0.02). These findings point out that a system for monitoring and controlling is important to accomplishing effective project management (consistent with Jun, Qiuzhen, and Qingguo (2011)), but has relatively little effect on business effectiveness, thus contradicting prior research (e.g. Gopal and Gosain (2010) and S. Liu (2015)). Maybe this situation occurs because monitoring and controlling activities have been traditionally associated to verify the progress and final results of a project in terms of cost and schedule, obviating other intangible long-term benefits.

6.2.6 The effect of innovating on project value

The study predicts a positive association between innovating and project value comprised of two dimensions, project management success (H6a) and project success (H6b). The results support H6a (β=0.254; p-value<0.01; f^2=0.067; q^2=0.032), while H6b, although the p-value of path coefficient is significant at the 0.05 level, is nevertheless not supported because f^2 and q^2 are very small (<0.02) so that there is almost no effect among these constructs. The findings support the influence of innovating on the success of project management, in accordance with previous literature (e.g., Svetlik et al. (2007)); however, the results are contradictory for H6b, because the data do not support the association between innovating and project success as posited by Biedenbach and Müller (2012). This finding may be obtained because this study considered innovating as a management approach more than a key performance indicator of created value from the project as proposed by Svejvig and Andersen (2015) and Weiss, Hoegl and Gibbert (2017).

6.2.7 The effect of project management success on project success

The conceptual framework expects that project management success has an impact on project success (hypothesis 7). The scores show a significant effect (β=0.618; p-value<0.001; f^2=0.593 (large effect); q^2=0.190 (medium effect)). Consequently, H7 is fully supported, as broadly featured in previous project management literature (e.g., Alsudiri et al. (2013); Cooke-Davies (2002); Mir and Pinnington (2014); Zwikael and Smyrk (2012)).

6.3 Moderated relationships

Hypothesis 8 about the moderated relationship between value creation processes and project value by requirements uncertainty (RU) and project complexity (PC) is tested using sub-group analysis. Following the recommendations of Sarstedt et al. (2011), the significant differences between model parameters (i.e. path coefficients) of each sub-group are analysed (i.e. for projects type A, B, C and D) (referring to Table 5.50). It is possible to infer that RU and PC acting together have a moderating effect on the relationship between value creation processes and project value. Therefore, H8 is supported. The sub-group analysis for H8 is illustrated below. The results are summarised in Table 6.2.

Table 6.2: Summary of results from the moderation analysis

Type	**Path**	**Coefficient**	R^2	f^2	q^2	**Significant**
Certain simple *(type A)* projects	CA –» CO	0.210	0.587	0.097 (S)	0.021 (S)	No
	CA –» CL	-0.044	0.724	0.007 (N/E)	-0.025 (N/E)	No
	CO –» MC	0.662***	0.438	0.778 (L)	0.209 (M)	Yes
	MC –» PMS	0.585*	0.306	0.423 (L)	0.0.71 (S)	Yes
	MC –» PSU	-0.012	0.588	0.000 (N/E)	-0.021 (N/E)	No
	RE –» CO	0.676***	0.587	1.005 (L)	0.381 (L)	Yes
	RE –» CL	0.863***	0.724	2.448 (L)	0.716 (L)	Yes
	CL –» IN	0.680***	0.462	0.860 (L)	0.546 (L)	Yes
	IN –» PMS	-0.108	0.306	0.014 (N/E)	-0.034 (N/E)	No
	IN –» PSU	0.306***	0.588	0.192 (M)	0.030 (S)	Yes
	PMS –» PSU	0.677***	0.588	0.770 (L)	0.220 (M)	Yes
Uncertain simple (*type B)* projects	CA –» CO	-0.230	0.493	0.095 (S)	0.018 (N/E)	No
	CA –» CL	0.130	0.609	0.039 (S)	0.000 (N/E)	No
	CO –» MC	0.420*	0.176	0.214 (M)	0.089 (S)	No
	MC –» PMS	0.221	0.349	0.054 (S)	0.008 (N/E)	No
	MC –» PSU	-0.139	0.538	0.028 (S)	-0.003 (N/E)	No
	RE –» CO	0.734***	0.493	0.973 (L)	0.450 (L)	Yes
	RE –» CL	0.733***	0.609	1.256 (L)	0.276 (M)	Yes
	CL –» IN	0.567*	0.322	0.475 (L)	0.208 (M)	Yes
	IN –» PMS	0.441**	0.349	0.213 (M)	0.059 (S)	Yes
	IN –» PSU	0.129	0.538	0.021 (S)	0.000 (N/E)	No
	PMS –» PSU	0.713***	0.538	0.716 (L)	0.183 (M)	Yes
Certain complex (*type C)* projects	CA –» CO	0.328*	0.660	0.249 (M)	0.066 (S)	Yes
	CA –» CL	0.161	0.672	0.062 (S)	0.020 (S)	No
	CO –» MC	0.645***	0.416	0.711 (L)	0.299 (M)	Yes
	MC –» PMS	0.360*	0.422	0.178 (M)	0.065 (S)	Yes
	MC –» PSU	-0.167	0.376	0.030 (S)	0.001 (N/E)	No
	RE –» CO	0.607***	0.660	0.851 (L)	0.230 (M)	Yes
	RE –» CL	0.733***	0.672	1.288 (L)	0.442 (L)	Yes
	CL –» IN	0.837***	0.701	2.344 (L)	0.805 (L)	Yes
	IN –» PMS	0.402*	0.422	0.223 (M)	0.089 (S)	Yes
	IN –» PSU	0.147	0.376	0.023 (S)	-0.012 (N/E)	No
	PMS –» PSU	0.598*	0.376	0.332 (M)	0.110 (S)	Yes
Uncertain complex (*type D)* projects	CA –» CO	0.385***	0.611	0.345 (L)	0.109 (S)	Yes
	CA –» CL	0.086	0.797	0.033 (S)	0.004 (N/E)	No
	CO –» MC	0.690***	0.475	0.906 (L)	0.439 (L)	Yes
	MC –» PMS	0.348*	0.353	0.114 (S)	0.058 (S)	Yes
	MC –» PSU	0.112	0.627	0.018 (N/E)	0.000 (N/E)	No
	RE –» CO	0.573***	0.611	0.766 (L)	0.234 (M)	Yes
	RE –» CL	0.862***	0.797	3.316 (L)	0.774 (L)	Yes
	CL –» IN	0.776***	0.602	1.514 (L)	0.664 (L)	Yes
	IN –» PMS	0.311*	0.353	0.092 (S)	0.048 (S)	Yes
	IN –» PSU	0.068	0.627	0.007 (N/E)	0.000 (N/E)	No
	PMS –» PSU	0.685***	0.627	0.815 (L)	0.199 (M)	Yes

Note: Significance was calculated by the use of bootstrapping routine with 5000 subsamples, assuming a certain level of confidence at 95%. Critical t-values for a two-tailed test are 1.96* (confidence level = 5%), 2.58** (confidence level = 1%), and 3.29*** (confidence level = 0.1%); S=small effect, M=medium effect, L=large effect, N/E=no effect

6.3.1 The case of certain simple (type A) projects

When the project is simple and certain (type A), contractual agreements have no effect on coordination and collaboration (p-value>0.05). Instead, relational engagements drive coordination (β=0.676; p-value<0.001) and collaboration (β=0.863; p-value<0.01). Subsequently, coordination has a significant impact on monitoring & controlling (β=0.662; p-value<0.001) that directly affects project management success (β=0.585; p-value<0.05), but does not influence project success (p-value>0.05). Collaboration is significantly associated with innovating (β=0.680; p-value<0.001) which in turn has an impact on project success (β=0.306; p-value<0.001), but has no significant effect on project management success (p-value>0.05). Finally, project management success with regard to budget, schedule, scope and quality has a positive effect on project success (β=0.677; p-value<0.001).

6.3.2 The case of uncertain simple (type B) projects

When projects are low in complexity but have a high level of requirements uncertainty (type B), the value co-creation process is the primary value driver for the project, in which relational engagement drives collaboration (β=0.733; p-value<0.001). In turn, collaborations lead to innovating (β=0.567; p-value<0.05) which ultimately impacts project management success (β=0.441; p-value<0.01), but has little impact on project success (p-value>0.05). Finally, project efficiency (i.e. cost, time and scope) and clients have a positive impact on project success (β=0.713; p-value<0.001).

6.3.3 The case of certain complex (type C) projects

Both processes of value creation (i.e. independent creation and co-creation) are relevant in projects with high complexity and low levels of requirements uncertainty (type C). In other words, both processes have a direct impact on project management performance that leads to successful projects. Specifically, a formal contract drives coordination (β=0.328; p-value<0.05), but not collaboration (p-value>0.05). A relational governance strategy enables coordination (β=0.607; p-value<0.001) and collaboration (β=0.733; p-value<0.001). While coordination strongly impacts monitoring and controlling (β=0.645; p-value<0.001), collaboration is significantly associated with innovating (β=0.837; p-value<0.001). Monitoring & controlling and innovating drive project management success separately (β=0.360; p-value<0.05 and β=0.402; p-value<0.05, respectively), but they do not significantly affect project success (p>0.05). Finally, successful project management increases the likelihood of a positive impact on project success (β=0.598; p-value<0.05).

6.3.4 The case of uncertain complex (type D) projects

Similar to the with previous scenario (type C), projects with high complexity and requirements uncertainty (type D) need to focus on an independent value creation process as well as a value co-creation process. In this case, formal contracts drive coordination (β=0.385; p-value<0.001), but not collaboration (p-value>0.05). Coordination impacts monitoring and controlling (β=0.690; p-value<0.001) which in turn affects project management success (β=0.348; p-value<0.05), but is not significantly related to project success (p-value>0.05). On the other hand, relational engagement leads to coordination (β=0.573; p-value<0.001) and also collaboration (β=0.862; p-value<0.001). Collaboration is then significantly associated with innovating (β=0.776; p-value<0.001) which ultimately impacts project management success (β=0.311; p-value<0.05), but it does not influence project success (p-value>0.05). Lastly, project success is strongly impacted by project management success (β=0.685; p-value<0.001).

6.4 Research findings

The main purpose of this research is to investigate the effects of value creation processes on project value and to analyse the moderating influence of requirements uncertainty and project complexity on these effects. Specifically, the research questions addressed are (1) how do value creation processes (i.e. independent value creation and value co-creation) in projects impact on project value (i.e. project management success and project success)? (2) How do requirements uncertainty and project complexity moderate the effects of value creation processes on project value?

6.4.1 The joint effects of value creation processes on project value

In addressing the first research question and contributing to the literature, both independent creation and co-creation processes have an impact on project management success as measured by project efficiency (i.e. cost, time and scope) and client satisfaction (i.e. quality). Subsequently, project management success impacts on project success (measured by business and organisational success and preparation for the future).

In detail, project governance strategies (i.e. contractual agreement and relational engagement) drive complementarily two key modes of inter-organisational interaction for mobilising resources into the project: coordination and collaboration. While contractual agreement drives coordination, relational engagement underpinned by a favourable quality of interactions and relational norms enables both coordination and collaboration. For this part, prior research has accepted that contractual governance mechanisms are complemented by relational mechanisms, such as trust and interactions, that prevent conflicts and adversarial behaviour between the parties involved, and also promote problem-solving and information sharing (e.g. Hartmann et al. (2014)).

In contributing to knowledge, this research identifies contractual agreements as an enabler of coordination, and relational engagement as an enabler of both coordination and collaboration. Additionally, coordination is strongly associated with monitoring and controlling, whereas collaboration between the parties involved has a marked influence on innovating. Both managerial approaches (i.e. monitoring & controlling and innovating) impact significantly on project management success, but not on project success. The findings here contradict the paradoxical view of control versus innovation in organisations as elucidated by Fonseca (2002), who established the divergence between controlling and innovating. Additionally, this research shows that the traditional control paradigm based on coordination is complemented by collaboration (Schneider, 2008).

6.4.2 The contingent effects of requirements uncertainty and project complexity

On the moderating effects of the two key contextual variables in project management research known as requirements uncertainty (RU) and project complexity (PC) (research question two) this study proposes a 2x2 matrix which includes the combination of two dichotomy levels of RU and PC, labelled as low and high (see Figure 3.2). In the matrix, projects are grouped into four types: (1) certain simple (type A); (2) uncertain simple (type B); (3) certain complex (type C); and (4) uncertain complex (type D) projects.

Overall, the sub-group analysis results show patterns that are consistent with the relationship between value creation processes and project value being moderated by RU and PC.

First, in projects where RU and PC are low, there is a positive effect of monitoring and controlling on project management success, supported by relational governance strategies and coordination. Additionally, the relational engagement motivates collaboration among parties and, as a result, motivates innovation that adds project value. Because these certain simple projects are characterised by stability, known requirements, and straightforward cause-effect relationships, the decision-making process is often unquestioned. In addition, the parties share a common understanding so that they rely on relational mechanisms such as trust and commitment rather than on a pressing need for formal contracts. Hence, the project execution follows a predictable and controllable path where best practices apply standardisation and efficient coordination for managing any minimum variation throughout the project. Moreover, these types of projects can be evaluated by using quantitative project management success measures such as time and cost performance, and other measures directly related to delivered products; for example, client satisfaction (Atkinson, Crawford, & Ward, 2006; L. Liu, Borman, & Gao, 2014; Oehmen, Thuesen, Ruiz, & Geraldi, 2015; Van Donk & Molloy, 2008).

Second, in projects where RU is high, and PC is low, there is a positive effect from innovating on project management success, underpinned by relational governance and collaboration. In this context, contracts become less useful because it becomes more difficult to predict all potential contingencies and outcomes to include in the contract. Furthermore, these contractual agreements can impose precise controls and constraints on the parties involved that limit their capacity for the creativity and innovation required to cope with this uncertainty. Accordingly, integration among project actors is required to improve flexibility, adaptation, and collaboration during project execution, where relational norms and interactions are essential for effective governance (Clauss & Spieth, 2016; Yuzhu Li, Shepherd, Liu, & Klein, 2016; Y. Wang et al., 2017). Collaborative efforts toward reducing requirements uncertainty based on sharing knowledge, joint problem-solving, and goal conflict resolution prove to be useful ways to increase project innovativeness and, as a consequence, improve project performance (Brettel, Heinemann, Engelen, & Neubauer, 2011; Eriksson, 2013; Liberatore & Wenhong, 2010; Von Branconi & Loch, 2004; T. Williams, 2005; Winch, 2001; Wu et al., 2017).

Third, for complex projects, with low or high levels of requirements uncertainty, monitoring & controlling and innovating have positive effects on project management success, supported by both governance strategies, contractual and relational. Here, formal contracts significantly influence coordination, whereas relational governance strategies affect both coordination and collaboration. These findings partly contradict the previous research (e.g. Little (2005) and Tidd (2001)) that shows marked differences between managing complex projects with high uncertainty and those with low uncertainty. Perhaps a good explanation for this contradiction is that an increase of requirements uncertainty in the project amplifies its complexity. In other words, uncertainty is inherent in a complex project. Consequently, the management of highly complex projects encompasses a holistic view of value creation. Having said that, complex projects are characterised by cause-effect relationships that are typically ambiguous, where both contractual and relational governance approaches can be effective. Thus, effective relational mechanisms such as trust, continuous interactions and mutual norms reduce the need to guard against opportunistic behaviour by exerting full control and concentrating on project delivery, amplifying the effects of contractual governance through resources and task coordination and outcome controls. Additionally, those relational mechanisms enhance collaboration between organisations and stimulate performance gains at the project level by creating platforms for new ideas, creativity and innovation. Hence, monitor & control and innovating become levers for adapting the delivery of the project to these challenging environments of complexity. Previous research (e.g., Barlow (2000); Hanisch and Wald (2014); Jergeas and Lynch (2015); L. Liu et al. (2014); S. Liu (2015); Oehmen et al. (2015); Schneider (2008)) partially shows these findings in complex scenarios.

Finally, in all of the scenarios discussed, project management success leads to project success, as previously stated by Munns and Bjeirmi (1996).

In light of these findings, Figure 6.1 below presents a validated contingent framework for the effect on project value of value creation processes.

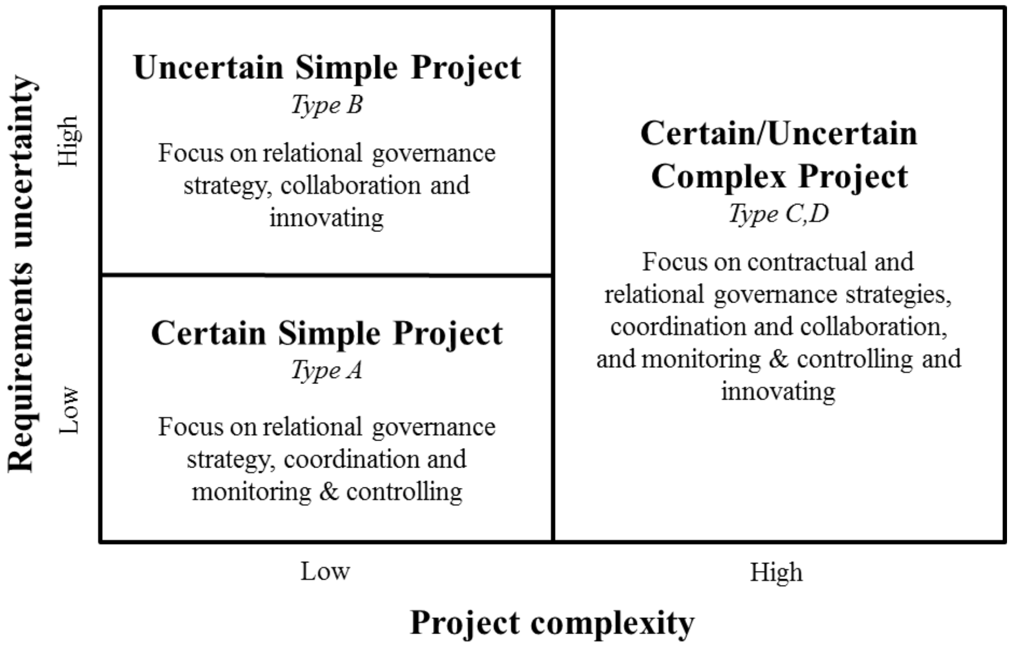


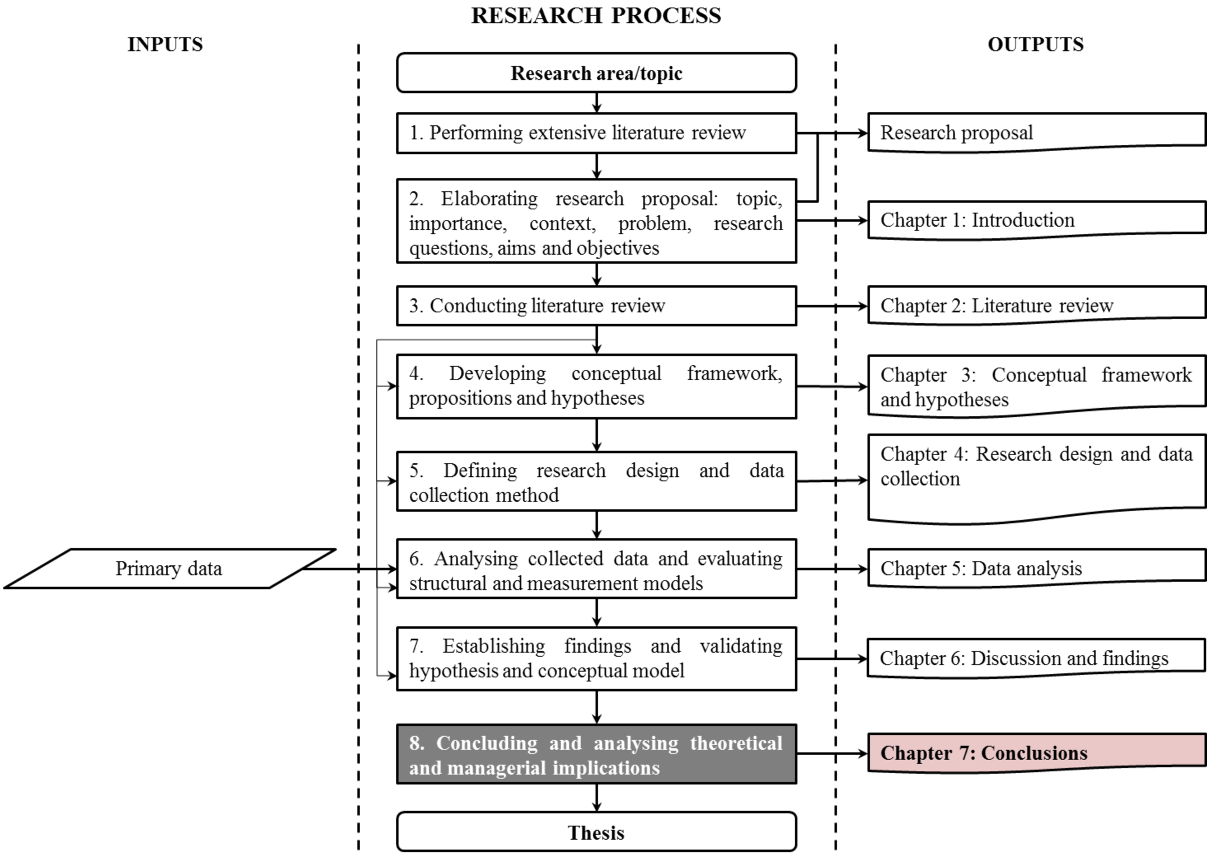
Figure 6.1: A validated contingent framework for value creation in projects

6.5 Summary

Responding to both research questions, this chapter summarises the results of the structural model assessment and moderation analysis detailed in Chapter 5. The hypotheses developed in the conceptual framework (Chapter 3) are tested and discussed. Eight of the eleven hypotheses were supported by the empirical analysis, and three hypotheses were not supported (i.e. H1b, H5b and H6b). Additionally, the moderating effects of requirements uncertainty (RU) and project complexity (PC) on the relationship between value creation processes and project value are significantly supported (i.e. hypothesis eight) by sub-group analysis. Finally, the main findings of the research are compared with those from past research and compressed, including a validated contingent framework for value creation in projects under dichotomy levels of RU and PC.

Chapter 7: CONCLUSIONS

- Introduction
- Summary of the research findings and conclusions
- Research implications
- Research limitations and future work



7.1 Introduction

Having discussed the research findings, this final chapter highlights the main conclusions obtained. Specifically, the summary of main findings and conclusions are first presented (Section 7.2), and theoretical and managerial implications of this research are discussed (Section 7.3). Finally, Section 7.4 explains the research limitations and suggests future research directions.

Recognising the contingent nature of management theories, this thesis develops and validates a contingent conceptual framework on the effects of value creation processes (i.e., independent creation and co-creation) on project value. Each value creation process is underpinned by three components, namely governance strategy, mode of interaction, and management foci. The conceptual framework is validated using data collected via a self-administered, cross-sectional survey. In total, 168 valid responses were returned corresponding to a response rate of 46%. Multivariate analysis is conducted using partial least square - structural equation modelling method (PLS-SEM) to validate the conceptual framework by nonparametric techniques, such as bootstrapping and blindfolding. In addition, the moderation analysis of the two contextual factors – requirements uncertainty and project complexity – is realised by separating the gathered data into four scenarios. Hence, the significant differences between these scenarios support the contingent effects of value creation processes on project value.

7.2 Summary of the research findings and conclusions

The principal findings of this research are summarised in Table 7.1.

Table 7.1: Summary of research findings

The interdependence between value creation processes and their effect on project value
▪ Independent value creation is underpinned by contractual agreements, coordination and monitoring & controlling. ▪ Value co-creation is underpinned by relational engagement, collaboration and innovating. ▪ Both processes are complementary because they jointly impact on project management success. ▪ Value creation processes do not directly influence project success.

Table 7.1: Summary of research findings (continued)

The effect of governance strategy on the mode of interaction

- Contractual agreements lead to coordination but no collaboration.
- Relational engagement leads to coordination and collaboration.

The effect of the mode of interaction on the management foci

- Coordination leads to monitoring and controlling.
- Collaboration leads to innovating.

The effect of the management foci on project value

- Monitoring & controlling and innovating lead to project management success, but not to project success.
- Project management success leads to project success.

The contingent effect of requirements uncertainty and project complexity

- Requirements uncertainty (RU) and project complexity (PC) jointly moderate the relationship between value creation processes and project value.

  In projects where RU and PC are low (i.e. certain simple projects)

  - Relational engagement drives coordination and collaboration.
  - Coordination leads to monitoring and controlling which in turn drives project management success but no project success.
  - Collaboration leads to innovating which in turn drives project success but not project management success.

  In projects where RU is high, and PC is low (i.e. uncertain simple projects)

  - Relational engagement leads to collaboration.
  - Collaboration leads to innovating which in turn drives project management success but not project success.

  In projects where RU is low or high, and PC is high (i.e. certain/uncertain complex projects)

  - Contractual agreements lead to coordination.
  - Relational engagement leads to coordination and collaboration.
  - Coordination leads to monitoring and controlling.
  - Collaboration leads to innovating.
  - Monitoring & controlling and innovating impact project management success but not project success.
- In all projects, project management success impact significantly on project success.

Value creation literature establishes two processes for value creation, i.e. independent creation and co-creation, and validates the relationships between these value creation processes and project value. In relation to the first research question, value creation processes entail three key components: project governance strategy (contractual or relational) which drives the mode of interaction (coordination or collaboration) and in turn leads to the management foci (monitoring and controlling or innovating). An independent value creation process emphasises the implementation of formal contracts through coordination and monitoring & controlling. In contrast, value co-creation functions through collaboration and innovations based on relational mechanisms, such as quality of interactions and relational norms. The findings here establish that monitoring & controlling and innovating lead to project management success with regard to cost, time, scope and quality, which has a positive effect on project success as measured by intangible benefits for the long-term.

Addressing the second research question, this study finds that the effect of the value creation processes on project value is moderated by two contextual variables recognised in the project management discipline – requirements uncertainty and project complexity. Moderating effects refer to different levels of requirements uncertainty and project complexity as relating to stronger or weaker relationships between value creation processes and project value. For example, when projects are certain and simple, there are significant effects from monitoring and controlling on project management success and on innovating for project success. Both management approaches are supported by relational governance which in turn leads to coordination and collaboration, respectively. On the other hand, when projects have higher levels of requirements uncertainty and lower complexity, there is a positive effect of innovating on project management success supported by relational governance and collaboration. In other words, only the value co-creation process becomes significant. Ultimately, in projects where requirements uncertainty is either low or high, and project complexity is high, there is a positive effect from monitoring & controlling and innovating on project management success. In this case, both project governance mechanisms (i.e. contractual and relational) affect coordination, which drives monitoring and controlling; and collaboration, which drives innovativeness.

7.3 Research implications

7.3.1 Implications for theory

This thesis makes several theoretical contributions to literature. Drawing mainly from transaction cost economics (TCE) and inter-organisational relationships (IOR) research, two distinct value creation processes were identified: independent value creation and value co-creation. An independent value creation process is characterised by a contractual governance strategy that safeguards the exchange of technical information and efficient coordination between parties, and promotes the monitoring and controlling of tasks and project outcomes to assure a satisfactory level of performance. This process is designated as independent because it is realised by the focal firm (e.g., contractor) which has the competencies, knowledge and expertise for creating value without the substantive involvement of other stakeholders (e.g., owner). In contrast, a value co-creation process demands collaborative and close work among parties, supported by relational governance strategies, such as continuous interactions and relational norms (i.e. trust, honesty, commitment, a 'no-blame' culture), that are conducive to strategic sharing of information and knowledge and joint problem solving for innovating. The former process focuses on realising value through permanent coordination for monitoring and controlling of the project targets and milestones, therefore ensuring the delivery of the project outcomes on time, within budget and according to agreed scope and quality. The latter process emphasises identifying emerging value propositions and realising values innovatively through the exchange of strategic information, knowledge sharing and collaboration. Thus, the key contribution of this thesis to literature is the conceptualisation of the two value creation processes and the empirical validation of the conceptual framework as presented in Figure 5.9.

Traditionally, both processes have been recognised as divergent, but based on an extant review of empirical management and business research, these processes are defined as interconnected and inclusive, in line with propositions made by Grönroos and Voima (2013) at the firm level Winter and Szczepanek (2009) at the project level. Thus, this thesis contributes to theory because it confirms that both processes act conjointly in pursuit of achieving the project outcomes and client's satisfaction according to recent studies (e.g., Y. Cohen and Rozenes, 2017; Wu et al, 2017). Despite the findings, it was not possible to validate that value creation processes affect directly on business and organisational success and future intangible values. However, there was enough proof that successful projects regarding triple constraint criteria and project quality achievement are a real support to accomplish long-term benefits to stakeholders during realisation phase.

Further contributing to literature, drawing from contingency theory the findings confirmed that the relationship between value creation processes and project value is moderated by both, requirements uncertainty and project complexity. When the uncertainty of project requirements is high, and complexity is low, project governance should be relationship oriented which directs parties to collaborate and to deliver project values innovatively. When project complexity is high, both value creation processes impact on project management success. This moderating effect represents a theoretical contribution in the form of proposing a new way to deal with uncertainty and complexity in projects. Although more collaborative value creation actions have been indicated as the best method to face uncertain or complex projects, the empirical evidence of this research emphasised the fundamental role of contractual governance mechanisms in complex contexts, and also its irrelevance when the project is simple with uncertain requirements. In this last case, trust, mutual engagement and permanent interconnections among the major actors are more effective for reducing uncertainty and maximising project value.

Finally, a special case of moderating effects arises when the project is simple and certain, as related to the requirements. Although there is complete agreement that monitoring and controlling, supported by relational mechanisms and coordination, represents an outstanding direction for creating a positive impact on performance, the findings also demonstrated that relational engagement enables collaboration. Thus, a collaborative work, knowledge sharing, and mutual problem-solving influences innovations for impact significantly on the organisational and business success and other future benefits.

7.3.2 Implications for practice

From a practical perspective, separating value creation into two processes (i.e. independent and co-creation) and governing them provides an adequate sounding board for project managers to identify improved ways to maximise project value in diverse environments of complexity and uncertainty.

First, practitioners must pay attention to the role of governance strategies in creating value which is fundamental to successful projects. Contractual and relational governance mechanisms lead to coordination and collaboration distinctly. While contracts support coordination, relational attributes such as trust, shared goals, commitment and interactions (i.e. relational engagement) enable mainly collaboration but also coordination. In other words, both mechanisms of project governance work together. Hence, detailed contracts include clauses that determine the type, mode and quantity of technical information exchange to coordinate tasks and activities between parties effectively. Additionally, relational mechanisms support personal interactions based on trust and commitment for planning, organising and allocating resources (i.e. coordination), and maintaining permanent communication and collaborative work for transferring critical information and knowledge throughout the project (i.e. collaboration).

Second, coordination has strong influences on project management success through monitoring and controlling. This influence helps project managers to focus on coordination tasks for improving the monitoring and control process, thereby reducing error and revisions to ensure the achievement of project outcomes with regard to cost, time, scope and quality. On the other hand, better collaboration provides more opportunities to apply distinctive competencies, capabilities and expertise from all parties, thus facilitating the capacity to solve complicated situations in new and creative ways by working together (i.e. innovating).

Third, this research demonstrated that practitioners should consider monitoring & controlling and innovating as relevant contributors to project efficiency and client satisfaction. This means that managing projects successfully not only demands great attention to the effective application of controls as traditionally mentioned but also requires innovating from the parties involved to guarantee the desired project outcomes. Monitoring &

controlling and innovating then primarily affect project management performance (i.e. efficiency and client satisfaction) which, in turn, provides the key to achieving project success (i.e. project effectiveness measured by business success and future benefits). In this aspect, innovation in projects is highlighted as a pivotal factor for project success that has been previously neglected in prior project management bodies of knowledge and in traditional project management orientations, where the control process was prominently underlined.

Finally, the choice of the value creation processes that better face uncertainty and complex environments is another practical contribution from this research. The findings empirically showed that collaborative project delivery models such as early contractor involvement (ECI), strategic alliance, public-private partnership (PPP) or integrated project delivery (IPD) could be best suited to projects where requirements are uncertain; whereas when the project is complex, practitioners should keep in mind that contractual agreements and relational mechanisms work together and that the selected project delivery model (PDM) must deal with these characteristics. Especially for PPP projects where public and private actors are closely interrelated to project initiation and delivery, value creation processes (as characterised in this research) could have a significant impact to policymakers and managers for generating a network of partners and stakeholders, and for negotiating a coalition of different interests to achieve successful projects in terms of benefits and value additions. Hence, this practical implication opens a room to link value creation processes and contract management as proposed by Panda (2016). In sum, identifying the most suitable delivery model under diverse contexts can reduce the risk of failure and help accomplish superior project value.

7.4 Research limitations and future work

The validity of the implied causal links of the conceptual framework of this study is limited by the cross-sectional nature of our research design. First, the data collected to investigate the value creation phenomenon and its effect on project value was exclusively sourced from the perceptions of project managers. Although there is evidence about the consistency of perceptions between exchange partners (e.g., Zaheer, McEvily, and Perrone (1998)), further research could extend this work to include a wider spectrum of project stakeholders, such as clients, resource suppliers, users, government agencies and community.

Second, alternative data collection and analysis methods, such as interviews and in-depth case studies, longitudinal panel data and objective performance measurements, may be used in future studies to test this conceptual framework. The use of cross-sectional data, for example, did not allow for the examination of the influence of the value creation processes over time. Future investigations should seek to explore longitudinal data to see the pattern of change of value creation processes throughout the project lifecycle, including the operational phase. Thus, this longitudinal approach based on case study research could compare the four types of projects analysed (i.e. A, B, C, D) to confirm them or to explore new organisational settings to govern the processes of value creation in projects with complexity and requirements uncertainty. Moreover, in some cases, the statistical power for the proposed scenarios is relatively low (in particular for projects type B) due to reduced sample size. Future studies should confirm or dismiss the patterns of relationships among analysed variables for these projects.

Third, this study focused on projects in only one country. In diverse project contexts and substantive relationships, there could be significant differences being tested. Therefore, future research should investigate validating the conceptual framework in multiple countries and contexts. Hence, forthcoming works may look at multiple country-contexts where exists cultural, political and economic disparity that increases uncertainty and complexity in projects. Also, it is possible including others moderators previously used in project management research, e.g., external turbulence (Voss & Kock, 2013), the severity of contract enforcement (Quanji et al., 2017) and cultural distance (Cheung et al., 2010). Such studies could establish how projects create value for the main involved parties in these environments and their consequences on the project value realisation.

Fourth, from a data analysis perspective, this study applied PLS-SEM for empirical analyses. PLS biases have been underlined in previous research because apparently PLS "tends to overestimate the measurement paths connecting constructs to their indicators" (Chin, Marcolin, & Newsted, 2003, p. 205). Other limitations have also been discussed by Guide & Ketokivi (2015) and Rönkkö et al (2016). However, recent investigations demonstrate that PLS is a preferred data analysis method when a measurement model is operationalised by reflective or formative indicators with a sufficient sample size (i.e. more than 150) because it reduces the PLS error (Sarstedt, Hair, Ringle, Thiele, & Gudergan, 2016). This research was exploratory and uses reflective indicators adapted from previous scales. Along these lines; future research could consider the development of other measure indicators that can assure the indicator structure, thereby reducing PLS biases to the limit and exploring different interplays among measurement modes and population sizes.

Finally, selecting 'a priori' the project delivery model (PDM) what better works in determined complex and uncertain project environments has been a controversial issue. Despite the fact that this research opened a new window to analyse this issue based on the conceptualisation of two value creation processes, and their interrelation to impact on project value in different contextual settings. Further research is necessary for determining a preferential PDM for each situation or for otherwise proposing a new way to deal with the contextual factors that currently are increasingly more meaningful in projects and programs.

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APPENDICES

Appendix A: Achievements

Publications

Journal papers

Heredia Rojas, Boris & Liu, Li (2018) Moderated effect of value co-creation on project performance. *International Journal of Managing Projects in Business (Accepted for publication).*

Conference papers

Heredia Rojas, Boris & Liu, Li (2017) Governing project value creation processes—A contingent model for the delivery of complex projects. *31st Annual Australian New Zealand Academy of Management (ANZAM) Conference.* Melbourne, Australia.

Heredia Rojas, Boris & Liu, Li (2016) The impact of value co-creation on project performance moderated by requirements uncertainty—Evidence from Chilean construction industry. *30th Annual Australian New Zealand Academy of Management (ANZAM) Conference.* Brisbane, Australia.

Heredia Rojas, Boris & Liu, Li (2016) Unleashing the hidden potential of value creation in construction project delivery: The joint effect of coordination and collaboration on project value. In: *Proceedings of the International Conference on Construction and Real Estate Management (ICCREM).* Edmonton, Canada, 316-328.

Heredia Rojas, Boris, Liu, Li & Taborda, Louis (2015) Relational approach of value creation for construction project delivery: A conceptual framework. In: Raidén, A B and Aboagye-Nimo, E (Eds) Proceedings *31st Annual Association of Researchers in Construction Management (ARCOM) Conference*. Lincoln, United Kingdom, 1259-1268.

Heredia Rojas, Boris & Liu, Li (2015) Value creation in construction projects: Current approaches and insight from stakeholder theory for future directions. *Construction, Building and Real Estate (COBRA) Research Conference*. Sydney, Australia.

Posters and presentations

Heredia Rojas, Boris (2017) A contingent model for managing projects and creating value—Evidence from Chilean project managers. *5th Chilean Graduate Conference in Australia: Science, Technology and Innovation for Sustainable Development in Chile.* University of New South Wales. Sydney, Australia.

Heredia Rojas, Boris & Liu, Li (2017) The contingent effects of project delivery model's value creation processes on project performance. *2017 Student Research Conference - Global and local perspectives: what does innovation mean today?* Faculty of Engineering & Information Technologies, University of Sydney. Sydney, Australia.

Heredia Rojas, Boris & Liu, Li (2016) The impact of the PDM's value creation processes on project performance moderated by requirements uncertainty. *Postgraduate Poster Presentation*. School of Civil Engineering, University of Sydney. Sydney, Australia.

Heredia Rojas, Boris & Liu, Li (2015) Relational approach of value creation processes in construction projects. *Postgraduate Poster Presentation*. School of Civil Engineering, University of Sydney. Sydney, Australia.

Awards

AU$1250 Research Student Support from Project Management Program School of Civil Engineering, a monetary award for presenting a research paper in ANZAM 2017 Conference. Melbourne, Australia.

AU$1440 Research Student Support from Project Management Program School of Civil Engineering, a monetary award for presenting a research paper in ANZAM 2016 Conference. Brisbane, Australia.

AU$1755 Postgraduate Research Support Scheme (PRSS), a monetary award for presenting a research paper in ICCREM 2016 Conference. Edmonton, Canada.

AU$3000 Postgraduate Research Support Scheme (PRSS), a monetary award for presenting a research paper in 31st ARCOM 2015 Conference. Lincoln, United Kingdom.

Appendix B: Information statement, consent form and questionnaire (English)

VALUE CREATION PROCESS IN PROJECTS

QUESTIONNAIRE

PARTICIPANT INFORMATION STATEMENT

(1) What is this study about?

You are invited to take part in a research study on "Value Creation Process in Projects". This research examines how value creation process impacts on project success and how the project context affects this relationship.

You are invited to participate in this study because you have had a significant responsibility for managing projects. This Participant Information Statement (PIS) tells you about the research study. Knowing what is involved will help you decide if you want to take part in the research. Please read this sheet carefully and ask questions about anything that you don't understand or want to know more about.

Participation in this research study is voluntary.

By giving your consent to take part in this study you are telling us that you:
- Understand what you have read.
- Agree to take part in the research study as outlined below.
- Agree to the use of your personal information as described.

You will be given a copy of this Participant Information Statement to keep.

(2) Who is running the study?

Boris Heredia Rojas is conducting this study for the partial fulfilment of the requirements for the degree of Doctor of Philosophy at The University of Sydney. This will take place under the supervision of Dr Li Liu, Senior Lecturer, School of Civil Engineering.

(3) What will the study involve?

This study involves answering an 'online' questionnaire about the value creation process and the project value in relation to the latest finished project in which you have participated.

If you agree to take part of this questionnaire, it will ask questions about the value creation process performed during the project under diverse project characteristics, the relationships between the project contractor and the client and, the project success in terms of efficiency and effectiveness. The questionnaire will be web-based where the data is auto-recorded once you have submitted it. Also, anonymity and confidentiality will be assured. Personal information such as name and email will be requested, if you only accept to receive the summary of main findings.

(4) How much of my time will the study take?

It will take you approximately 20 minutes

(5) Who can take part in the study?

People whose have managed or worked in projects and have been a project manager, senior manager, executive manager, contract manager, or in a position with similar roles.

(6) Do I have to be in the study? Can I withdraw from the study once I've started?

Being in this study is completely voluntary and you do not have to take part. Your decision whether to participate will not affect your current or future relationship with the researchers or anyone else at the University of Sydney.

If you decide to take part in the study and then change your mind later, you are free to withdraw at any time. Submitting your completed questionnaire is an indication of your consent to participate in the study. You can withdraw your responses any time before you have submitted the questionnaire. Once you have submitted it, your responses cannot be withdrawn because they are anonymous and therefore we will not be able to tell which one is yours.

(7) Are there any risks or costs associated with being in the study?

Aside from giving up your time, we do not expect that there will be any risks or costs associated with taking part in this study.

(8) Are there any benefits associated with being in the study?

We cannot guarantee that you will receive any direct benefits from being in the study. However, your response is relevant to validate a framework that will help project-based organizations (PBOs) to better understand what the value creation process in theirs projects is and how it impacts on project success. Additionally, this research is expected to finish by end-2017, and in consequence participants can request to receive a summary of main findings.

(9) What will happen to information about me that is collected during the study?

By providing your consent, you are agreeing to us collecting personal information about you for the purposes of this research study. Your information will only be used for the purposes outlined in this Participant Information Statement, unless you consent otherwise.

Your information will be stored securely and your identity/information will be kept strictly confidential, except as required by law. Study findings may be published in academic conferences, peer-review journals, thesis and/or book chapters, but you will not be individually identifiable in these publications.

(10) Can I tell other people about the study?

Yes, you are welcome to tell other people about the study.

(11) What if I would like further information about the study?

When you have read this information, the researchers will be available to discuss it with you further and answer any questions you may have. If you would like to know more at any stage during the study, please feel free to contact Boris Heredia Rojas, PhD student, School of Civil Engineering, Faculty of Engineering & IT, The University of Sydney, by Email: boris.herediarojas@sydney.edu.au

(12) Will I be told the results of the study?

You have a right to receive feedback about the overall results of this study. You can tell us that you wish to receive feedback by answering the relevant question in the 'online' questionnaire. This feedback will be in the form of a summary of main results by Email. You will receive this feedback after the study is finished.

(13) What if I have a complaint or any concerns about the study?

Research involving humans in Australia is reviewed by an independent group of people called a Human Research Ethics Committee (HREC). The ethical aspects of this study have been approved by the HREC of the University of Sydney 'Protocol No.: 2015/759'. As part of this process, we have agreed to carry out the study according to the *National Statement on Ethical Conduct in Human Research (2007)*. This statement has been developed to protect people who agree to take part in research studies.

If you are concerned about the way this study is being conducted or you wish to make a complaint to someone independent from the study, please contact the university using the details outlined below. Please quote the study title and protocol number.

The Manager, Ethics Administration, University of Sydney:

- **Telephone:** +61 2 8627 8176
- **Fax:** +61 2 8627 8177
- **Email:** ro.humanethics@sydney.edu.au

Additionally to participants who are located overseas and completed the questionnaire in Spanish, an independent local complaints contact has been defined. Please contact him using the following details.

Alfredo González León, Department of Construction Management, Universidad Católica del Norte:

- **Telephone:** +56 55 235 5451
- **Fax:** +56 55 235 5474
- **Email:** agonzale@ucn.cl

PARTICIPANT CONSENT FORM

I, ____ [PRINT NAME], agree to take part in this research study.

In giving my consent I state that:

- ✓ I understand the purpose of the study, what I will be asked to do, and any risks/benefits involved.
- ✓ I have read the Participant Information Statement and have been able to discuss my involvement in the study with the researchers if I wished to do so.
- ✓ The researchers have answered any questions that I had about the study and I am happy with the answers.
- ✓ I understand that being in this study is completely voluntary and I do not have to take part. My decision whether to be in the study will not affect my relationship with the researchers or anyone else at the University of Sydney now or in the future.
- ✓ I understand that I can withdraw from the study at any time.
- ✓ I understand that personal information about me that is collected over the course of this research project will be stored securely and will only be used for purposes that I have agreed to. I understand that information about me will only be told to others with my permission, except as required by law.
- ✓ I understand that the results of this study may be published, and that publications will not contain my name or any identifiable information about me.

Would you like to receive feedback about the overall results of this study?

YES ☐ **NO** ☐

0. Guidelines

- ✓ The following sections of this questionnaire include questions regarding the **latest finished project** in which you have participated and will be referred to here as 'The project'.
- ✓ *'The project contractor'* refers to the parent organization where you were employed during the project.
- ✓ *'The client'* refers the partner who maintained a contractual relationship with the parent organization during the project.
- ✓ You must have had a significant role of responsibility in the project, and therefore, should have had enough information about the project and know the history of the relationship between the project contractor and the client.
- ✓ Answers to every question are mandatory.
- ✓ There are not 'good' (right) or 'bad' (wrong) answers.
- ✓ Please you must answer as honestly as possible.

1. Specific characteristics of the project

1.1 In which of the following would you **classify the project**?

- ☐ Engineering and construction
- ☐ Information system and technology
- ☐ Business processes / organizational change / administrative
- ☐ New product development / manufacturing
- ☐ Service (consulting, financial, transport, retail, tourism, health, education)
- ☐ Maintenance / equipment or system installation
- ☐ Research and development (R&D)
- ☐ Other (please specify) ________________________________

1.2 What size was the project, in terms of the **total planned budget** (***in millions of AU$***) established in the contractual agreement between the project contractor and the client?

- ☐ Less than 1
- ☐ Between 1 and 9.9
- ☐ Between 10 and 99.9
- ☐ Between 100 and 499.9
- ☐ Between 500 and 999.9
- ☐ More than 1000

1.3 What size was the project, in terms of the **total planned duration** (***in months***) established in the contractual agreement between the project contractor and the client?

- ☐ Less than 6
- ☐ Between 6 and 12
- ☐ Between 13 and 24
- ☐ Between 25 and 36
- ☐ Between 37 and 48
- ☐ More than 48

1.4 What size was the project, in terms of the amount of **people involved**?

- ☐ Less than 20
- ☐ Between 20 and 99
- ☐ Between 100 and 249
- ☐ Between 250 and 499
- ☐ Between 500 and 999
- ☐ More than 1000

1.5 What was the **perceived time pressure** during the project?

- ☐ Not at all
- ☐ Normal
- ☐ High
- ☐ Very high/critical

2. Project value creation process

Please answer according to following scale:

Fully Agree	Agree	Partially Agree	Partially Disagree	Disagree	Fully Disagree	Don't know/ Unsure
6	5	4	3	2	1	N/A

To what extent do you **agree** or **disagree** with the following statements regarding the project?

		6	5	4	3	2	1	N/A
2.1	The client-project contractor relationship was primarily governed by written contracts.	☐	☐	☐	☐	☐	☐	☐
2.2	The client and the project contractor made contractual agreements where they detailed both parties' rights and obligations.	☐	☐	☐	☐	☐	☐	☐
2.3	During the project, the project contractor completed tasks for the client that never needs to be expressed contractually or formally.	☐	☐	☐	☐	☐	☐	☐
2.4	Each party considered the contingencies that might emerge in the future at its best and made an exhaustive explanation in the contract.	☐	☐	☐	☐	☐	☐	☐
2.5	The client and the project contractor permanently referred to the contract to resolve disputes and conflicts between them during the project.	☐	☐	☐	☐	☐	☐	☐
2.6	The different job and work activities between the project contractor and the client fit together very well.	☐	☐	☐	☐	☐	☐	☐
2.7	The routines between the project contractor and the client were well established during the project.	☐	☐	☐	☐	☐	☐	☐
2.8	The decisions were well coordinated between both parties.	☐	☐	☐	☐	☐	☐	☐
2.9	Both parties linked together to achieve the project objectives.	☐	☐	☐	☐	☐	☐	☐
2.10	The project contractor and the client coordinated the project activities through…							
	a) … periodic meetings	☐	☐	☐	☐	☐	☐	☐
	b) … informal conversations (telephone, face to face dialog)	☐	☐	☐	☐	☐	☐	☐
	c) … site visits	☐	☐	☐	☐	☐	☐	☐
	d) … written correspondence (Email, letters)	☐	☐	☐	☐	☐	☐	☐
	e) … plans and procedures	☐	☐	☐	☐	☐	☐	☐
	f) … schedules	☐	☐	☐	☐	☐	☐	☐
	g) … reports	☐	☐	☐	☐	☐	☐	☐
	h) … contract documents (clauses, specifications and drawings)	☐	☐	☐	☐	☐	☐	☐
2.11	Both parties provided with the technical information of the kind that other needed.	☐	☐	☐	☐	☐	☐	☐
2.12	Proprietary technical information was exchanged between both parties frequently.	☐	☐	☐	☐	☐	☐	☐
2.13	Both parties were expected to keep the other party informed about changes that could affect the project.	☐	☐	☐	☐	☐	☐	☐
2.14	The project contractor had several sources of objective data that indicated how well the project was meeting the goals.	☐	☐	☐	☐	☐	☐	☐
2.15	The project contractor frequently discussed progress toward the project objectives with the client.	☐	☐	☐	☐	☐	☐	☐
2.16	The project contractor monitored and controlled whether the project (or deliverable) was completing on time.	☐	☐	☐	☐	☐	☐	☐
2.17	The project contractor monitored and controlled whether the project (or deliverable) was completing within budget.	☐	☐	☐	☐	☐	☐	☐
2.18	The project contractor monitored and controlled whether the project (or deliverable) was satisfying the client' requirements.	☐	☐	☐	☐	☐	☐	☐
2.19	The project contractor monitored and controlled whether the project tasks were performing efficiently.	☐	☐	☐	☐	☐	☐	☐

Continue...		6	5	4	3	2	1	N/A
2.20	The project contractor applied mechanisms for the identification and resolution of project issues requiring corrective actions	☐	☐	☐	☐	☐	☐	☐
2.21	The client was intensely involved in the design phase.	☐	☐	☐	☐	☐	☐	☐
2.22	The project contractor was intensely involved in the design phase.	☐	☐	☐	☐	☐	☐	☐
2.23	The client was intensely involved in the implementation phase.	☐	☐	☐	☐	☐	☐	☐
2.24	The interactions between both parties produced novel insights.	☐	☐	☐	☐	☐	☐	☐
2.25	Both parties displayed a sound strategic understanding of each other business in their interactions.	☐	☐	☐	☐	☐	☐	☐
2.26	Both parties played a proactive role during their interactions.	☐	☐	☐	☐	☐	☐	☐
2.27	Both parties were intentionally open and honest in their interactions.	☐	☐	☐	☐	☐	☐	☐
2.28	Both parties were enthusiastic in achieving the project objectives.	☐	☐	☐	☐	☐	☐	☐
2.29	Both parties felt confident that the other party was reliable and trustworthy.	☐	☐	☐	☐	☐	☐	☐
2.30	Both parties believed the other party made its best efforts.	☐	☐	☐	☐	☐	☐	☐
2.31	Both parties adopted 'no blame culture' whenever problems arise.	☐	☐	☐	☐	☐	☐	☐
2.32	Both parties worked effectively on joint project tailored to joint needs.	☐	☐	☐	☐	☐	☐	☐
2.33	Both parties worked together effectively to exploit unique opportunities.	☐	☐	☐	☐	☐	☐	☐
2.34	Both parties were always looking for synergistic ways to do business together.	☐	☐	☐	☐	☐	☐	☐
2.35	When conflicts arose both parties found out a proper solution jointly.	☐	☐	☐	☐	☐	☐	☐
2.36	When the project contractor's performance did not match with client's expectation, the client helped it or provided suggestions.	☐	☐	☐	☐	☐	☐	☐
2.37	Both parties worked closely to reduce risks, sharing gains and/or pains throughout the project.	☐	☐	☐	☐	☐	☐	☐
2.38	Both parties shared information on successful and/or unsuccessful experiences with deliverables exchanged in the relationship.	☐	☐	☐	☐	☐	☐	☐
2.39	Both parties exchanged information related to changes in the users' needs, preferences, and behaviour.	☐	☐	☐	☐	☐	☐	☐
2.40	Both parties exchanged information as soon as any unexpected problems arise.	☐	☐	☐	☐	☐	☐	☐
2.41	Both parties exchanged information related to changes in the two organizations' strategies and policies.	☐	☐	☐	☐	☐	☐	☐
2.42	Both parties exchanged information that is sensitive for them, such as financial performance and organizational know-how.	☐	☐	☐	☐	☐	☐	☐
2.43	Both parties collaboratively and frequently tried out new ideas for the project.	☐	☐	☐	☐	☐	☐	☐
2.44	Both parties collaboratively and frequently seek new ways of doing things for the project.	☐	☐	☐	☐	☐	☐	☐
2.45	During the project, both parties were creative in its operating methods.	☐	☐	☐	☐	☐	☐	☐
2.46	During the project, both parties put much value on taking risks even if that turns out to be a failure.	☐	☐	☐	☐	☐	☐	☐
2.47	During the project, innovation was perceived for any party as too risky and was resisted	☐	☐	☐	☐	☐	☐	☐

3. Project context

Please respond according to following scale:

Fully Agree 6	Agree 5	Partially Agree 4	Partially Disagree 3	Disagree 2	Fully Disagree 1	Don't know/ Unsure N/A

To what extent do you **agree** or **disagree** with the following statements regarding the project context?

		6	5	4	3	2	1	N/A
3.1	The project had a high degree of task novelty.	☐	☐	☐	☐	☐	☐	☐
3.2	The project had a high degree of complexity concerning to content.	☐	☐	☐	☐	☐	☐	☐
3.3	The project had a high degree of complexity concerning to interdisciplinary participants and specialities.	☐	☐	☐	☐	☐	☐	☐
3.4	The project was characterized by high risk and uncertainty.	☐	☐	☐	☐	☐	☐	☐
3.5	The country's regulations and politics were challenging.	☐	☐	☐	☐	☐	☐	☐
3.6	The market situation (e.g. exchange rate) was highly unstable.	☐	☐	☐	☐	☐	☐	☐
3.7	The project site (location) was challenging or difficult to access.	☐	☐	☐	☐	☐	☐	☐
3.8	The pressure from external stakeholders was high.	☐	☐	☐	☐	☐	☐	☐
3.9	Project requirements fluctuated quite a bit in later phases.	☐	☐	☐	☐	☐	☐	☐
3.10	Project requirements identified at the beginning were quite different from those at the end.	☐	☐	☐	☐	☐	☐	☐
3.11	Project requirements are expected to fluctuate quite a bit in the future.	☐	☐	☐	☐	☐	☐	☐
3.12	Users/stakeholders of the project often differed among themselves in the requirements to be met.	☐	☐	☐	☐	☐	☐	☐
3.13	A lot of effort had to be spent in reconciling the requirements of various users/stakeholders of the project.	☐	☐	☐	☐	☐	☐	☐
3.14	It was difficult to customize the project output to one set of users/stakeholders without reducing support to other users/stakeholders.	☐	☐	☐	☐	☐	☐	☐

4. Project value

According to your experience in the project, **to what extent** was each of the following objectives fulfilled by the project?

		Not at all 1	2	3	4	5	6	To a great extent 7
4.1	The project was completed within or below budget.	☐	☐	☐	☐	☐	☐	☐
4.2	The project was completed on time or earlier.	☐	☐	☐	☐	☐	☐	☐
4.3	The project had minor changes.	☐	☐	☐	☐	☐	☐	☐
4.4	The product (or deliverable) improved the client's performance.	☐	☐	☐	☐	☐	☐	☐
4.5	The client was satisfied.	☐	☐	☐	☐	☐	☐	☐
4.6	The product (or deliverable) met the client's requirements.	☐	☐	☐	☐	☐	☐	☐
4.7	The client is using the product (or deliverable).	☐	☐	☐	☐	☐	☐	☐
4.8	The client came/will come back for future work.	☐	☐	☐	☐	☐	☐	☐
4.9	The project was an economic business success for the project contractor.	☐	☐	☐	☐	☐	☐	☐
4.10	The project increased the project contractor's profitability.	☐	☐	☐	☐	☐	☐	☐
4.11	The project has a positive return on investment.	☐	☐	☐	☐	☐	☐	☐
4.12	The project contributed to the project contractor's direct performance.	☐	☐	☐	☐	☐	☐	☐
4.13	The project outcome contributed/will contribute to future projects.	☐	☐	☐	☐	☐	☐	☐
4.14	The project led/will lead to additional new products.	☐	☐	☐	☐	☐	☐	☐
4.15	The project helped/will help create new markets.	☐	☐	☐	☐	☐	☐	☐
4.16	The project created new technologies for future use.	☐	☐	☐	☐	☐	☐	☐
4.17	The project contributed to new business processes/models.	☐	☐	☐	☐	☐	☐	☐
4.18	The project developed better managerial capabilities.	☐	☐	☐	☐	☐	☐	☐
4.19	Overall the project was a great success.	☐	☐	☐	☐	☐	☐	☐

5. Personal background information

5.1 What was your **designation/job tittle** in the project/parent organization at the time you worked on the project?

- ☐ Project manager
- ☐ Senior manager
- ☐ Executive manager
- ☐ Contract manager
- ☐ Other (please specify) ________________________________

5.2 How many **years of experience** do you have working in projects?

- ☐ Under 10
- ☐ Between 10 and 19
- ☐ Between 20 and 29
- ☐ Between 30 and 39
- ☐ Over 40

5.3 What is your **age**?

- ☐ Between 20 and 29
- ☐ Between 30 and 39
- ☐ Between 40 and 49
- ☐ Between 50 and 59
- ☐ Over 60

5.4 What is the **highest level of education** you have completed?

- ☐ High school
- ☐ Technical Diploma
- ☐ Bachelor/Professional degree
- ☐ Master degree/Honours
- ☐ PhD/Doctorate

Comments:
Please use the following space to write some comments in regards to the questionnaire.

Thank you for your valuable contribution to our research!

Appendix C: Information statement, consent form and questionnaire (Spanish)

EL PROCESO DE CREACION DE VALOR EN PROYECTOS

CUESTIONARIO

DECLARACION DE INFORMACION PARA EL PARTICIPANTE

(1) ¿Acerca de qué es este estudio?

Usted ha sido invitado a tomar parte en este estudio de investigación sobre *"El Proceso de Creación de Valor en Proyectos"*. Esta investigación examina cómo el proceso de creación de valor impacta en el éxito del proyecto y cómo el contexto del proyecto afecta esta relación.

Usted es invitado a participar porque ha tenido un rol de significativa responsabilidad en la gestión de proyectos. Esta Declaración de Información para el Participante (PIS –por su nombre en inglés) entrega información acerca de este estudio de investigación. Conocer lo que está involucrado en él, le ayudará a decidir si desea tomar parte en el estudio. Por favor, lea este documento cuidadosamente y haga las preguntas necesarias acerca de algo que no entienda o requiera conocer más.

La participación en este estudio de investigación es voluntaria.

Al dar su consentimiento para tomar parte de este estudio, usted nos está diciendo que:

- Entiende lo que ha leído.
- Está de acuerdo en tomar parte en este estudio tal cómo más abajo se explica.
- Está de acuerdo en que podemos usar la información personal cómo se describe.

Usted recibirá una copia de esta Declaración de Información del Participante para guardarla.

(2) ¿Quién está realizando el estudio?

Boris Heredia Rojas está conduciendo este estudio para el cumplimiento parcial de los requisitos para obtener el grado de Doctor de Filosofía en la Universidad de Sídney. Esta investigación se realiza bajo la supervisión del Dr. Li Liu, Profesor Sénior, Escuela de Ingeniería Civil.

(3) ¿Qué involucrará este estudio?

Este estudio comprende responder un cuestionario 'online' acerca del proceso de creación de valor y el valor del proyecto en relación al último proyecto terminado en el cual usted haya participado.

Si está de acuerdo en tomar parte de esta encuesta, las preguntas serán acerca del proceso de creación de valor realizado durante el proyecto bajo diversas características del proyecto, las relaciones entre el contratista del proyecto y el cliente y el éxito del proyecto en términos de eficiencia y efectividad. El cuestionario será 'web' donde los datos serán guardados automáticamente una vez lo haya enviado. Además, su anonimato y confidencialidad será asegurada. La información personal tal como nombre y email será requerida solamente si acepta recibir el resumen ejecutivo con los principales hallazgos.

(4) ¿Cuánto tiempo tomará el estudio?

La encuesta tomará aproximadamente 25 minutos.

(5) ¿Quién puede tomar parte en el estudio?

Personas quiénes han dirigido o trabajado en proyectos y han sido director/gerente/jefe de proyecto, gerente sénior, gerente ejecutivo, gerente/administrador de contrato, o en alguna posición con roles similares.

(6) ¿Tengo la obligación de estar en el estudio? ¿Puedo retirarme del estudio una vez haya iniciado?

Estar en este estudio es completamente voluntario y usted no tiene la obligación de tomar parte en él. Su decisión de participar no afectará su actual o futura relación con los investigadores o con alguien en la Universidad de Sídney.

Si usted decide tomar parte en el estudio y luego cambia su decisión, usted está libre de retirarse en cualquier momento. Enviar el cuestionario completo es una indicación de su consentimiento a participar en el estudio. Usted puede retirar sus respuestas en cualquier momento antes de que envíe el cuestionario. Una vez que usted lo haya enviado, sus respuestas no pueden ser retiradas porque ellas son anónimas y nosotros no podemos determinar cuál es la suya.

(7) ¿Hay algunos riesgos o costos asociados por estar en el estudio?

Aparte de ocupar un poco de su tiempo, nosotros no esperamos que haya riesgos o costos asociados con ser parte de este estudio.

(8) ¿Hay algunos beneficios asociados por estar en el estudio?

Nosotros no podemos garantizar que usted recibirá algún beneficio directo por estar en el estudio. Sin embargo, su respuesta es relevante para validar un modelo que ayudará a organizaciones basadas en proyectos (PBOs, por su nombre en inglés) a entender mejor qué es el proceso de creación de valor y cómo éste impacta en el éxito del proyecto. Adicionalmente, se espera que esta investigación termine a finales de 2017 y en consecuencia, los participantes podrán recibir un resumen ejecutivo con los principales hallazgos.

(9) ¿Qué sucederá con la información personal que será recolectada durante el estudio?

Al entregar su consentimiento, usted está de acuerdo con que nosotros recolectemos su información personal respecto a los propósitos de este estudio. Su información será utilizada solamente con la finalidad resumida en esta Declaración de Información para el Participante, a no ser que su consentimiento indique lo contrario.

Su información será almacenada en forma segura y su identidad será guardada bajo estricta confidencialidad, excepto en los casos requeridos por la ley. Los hallazgos o conclusiones del estudio pueden ser publicados en conferencias académicas, revistas científicas, tesis y/o capítulos de libros, pero usted no será identificable individualmente en estas publicaciones.

(10) ¿Puedo mencionarle a otra persona acerca del estudio?

Si, usted puede mencionarle a otra persona acerca de este estudio.

(11) ¿Qué sucede si deseo más información acerca del estudio?

Cuando usted haya leído esta información, los investigadores estarán disponibles para conversar con usted sobre más antecedentes del estudio y responder alguna pregunta que usted pueda tener. Si le gustaría saber más durante alguna etapa del estudio, por favor siéntase con la libertad de contactar a Boris Heredia Rojas, estudiante de Doctorado, Escuela de Ingeniería Civil, Facultad de Ingeniería & TI, Universidad de Sídney, por email a: boris.herediarojas@sydney.edu.au

(12) ¿Tendré los resultados del estudio?

Usted tiene el derecho de recibir retroalimentación acerca de los resultados generales de este estudio. Usted puede decirnos que desea recibir retroalimentación respondiendo la pregunta correspondiente en el cuestionario '*online*'. Esta retroalimentación será en forma de un resumen ejecutivo con los principales resultados enviado a través de email. Usted recibirá esta información una vez que el estudio haya finalizado.

(13) ¿Qué sucede si tengo algún reclamo o preocupación acerca del estudio?

En Australia, las investigaciones que involucran humanos son revisadas por un grupo independiente de personas llamado Comité de Ética para la Investigación Humana (HREC, por su nombre en inglés). Los aspectos éticos de este estudio han sido aprobados por el HREC de la Universidad de Sídney 'número de protocolo 2015/759'. Como parte de este proceso, nosotros estuvimos de acuerdo en realizar este estudio según la Declaración Nacional sobre Conducta Ética en Investigaciones Humanas (2007). Esta declaración fue desarrollada para proteger a las personas que estén de acuerdo con tomar parte en estudios de investigación.

Si usted está preocupado con la forma que este estudio está siendo conducido o desea hacer algún reclamo a alguien independiente del estudio, por favor contactarse a la universidad usando los detalles mencionados abajo. Por favor indique el título y número de protocolo del estudio.

El Gerente, Administración de Ética Humana, Universidad de Sídney:

- **Teléfono:** +61 2 8627 8176
- **Fax:** +61 2 8627 8177
- **Email:** ro.humanethics@sydney.edu.au

Adicionalmente para los participantes localizados en el extranjero y que completaron el cuestionario en español, un contacto local e independiente para reclamos o preocupaciones ha sido definido. Favor contactarse con él usando la siguiente información.

Alfredo González León, Departamento de Gestión de la Construcción, Universidad Católica del Norte:

- **Teléfono:** +56 55 235 5451
- **Fax:** +56 55 235 5474
- **Email:** agonzale@ucn.cl

FORMATO DE CONSENTIMIENTO DEL PARTICIPANTE

Yo, ______________________________ [NOMBRE], estoy de acuerdo en tomar parte de esta investigación.

Para dar mi consentimiento, yo manifiesto que:

- ✓ Entiendo el propósito del estudio al cuál yo he sido invitado a participar y los riesgos/beneficios involucrados.
- ✓ He leído la Declaración de Información para el Participante y he podido hablar con los investigadores sobre mi participación en el estudio, si yo así lo deseaba hacer.
- ✓ Los investigadores han contestado algunas preguntas que yo tuve acerca del estudio y estoy contento con las respuestas.
- ✓ Entiendo que estar en este estudio es completamente voluntario y no tengo la obligación de ser parte. Mi decisión de estar en el estudio no afectará mi relación con los investigadores o con alguien en la Universidad de Sídney, ahora o en el futuro.
- ✓ Entiendo que puedo retirarme del estudio en cualquier momento.
- ✓ Entiendo que la información personal recolectada en el transcurso de este proyecto de investigación será almacenada en forma segura y sólo será usada para los propósitos que he aceptado. Entiendo que mi información será entregada a otros sólo con mi permiso, excepto en los casos requeridos por la ley.
- ✓ Entiendo que los resultados de este estudio pueden ser publicados y que las publicaciones no incluirán mi nombre o alguna información que me identifique.

¿Le gustaría recibir retroalimentación acerca de los resultados generales de este estudio?

SI ☐ **NO** ☐

0. Directrices

- ✓ Las siguientes secciones de este cuestionario contienen preguntas en relación al **último proyecto terminado** en el cual usted haya participado y será referido aquí como '*el proyecto*'.
- ✓ '*El contratista del proyecto*' se refiere a la organización matriz donde Ud. estuvo empleado durante el proyecto.
- ✓ '*El cliente*' se refiere al socio quién mantuvo una relación contractual con la organización matriz durante el proyecto.
- ✓ Usted debería haber tenido un rol de significativa responsabilidad en el proyecto, por lo tanto, debería tener suficiente información acerca del avance del proyecto y conocer la historia de la relación entre el contratista del proyecto y el cliente.
- ✓ Las respuestas a cada pregunta son obligatorias.
- ✓ No hay respuestas 'buenas' (correctas) ni 'malas' (incorrectas).
- ✓ Por favor, Ud. debe contestar lo más honestamente posible.

1. Características específicas del proyecto

1.1 ¿De acuerdo a cuál de los siguientes **tipos** podría usted clasificar el proyecto?

- ☐ Ingeniería y construcción
- ☐ Tecnología y sistemas de información
- ☐ Procesos de negocio / cambio organizacional / administrativo
- ☐ Desarrollo de nuevos productos / manufactura
- ☐ Servicio (consultoría, financiero, transporte, retail, turismo, salud, educación)
- ☐ Mantenimiento / instalación de sistemas o equipamiento
- ☐ Investigación y desarrollo (I+D)
- ☐ Otro (favor especifique) ________________________________

1.2 ¿Cuál fue el tamaño del proyecto en términos del **presupuesto total planeado** (**en millones de US$**) establecido en el acuerdo contractual entre el contratista del proyecto y el cliente?

- ☐ Menos de 0.7
- ☐ Entre 0.7 y 6.9
- ☐ Entre 7 y 69.9
- ☐ Entre 70 y 349.9
- ☐ Entre 350 y 699.9
- ☐ Más de 700

1.3 ¿Cuál fue el tamaño del proyecto en términos de la **duración total planeada** (**en meses**) establecido en el acuerdo contractual entre el contratista del proyecto y el cliente?

- ☐ Menos de 6
- ☐ Entre 6 y 12
- ☐ Entre 13 y 24
- ☐ Entre 25 y 36
- ☐ Entre 37 y 48
- ☐ Más de 48

1.4 ¿Cuál fue el tamaño del proyecto en términos de la **cantidad de personas involucradas**?

- ☐ Menos de 20
- ☐ Entre 20 y 99
- ☐ Entre 100 y 249
- ☐ Entre 250 y 499
- ☐ Entre 500 y 999
- ☐ Más de 1000

1.5 ¿Cuál fue la **presión de tiempo percibida** durante el proyecto?

- ☐ Baja
- ☐ Normal
- ☐ Alta
- ☐ Muy alta/crítica

2. El Proceso de Creación de Valor del Proyecto

Favor responda considerando la siguiente escala:

Totalmente de Acuerdo 6	De Acuerdo 5	Parcialmente de Acuerdo 4	Parcialmente en Desacuerdo 3	En Desacuerdo 2	Totalmente en Desacuerdo 1	No sé/ No estoy seguro N/A

¿Qué tan **de acuerdo** o **en desacuerdo** está Ud. con las siguientes declaraciones en relación al proyecto?

		6	5	4	3	2	1	N/A
2.1	La relación entre el cliente y el contratista del proyecto fue primariamente gobernada por contratos escritos.	☐	☐	☐	☐	☐	☐	☐
2.2	El cliente y el contratista del proyecto hicieron acuerdos contractuales donde detallaban los derechos y obligaciones de ambas partes.	☐	☐	☐	☐	☐	☐	☐
2.3	Durante el proyecto, el contratista realizó tareas para el cliente que nunca necesitaron ser expresadas contractual o formalmente.	☐	☐	☐	☐	☐	☐	☐
2.4	Cada parte consideró las contingencias que podrían emerger en el futuro de la mejor manera posible e hizo una explicación exhaustiva en el contrato.	☐	☐	☐	☐	☐	☐	☐
2.5	El cliente y el contratista permanentemente se refirieron al contrato para resolver disputas y conflictos entre ellos durante el proyecto.	☐	☐	☐	☐	☐	☐	☐
2.6	Los diferentes trabajos y actividades entre el contratista del proyecto y el cliente se ajustaron muy bien.	☐	☐	☐	☐	☐	☐	☐
2.7	Las rutinas entre el contratista y el cliente fueron bien establecidas durante el proyecto.	☐	☐	☐	☐	☐	☐	☐
2.8	Las decisiones fueron bien coordinadas entre ambas partes.	☐	☐	☐	☐	☐	☐	☐
2.9	Ambas partes se vincularon entre sí para alcanzar los objetivos del proyecto.	☐	☐	☐	☐	☐	☐	☐
2.10	El contratista y el cliente coordinaron las actividades del proyecto a través de…							
a)	…reuniones periódicas	☐	☐	☐	☐	☐	☐	☐
b)	…conversaciones informales (por teléfono, cara a cara)	☐	☐	☐	☐	☐	☐	☐
c)	…visitas a terreno	☐	☐	☐	☐	☐	☐	☐
d)	…correspondencia escrita (email, cartas)	☐	☐	☐	☐	☐	☐	☐
e)	…planes y procedimientos	☐	☐	☐	☐	☐	☐	☐
f)	…programaciones	☐	☐	☐	☐	☐	☐	☐
g)	…reportes	☐	☐	☐	☐	☐	☐	☐
h)	…documentos contractuales (cláusulas, especificaciones, planos)	☐	☐	☐	☐	☐	☐	☐
2.11	Ambas partes proveyeron información técnica del tipo que la otra parte necesitaba.	☐	☐	☐	☐	☐	☐	☐
2.12	Información técnica confidencial fue intercambiada frecuentemente entre ambas partes.	☐	☐	☐	☐	☐	☐	☐
2.13	Ambas partes estaban expectantes por mantener informada a la otra parte acerca de los cambios que podrían afectar el proyecto.	☐	☐	☐	☐	☐	☐	☐
2.14	El contratista del proyecto tuvo varias fuentes de datos objetivos que indicaban qué tan bien el proyecto estaba logrando las metas.	☐	☐	☐	☐	☐	☐	☐
2.15	El contratista del proyecto frecuentemente habló con el cliente sobre el avance en el cumplimiento de los objetivos del proyecto.	☐	☐	☐	☐	☐	☐	☐
2.16	El contratista del proyecto monitoreó y controló si el proyecto (o entregable) se estaba realizando dentro del presupuesto.	☐	☐	☐	☐	☐	☐	☐
2.17	El contratista del proyecto monitoreó y controló si el proyecto (o entregable) se estaba realizando a tiempo.	☐	☐	☐	☐	☐	☐	☐
2.18	El contratista del proyecto monitoreó y controló si el proyecto (o entregable) estaba satisfaciendo los requerimientos del cliente.	☐	☐	☐	☐	☐	☐	☐
2.19	El contratista del proyecto monitoreó y controló si las actividades del proyecto se estaban ejecutando eficientemente.	☐	☐	☐	☐	☐	☐	☐

Continúa...		6	5	4	3	2	1	N/A
2.20	El contratista aplicó mecanismos para la identificación y resolución de problemas del proyecto requiriendo de acciones correctivas.	☐	☐	☐	☐	☐	☐	☐
2.21	El cliente estuvo involucrado intensamente en la fase de diseño.	☐	☐	☐	☐	☐	☐	☐
2.22	El contratista estuvo involucrado intensamente en la fase de diseño.	☐	☐	☐	☐	☐	☐	☐
2.23	El cliente estuvo involucrado intensamente en la fase de implementación (ejecución).	☐	☐	☐	☐	☐	☐	☐
2.24	Las interacciones entre ambas partes produjeron conocimientos innovadores.	☐	☐	☐	☐	☐	☐	☐
2.25	Ambas partes mostraron un buen entendimiento estratégico del negocio de la otra parte durante sus interacciones.	☐	☐	☐	☐	☐	☐	☐
2.26	Ambas partes tuvieron un rol proactivo durante sus interacciones.	☐	☐	☐	☐	☐	☐	☐
2.27	Ambas partes fueron intencionalmente abiertas y honestas durante sus interacciones.	☐	☐	☐	☐	☐	☐	☐
2.28	Ambas partes estuvieron entusiasmadas en lograr los objetivos del proyecto.	☐	☐	☐	☐	☐	☐	☐
2.29	Ambas partes se sentían seguras que la otra parte era fiable y confiable.	☐	☐	☐	☐	☐	☐	☐
2.30	Ambas partes creyeron que la otra parte hizo sus mejores esfuerzos.	☐	☐	☐	☐	☐	☐	☐
2.31	Ambas partes adoptaron la 'cultura de no culpar al otro' cuando aparecieron problemas.	☐	☐	☐	☐	☐	☐	☐
2.32	Ambas partes trabajaron conjunta y efectivamente en el proyecto considerando mutuas necesidades.	☐	☐	☐	☐	☐	☐	☐
2.33	Ambas partes trabajaron conjunta y efectivamente en el proyecto para aprovechar oportunidades únicas.	☐	☐	☐	☐	☐	☐	☐
2.34	Ambas partes estuvieron siempre buscando sinergias para hacer negocios en conjunto.	☐	☐	☐	☐	☐	☐	☐
2.35	Cuando aparecieron los conflictos, ambas partes encontraron conjuntamente una solución apropiada.	☐	☐	☐	☐	☐	☐	☐
2.36	Cuando el desempeño del contratista del proyecto no cumplió la expectativa del cliente, el cliente le ayudó o le entregó sugerencias.	☐	☐	☐	☐	☐	☐	☐
2.37	Ambas partes trabajaron estrechamente para reducir riesgos, compartir ganancias y/o pérdidas a lo largo del proyecto.	☐	☐	☐	☐	☐	☐	☐
2.38	Ambas partes compartieron información sobre experiencias exitosas y/o fallidas en el intercambio de entregables durante la relación.	☐	☐	☐	☐	☐	☐	☐
2.39	Ambas partes intercambiaron información relacionada con cambios en las necesidades, preferencias y comportamiento de los usuarios.	☐	☐	☐	☐	☐	☐	☐
2.40	Ambas partes intercambiaron información tan pronto como aparecieron problemas inesperados.	☐	☐	☐	☐	☐	☐	☐
2.41	Ambas partes intercambiaron información relacionada con cambios en las políticas y estrategias de las dos organizaciones.	☐	☐	☐	☐	☐	☐	☐
2.42	Ambas partes intercambiaron información sensible para ellos, tal como el desempeño financiero y el *know-how* organizacional.	☐	☐	☐	☐	☐	☐	☐
2.43	Ambas partes probaron colaborativa y frecuentemente nuevas ideas para el proyecto.	☐	☐	☐	☐	☐	☐	☐
2.44	Ambas partes buscaron colaborativa y frecuentemente nuevas formas de hacer las cosas para el proyecto.	☐	☐	☐	☐	☐	☐	☐
2.45	Durante el proyecto, ambas partes fueron creativas en sus métodos operativos.	☐	☐	☐	☐	☐	☐	☐
2.46	Durante el proyecto, ambas partes pusieron mucha importancia en tomar riesgos incluso si resultaba ser un fracaso.	☐	☐	☐	☐	☐	☐	☐
2.47	Durante el proyecto, innovación fue percibida por alguna de las partes como riesgosa y fue resistida.	☐	☐	☐	☐	☐	☐	☐

3. Contexto del proyecto

Favor responda considerando la siguiente escala:

Totalmente de Acuerdo	De Acuerdo	Parcialmente de Acuerdo	Parcialmente en Desacuerdo	En Desacuerdo	Totalmente en Desacuerdo	No sé/ No estoy seguro
6	**5**	**4**	**3**	**2**	**1**	**N/A**

¿Qué tan **de acuerdo** o **en desacuerdo** está Ud. con cada una las siguientes declaraciones en relación al contexto del proyecto?

		6	5	4	3	2	1	N/A
3.1	El proyecto tuvo un alto grado de tareas o actividades novedosas.	☐	☐	☐	☐	☐	☐	☐
3.2	El proyecto tuvo un alto grado de complejidad respecto a su contenido.	☐	☐	☐	☐	☐	☐	☐
3.3	El proyecto tuvo un alto grado de complejidad respecto a la interdisciplinariedad de los participantes y especialidades.	☐	☐	☐	☐	☐	☐	☐
3.4	El proyecto estuvo caracterizado por alto riesgo e incertidumbre.	☐	☐	☐	☐	☐	☐	☐
3.5	Las regulaciones y políticas del país fueron desafiantes.	☐	☐	☐	☐	☐	☐	☐
3.6	La situación del mercado (ej. tipo de cambio) fue altamente inestable.	☐	☐	☐	☐	☐	☐	☐
3.7	El sitio (ubicación) del proyecto fue desafiante o de difícil acceso.	☐	☐	☐	☐	☐	☐	☐
3.8	La presión de los interesados (*stakeholders*) externos fue alta.	☐	☐	☐	☐	☐	☐	☐
3.9	Los requerimientos del proyecto fluctuaron muy poco en fases posteriores.	☐	☐	☐	☐	☐	☐	☐
3.10	Los requerimientos del proyecto identificados en el comienzo fueron muy diferentes de aquellos que se tuvieron en el final.	☐	☐	☐	☐	☐	☐	☐
3.11	Se espera que los requerimientos del proyecto fluctúen muy poco en el futuro.	☐	☐	☐	☐	☐	☐	☐
3.12	Los usuarios/interesados del proyecto frecuentemente diferían entre sí en los requerimientos que se debían cumplir.	☐	☐	☐	☐	☐	☐	☐
3.13	Se realizó mucho esfuerzo para reconciliar los requerimientos de varios usuarios/interesados del proyecto.	☐	☐	☐	☐	☐	☐	☐
3.14	Fue difícil personalizar los entregables del proyecto para un grupo de usuarios/interesados sin reducir el soporte para otros usuarios/interesados.	☐	☐	☐	☐	☐	☐	☐

4.	**Valor del proyecto**

Considerando su experiencia en el proyecto, **¿en qué medida** fueron cumplidos por el proyecto cada uno de los siguientes objetivos?

		Para nada 1	2	3	4	5	6	En gran medida 7
4.1	El proyecto fue completado dentro o bajo el presupuesto.	☐	☐	☐	☐	☐	☐	☐
4.2	El proyecto fue completado a tiempo o antes.	☐	☐	☐	☐	☐	☐	☐
4.3	El proyecto tuvo sólo cambios menores.	☐	☐	☐	☐	☐	☐	☐
4.4	El producto (o entregable) mejoró el desempeño del cliente.	☐	☐	☐	☐	☐	☐	☐
4.5	El cliente estuvo satisfecho con el producto (o entregable).	☐	☐	☐	☐	☐	☐	☐
4.6	El producto (o entregable) cumplió los requerimientos del cliente.	☐	☐	☐	☐	☐	☐	☐
4.7	El cliente está usando el producto (o entregable).	☐	☐	☐	☐	☐	☐	☐
4.8	El cliente regresó/regresará por futuros trabajos.	☐	☐	☐	☐	☐	☐	☐
4.9	El proyecto fue un negocio económicamente exitoso para el contratista.	☐	☐	☐	☐	☐	☐	☐
4.10	El proyecto incrementó la rentabilidad del contratista.	☐	☐	☐	☐	☐	☐	☐
4.11	El proyecto tuvo un retorno positivo sobre la inversión.	☐	☐	☐	☐	☐	☐	☐
4.12	El proyecto contribuyó para el desempeño directo del contratista.	☐	☐	☐	☐	☐	☐	☐
4.13	El resultado del proyecto contribuyó/contribuirá para futuros proyectos.	☐	☐	☐	☐	☐	☐	☐
4.14	El proyecto condujo/conducirá hacia nuevos productos adicionales.	☐	☐	☐	☐	☐	☐	☐
4.15	El proyecto ayudó/ayudará a crear nuevos mercados.	☐	☐	☐	☐	☐	☐	☐
4.16	El proyecto creó nuevas tecnologías para el uso futuro.	☐	☐	☐	☐	☐	☐	☐
4.17	El proyecto contribuyó en nuevos procesos/modelos de negocio.	☐	☐	☐	☐	☐	☐	☐
4.18	El proyecto desarrolló mejores capacidades gerenciales.	☐	☐	☐	☐	☐	☐	☐
4.19	En general, el proyecto fue un gran éxito.	☐	☐	☐	☐	☐	☐	☐

5. Antecedentes personales

5.1 ¿Cuál fue su **cargo/función** en el proyecto/organización matriz durante el tiempo que estuvo trabajando en el proyecto?

- ☐ Director/Gerente/Jefe del proyecto
- ☐ Gerente sénior
- ☐ Gerente ejecutivo
- ☐ Gerente/Administrador del contrato
- ☐ Otro (favor especifique) ________________________________

5.2 ¿Cuántos **años de experiencia** usted tiene trabajando en proyectos?

- ☐ Bajo 10
- ☐ Entre 10 y 19
- ☐ Entre 20 y 29
- ☐ Entre 30 y 39
- ☐ Sobre 40

5.3 ¿Cuál es su **edad**?

- ☐ Entre 20 y 29
- ☐ Entre 30 y 39
- ☐ Entre 40 y 49
- ☐ Entre 50 y 59
- ☐ Sobre 60

5.4 ¿Cuál es el **más alto nivel de educación** que usted ha completado?

- ☐ Secundaria
- ☐ Técnico profesional
- ☐ Licenciatura/Profesional
- ☐ Maestría/Magíster
- ☐ Doctorado

Comentarios:
Favor use el siguiente espacio para escribir algunos comentarios en relación al cuestionario

¡Muchas gracias por su valiosa contribución con esta investigación!

Appendix D: Human research ethics approval letter

THE UNIVERSITY OF SYDNEY

Research Integrity
Human Research Ethics Committee

Tuesday, 29 September 2015

Dr Li Liu
Civil Engineering; Faculty of Engineering and Information Technologies
Email: li.liu@sydney.edu.au

Dear Li

I am pleased to inform you that the University of Sydney Human Research Ethics Committee (HREC) has approved your project entitled "**Value creation process in construction projects**".

Details of the approval are as follows:

Project No.: **2015/759**

Approval Date: **29 September 2015**

First Annual Report Due: **29 September 2016**

Authorised Personnel: **Liu Li; Heredia Rojas Boris;**

Documents Approved:

Date	Type	Document
14/08/2015	Other Type	Research background
14/08/2015	Other Type	Research methodology
19/08/2015	Recruitment Letter/Email	Email to potential respondents
19/08/2015	Questionnaires/Surveys	Questionnaire survey
19/08/2015	Participant Consent Form	Participant Consent Form
19/08/2015	Participant Info Statement	Participant information statement
19/08/2015	Interview Questions	Semi-structured interview questions
25/09/2015	Participant Info Statement	PIS to interview
25/09/2015	Participant Consent Form	PCF to interview
25/09/2015	Participant Info Statement	PIS to questionnaire
25/09/2015	Participant Consent Form	PCF to questionnaire
25/09/2015	Questionnaires/Surveys	Questionnaire
25/09/2015	Recruitment Letter/Email	Introductory letter to questionnaire
25/09/2015	Recruitment Letter/Email	Introductory letter to interview
25/09/2015	Recruitment Letter/Email	Invitation Email to interview
25/09/2015	Recruitment Letter/Email	Invitation Email to questionnaire

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CRICOS 00026A

HREC approval is valid for four (4) years from the approval date stated in this letter and is granted pending the following conditions being met:

Special Condition/s of Approval

- 1. It is a condition of approval that you obtain organisational consent to recruit employees. You will need to ensure you retain evidencing documentation in your study files. You do not need to submit evidence to the HREC.

- 2. It will be a condition of approval that independently certified translations of the public documents are forwarded to the HREC. These can be forwarded once the English versions are approved. The certified translations must be uploaded in IRMA as a Condition of Approval and approved before being provided to participants. The translations must be certified by a person who is a native speaker or highly competent in the specific language. In the declaration the translators need to indicate that the translated documents are a true and accurate representation of the English language versions submitted to the HREC, include a list of the documents translated (with version number) and provide details of the translator's fluency in the language.

- 3. Australia has strict legislation in relation to recording of telephone conversations. If you conduct interviews via phone/digital medium, please ensure you comply with the relevant legislation and seek consent to record the conversation. Consent should be specific, and identify how the information will be stored, used and distributed. http://sydney.edu.au/research_support/ethics/human/guidelines/telephone.shtml

Condition/s of Approval

- Continuing compliance with the National Statement on Ethical Conduct in Research Involving Humans.

- Provision of an annual report on this research to the Human Research Ethics Committee from the approval date and at the completion of the study. Failure to submit reports will result in withdrawal of ethics approval for the project.

- All serious and unexpected adverse events should be reported to the HREC within 72 hours.

- All unforeseen events that might affect continued ethical acceptability of the project should be reported to the HREC as soon as possible.

- Any changes to the project including changes to research personnel must be approved by the HREC before the research project can proceed.

- Note that for student research projects, a copy of this letter must be included in the candidate's thesis.

Chief Investigator / Supervisor's responsibilities:

1. You must retain copies of all signed Consent Forms (if applicable) and provide these to the HREC on request.

2. It is your responsibility to provide a copy of this letter to any internal/external granting agencies if requested.

Please do not hesitate to contact Research Integrity (Human Ethics) should you require further information or clarification.

Yours sincerely

E

Professor Glen Davis
Chair
Human Research Ethics Committee

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research (2007), NHMRC and Universities Australia Australian Code for the Responsible Conduct of Research (2007) and the CPMP/ICH Note for Guidance on Good Clinical Practice.

Appendix E: Studies applying PLS-SEM in a project management context

List of selected journals:

IJPM: International Journal of Project Management
PMJ: Project Management Journal
IJPOM: International Journal of Project Organization of Management
IJISPM: International Journal of Information Systems and Project Management
CME: Construction Management and Economics
AiC: Automation in Construction
JCEM: Journal of Construction Engineering and Management
BPMJ: Business Process Management Journal
I&M: Information and Management
MIS: Management Information Systems Quarterly
JCIS: Journal of Computer Information Systems
IST: Information and Software Technology
JBIM: Journal of Business & Industrial Marketing
PEng: Procedia Engineering
JKM: Journal of Knowledge Management

Table E.1: Number of publications by year and source

Year	**IJPM**	**PMJ**	**IJPOM**	**IJISPM**	**CME**	**AiC**	**JCEM**	**BPMJ**	**I&M**	**MIS**	**JCIS**	**IST**	**JBIM**	**PEng**	**JKM**	**Others**	**Total**
2016	4		1					1					2			4	12
2015	15	2	1	1			1							2		3	25
2014	9			1	1	1	4	1								5	22
2013	2	1			2	1	1				1					4	12
2012	4	1													2	1	8
2011	8				1				1			1				2	13
2010	2					1			1	1		1				2	8
2009	1	1							1								3
2008	1																1
2007										1							1
2006																	0
2005										1							1
2004																	0
2003																	0
2002																	0
2001										1							1
2000											1						1
Total	46	5	2	2	4	3	6	2	3	4	2	2	2	2	2	21	**108**

Table E.2: Number of publications by type of project

Type of project	Number	%
Engineering and construction	28	25.9
Information system and technology	55	50.9
Business processes/organizational change/administrative	2	1.9
New product development/manufacturing	9	8.3
Service (consulting, financial, transport, retail, tourism)	0	0.0
Maintenance/equipment or system installation	2	1.9
Research & development (R&D)	2	1.9
Several or not defined	10	9.3
Total	**108**	**100.0**

Table E.3: Selected publications reviewed

	Research	Source	Project Type	Country	PLS tool	N	Motivation for using PLS
1	Açikgöz, Günsel, Bayyurt, and Kuzey (2014)	Other	IS/IT	Turkey	SmartPLS	139	Not explicitly mentioned.
2	Açikgöz et al. (2016)	Other	NPD	Turkey	SmartPLS	239	Not explicitly mentioned.
3	Aibinu and Al-Lawati (2010)	AiC	Engineering & Construction	Oman	PLS-Graph	64	"PLS is distribution-free hence suitable for data from non-normal or unknown distributions […] is suitable where the sample size is relatively small […], and normality assumption is in doubt" (p. 718)
4	Aibinu, Ling, and Ofori (2011)	CME	Engineering & Construction	China	PLS-Graph	41	"PLS does not presume any distributional form of measured variables […] is distribution free, hence suitable for data from non-normal or unknown distributions […] is also suitable where the sample size is not large […] is primarily intended for predictive analysis in situations of model complexity but less strict statistical assumptions […]suited for complex relationships with large numbers of indicators […], where research is relatively new or changing and where theoretical models are not well-formed […]" (p. 470)
5	Akgün, Keskin, Byrne, and Gunsel (2011)	Other	IS/IT	Turkey	PLS-Graph	95	Not explicitly mentioned.
6	Alashwal and Abdul-Rahman (2014a)	Other	Engineering & Construction	Malaysia	SmartPLS	203	"The utilisation of PLS-PM approach… some advantages including suitable to cope with conceptual models with low theoretical support, easy to specify and analyse hierarchical measurement models, and enables testing the model's reliability, validity and quality." (p. 240)
7	Alashwal and Abdul-Rahman (2014b)	AiC	Engineering & Construction	Malaysia	SmartPLS	203	"PLS-PM has rarely been used in the construction field […]. It is suitable for explorative research, for which there is little theoretical support or a new phenomenon, and producing maximum estimations. PLS does not impose any restrictions on the data." (p. 178)
8	Alashwal and Fong (2015)	JCEM	Engineering & Construction	Malaysia	SmartPLS	203	"PLS-PM can analyse and determine the mathematical models of formative constructs, and complex models […] previous studies have demonstrated the ability of PLS-PM to conduct CFA successfully […]" (p. 4)
9	Al-Sibaie, Alashwal, Abdul-Rahman, and Zolkafli (2014)	Other	Engineering & Construction	Malaysia	SmartPLS	161	"PLS is suitable for explorative research where there is minimal theoretical support or the model has not been fully crystallised […] is preferred when the purpose of the study is to predict the relationships among latent variables or when the data are not normal with too many variables […]" (p. 376)
10	Arviansyah, Spil, and Hillegersberg (2015)	IJISPM	IS/IT	Netherlands	SmartPLS	111	"We continued to utilise PLS […] since it suited the nature of our study. This is a theory building study, and at an early stage, we attempted to define the equivocal situations […]. The proposed research model, which includes a mix of reflective and formative measures [...]" (p. 36)

	Research	Source	Project Type	Country	PLS tool	N	Motivation for using PLS
11	Basu (2014)	IJPM	Several industries	United Kingdom	PLS-Graph	73	"PLS technique for predictive causal modelling to deal with small data samples." (p. 182)
12	Bernroider, Wong, and Lai (2014)	IJPM	Several industries	Austria	SmartPLS	57	"PLS is a softer modelling approach with fewer stringent requirements regarding distributions properties, i.e., the multivariate normality of data and large samples […] supports the use of our formative and reflective latent variables […]" (p. 354)
13	Brettel et al. (2011)	Other	NPD	Germany	PLS-Graph	118	"PLS is the most accepted variance-based SEM approach that accommodates models that combine formative and reflective constructs" (p. 257)
14	Brion, Chauvet, Chollet, and Mothe (2012)	IJPM	Manufacturing and NPD	France	-	73	"Our sample of 73 cases was sufficient to carry out a PLS analysis, as it satisfies […] that the sample size must be at least ten times bigger than the largest number of structural paths directed at any one construct." (p. 715)
15	Calvo-Mora, Navarro-García, and Periañez-Cristobal (2015)	IJPM	Several industries	Spain	SmartPLS	225	"This research is focused on the prediction of dependent variables and tackles a theory building environment (exploratory analysis) […] the sample is not too large (n = 225) […] 'PLS should be the method of choice for all situations in which the number of observations is lower than 250'; and, […] PLS is the best option if the researcher needs to use scores of latent variables in later analyses for predictive relevance." (p. 1646)
16	Caniëls and Bakens (2012)	IJPM	Manufacturing and R&D	Netherlands	SmartPLS	91	"PLS is robust on multicollinearity, small sample sizes, complex modelling including […] hierarchical constructs, mediating and moderating effects […] and even violations of the normality distribution assumption […]." (p. 167)
17	Cao, Li, and Wang (2014)	JCEM	Engineering & Construction	China	SmartPLS	92	"PLS allows for simultaneous estimation of multiple dependent variables and thus is well suited for the assessment of mediation effects […] PLS's ability to analyse research models with single-item constructs […] makes it particularly appropriate as the analysis technique." (p. 5)
18	Carbonell and Rodriguez-Escudero (2014)	Other	NPD	Spain	SmartPLS	102	"PLS was preferred […] because it uses a least-squares estimation procedure, thereby avoiding many of the restrictive assumptions such as multivariate normality and residual distribution […]. PLS is more appropriate for this study in light of our small sample size." (p. 115)
19	K. Chang, Sheu, Klein, and Jiang (2010)	Other	IS/IT	Taiwan	PLS-Graph	128	Not explicitly mentioned.
20	K. Chang, Wong, Li, Lin, and Chen (2011)	Other	IS/IT	Taiwan	SmartPLS	118	Not explicitly mentioned.
21	K. Chang, Yen, Chiang, and Parolia (2013)	IJPM	IS/IT	Taiwan	PLS-Graph	71	"The reason we select PLS is primarily based on the sample size of 71 teams obtained for data analysis" (p. 258)

	Research	Source	Project Type	Country	PLS tool	N	Motivation for using PLS
22	Cheng and Yang (2014)	JETM	IS/IT	Taiwan	-	322	"PLS can accommodate different variable type, as well as direct, indirect, and moderating effects […], such that latent constructs to be modelled as formative or reflective indicators […], and it makes minimal demands on measurement scales, sample size, and residual distributions ." (p. 9)
23	Chollet, Brion, Chauvet, Mothe, and Géraudel (2012)	Other	NPD	France	PLS-Graph	73	"Because PLS can be used to model latent constructs, even under conditions of nonnormality, it is particularly suited to analysing small- to medium-sized samples." (p. 58)
24	De Carvalho, Patah, and De Souza Bido (2015)	IJPM	Several industries	Argentina, Brazil, Chile	SmartPLS	294, 823, 270	"[…] incorporate nominal variables into the structural model [...] incorporate variables measured by formative indicators […] it depended neither on the normality of the variables […] nor the normality of the residuals because the significance probabilities were estimated by bootstrap […]. (p. 1515)
25	Doloi (2014)	Other	Engineering & Construction	Australia	SmartPLS	77	"PLS-SEM […] do not demand a high sample size, yet without compromising the high levels of statistical power" (p. 5)
26	Gde Agung Yana, Rusdhi, and Wibowo (2015)	Other	Engineering & Construction	Indonesia	SmartPLS	60	"This model can be built by a theory that is not very strong […], sample size is relatively small […], the aims of analysis are to develop a theory or prediction models […], indicators can be shaped reflective and formative" (p. 42)
27	Gemino, Reich, and Sauer (2007)	Other	IS/IT	USA	-	194	"[…] it is preferred over covariance based techniques for theory development and the use of formative constructs […]." (p. 24)
28	Gemino, Reich, and Sauer (2015)	IJPM	IS/IT	Canada	SmartPLS	212	"PLS does not require measurement errors to be uncorrelated […] handles formative constructs more readily than covariance-based SEM techniques […] and the dependent variable in this study was estimated formatively." (p. 305)
29	Ghapanchi and Aurum (2012)	IJPM	IS/IT	Several countries	PLS-Graph and SmartPLS	607	"(i) […] simultaneously estimate the interrelation between multiple dependent and independent variables, and (ii) […] to support unobserved variables (latent constructs) […]" (p. 412)
30	Ghobadi and D'Ambra (2012)	Other	IS/IT	Australia	PLS-Graph	115	"PLS has more consistency, flexibility and robustness in small to moderate sample sizes […] also allows modelling formative constructs, and it has the ability of latent modelling constructs under conditions of fewer statistical constraints on the data (e.g. assumptions of non-normality)." (p. 292)
31	Gopal and Gosain (2010)	Other	IS/IT	India	PLS Analysis	96	"[…] it is appropriate for situations where sample sizes are small, and models are complex, and the goal of the research is explaining variance […]. It also supports the modelling of formative constructs." (p. 973)
32	Govindaraju, Bramagara, Gondodiwiryo, and Simatupang (2015)	Other	IS/IT	Indonesia	SmartPLS	46	Not explicitly mentioned.
33	Han and Hovav (2013)	IJPM	IS/IT	South Korea	SmartPLS	177	"PLS is suitable for assessing theories in the early stages of development […] requires minimal demands on sample size […]." (p. 383)

	Research	Source	Project Type	Country	PLS tool	N	Motivation for using PLS
34	Hartmann and Hietbrink (2013)	CME	Maintenance	Netherlands	SmartPLS	81	"[…] relaxes some of the assumptions and requirements of covariance-based techniques such as sample size, formative measurements, and normality […]. PLS is particularly useful for exploratory studies […], we regarded it as a suitable approach for this study" (p. 352)
35	He (2012)	PMJ	IS/IT	USA	PLS-Graph	227	"1. PLS has the flexibility of accepting single-item constructs (i.e., team size in this study). 2. The algorithm of PLS, which is component-based rather than covariance-based, allows the modelling of formative indicators […]." (p. 67)
36	J. Hsu, Chang, Klein, and Jiang (2011)	IJPM	IS/IT	India	PLS-Graph	194	"[…] our sample size is higher than the minimum required sample size, more than ten times the number of constructs included in the model […] The values of skewness and kurtosis […] indicate the normality assumption is likely not violated, and the levels of correlation show a good possibility of linear relationships between dependent and independent variables." (p. 8)
37	J. Hsu et al. (2013)	PMJ	IS/IT	Taiwan	-	103	"PLS was adopted because several variables cannot meet the normality assumption required by other techniques (e.g., covariance structural equation modelling)." (p. 77)
38	J. Hsu, Liang, Wu, Klein, and Jiang (2011)	IJPM	IS/IT	Taiwan	PLS-Graph	128	Not explicitly mentioned.
39	J. Hsu et al. (2012)	IJPM	IS/IT	Taiwan	PLS-Graph	236	"Variables in this study are significant at 0.01 levels of the Kolmogorov-Smirnov and Shapiro-Wilk normal test results, which implies that our data not fitting the normality requirements of covariance-based SEM" (p. 335)
40	Y. Hsu, Johnston, and Johnston (2016)	Other	NPD and IS/IT	Taiwan	-	247	"it can include multiple dependents, and multiple independent variables […] can be used to control multicollinearity among independent variables […] maintains robustness, even with noisy or missing data […] performs strong predictions for independent latent variables […] allows for reflective and formative variables […] can be applied to small samples, and (g) not subject to distributional constraints [...]" (p. 9)
41	Jun et al. (2011)	IJPM	IS/IT	China	VisualPLS	93	"PLS is suitable for analysing small samples […] the respondents in this study tend to select projects that perform well, which likely leads to non-normal data distributions […] not require multivariate normal data […]" (p. 928)
42	Jurisch, Palka, Wolf, and Krcmar (2014)	BPMJ	Business Process Change	Several countries	SmartPLS	130	"[…] the hypotheses are grounded in specified impact factors; the epistemic relationships between the latent variables and its measures are both formative and reflective, and the sample size is relatively small." (p. 55)
43	Jurisch, Rosenberg, and Krcmar (2016)	BPMJ	Business Process Change	Several countries	SmartPLS	130	"[…] the hypotheses are grounded in specified impact factors; […] handles both formative and reflective epistemic relationships between the latent variables and its measures, and […] avoids the problems with small sample size." (p. 800)

	Research	Source	Project Type	Country	PLS tool	N	Motivation for using PLS
44	Keskin (2009)	I&M	IS/IT	Turkey	PLS-Graph	67	Not explicitly mentioned.
45	Le, Shan, Chan, and Hu (2014)	JCEM	Engineering & Construction	China	-	188	"PLS-SEM has a minimum requirement on sample size, but it can handle non-normal data sets […]." (p. 4)
46	Leal-Rodríguez, Roldán, Ariza-Montes, and Leal-Millán (2014)	IJPM	Manufacturing	Spain	SmartPLS	110	"This study is oriented toward the prediction of the dependent variables […]; the sample (n = 110) is small […] the research model is complex, both in the type of variables (first and high order constructs) and in the hypothesised relationships (direct, moderated and mediated effects) […] uses latent variables scores in the subsequent analysis for a predictive relevance " (p. 900)
47	G. Lee and Xia (2010)	Other	IS/IT	USA, Canada	-	399	"PLS is more appropriate […] for exploratory research […]. Response extensiveness and response efficiency are formative latent variables […] the hypotheses are exploratory in nature […] We also tested a modified PLS model […] is modelled as a second-order construct […] (p. 108)
48	H. Lee, Park, and Lee (2013)	Other	IS/IT	South Korea	SmartPLS	285	"[…] not have strict requirements for the sample size and residual distribution […]." (p. 4)
49	Jae Lee and Choi (2011)	I&M	IS/IT	South Korea	PLS-Graph	148	"It is suitable for assessing theories in the early stages of development. Also, it requires minimal demands on sample size as opposed to other SEM." (p. 99)
50	Jungwoo Lee, Park, and Lee (2015)	IJPM	IS/IT	South Korea	SmartPLS	126	"[…] the conceptual framework of the relationships between main variables was based on theories, whereas the relationships between the sub-dimensions were to be studied in an exploratory approach." (p. 802)
51	L. Lee, Reinicke, Sarkar, and Anderson (2015)	PMJ	-	USA	SmartPLS	78	"The hypotheses were tested using partial least squares (PLS), structural equation modelling technique […] we hypothesised a comprehensive set of relationships among the various constructs." (p. 44)
52	Yuzhu Li et al. (2016)	Other	IS/IT	China	PLS-Graph	129	"it is not dependent on data with a multivariate normal distribution […], and it supports both formative and reflective relationships." (p. w/p)
53	Yuzhu Li, Yang, Klein, and Chen (2011)	IJPM	IS/IT	China	PLS-Graph	119	"Since we have a relatively small sample size (119 observations" (p. 917)
54	T. Lin, Chen, Hsu, and Fu (2015)	IJPM	IS/IT	Taiwan	PLS-Graph	215	Not explicitly mentioned.
55	Lindner and Wald (2011)	IJPM	Several industries	Germany	SmartPLS	414	"PLS is less demanding in terms of sample size, multicollinearity between indicators of latent constructs, and missing values. […] in the case of complex models, newly developed scales and rather small samples — in multi-group analysis for testing control variables, it does not require a multivariate normal distribution of the data […]." (p. 883)
56	Ling, Ning, Ke, and Kumaraswamy (2013)	AiC	Engineering & Construction	Hong Kong	SmartPLS	51	"[…] it is able to identify the key driving constructs […], deal with a non-normal data set […], and has minimum demand for sample size […]." (p. 18)

	Research	Source	Project Type	Country	PLS tool	N	Motivation for using PLS
57	B. Liu et al. (2016)	Other	Engineering & Construction	China	Visual PLS	50	"[…] the model best suits the hierarchical index system (numerous variables exist, i.e., intelligence, ability, and level, that cannot be measured directly) … to render the computation result more reliable and stable" (p. 4)
58	G. Liu, Wang, and Chua (2015)	IJPM	IS/IT	Taiwan	SmartPLS	125	Not explicitly mentioned.
59	J. Liu et al. (2011)	IJPM	IS/IT	Taiwan	-	114	"[…] its strength in reducing measurement error. […] PLS does not require a strict assumption of the normal distribution." (p. 552)
60	J. Liu, Chen, Jiang, and Klein (2010)	IJPM	IS/IT	Taiwan	-	205	"It places minimal demands on sample size and residual distribution […] supports formative structures and is appropriate for testing models in the early stages of development […]." (p. 224)
61	S. Liu and Wang (2014a)	IJPM	IS/IT	China	-	128	"PLS allowed for maximum explained variance and considerable statistical power produced by a small sample size […]. Additionally, hierarchical regression analysis was performed to test the hypotheses." (p. 1500)
62	S. Liu and Wang (2014b)	Other	IS/IT	China	SmartPLS	63	"PLS was appropriate for small sample sizes." (p. 1158)
63	S. Liu and Wang (2016)	IJPM	IS/IT	China	SmartPLS	195	"Not only was PLS appropriate for developing an exploratory model, but it can generate sufficient statistical power with limited samples as well." (p. 109)
64	Low, Abdul-Rahman, and Zakaria (2015)	IJPM	Engineering & Construction	Malaysia	SmartPLS	44	"[…] is a good alternative to theory testing and relationship exploration especially if the theory is less developed […] applicable to a relatively small sample size (30 and more) […] handle extremely nonnormally distributed data, […] tolerates well on reflective and formative measure models (p. 922)
65	Lu, Guo, Qian, He, and Xu (2014)	IJPM	Engineering & Construction	China	SmartPLS	225	"It is appropriate to adopt PLS method in our study because there are formative indicators in latent constructs." (p. 217)
66	Mahaney and Lederer (2010)	IJPM	IS/IT	USA	PLS-Graph	220	Not explicitly mentioned.
67	Majchrzak, Beath, Lim, and Chin (2005)	Other	IS/IT	USA	PLS-Graph	85	"PLS is able to obtain robust estimates even with small sample sizes" (p. 660)
68	Memon, Rahman, Aziz, and Abdullah (2013)	Other	Engineering & Construction	Malaysia	SmartPLS	159	"PLS is dominant approach to establishing rigour in complex models" (p. 6)
69	Mesly (2015)	IJPM	Engineering & Construction	Canada	WarpPLS	102	"[…] because of the relatively small number of participants and the need to check for the moderation of the 'distance' construct. […]." (p. 1431)
70	Mikalef, Pateli, Batenburg, and Van de Wetering (2014)	IJISPM	IS/IT	Several (Europe)	SmartPLS	172	"[…] its ability to operationalize and test second-order constructs as well as examine complex causal relationships." (p. 46)
71	Mohan, Ahlemann, and Braun (2016)	IJPOM	IS/IT	Germany	-	456	-

	Research	Source	Project Type	Country	PLS tool	N	Motivation for using PLS
72	Ning (2014)	IJPM	Engineering & Construction	Singapore	SmartPLS	104	"[…] is able to identify key driving constructs […]; is able to deal with non-normal data set […], and has minimum demand for sample size […]." (p. 289)
73	Ning and Ling (2013)	JCEM	Engineering & Construction	Singapore	SmartPLS	104	"[…] it can identify key driving constructs […], can handle non-normal data sets […], and has minimum demands for sample size […]." (p. 5)
74	Ning and Ling (2015)	IJPM	Engineering & Construction	Singapore	SmartPLS	104	"[…] is able to identify the key driving constructs and deal with a non-normal data set, and it has minimum demand for sample size […]" (p. 1002)
75	Oz and Sosik (2000)	Other	IS/IT	North America and Europe	-	159	"PLS is appropriate for analysing predictive research models that are in the early stages of theory development and those tested with small samples, conditions characterising the present study." (p. 73)
76	Padovani and Carvalho (2016)	IJPM	Several industries	Brazil, USA, other Latin America	SmartPLS	103	"[…] the research goal involves identifying key driver constructs, the structural model is complex (many constructs and many indicators), and the sample size is small, and the data are non-normally distributed." (p. 635)
77	Park and Lee (2014)	IJPM	IS/IT	South Korea	SmartPLS	135	"PLS has the ability to handle relatively small sample sizes, making it an appropriate choice for testing the research model […]." (p. 159)
78	Parolia, Jiang, Klein, and Sheu (2011)	IJPM	IS/IT	India	PLS-Graph	184	"[…] it is not contingent upon data having multivariate normal distributions. PLS supports both types of relationships: formative and reflective." (p. 319)
79	Pournader, Tabassi, and Baloh (2015)	IJPM	Engineering & Construction	Iran	SmartPLS	98	"PLS aims to maximise the proportion of variance of the latent construct that is explained by the predictor constructs… extremely useful when there is a considerable amount of highly collinear factors […]. PLS also supports both reflective and formative types of relationships […]" (p. 427)
80	I. Rahman, Memon, Azis, and Abdullah (2013)	Other	Engineering & Construction	Malaysia	SmartPLS	118	"PLS approach was used as it is more advisable when the object of study is testing the causal relation and theory development […]" (p. 1964)
81	Ram, Wu, and Tagg (2014)	IJPM	IS/IT	Australia	SmartPLS	217	"PLS is considered relatively less sensitive to violation of assumptions of normality, and can estimate complex models with a relatively small sample size […]". (p. 668)
82	Raymond and Bergeron (2008)	IJPM	IS/IT	Canada	-	39	"[…] its robustness as it does not require a large sample or normally distributed multivariate data in comparison to covariance methods" (p. 216)
83	Reich, Gemino, and Sauer (2014)	IJPM	IS/IT	Canada	SmartPLS	212	"[…] it does not require measurement errors to be uncorrelated and so provides some flexibility when measures …have not been well established […]. In addition, the dependent variable in this study was estimated formatively. PLS handles formative constructs more readily [...]" (p. 596)
84	Sáenz, Aramburu, and Blanco (2012)	Other	R&D	Spain and Colombia	PLS-Graph	75 69	"According to the complexity level of the model […] the minimum sample size required was calculated, and this was made up of 30 firms" (p. 927)
85	Sakka, Barki, and Côté (2013)	I&M	IS/IT	Canada	SmartPLS	93	"[…] it allows the analysis of research models with multiple dependent constructs while recognising measurement error, and is robust with small sample sizes." (p. 269)

	Research	Source	Project Type	Country	PLS tool	N	Motivation for using PLS
86	Sakka et al. (2016)	IJPM	IS/IT	Canada	SmartPLS	93	"[…] formative constructs […] can be examined with PLS […] the relatively small size of our sample and the moderate non-normality of one of our variables […] is not dependent on data normality because path significance is calculated by bootstrapping and is suitable for relatively small sample sizes […]." (p. 515)
87	Shanmugapriya and Subramanian (2015)	Other	Engineering & Construction	India	SmartPLS	113	"[…] not require the data to be normally distributed, it is evaluated with squared multiple correlations (R^2) for each endogenous latent variable which provides how well the model fits the hypothesised relationships" (p. 1982)
88	Subiyakto, Ahlan, Kartiwi, and Sukmana (2015)	Other	IS/IT	Indonesia	SmartPLS	62	"[…] was considered to be used because the small size of the sample with n=62" (p. 273)
89	Suprapto, Bakker, and Mooi (2015)	IJPM	Several industries	Netherlands	SmartPLS	113	"[…] our model is not yet well-established in previous research […] we were able to include second-order latent constructs as second-order formative with first-order reflective constructs […] exhibits higher statistical power […] when used on complex models with limited sample size […] transforms non-normal data by the central limit theorem […]" (p. 1352)
90	Suprapto, Bakker, Mooi, et al. (2015)	IJPM	Several industries	Netherlands	SmartPLS	113	"[…] the underlying theory […] is still 'less developed'[…] exhibits higher statistical power […] when used in complex models with smaller sample size […] transforms non-normal data by the central limit theorem […] results robust when using skewed data and formative measures…" (p. 1076)
91	Tabassi, Ramli, Roufechaei, and Tabasi (2014)	CME	Engineering & Construction	Malaysia	SmartPLS	128	"…was adopted in determining the hierarchical model […], since it leads to greater theoretical parsimony and lower model complexity […]" (p. 933)
92	Tepic, Kemp, Omta, and Fortuin (2013)	Other	R&D	Netherlands and France	SmartPLS	96	Not explicitly mentioned.
93	Tesch, Sobol, Klein, and Jiang (2009)	IJPM	IS/IT	USA	PLS-Graph	167	"PLS places minimal demands on sample size and residual distribution […]. PLS supports formative structures and is appropriate for testing models in the early stages of development […]" (p. 661)
94	Tomasi, Parolia, Han, and Porterfield (2015)	IJPOM	IS/IT	Several countries	-	194	-
95	C. Wang, Xu, Zhang, and Chen (2016)	IJPM	Engineering & Construction	China	SmartPLS	152	"[…] this research was in an exploratory stage and tackled a theory building […] has a minimum demand for sample size, […] is a good option if scores of latent variables are used in the later analyses for predictive purpose." (p. 1299)
96	E. Wang, Chang, Jiang, and Klein (2011)	IJPM	IS/IT	Taiwan	PLS-Graph	128	Not explicitly mentioned.

	Research	Source	Project Type	Country	PLS tool	N	Motivation for using PLS
97	Y. Wang, Lin, and Tsay (2016)	Other	IS/IT	Taiwan	SmartPLS	254	"For complex research models, PLS has an advantage over regression in that it can analyse the entire model as a unit […] our sample size for analysis was relatively small […] PLS had the smallest occurrence of false positives […] PLS was highly suitable for the initial exploratory stages." (p. 396)
98	Westner and Strahringer (2010)	I&M	IS/IT	Germany	SmartPLS	304	"PLS does not demand identical distribution of residuals […] the sampled data was not normally distributed, and the research model included formative as well as reflective constructs." (p. 295)
99	Wibowo, Astana, and Rusdhi (2015)	Other	Engineering & Construction	Indonesia	SmartPLS	61	Not explicitly mentioned.
100	P. Williams, Ashill, Naumann, and Jackson (2015)	IJPM	System Installation	USA, Canada	PLS-Graph	588	"[…] is particularly well suited to operationalizing satisfaction models and exploratory research settings […] can deal with small sample sizes […] because the iterative algorithm behind PLS estimates parameters in only small subsets of a model during any given iteration. […] can produce reliable results although sample size inequity […] can be used for both confirmatory and exploratory applications […]"(p. 1842)
101	Wixom and Watson (2001)	Other	IS/IT	USA	PLS-Graph	111	"[…] its ability to handle formative constructs and its small sample size requirements." (p. 27)
102	Xu, Zhang, and Barkhi (2010)	Other	IS/IT	USA	PLS-Graph	91	"PLS has the advantage of being less demanding on data. PLS can work with small data sets with many missing values. But with a large sample size, PLS can leverage the statistical power to reach strong conclusions […]." (p. 132)
103	Yazici (2009)	PMJ	Service; Manufacturing Engineering & Construction	USA	PLS-Graph	86	"PLS is an efficient structural equation modelling method and analysis when measurement scales are still being developed. PLS is considered better suited for explaining complex relationships, placing minimal demand on sample size and residual distribution. […] PLS is used in exploratory studies where theory development is the primary focus." (p. 21)
104	Yusof, Abidin, Zailani, Govindan, and Iranmanesh (2016)	Other	Engineering & Construction	Malaysia	SmartPLS	375	"PLS-SEM is therefore selected for this study as the study is exploratory in nature [...]". (p. 68)
105	L. Zhang and Cheng (2015)	PMJ	Engineering & Construction	China	-	178	Not explicitly mentioned.
106	D. Zhao, Zuo, and Deng (2015)	IJPM	IS/IT	China	PLS-Graph	60	"PLS is not restricted by the distribution requirements, makes minimal demands of the sample size […] and has been effectively used in extant IS studies […]. And it is also suited to our relatively small sample size […] can avoid the serious problems of inadmissible solutions and factor indeterminacy, enabling us to explain whether there exist relationships among constructs […] is appropriate for our exploratory test [...]" (p. 331)

	Research	Source	Project Type	Country	PLS tool	N	Motivation for using PLS
107	X. Zhao, Hwang, and Low (2013)	CME	Engineering & Construction	China	-	89	"PLS-SEM can analyse complex problems without requiring a large sample size and normal distribution of data, and estimate latent constructs as linear combinations of observable variables through weight relations […]. Because the number of the questionnaire responses was not large, PLS-SEM was adopted to validate the conceptual framework." (p. 1208)
108	Y. Zhao and Cao (2015)	IJPM	Manufacturing and NPD	China	SmartPLS	60	"it allows "latent constructs to be modelled either as formative or reflective indicators as was the case with survey data" […], and it demands a considerably smaller sample size to validate a model […] especially for complex models […]" (p. 1815)

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