IT-Enabled Dynamic Capabilities

Antecedents and impact on competitive advantage

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IT-Enabled Dynamic Capabilities: Antecedents and impact on competitive advantage

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“For last year's words belong to last year's language and next year's words await another voice.”

T.S. Elliot

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- Mikalef, P., & Pateli, A. (2011) A Systematic Meta-Analytic review on Factors Influencing the Strategic Alignment in Service-Oriented Architecture Projects, In: *Karahanna, E., Kokkinaki, A., Stylianou, A. (Eds.) Proceedings of the 6th Mediterranean Conference on Information Systems, September 3-5, Limassol, Cyprus.*

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ABSTRACT

This study describes how Information Technology (IT) can be leveraged as a source of competitive advantage in rapidly changing environments. Drawing on the Dynamic Capabilities View (DCV) of the firm (Teece et al., 1997), IT-enabled dynamic capabilities are proposed as a higher-order construct, formed by five underlying capabilities – sensing, coordinating, learning, integrating, and reconfiguring. IT-enabled dynamic capabilities are defined as a firm's ability to leverage its IT resources and competencies, in combination with other organizational resources and capabilities, to address rapidly changing business environments. The idea of developing a construct that can explain the mechanisms through which IT can be leveraged to address changing market conditions is largely based on the shortcomings identified in past IT-business value studies.

Grounded on theoretical and empirical developments of the DCV, a conceptual model is constructed presenting the mechanisms through which IT-enabled dynamic capabilities result in competitive performance gains, the conditions under which value is derived, as well as antecedents that contribute towards their development. To empirically examine the conceptual model, a survey-based quantitative study is performed on a sample of IT managers from 274 international firms. By performing Partial Least Squares Structural Equation Modeling (PLS-SEM) and Fuzzy Set Qualitative Comparative (fsQCA) analysis, IT architecture modularity coupled with a decentralized IT governance structure are found to be important antecedents of IT enabled-dynamic capabilities. Results show that the value of IT-enabled dynamic capabilities on competitive performance is realized by two primary mechanisms; by increasing organizational agility, and by augmenting a firm's innovative capability. Their effect is found to be accentuated under conditions of moderate to high

environmental uncertainty. In closing, theoretical, managerial, and research implications are discussed, and future directions are highlighted.

ABSTRACT (IN GREEK)

Η παρούσα έρευνα επιχειρεί να περιγράψει τους τρόπους με του οποίους μπορεί να αξιοποιηθούν οι Τεχνολογίες της Πληροφορίας (ΤΠ), ως πηγή επίτευξης ανταγωνιστικού πλεονεκτήματος σε ταχέως μεταβαλλόμενα επιχειρηματικά περιβάλλοντα. Βασιζόμενοι στην θεωρία των Δυναμικών Ικανοτήτων (Teece et al., 1997), οι *δυναμικές ικανότητες ενεργοποιούμενες από τις ΤΠ,* παρατίθενται ως μια μεταβλητή αποτελούμενη από πέντε επιμέρους ικανότητες – τον εντοπισμό, το συντονισμό, τη μάθηση, την ενσωμάτωση, και την αναμόρφωση. Οι *δυναμικές ικανότητες ενεργοποιούμενες από τις ΤΠ,* ορίζονται ως οι δυνατότητες που έχει μια επιχείρηση να αξιοποιεί τους πόρους και τις αρμοδιότητες που άπτονται με τις ΤΠ, ώστε να αντιμετωπίζει απρόβλεπτές αλλαγές στο επιχειρηματικό της περιβάλλον. Η ανάπτυξη μιας μεταβλητής που μπορεί να περιγράψει τους τρόπους επίτευξης ανταγωνιστικού πλεονεκτήματος σε τέτοιες συνθήκες, βασίζεται στα κενά που παρουσιάζουν οι μελέτες στην αποτίμηση της αξίας των επενδύσεων σε ΤΠ.

Βασιζόμενοι στις θεωρητικές και εμπειρικές εξελίξεις της θεωρία των δυναμικών ικανοτήτων, κατασκευάσαμε ένα εννοιολογικό μοντέλο που παρουσιάζει τους μηχανισμούς μέσω των οποίων οι *δυναμικές ικανότητες ενεργοποιούμενες από τις ΤΠ* επιδρούν στην επίτευξη ανταγωνιστικού πλεονεκτήματος, τις συνθήκες κάτω από τις οποίες αυτό επιτυγχάνεται, καθώς και τους παράγοντες που βοηθούν στον σχηματισμό τους. Για να εξεταστεί εμπειρικά το εννοιολογικό μοντέλο, πραγματοποιήθηκε μια έρευνα σε διευθυντές ΤΠ (IT Managers) από 274 διεθνείς επιχειρήσεις. Αναλύοντας τα δεδομένα μέσω στατιστικών τεχνικών όπως τα δομικά μοντέλα εξισώσεων μερικών ελαχίστων τετραγώνων (PLS-SEM), και η ποιοτική συγκριτική ανάλυση θολών συνόλων (fsQCA), βρίσκουμε ότι η τμηματοποίηση της αρχιτεκτονικής των ΤΠ, συνδυαζόμενη με μια αποκεντρωμένη διοίκηση τους,

επιδρούν θετικά στον σχηματισμό *δυναμικών ικανοτήτων ενεργοποιούμενων από τις ΤΠ.* Τα αποτελέσματα επίσης δείχνουν ότι η επίδραση τους στην επίτευξη ανταγωνιστικού πλεονεκτήματος πραγματοποιείται μέσω δύο κύριων μηχανισμών, αυξάνοντας την οργανωτική ευελιξία, και ενδυναμώνοντας την ικανότητα της επιχείρησης στην ανάπτυξη καινοτόμων προϊόντων/υπηρεσιών. Το αποτέλεσμα των *δυναμικών ικανοτήτων ενεργοποιούμενων από τις ΤΠ,* επιτείνεται κάτω από συνθήκες μέτριας έως μεγάλης επιχειρηματικής αβεβαιότητας. Κλείνοντας, περιγράφονται αναλυτικά οι επιπτώσεις που έχουν τα αποτελέσματα της μελέτης για την διοικητική των ΤΠ, καθώς και για μελλοντικές έρευνες.

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CHAPTER 1

INTRODUCTION

This chapter serves as an introduction to the study's subject area, and presents its main research objectives. To this end, it describes the theoretical background and context on which the research is developed, defines the prime motivation of engaging in this topic, and presents the methodological tools chosen to realize the objectives set. The first section frames the scientific areas on focus, and then briefly sketches the theoretical underpinnings on which this research builds. The motivation and the primary objectives of this research are then outlined, followed by a description of the methodological approach employed to realize them. The chapter ends with a presentation of the thesis structure.

1.1 Research Background and Context

The research described in this thesis is aimed at understanding the network of causal effects by which investments in Information Technology (IT) facilitate competitive performance gains in rapidly changing business environments. Following, we present the main empirical challenges associated with capturing IT business value in such volatile conditions, and underline the predominant theoretical perspectives through which this issue has been explored.

1.1.1. IT-Business Value

In the contemporary knowledge-intensive business environment, characterized by rapid, relentless, and highly unpredictable changes, firms must be able to detect and capitalize on market shifts and avoid emerging threats with speed in order to survive (Sambamurthy et al., 2003). Fast-changing environments can destroy the value potential of existing organizational capabilities, and thus, disrupt prevailing means of competition (Sambamurthy, 2000). Static capabilities may turn into core-rigidities and inhibit performance (De Carolis, 2003). Organizations need to evolve, adapt, and reinvent themselves to match constantly shifting market and technological conditions (Eisenhart & Martin, 2000). The most important means of achieving a competitive advantage in these dynamic markets are innovative moves and strategic flexibility (Sambamurthy, 2000).

Investing in IT has long been argued as being a means of achieving a state of competitive advantage. However, several critiques have raised the question of whether this claim stands, and if so, by what means IT investments can be effectively leveraged. To tackle this question, research has seen a proliferation of articles over the past three decades concerning how IT can potentially contribute to a firm's competitive advantage. Despite multi-trillion investments in IT, the only solid evidence concerning the effectiveness of IT is on the traditional function of automating and improving static functional processes and operational activities (Sambamurthy, 2000; Melville et al., 2004; Pavlou & El Sawy, 2006). Yet, the role of IT has evolved from what was considered as a tool to support day-to-day operations, to a strategic asset (Henderson & Venkatraman, 1999). While Information Systems (IS) research has addressed theory and practice regarding the operational role of IT, little effort has been put on investigating how IT can be leveraged to maintain a sustained competitive advantage (Sambamurthy, 2000).

Current research on IT-business value has predominantly relied on the Resource Based View (RBV) of the firm to explain how IT can be a source of performance gains. The main premise of these studies has been that firms which manage to have under their control IT resources that are valuable, rare, in-imitable, and non-substitutable, will be more likely to realize gains and outperform competition. Under this view, a firm is considered as having an IT capability if it manages to accumulate a bundle of IT resources that present the abovementioned characteristics. Nevertheless, recent commentaries stress that there is a lack of understanding on the mechanisms through which IT affects a firm's ability to attain a state of competitive advantage. Drawing on the insights of the RBV, several studies have built on the competence-based perspective (CBP) which places emphasis on a firm's IT competencies; meaning the ability to plan, acquire, assimilate, and manage IT effectively. Yet, this perspective is internally oriented, and does not explain how IT investments can be strategically applied under changing market conditions.

1.1.2. A Strategic Management Perspective

Strategic management literature has long been focused on providing the theoretical basis to explain how firms can realize competitive gains. Extending on the RBV which has been the predominant theoretical backbone of IT capabilities research, the Dynamic Capabilities View (DCV) is argued to be more appropriate in explaining how firms manage to create, extend, and reconfigure their resources and competencies in order to cope with changes of the external environment (Teece et al., 1997). The main difference between the RBV and the DCV is that the former represents a static view of core resources that a firm must have under its control, while the latter describes the capability to change and evolve when the need or opportunity arises. In effect, the DCV incorporates aspects of the external environment and considers the influence of competitive pressures in realizing a competitive advantage.

The DCV has emerged as a critical theoretical domain in the context of IT research (Sambamurthy et al., 2003; Pavlou & El Sawy, 2006). Recent studies suggest that it is more suitable to examine IT in terms of the organizational capabilities it enables or strengthens, rather than examining IT resources in isolation (Kohli & Grover, 2008). This approach coheres with what has been described as the "process-oriented" view of examining the value of IT, since organizational capabilities are also embedded in business processes (Kim et al., 2011). Hence, the study of how IT can be applied to activate dynamic capabilities, hereafter termed as IT-enabled dynamic capabilities, is a much promising avenue in explaining how IT can create differential value for firms.

1.2 Research Motivation and Objectives

The main motivation of our research stemmed from the increasing in frequency research studies stressing the need for a theoretical shift in terms of explaining how IT investments contribute towards realizing a competitive advantage (Tanriverdi et al., 2010). These research commentaries underscore the limitations of the RBV in explaining the mechanisms through which IT investments add value, as well as the impact of external factors in realizing IT-business value. The complexity and uncertainty of contemporary market conditions requires adopting a new theoretical paradigm and adapting it to the IT context. Our research aims at shedding light on how the DCV can be applied to IT research, and exploring what we can learn by adopting this theoretical view.

This research is grounded on the assumption that IT can be a source of competitive advantage only if it is leveraged to support or enable certain organizational capabilities. A basic theoretical premise is that IT-enabled dynamic capabilities are particularly relevant for firms operating in turbulent and uncertain

environments. Apart from the context and the types of organizational capabilities that are enabled by leveraging IT, the flexibility of the underlying IT architecture is also assumed to play an important role on providing the platform upon which competitive actions are launched. As such, our research aims to exemplify the link between IT resources, and fill the gap of past studies by demonstrating the mechanisms through which IT investments can be a source of competitive advantage.

Further theoretical and empirical challenges targeted by this research include:

a) Identify the theoretical perspectives on which the notion of IT capabilities has been built (e.g. Resource-based View, Knowledge-based View, Competence-based Perspective, and Dynamic Capabilities View), and accordingly examine their effect in realizing competitive performance in past empirical studies.

b) Conceptualize IT-enabled dynamic capabilities using the DCV, and develop a validated construct that can be applied to IT-business value research.

c) Identify and provide empirical support for the hypothesized mechanisms through which IT-enabled dynamic capabilities impact competitive performance,

d) Explore the patterns of environmental conditions under which IT-enabled dynamic capabilities add value.

e) Understand how modular systems (in the form of IT architecture and IT governance) are associated with the formation of IT-enabled dynamic capabilities.

1.3 Research Methodology

The cycle of our research methodology starts with an attempt to review past studies in the subject-area of IT-business value, and specifically those that base their examination of IT in terms of IT capabilities. The purpose of the literature review is, at a first stage, to understand how IT capabilities have been conceptualized, measured, and applied in empirical studies, and at a second stage, to detect theoretical shortcomings and research areas that are underexplored. The outcomes of the literature review direct our efforts towards employing the Dynamic Capabilities View (DCV) of the firm, which is deemed as the most suitable theoretical framework to ground our assumptions. Consequently, we define the notion of IT-enabled dynamic capabilities and empirically validate the development of the construct. Based on related theories and previous empirical findings, we build a conceptual model explaining antecedents of IT-enabled dynamic capabilities, and their impact on competitive performance. Accordingly, a set of research hypotheses and propositions are formulated. The conceptual model, along with its underlying research hypotheses and propositions is then developed and tested, through a survey-based quantitative approach.

To investigate our research hypotheses and propositions, we employ a mixed methods approach applying quantitative (structural equation modeling) and deterministic (qualitative comparative analysis - QCA) methods. There are multiple ways in which researchers can combine these two techniques, with several past studies demonstrating their complementary nature (Gunawan & Huarng, 2015). Our research uses a quantitative approach to explore the antecedents of IT-enabled dynamic capabilities and the mechanisms via which they improve a firm's competitive performance, and a determinist approach to further explore the conditions under which IT-enabled dynamic capabilities increase a firm's absorptive capacity and organizational agility.

1.4 Thesis Outline

The thesis has been structured into eight chapters. Chapter 1 serves as an introduction to the reader, presenting some key concepts discussed in this thesis and highlighting the research background, the motivation, and the objectives to be pursued.

Chapter 2 provides a systematic literature review on the concept of IT capabilities as employed in Information Systems (IS) and strategic management research areas over the past 15 years. Although IT capabilities is a widely used construct in empirical research, it is conceptualized and measured in a highly divergent manner. Hence, by selecting the most important studies through a systematic approach, the literature review aims to identify the theoretical groundings on which conceptualizations and measurements have been based. To do so, we develop a taxonomy of concepts, and map studies according to the level at which they employ the IT capabilities construct. The chapter provides a theory-driven discussion on the value and limitations of each level of IT capabilities, and discusses how these levels are associated. The literature review concludes with suggestions concerning the theoretical grounding and the type of research that would be most valuable for contemporary firms.

Chapter 3 extends the findings of the literature review and introduces the Dynamic Capabilities View (DCV) of the firm as a pertinent theoretical grounding to explain how IT can add value in turbulent and uncertain environments. As such, chapter 3 introduces the concept of dynamic capabilities and describes how it can be operationalized and measured. It also addresses the boundaries and underlying assumptions of the theory, describing facilitating conditions of dynamic capabilities, as well as potential effects on competitive performance. The chapter concludes with a conceptual outline of the main associations that guide the DCV.

Chapter 4 extends the developments of the previous chapter and is directed towards describing how dynamic capabilities can be applied in the IT context. The chapter starts by describing the IT-enabled dynamic capabilities construct and delineating how the construct was developed and validated. It then proceeds on to explain how each dimension of which the construct is comprised is applicable in the enterprise domain through several illustrative examples. In turn, as conceptual model is designed which investigates how modularity, in terms of IT architecture and IT governance, act as antecedents of IT-enabled dynamic capabilities, as well how the impact of IT-enabled dynamic capabilities on competitive performance is actualized. We describe two primary mechanisms through which IT-enabled dynamic capabilities affect competitive performance, (a) by enhancing a firm's innovative capability, and (b) by augmenting organizational agility. The chapter concludes with two propositions on the role of diverse environmental uncertainty conditions (dynamism, hostility, and heterogeneity) regarding the impact of IT-enabled dynamic capabilities on the above mediating mechanisms.

Chapter 5 describes the research design applied to test the research model. It first discusses the data requirements of the study and then proceeds to delineate the data collection process. For all constructs used in the study, a detailed description is included concerning the sources used to develop them, as well as how they are measured and operationalized. The chapter concludes with some descriptive statistics of the sample of firms collected during the data collection procedure, as well as information of the profiles of respondents that participated.

Chapter 6 utilizes the data collected to put the conceptual model, along with the underlying hypotheses and propositions to test. At a first stage, the choice of the Structural Equation Modeling (SEM) approach, and more specifically the Partial Least Squares (PLS) technique is justified. In addition, the fuzzy set Qualitative Comparative Analysis (fsQCA) method is discussed, explaining its value for the purposes of this study. The data analysis of the conceptual models starts with a set of

tests aiming at examining reliability and validity of the measurement model. The analysis of the path model, which involves examination of direct, indirect and total effects, provides support for our hypotheses. In addition, fsQCA outcomes refine outcomes by indicating the specific conditions upon which IT-enabled dynamic capabilities lead to improved organizational agility and absorptive capacity.

Chapter 7 follows the empirical analysis of data to discuss what the outcomes reflect in terms of advancing theory, practice, and current research. The chapter starts with a summary of the objectives of the study as well as its main findings. Following the brief summarization of outcomes, practical implications are discussed in detail. The concluding chapter, i.e. chapter 8, highlights some of the most important research limitations of the study, as well as some boundaries concerning the objectives and the research questions asked. The thesis ends with a discussion of how future studies should proceed based on the outcomes of this study, and suggestions of areas of research that remains underexplored.

1.5 Summary

Chapter 1 provided an introduction to key concepts of IT-business value research, and more specifically on the notions and theories that underpin IT capabilities literature. The introductory discussion aimed at framing the research area along with the current status of studies based on which theoretical and empirical challenges are set. The motivation and objectives of this study are developed on the shortcomings of existing studies, as well as on recent calls concerning the direction in which IT-business value research should aim for, taking into account the contemporary business environment and the increasingly important role of IT. More specifically this study is aimed at understanding the organizational capabilities that firms should strengthen through targeted IT deployments. The construct of IT-enabled dynamic capabilities is put forth

in order to examine the mechanisms through which competitive performance gains are realized, the combinations of environmental uncertainty conditions that accentuate value appropriation, as well as antecedents that contribute towards their development. The research methodology employed to tackle the objectives of this study is described in brief, and includes a literature review on the area of IT capabilities, the development of a conceptual model capable of explaining how IT can add value in conditions of constant change, and a mix of quantitative and deterministic techniques to analyze data collected through a survey administered to IT managers. For each of the subsequent chapters, a short description of the contents is provided to give the reader an overview of its content.

CHAPTER 2

REVIEW OF RESEARCH ON IT CAPABILITIES

This chapter introduces the notion of IT capabilities, the predominant construct in assessing IT business value. The chapter starts with an introduction to the notion and an overview of issues concerning the conceptualization and use of the construct in empirical research. Section 2.2 delineates the methodology applied to review existing studies and to screen publications. In section 2.3 a taxonomy is devised, which based on theoretical developments, distinguishes IT capabilities into different levels: IT resources, IT competences, and IT-enabled capabilities. Each of these levels is thoroughly analyzed, with reference to how each, along with the sub-dimensions that comprise them, have been operationalized in empirical studies. The purpose of section 2.4, is to explain the relationships and interdependencies of the different levels of analysis, while section 2.5 overviews the nomological position of the concept in empirical studies. Finally, section 2.6 provides a discussion on the discourse of IT capabilities literature, pinpointing what we already know, and highlighting the directions that contemporary requirements necessitate.

2.1 Introduction

The value of information technology in supporting and shaping competitive strategies has been at the top of the agenda for academics and practitioners for more than 20 years (Duhan, 2007). Studies have shown that IT can potentially enable firms to achieve enhanced levels of organizational performance (Ravichandran & Lertwongsatien, 2005), increased agility (Lu & Ramamurthy, 2011), higher levels of innovation output (Gordon & Tarafdar, 2007), and even help derive more value from

strategic alliances (Tafti et al., 2013). In order to appertain to a firm's proficiency in exploiting its IT assets, scholars have coined the term IT capabilities. According to Bharadwaj (2000), an IT capability is not so much a specific set of technological functionalities as it is an enterprise-wide capability to leverage technology to differentiate from competition. IS researchers have been attracted to the IT capabilities construct for its potential relevance in explaining performance gains stemming from IT investments. Over the years numerous studies have adopted this conceptualization in order to attribute a firm's superior performance as a result of its capacity to manage, leverage, and exploit IT. However, despite the unanimous acceptance of the definition, literature presents highly inconsistent conceptualizations, often referring to dissimilar elements under the overarching term of IT capabilities (Gordon & Tarafdar, 2007).

With the notion of IT capabilities moving from its inception to maturity, there is a need to provide a synthesis of past studies and examine how the concept has been applied in Information Systems (IS) research. Due to its inherently complex nature, defining what constitutes an IT capability can be elusive and difficult to capture. Numerous studies have urged researchers to examine the multidimensional nature of IT capabilities, signaling a nexus of interdependencies that exist between the subcomponents that comprise it (Santhanam & Hartono, 2003). Decomposing and clearly defining the building blocks of IT capabilities is particularly important for the discourse of empirical research and for providing managers with guidelines of how to improve their firms' competitive position. In the face of rapidly changing business environments, increasingly permeable firm boundaries, and growing embeddedness of IT in organizational processes and products, it is imperative to revisit what we know about IT capabilities.

Therefore, the purpose of this review is twofold. First, we assess the extent to which researchers have examined the construct space of IT capabilities. The construct space refers to the theoretical domain of IT capabilities, i.e. how they have been

conceptualized and measured in research. By constructing a research framework grounded on the resource-based, competence-based and dynamic capabilities views of the firm, we define different levels of the construct as used in literature in a comprehensive and systematic manner. Through this taxonomy we survey the status quo of the IT capabilities concept. We then proceed to identify how it has been employed in empirical research, examining as such the network space of the construct. The network space refers to analyzing the nomological utility of IT capabilities in the IS field, and eliciting their role in explaining organizational phenomena. To fully comprehend the network space of the IT capabilities construct, the interdependencies that exist between the dimensions that comprise the construct are first evoked. Based on our review, we identify gaps in IT capabilities literature and pane the way for future research streams.

2.2 Methodology of Literature Review

The methodology employed for the review consists of two primary phases; the selection, and the analysis of related literature. The purpose of the selection phase is to assemble the most influential studies concerning IT capabilities over a predefined timeframe. After carefully selecting a pool of papers, the analysis phase is initiated and involves the identification of how IT capabilities are conceptualized and used in research. Due to the complex nature of IT capabilities, and the highly divergent conceptualizations that exist, a theoretically informed taxonomy is then devised to classify how studies employ the concept.

2.2.1. Selection Phase

Due to the importance of the selection phase in determining the overall validity of the literature review, a number of selection criteria are applied. The first concerns the restriction of selected publications to a time-frame of 15 years. This decision is based on the fact that aspects included in publications of more than 15 years are repeated in more recent papers or are aggregated in literature reviews. Second, the retention of papers is limited to journal publications and full conference proceedings, thus omitting poster and research in progress papers. The search process is performed on several sources, including publisher websites (e.g. Willey, Sage, and Springer), digital libraries (e.g. ScienceDirect, EBSCOhost, and JSTOR), and scholarly search engines (e.g. Google Scholar, and CiteSeerX). Structured queries are then applied using combinations of the following two sets of keywords {Information Technology; Information Systems; Digital; IT; IS; Technical; IT-enabled; IT-based} and {Capability; Competence, Resource; Asset; Capacity; Ability}.

The initial pool of retrieved publications span a range of disciplines, such as: information systems, strategic management, operational research, and economics. The set of publications are then meticulously screened, with studies being omitted due to non-adherence with certain criteria such as: relevance to IT capabilities research (publications that only used a minor reference to IT capabilities are discarded), and quality of the publication source. The quality of publications is also assessed by journals-ranking lists (Willcocks et al., 2008). The relevance to IT capabilities research is evaluated by examining if IT capabilities are discussed thoroughly, examined empirically, or surveyed. Publications that only have a minor reference to IT capabilities, or do not provide at least one of the following: definition, construct measurement, or dimensions are not retained for further analysis.

Following the screening process, a total of 45 papers are kept. Using references contained in these publications a second round of selection and screening is initiated.

Relative publications are then directly identified, and journal outlets concentrating a high number of relative publications are scanned to discover other relevant papers. These studies are also subject to the same screening process. This iterative cycle of screening and selection resulted in a pool of 62 papers, with **Table 2-1** presenting the outlets of the final set of publications ordered by frequency of publications, and grouped by the subject area.

Table 2-1 Reference subject areas and journal frequency of publications

Subject Area	No. of Studies	Published in	Freq.
Information Systems	37	MIS Quarterly	8
		Information Systems Research	8
		Journal of Management Information Systems	5
		Journal of Strategic Information Systems	4
		European Journal of Information Systems	2
		Journal of the Association of Information Systems	2
		Industrial Management & Data Systems	1
		Information Systems Frontiers	1
		Decision Support Systems	1
		Information Systems Journal	1
		Journal of Engineering and Technology Management	1
		International Conference on Information Systems Proceedings	1
		Hawaii International Conference on System Sciences Proceedings	1
		Communications of the Association for Information Systems	1
Information Management	8	Information & Management	4
		International Journal of Information Management	2
		Information Development	1
		Journal of Enterprise Information Management	1
Strategic Management	9	Strategic Management Journal	3
		Organization Science	2
		Management Science	1
		Decision Sciences	1
		Business Process Management Journal	1
		European Management Journal	1

Operations Research	6	International Journal of Production Economics	3
		Productions and Operations Management	1
		International Journal of Production Research	1
		Journal of Business Logistics	1
Marketing	2	Industrial Marketing Management	2

2.2.2. Analysis Phase

The objective of the analysis phase is to present how the notion of IT capabilities has been conceptualized and employed in research in a structured manner. The first step concerns the identification of the different levels of analysis on which the IT capabilities construct has been developed. Since the Resource-Based View (RBV) has been the predominant backbone of IT capabilities literature, this paper builds on the definitions provided in the seminal work of Amit and Schoemaker (1993), and distinguishes between the notions of *resource*, *competence*, and *capability*. Guided theoretically by the key concepts of the RBV, publications are then segregated based on how they measure IT capabilities, rather than on definitions. We argue that measurements provide a more accurate and precise representation of IT capabilities, since in many occasions definitions are not accurate reflections of what is actually quantified. Literature is then mapped on these key concepts guided by theoretical underpinnings, and uses both empirical and theoretical studies (**Table 2-2**). The final taxonomy highlights the multiple levels at which IT capabilities have been measured, as well as the relationships that exist between them.

Table 2-2 Categorization of literature based on research methodology

Type of Study	Research Method	Publications
Empirical - Quantitative		
	Survey	49

Empirical – Qualitative	Secondary Data	5
	Longitudinal	2
	Interviews	1
Mixed Method	Quantitative-Qualitative	1
Theoretical	Literature Review	1
	Conceptual	5

The second part of the analysis phase is focused on determining how IT capabilities are studied in empirical research. The objective therefore, is to define and describe the properties of the different dimensions comprising the IT capabilities construct, and illustrate the nomological network of associations surrounding each dimension of the taxonomy. Past studies are reviewed to determine research themes of IT capabilities used in empirical studies. The ultimate goal is to identify antecedents of IT capabilities, as well as mechanisms through which business value is realized. This part of the analysis is of particular relevance for identifying future research directions and isolating cause-effect relationships which have yet to be explored. By decomposing the IT capability construct, and describing the cause-effect relationships of its levels, we hope to provide a holistic perspective on the concepts position in IS research.

2.3 Decomposing the Notion of IT Capabilities

The need to develop and sustain a competitive advantage is of paramount importance for operations strategy, which draws on a number of interweaved yet distinct elements and notions (Wernerfelt, 1984; Peteraf, 1993; Amit & Schoemaker, 1993; Teece et al., 1997). Strategic management literature provides a comprehensive and well-grounded theoretical framework for understanding how firms can sustain a

competitive advantage, with organizational capabilities being at the cornerstone of success. In spite of the importance of organizational capabilities, the conception has often been left vague (Collis, 1994). Literature is riddled with inconsistencies, overlapping definitions, and outright contradictions (Zahra et al., 2006), and the term *capabilities* is often used interchangeably with concepts such as *resources* and *competences* (Größler & Grübner, 2006; Wu et al., 2010). Several researchers define organizational capabilities as a higher level construct that is developed on the interaction and orchestration of resources (Helfat & Winter, 2011). In this sense, there seems to a consensus that capabilities do not constitute of a single resource, but rather an optimal way of allocating and combining resources through a series of complex processes (Amit & Schoemaker, 1993). Therefore, capabilities can be built in different fields and on different levels of organizational activity (Schreyögg & Kliesch-Eberl, 2007).

In the context of the IS domain, IT capabilities have been defined as "*the ability to mobilize and deploy IT-based resources in combination or copresent with other resources and capabilities*" (Bharadwaj, 2000). Yet, conceptualizations of the IT capabilities construct suffer from the same inconsistencies noted in the strategic management domain. Terms such as "*capability*", "*competence*", "*resource*", "*asset*", "*capacity*", and "*ability*" are often used as synonyms resulting in obscure and incoherent empirical outcomes. The lack of precision in terminology has been attributed to the immaturity of applying the RBV in IS research (Peppard & Ward, 2004; Wade & Hulland, 2004). The RBV has been the principal theoretical backbone for examining how IT resources can be leveraged in order to form IT capabilities, which in turn can conditionally influence competitive performance (Melville et al., 2004; Zhang, 2005). This view has gained research interest in recent years, since numerous studies have empirically demonstrated that firms that possess superior bundles of IT resources tend to outperform their competitors (Kim et al., 2011). Nevertheless, there is no consensus as to what constitutes an IT resource and how exactly these resources should be

managed to produce IT capabilities. It is a frequent phenomenon in literature to see that IT capabilities are merely referred to as an aggregation of IT resources (Wade & Hulland, 2004). Although the IT capability research stream is moving into its maturity, there is a lack of agreement regarding the definitions of these concepts, what they reflect, and how they should be measured. This poses a major issue for extracting useful theoretical and practical implications.

Grounded on this pitfall of research, we build on the theoretical foundations of the RBV and other theories that extend it, such as the Competency-Based Perspective (CBP) and Dynamic Capabilities View (DCV), in order to categorize concepts and constructs used in IT capabilities literature. The proposed taxonomy makes a distinction between *resources*, *competencies*, and *capabilities* in congruence with past studies (Amit & Schoemaker, 1993; Peppard & Ward, 2004). Through this segregation, it is easily recognizable under what prism constructs in literature are operationalized and examined. The following sub-sections delineate the key concepts of the RBV, CBP, and DCV, and provide illustrations as to what types of IT artifacts are associated with each level of analysis. This taxonomy is further extended by introducing classifications for each concept, reflecting the dimensions of which it is theoretically composed. By portraying each level into distinct dimensions, it is easier to identify the building blocks as well as their interdependencies. We use our pool of papers to map their operationalizations to our taxonomy. By doing so, the proposed taxonomy serves as a convenient way to review findings, aggregate results, and examine future research directions.

2.3.1. IT Resources

The original RBV defines resources as rare, inimitable, and non-substitutable firm-specific assets that enable a firm to implement a value-creating strategy to generate rents (Barney, 1991). This concept was further split to encompass resource-picking

and capability-building, two distinct facets central to the RBV. Amit and Schoemaker (1993) define resources as tradable and non-specific firm assets, and capabilities as non-tradable firm-specific abilities (competencies) to integrate, deploy, and utilize other resources within the firm. Thus, resources represent the input of the production process while a capability is the capacity to deploy these resources with the aim of improving productivity. Resources can be tangible (financial and physical resources), human (knowledge and skills), or intangible (reputation and culture) (Grant, 1991). A characteristic of resources is that they cannot generate a competitive advantage by themselves but require action to leverage them strategically. This is indicative by Grants (1991) description of resources as nouns, because they can lie dormant like an idle plant or unused knowledge until they are needed, and can be identified independently of their use (Wu et al., 2010). Hence, a resource is something that a firms has access to, rather than something it can do (Größler & Grübner, 2006).

In this study we define IT resources as commodity-like assets that are widely available and can be purchased from the factor market (Cragg et al., 2011; Wang et al., 2012). We build on this definition since it is indicative of the static nature of resources as applied in IS literature. Subsequently, IT resources are distinguished into (1) *IT infrastructure* (tangible), which includes resources such as hardware, software, information systems packages, network infrastructure, and data, (2) *Human skills and knowledge* resources (human), comprising technical and managerial skills, accumulated experience, as well as knowledge on specific aspects, and (3) *Relational IT resources* (intangible), which include social ties forged between employees of business and IT departments, culture of IT use within the firm, collaboration between and within departments, and ties with external entities such as vendors and consultants (**Table 2-3**).

Table 2-3 A categorization of IT Resources from past literature

Dimensions	Aspects	Relevant Studies
IT Infrastructure	• Hardware − Scalability − Standardization • Software − Modularity − Transparency − Standardization • Information systems • Network infrastructure • Databases	Aral & Weill, 2007; Benitez-Amado & Walczuch, 2012; Bharadwaj, 2000; Bhat & Grover, 2005; Chen, 2012; Chen et al., 2014; Chen & Tsou, 2012; Chuang & Lin, 2013; Dong et al., 2009; Fink, 2011; Fink & Neumann, 2009; Garrison et al., 2015; Gordon & Tarafdar, 2007; Joshi et al., 2010; Kim et al., 2011; Liu et al., 2013; Liu & Ravichandran, 2015; Lu & Ramamurthy, 2011; Mao et al., 2014; Oh et al., 2014; Pereze-Lopez & Alegre, 2012; Ravichandran & Lertwongsatien, 2005; Saraf et al., 2007; Ray et al., 2005; Ray et al., 2004; Raymond et al., 2014; Sambamurthy et al., 2003; Sanders & Premus, 2005; Tarafdar & Gordon, 2007; Tippins & Sohi, 2003; Wade & Hulland, 2004; Wang et al., 2012; Ward & Zhou, 2006; Zhang et al., 2008
Human Skills & Knowledge	• Technical IT skills − Programming − Technological vision − Database management − Software engineering − Alertness • Management IT skills − Project management − Business/IT alignment (Social) − Competitor IT knowledge − IT-based problem solving	Aral & Weill, 2007; Armstrong & Sambamurthy, 1999; Bassellier et al., 2003; Basselier et al., 2001; Bharadwaj, 2000; Bhat & Grover, 2005; Chen, 2012; Chen & Tsou, 2012; Chuang & Lin, 2013; Fink, 2011; Fink & Neumann, 2009; Garrison et al., 2015; Kim et al., 2011; Kmieciak et al., 2012; Liu et al., 2013; Pereze-Lopez & Alegre, 2012; Ravichandran & Lertwongsatien, 2005; Ray et al., 2005; Ray et al., 2004; Sambamurthy et al., 2003; Tippins & Sohi, 2003; Tiwana et al., 2003; Wade & Hulland, 2004; Wang et al., 2012; Yeh et al., 2012
Relational IT Resources	• External relationship management − Customers − Vendors − Suppliers − Partners • Internal relationship management	Aral & Weill, 2007; Armstrong & Sambamurthy, 1999; Bharadwaj, 2000; Bhat & Grover, 2005; Chen, 2012; Chen et al., 2014; Chen & Tsou, 2012; Chuang & Lin, 2013; Fink, 2011; Garrison et al., 2015; Han et al., 2008; Kim et al., 2011; Lu & Ramamurthy, 2011; Mao et al., 2014; Ravichandran & Lertwongsatien, 2005; Sambamurthy et al., 2003; Tarafdar & Gordon, 2007; Tiwana et al.,

	– Social alignment (Business/IT) – Culture of IT use – Reciprocity – Mutual understanding	2003; Tippins & Sohi, 2003; Wade & Hulland, 2004; Wang et al., 2012; Yeh et al., 2012; Zhang et al., 2008

IT Infrastructure

A firm's IT infrastructure has been described as the cornerstone of IT resources (Bharadwaj, 2000). However, since an IT infrastructure can be easily replicated by competition it is unlikely to constitute a source of a competitive advantage (Bradley & Byrd, 2007). The value of IT infrastructure lies in its capacity to facilitate inter- and intra-firm linkages, enable processes to be executed digitally, and serve as platform on which business applications can be instituted, thus providing digital options (Sambamurthy et al., 2003). A multitude of different approaches have been used to assess the level of IT infrastructure, such as examining the flexibility of software and systems (Bhat & Grover, 2005; Saraf et al., 2007; Liu et al., 2013; Tafti et al., 2013), budget appropriation (Chen & Tsou, 2012), data standardization (Ward & Zhou, 2006; Saraf et al., 2007), and investments in task-specific IT applications (Ray et al., 2004; Joshi et al., 2010; Oh et al., 2014). The necessity of investing in IT infrastructure to form linkages with suppliers, customers, and other business partners while being able to integrate back-end processes and increase breadth and reach in business networks is a focal point in remaining competitive especially in dynamic and uncertain business environments (Ray et al., 2005; Saraf et al., 2007; Tafti et al., 2013; Chen et al., 2014; Oh et al., 2014).

Human Skills & Knowledge

The capacity to develop an IT infrastructure, such as the aforementioned, and continuously monitor and improve it, is highly dependent upon the skills and knowledge of the human IT resources. These are divided into the (a) *technical IT skills and knowledge* such as programming aptitude, ability to spot new and emerging technologies, knowledge of system development and specific technologies, application use (Bassellier et al., 2003; Tippins & Sohi, 2003; Ravichandran & Lertwongsatien, 2005; Kim et al., 2011; Fink, 2011; Perez-Lopez & Alegre, 2011), and (b) *management IT skills and knowledge* which include coordination of technical staff, CIO IT knowledge, the degree to which top management is well informed about competitors IT use and initiates change, and the ability to align business requirements and IT solutions (Armstrong & Sambamurthy, 1999; Ray et al., 2004; Bhat & Grover, 2005; Ravichandran & Lertwongsatien, 2005; Kim et al., 2011; Fink, 2011). Firms that invest in both types of skills and knowledge, are more capable of delivering IT solutions that are tailored to business requirements (Tiwana et al., 2003).

Relational IT resources

Keeping up-to-date in terms of knowledge and skills, and effectively coordinating activities and tasks, is a process which is highly dependent upon the capacity to forge networks internally and externally of the firm. Close ties between IT staff and customers, suppliers, vendors, and other business partners', enable the exchange of information between collaborating parties. This process is of paramount importance in renewing knowledge of technical and managerial IT staff, and in facilitating efficient information exchange concerning IT solutions to be developed or outsourced to third parties (Tarafdar & Gordon, 2007; Han et al., 2008). Particular emphasis has been placed on relational IT resources forged between business and IT employees within the firm, especially in the business-IT alignment literature (Reich & Benbasat, 2000). These social interactions are the most complex and difficult IT resources to

replicate from successful counterparts, primarily due to the nexus of synergies that are created, and the specific social context in which they are developed (Bharadwaj, 2000; Zhang et al., 2008; Wang et al., 2012).

2.3.2. IT Competences

Although resources represent the raw materials in the quest of attaining competitive gains, they are insufficient without the underlying ability to utilize and mobilize them in order to harness their potential. There is considerable variety in labeling the capacity of utilizing and mobilizing resources, with studies terming it as a competence, organizational capability, collective skill, complex routine, or best practice (Schreyogg & Kliesch-Eberl, 2007). We follow the stream that is developing in IS literature and adopt the term competencies to denote the processes of effectively managing IT resources (Peppard & Ward, 2004; Caldeira & Dhillon; Cragg et al., 2011). According to the definition provided by Cragg et al., (2011),"*competencies involve the ability to develop, manage and deploy resources in support of a capability*". Through appropriate organizational routines manifested in business activities and processes, competencies bring together resources and enable them to be deployed advantageously, thus generating organizational capabilities (Teece et al., 1997; Dhillon, 2008). They therefore act as a buffer between capabilities and the bundle of resources a firm possesses.

In IS literature the main difference between IT competencies and capabilities is that the former are concerned with managing IT resources within the IS function, whereas the latter refer to the potential use of IT to support or enable organizational capabilities (Cragg et al., 2011). A number of studies have attempted to identify and group IT competencies, with multiple frameworks proposed in literature (Feeny & Wilcocks, 1998; Peppard et al., 2000; Wade & Hulland, 2004; Ravichandran & Lertwongsatien, 2005; Caldeira & Dhillon, 2010; Cragg et al., 2011). The differences

inherent in each of the frameworks can be attributed to underlying philosophy and theoretical lens through which they are examined. However, there is still a lack of consensus on a specific taxonomy of IT competencies. Based on the competence-based perspective which portrays competences as distinct to capabilities (Stalk et al., 1992), and Lado's and Wilson's (1994) and McGrath's et al. (1995) taxonomies, we discern IT competencies into (1) *Planning*, (2) *Sourcing*, (3) *Deployment*, and (4) *IT Management* as presented in **Table 2-4**.

Table 2-4 A categorization of IT Competencies from past literature

Dimensions	Aspects	Relevant Studies
IT Planning	• IT innovation • Proactive IT stance • Business systems thinking • IS/IT Governance • Information Governance • IT investment criteria • Business/IT alignment (operational) • Analyzing for opportunities of IT-based competitive advantage • IT planning methodology selection • IT application portfolio prioritization	Chen et al., 2014; Cragg et al., 2011; Doherty & Terry, 2009; Gordon & Tarafdar, 2007; Kim et al., 2011; Lu & Ramamurthy, 2011; Mao et al., 2014; Peppard et al., 2000; Peppard & Ward, 2004; Ravichandran & Lertwongsatien, 2005; Tarafdar & Gordon, 2007; Wade & Hulland, 2004; Wang et al., 2012; Willcocks et al., 2006; Wu et al., 2006; Yeh et al., 2012; Zhang et al., 2008
IT Sourcing	• IT purchasing • Outsourcing IT • Capacity to develop IT solutions • Software sourcing strategies • Manage IS supplier relationships • Contract facilitation • Fast delivery of IT application • IS acquisition processes	Cragg et al., 2011; Doherty & Terry, 2009; Han et al., 2008; Peppard et al., 2000; Peppard & Ward, 2004; Ravichandran & Lertwongsatien, 2005; Tiwana et al., 2003; Wade & Hulland, 2004; Wang et al., 2012; Willcocks et al., 2006; Wu et al., 2006
IT Deployment	• IT assimilation • IT business process integration • IT functionality use • Familiarity with IT • Apply and use technology	Chen et al., 2014; Cragg et al., 2011; Doherty & Terry, 2009; Kmieciak et al., 2012; Liang et al., 2007; Liu et al., 2013; Peppard et al., 2000; Peppard & Ward, 2004;

	• Implementation and integration	Raymond et al., 2014; Tiwana et al., 2003; Wang et al., 2012; Willcocks et al., 2006; Yeh et al., 2012; Zhang et al., 2008
IT Management	• IT budgeting • Project rules implementation • Data backup and recovery • Information asset management and maintenance • Staff development • Project management • IT and data security • Standards compliance	Benitez-Amado & Walczuch, 2012; Chen et al., 2014; Cragg et al., 2011; Doherty & Terry, 2009; Dong et al., 2009; Fink, 2011; Fink & Neumann, 2009; Han et al., 2008; Kim et al., 2011; Peppard et al., 2000; Peppard & Ward, 2004; Ravichandran & Lertwongsatien, 2005; Tarafdar & Gordon, 2007; Wade & Hulland, 2004; Wang et al., 2012; Willcocks et al., 2006; Yeh et al., 2012; Zhang et al., 2008

IT Planning

An ***IT Planning*** competence, refers to a firm's ability to consider the effects of IT with regard to the business strategy, shape strategy in accordance with IT innovations, select an appropriate IS planning methodology, devise or modify plans to achieve full value from IT investments, and define the requirements for IT. It manifests a starting point, and requires top management to be knowledgeable about new developments in both business and technological contexts in order to continuously leverage IT resources in the face of changing business requirements. Lu and Ramamurthy (2011) include an IT proactive stance as an important competence in developing an IT capability. An IT proactive stance denotes a competence in effectively planning how IT should be harnessed at the strategic level (Doherty & Terry, 2009; Mao et al., 2014). A fundamental notion in developing an IT planning competence is that it should be integrated with business strategic planning, and that there should be understanding concerning the value of IT initiatives (Zhang et al., 2008; Kim et al., 2011). Willcocks et al. (2006) recognize that IT planning should be established at the strategy formulation level (business systems thinking), as well as the operational level (IS/IT

governance). The former aspect of IT planning concerns the envisioning of IT technologies as part of every business process, while the latter includes the tasks of defining structures, processes, and staffing to ensure that the IT function delivers value for money (Ravichandran & Lertwongsatien, 2005; Chen et al., 2014).

IT Sourcing

An ***IT sourcing*** competence reflects the ability to develop, purchase, and/or outsource the necessary IT resources to support the overall digital business strategy. IT resource sourcing consists of processes by which firms purchase, accumulate and divest IT resources (Sirmon et al., 2011). Firms' therefore can opt to purchase IT resources from strategic factor markets, develop them internally, or divest firm-controlled IT resources by outsourcing them to external entities. An effective IT sourcing competence pertains to the quality and the routines that lead to a reliable and controlled delivery process of IT resources (Ravichandran & Lertwongsatien, 2005). In the definition of Doherty and Terry (2009), an IT sourcing competence is also determined based on the time-to-deliver, since its value is contingent upon market requirements. Tiwana et al. (2003) also consider the value of an IT competence in terms of the capacity to deliver IT solutions that meet the firms evolving business needs in an agile manner. These definitions suggest that an IT sourcing competence is of value only if it is capable of delivering solutions in line with requirements (Bhardwaj, 2000; Willcocks et al., 2006). Han & Han (2008) focus on IT outsourcing in particular, and find that critical antecedents include establishing effective vendor management processes, formalizing selection criteria, and developing evaluation and systematic control mechanisms. In contrast, Tiwana et al. (2003) focus on development as part of IT sourcing competence, and find that it is improved by integrating internal and external knowledge.

IT Deployment

An ***IT Deployment*** competence refers to the sequential step after the planning and acquisition of resource, and entails the effectiveness of using IT resources, the degree of assimilation within firms operations, and the speed to which full functionality of IT is attained (Pavlou & El Sawy, 2006; Liu et al., 2013; Chen et al., 2014). An IT deployment competence is seen as a key ingredient in enabling efficiency and effectiveness of business process, thus enhancing overall agility and absorptive capacity (Kmieciak et al., 2012; Liu et al., 2013). Cragg et al. (2011) note that developing a robust IT deployment competence is dependent upon the skills and knowledge of staff, the right attitude, and organizational culture that encourages experimentation with IS. In the context of ERP assimilation, Liang et al. (2007) examine how institutional forces prompt managers to routinize ERP use within the organizational projects or work processes. Their findings confirm that top management participation and perceptions regarding the value of ERP systems promote higher levels of assimilation. The competence of assimilating ERP systems is evaluated in terms of the percentage of business processes that use ERP systems, the diversity of functional areas that use ERP, and extent to which ERP systems are used in operations, management, and decision making. Wang et al. (2012) on the other hand evaluate an IT deployment competence as the collective ability to effectively use IT functionalities, understand why IS are used, know what functionalities are available, and being familiar with using them.

IT Management

IT Management competencies encompass activities such as staff development initiatives, managing costs, and managing IT projects. Ravichandran and Lertwongsatien (2005) address IT management competencies from a technical perspective. Their conceptualization includes procedures for data backup, unplanned

system outages, assessing security vulnerabilities, and disaster recovery. Wang et al. (2012) perceive IT management through a broader spectrum that is not restricted to the management of IT infrastructure, but also includes functions of training IT staff, maintaining efficient budgets, and satisfying business requirements in a timely manner. Similarly, Dong et al. (2009), in their conceptualization of managerial skills, include elements of IT management and processes re-engineering as well as the capacity to acquire expertise critical for managing IT-supported activities. The idea of measuring IT management competencies through the capacity to manage physical and human resources is present in numerous studies (Fink & Neumann, 2009; Fink, 2011). Yeh et al. (2012) measure project management capability as the ability to implement project rules to grasp progress and meet budget needs. Similarly, but focused primarily on effective management of IT in projects, is the conceptualization of Zhang et al. (2008). In their study, an IT management competence is measured in terms of evaluation and control of systems, consistency of IT policy use within the enterprise, security, standards compliance, and disaster recovery processes. Their findings indicate that IT management competence positively impacts international firm performance.

2.3.3. IT-Enabled Capabilities

The competitive benefits that a firm currently possesses are a result of strengths built in reaction to environmental responsiveness strategies. These strengths are described in terms of organizational capabilities, i.e. mechanisms that enable the most efficient and competitive use of a firms assets whether tangible or intangible (Sharma & Vredenburg, 1998). In this respect, capabilities represent the potential of a business to attain certain goals through focused deployment, and constitute the basis on which firms compete in the market. Designing and creating desired organizational capabilities is a process that unfolds over time, and reflects choices made in support

of a firm's competitive strategy. Organizational capabilities emerge through the strategic application and complex interactions among resources and competences that a firms owns or is capable of accessing. Peppard and Ward (2004) do a good job at drawing the distinction between capability and competence and note that: "*Competing organizations can have a manufacturing capability; however, the competencies underpinning this capability are likely be resourced differently in different organizations and the resources integrated and coordinated in different ways, depending on the context of each organization, including its history, people, and structural characteristics*". This implies that there are multiple possible choices that lead to the development of a particular capability.

Strategic management literature is replete with conceptualizations and definitions of what constitutes an organizational capability. According to Winter (2003), a capability is described as a high-level routine (or a collection of routines), with routines consisting of learned behaviors, highly patterned, repetitious or quasi-repetitious, founded in part in tacit knowledge. Grant (1991) describes organizational capabilities as verbs, because they focus on how resources are used. Helfat and Winter (2011) explicate that a capability implies that the firm has the capacity to perform a particular activity in a reliable and at least minimally satisfactory level. Organizational capabilities can be purposely built by focusing on the complex interactions between a firm's resources and competencies, and are deeply rooted within its idiosyncratic social structure (Grant, 1996; Schreyögg & Kliesch-Eberl, 2007). Previous research in the area of strategic management has made great strides to develop and refine the different types of capabilities that exist. It is generally agreed that capabilities operate quite differently, and result in varying levels of competitive advantage and firm performance based on a number of internal and external factors (Hoopes & Madsen, 2008). Grounded on the idea that firms must be both stable enough to continue to deliver value in their own distinctive way, and agile and adaptive enough to restructure their value proposition when circumstances demand

it, there is a well-documented distinction between *operational (ordinary)* and *dynamic capabilities*.

In the RBV operational capabilities have been identified as an important source for the generation of sustainable competitive advantages (Barney, 1991). In incomplete markets, heterogeneity among firm resources and capabilities can serve as the basis for developing competitive advantages and rent differentials (Amit & Schoemaker, 1993). Nevertheless, conditions of high environmental uncertainty, market volatility, and frequent change, have raised questions regarding the rate to which operational capabilities erode and cease to provide competitive gains. It is argued that in such conditions emphasis should be shifted to developing capacities of change and rapid development of new operational capabilities. Scholars place dynamic capabilities (Teece et al., 1997), as a neo-Schumpeterian theory of the firm which repositions the focus on the renewal of existing organizational capabilities as a means of competitive survival for the firm. The main distinction between operational and dynamic capabilities can be explained as that the former enable firms to make a living in the present, while the latter facilitate their modification in response to the shifting external environment (Winter, 2003). If a company lacks dynamic capabilities, it has a chance to make a competitive return for a short period based on its operational capabilities, but it cannot sustain supra-competitive returns for the long term due to change (Teece, 2007). Dynamic capabilities are associated with rents from new combinations of capabilities and assets, and produce outcomes that are capable of shaping the marketplace, such as entrepreneurship, innovation, and semi-continuous asset orchestration and business reconfiguration. While the value of distinguishing operational from dynamic capabilities is still challenged by some scholars, there seems to be an emergent consensus in literature that they differ, with some studies proposing a set of guidelines on how to identify and categorize them (Winter, 2003).

Choices that result in embedding IT within areas that are critical to the organization are likely to generate important organizational capabilities, which

providing that they are dissimilar to those of competitors, can be rent-yielding (Ravichandran & Lertwongsatien, 2005). The processes of rooting IT into organizational capabilities serves as a leveraging mechanism of existing IT resources and competencies. Thus, firms that are able to effectively target IT initiatives in support of organizational capabilities are more likely to realize value from their IT resource and IT competencies inventory (Sambamurthy et al., 2003). Pavlou and El Sawy (2006) refer to the capacity of effectively implementing IT functionality in support of an organizational capability as an IT leveraging competence, and note that it is the primary source of competitive differentiation. The idea of an IT-enabled capability, although dependent upon other IT-related constructs as illustrated in previous sections, differs conceptually. In this respect, an IT-enabled capability is not restricted to the investments made in IT or the functionality provided through IT systems. Simply investing in IT does not guarantee any enhancements in performance, nor does the assimilation of IT systems if not leveraged strategically. IT-enabled capabilities therefore are defined as the capacity to augment, build, and strengthen a firms' organizational capabilities through targeted use of IT resources and competencies. They represent the routines that surround the use of IT in a particular way. There is a growing stream in literature that recognizes the value of examining IT in terms of the capabilities it strengthens or enables, instead of examining resources and competencies in isolation (Kohli & Grover, 2008; Setia & Patel, 2013).

Building on the ideas presented in strategic management literature regarding the distinction that exists between different types of organizational capabilities, two broad categories are identified accordingly: (1) *IT-enabled operational capabilities* and (2) *IT-enabled dynamic capabilities,* with relevant studies for each presented in **Table 2-5**.

Table 2-5 A categorization of IT-enabled capabilities from past literature

Dimensions	Aspects	Relevant Studies
IT-enabled operational capabilities	• Technical Capabilities – Order entry – Billings – Purchasing – Inventory control – Financial reporting – Increasing logistics speed – Integrating supply chain • Marketing Capabilities – Customer information gathering – Analyzing market intelligence – Determining customer requirements	Aral & Weill, 2007; Armstrong & Sambamurthy, 1999; Bendoly et al., 2012; Chuang & Lin, 2013; Doherty & Terry, 2009; Drnevich & Kriauciunas, 2011; Fink & Neumann, 2009; Im & Rai, 2013; Jin et al., 2014; Kim et al., 2012; Kmieciak et al., 2012; Oh et al., 2014; Pavlou & El Sawy, 2006; Pereze-Lopez & Alegre, 2012; Rai & Tang, 2010; Rai et al., 2006; Ravichandran & Lertwongsatien, 2005; Saraf et al., 2007; Real et al., 2006; Rivald et al., 2006; Sambamurthy et al., 2003; Setia et al., 2013; Tippins & Sohi, 2003; Wang et al., 2012; Wong et al., 2015; Yang et al., 2009
IT-enabled dynamic capabilities	• Sensing • Learning • Coordinating • Integrating • Reconfiguring	Drnevich & Kriauciunas, 2011; Joshi et al., 2010; Oh et al., 2014; Pavlou & El Sawy, 2006; Pavlou & El Sawy, 2010; Schwarz et al., 2010

IT-Enabled Operational Capabilities

IT-enabled operational capabilities include the capabilities that are facilitated through IT solutions and allow the firm to operate more efficiently in everyday operations (Winter, 2003). Following literature which suggests that technical and marketing operational capabilities are central to the competitive advantage process (Lado et al., 1992; Spanos & Lioukas, 2001; Protogerou et al., 2012), we group studies of IT-enabled operational capabilities accordingly. Technical capabilities include activities for efficient product development and delivery such as streamlining operations, integrating activities with suppliers and business partners, and reducing costs and

delivery-cycles without disruptions or performance losses (Spanos & Lioukas, 2001). In IS literature, technical IT-enabled operational capabilities have been examined in terms of internal and external process integration (Rai et al., 2006; Saraf et al., 2007; Rai & Tang, 2010; Rai et al., 2012), information exchange processes (Kmieciak et al., 2012; Bendoly & Bharadwaj, 2012), managing supply chain activities (Swafford et al., 2008; Im & Rai, 2013; Wong et al., 2015), resource management (Pavlou & El Sawy, 2006) and knowledge acquisition and codification (Liu & Ravichandran, 2015). The development of these types of IT-enabled operational capabilities is seen as important in improving the efficiency of related processes, which ultimately can lead to performance gains (Rai et al., 2006).

Marketing capabilities on the other hand enable firms to better understand their customers' current and future needs, interpret information, identify new customers, and analyze competition to detect new competitors (Fowler et al., 2000). IS studies have examined how marketing IT-enabled operational capabilities augment processes such as facilitating customer information gathering (Saraf et al., 2007; Chuang & Lin, 2013), fulfilling customer needs (Ravichandran & Lertwongsatien, 2005; Chuang & Lin, 2013), analyzing market intelligence (Perez-Lopez & Alegre, 2012), and accessing new markets (Wang et al., 2012). Marketing capabilities have an external emphasis and add value by allowing firms to be in close proximity to their customers. IS literature supports the argument that IT-enabled operational capabilities improve a firms existing processes and products, which in turn result in increased revenues (Zhu & Kraemer, 2002; Barua et al., 2004; Lai et al., 2008).

IT-Enabled Dynamic Capabilities

If competitive forces pressure companies to rapidly readdress their product/service offerings, tight IT arrangements or heavy investments on digital platforms for IT-enabled operations may prove to be a hindrance. Under such circumstances, firms

should possess the capability to innovate with IT, effect change and adapt business processes and practices to respond to change created by others (Peppard and Ward, 2004). The notion of *IT-enabled dynamic capabilities* is built on these requirements, and is grounded on the DCV. Firms that are effective in deploying dynamic capabilities are able to recognize and respond to opportunities and threats by extending, modifying, changing, or creating resource configurations and existing operational capabilities (Teece et al., 1997). Dynamic capabilities add value by enabling firms to develop new processes, products, and/or services, by improving the speed, effectiveness, and efficiency with which a firm operates, and by obtaining previously unavailable decision options (Drnevich & Kriauciunas, 2011). In contrast with operational capabilities, the aim of dynamic capabilities is to enable and support superior-long run business performance. Drawing on Eisenhardt's and Martin's (2000) suggestion that dynamic capabilities are identifiable and specific routines that often have been the subject of extensive empirical research in their own right, there have been a number of attempts to isolate them and examine their impact. In doing so, most empirical studies have based their measurements on the dimensions put forth in Teeces et al. (1997) (reconfiguring, learning, integrating, and coordinating) and Teeces (2007) work (sensing the environment, seizing opportunities', and reconfiguring assets).

The strategic IS agenda calls for a reframing of the dominant research discourse on IT-business value, taking into account the constantly changing competitive environment (Tanriverdi et al., 2010; Merali et al., 2012). The paradigm shift that is addressed in these commentaries is in coherence with the quest that is examined through dynamic capabilities theory. Already, there have been some empirical studies, although limited in number, which employ the DCV in order to examine the business value of IT. Oh et al. (2014) examine the impact of two types of IT-enabled dynamic capabilities on firm performance, market adaptation and operational flexibility. Market adaptation is defined as the ability to respond to market changes

rapidly by leveraging existing IT, while operational flexibility reflects the capacity to effectuate changes at the strategic and operational level using IT. Although these resemble the dimensions of operational capabilities presented earlier, they differ in that they measure the rate to which they are adapted in the face of change. Drnevich and Kriauciunas (2011) follow a similar approach, and measure IT-enabled dynamic capabilities as the degree to which they enable new operational capabilities to be developed. Their findings empirically demonstrate that although IT-enabled operational capabilities may increase relative firm performance, under conditions of high environmental dynamism it is IT-enabled dynamic capabilities that facilitate competitive performance gains. To our knowledge these are the only studies that develop their constructs in adherence with the DCV, despite several studies including items in their definitions of IT-enabled operational capabilities that resemble this theoretical grounding (Ravichandran & Lertwongsatien, 2005; Wang et al., 2012), and others that employ IT resources as antecedents of dynamic capabilities (Pavlou & El Sawy, 2006; Liu et al., 2013).

2.4 The Link Between Dimensions of IT Capabilities

2.4.1. From IT Resources to IT Competencies

As noted above, IT resources, tangible, intangible, and human, are the basic building blocks of IT competencies. In order to develop any IT-related competency a firm must have access to the necessary infrastructure, employ individuals that have the requisite knowledge and skills, and develop a culture than enables a shared understanding (Duhan, 2007). Each of these assets conveys a certain variable potential and collectively constitute the basis upon which a competency can be built (Spanos & Prastacos, 2004). The different types of IT competencies as categorized above are contingent to patterns of such fundamental building blocks (Kohli & Grover, 2008).

For instance, a different set of resources is required to develop a competency to effectively assimilate an ERP system, compared to a competency to develop an e-commerce portal. The expression of a particular competence depends on the different combinations of resources, the interactions developed between individuals or groups of people, the availability and ease at which knowledge can be transferred, as well as the coordination of efforts towards a common goal. Hence, resources become competencies when their loose coupling becomes structural coupling, i.e. is when they are purposefully brought together to perform certain complex tasks (Spanos & Prastacos, 2004). Harnessing the synergistic impact of combining these resources and translating them into valuable competencies requires that they are put into action. Peppard and Ward (2004) note that competencies emerge from organizational processes, with clearly defined roles, which are bounded by the structure of the organization. Processes define how activities should optimally be performed, and thus constitute a set of best practices for the development of competencies. Roles are important in the development of IT competencies since they assign responsibilities to individuals in groups and organizations. Manifested through job descriptions or positions titles, roles establish how the work of individuals is linked together in a cogent manner to produce a desired outcome. Structures are concerned with how people, departments, and other subsystems in the organization are arranged and can affect the development of competencies by alleviating communication barriers (Dosi et al., 2008).

The manner in which IT resources are transformed into distinct IT competencies and the complex interactions that develop between them has largely been neglected by research. Only a limited number of studies examine how the IT resources that a firms owns or has under its control can result in superior IT competencies (Tiwana et al., 2003; Ravichandran & Lertwongsatien, 2005; Wang et al., 2012). According to this view, IT resources act as direct or indirect antecedents of IT competencies, with their associations been characterized by path dependency. Such

an exemplar is the study of Tiwana et al. (2003) whom find that an IS development competence is facilitated through developing structural and cognitive linkages. These business-IS linkages serve as a mechanism to promote knowledge integration of internal and external sources, which ultimately enhances IS development competence by improving flexibility and fit with business needs. Despite the significance on their work in explaining how a specific type of IT competence is developed, very few studies have followed in the same direction. At a higher level of abstraction several studies have demonstrated that firms that possess a greater armory of IT resources are more prone to develop stronger IT competencies. Fink and Neumann (2009) for instance demonstrate that managerial-oriented competences (managerial capabilities) are dependent upon individual employees business, behavioral, and technical knowledge and skills, while technically oriented competences (physical capabilities) are primarily dependent upon technical knowledge and skills, and IT connectivity. In addition to illustrating how IT resources coalesce to form IT competencies, empirical findings suggest that the development of technical competences is influenced by the ability to reallocate IT resources (managerial capabilities). Although several other studies find that IT competencies cannot exist independently and are to a large extent based on the firms IT resources (Wang et al., 2012), the dependencies that are forged between IT competencies and the nexus of associations that are developed remain largely unexplored.

2.4.2. From IT Competencies to IT-Enabled Capabilities

Developing and enhancing IT competencies is crucial for firms, since the enactment of IT-enabled capabilities is heavily dependent upon the proficiency and efficacy of managing and orchestrating IT resources. It has been argued that strong IT competencies can help firms enhance existing organizational capabilities or enable the development of new organizational capabilities (Byrd, 2001). Firms that have invested

in IT competencies are also more inclined to perceive higher levels of business-IT alignment (Chan & Reich, 2007). In the face of cascading and rapidly shifting business environments, IT competencies help in developing and implementing the right IT solutions in a timely manner (Lee & Xia, 2005). Thus, they are particularly important in dynamic environments where organization and technology changes occur on a frequent basis (Wang et al., 2012). Additionally, firms that possess strong IT competencies have better trained staff and appropriate procedures that allow for a more effective exploitation and assimilation of IT resources in job routines (Liang et al., 2007). The extent, however, to which IT competencies contribute to IT-enabled capabilities is contingent on organizational strategy, investment decisions, complementary organizational resources and capabilities, and top management support for IT-enabled solutions (Peppard and Ward, 2004). Hence, possessing an armory of IT competencies does not automatically translate into effective IT-enabled capabilities, but rather competencies must be strategically applied in order to produce value. In this sense, the effect of IT competencies cannot be linked directly to performance metrics, since their value is mediated by the IT-enabled capabilities they create or enhance (Cragg et al., 2011).

To some extent empirical studies have proven the positive impact of IT competencies on IT-enabled capabilities. For instance, Ravichandran and Lertwongsatien (2005) find that the ability of a firm to strengthen its core capabilities through IT (IT-enabled capabilities) is likely to be dependent on its competency to plan and deploy IT resources. More specifically, they posit that firms must be competent in planning, sourcing, assimilating, and managing IT in order to realize improvements in their IT-based capabilities. This perspective implies that focusing solely on one type of IT competence will most likely not yield any effect on strengthening capabilities though IT, but rather, the combined effect of IT competencies is required to realize a substantial outcome. Hence, this proves that IT competencies are of significant importance, and should not be managed with a cost

reduction focus (Huber, 1992). **Figure 2-1** provides an outline of concepts and sketches their relationships as discussed above.

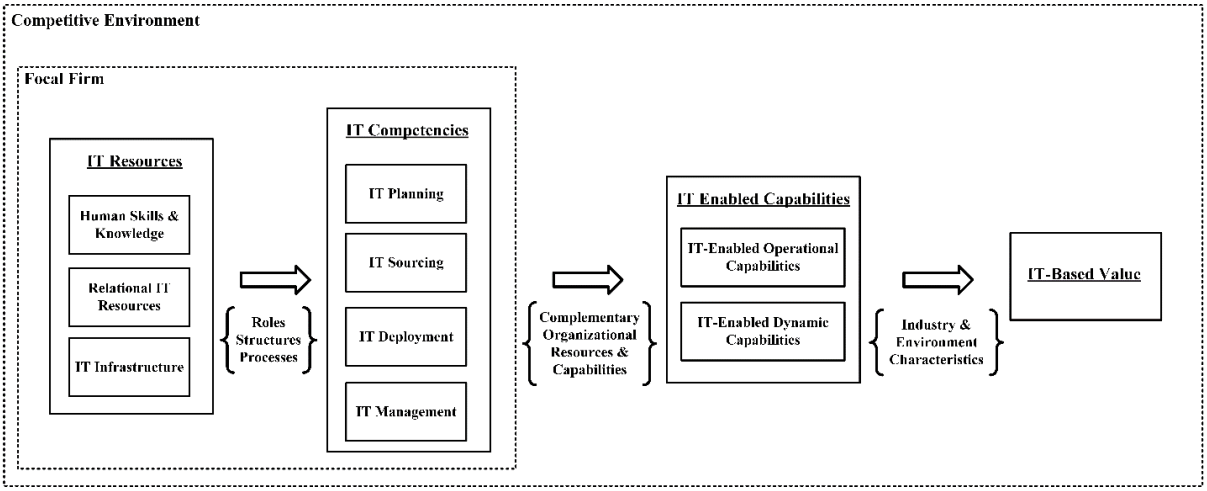


Figure 2-1 A conceptual segregation of IT Capabilities

2.5 The Impact of IT Capabilities on Performance

The proliferation of research articles concerning IT capabilities in recent years has been sparked by an attempt to describe how IT can contribute to organizational performance (Kohli & Grover, 2008). This has been in response to several research commentaries which argue that IT does not matter, implying that investments in IT do not add any substantial business value (Carr, 2003). Agarwal and Lucas (2005) argue that demonstrating the value of investing in IT is fundamental to the IS discipline. Therefore, it is important not only to define if IT creates value, but also to explicate through what causal mechanisms and under what conditions performance gains can be realized. It is generally accepted that IT changes the way business is conducted, and that different types of IT investments are linked to one another. A critical mass of studies has already demonstrated that IT adds value in some way, either directly on performance (financial, competitive performance), or indirectly by affecting organizational processes (agility, business reach, absorptive capacity)

(Melville et al., 2004; Kim et al., 2011). However, there is considerable diversity in empirical studies concerning how the different levels at which an IT capability is measured can produce value, what type of value can be expected from each, and through what cause-effect relationships it can be realized. Whether IT will facilitate the attainment of a competitive advantage, achieve a state of competitive par, increase financial indicators by slicing costs, or improve process efficiency, is contingent on the way the IT capabilities construct is operationalized. **Table 2-6** presents empirical studies grouped according to the levels at which the IT capabilities construct is operationalized, as well as the nature of the association to performance.

Table 2-6 Associations examined in empirical studies

Associations	**Direct**	**Indirect**
IT Resources → Firm Performance	Aral & Weill, 2007; Bharadwaj, 2000; Bhat & Grover, 2005; Ray et al., 2005; Tafti et al., 2013	Chen, 2012; Chen & Tsou, 2012; Garrison et al., 2015; Joshi et al., 2010; Sanders & Premus, 2005
IT Resources → IT Competencies	Armstrong & Sambamurthy, 1999	Tiwana et al., 2003
IT Resources & IT Competencies → Firm Performance	Dong et al., 2009; Gordon & Tarafdar, 2007; Lu & Ramamurthy, 2011; Tarafdar & Gordon, 2007; Zhang et al., 2008	Benitez-Amado & Walczuch, 2012; Chen et al., 2014; Han et al., 2008; Kmieciak et al., 2012; Pereze-Lopez & Alegre, 2012; Tippins & Sohi, 2003; Yeh et al., 2012
IT Resources → IT Competencies → Firm Performance	Fink & Neumann, 2009; Fink, 2011	Kim et al., 2011; Liu et al., 2013
IT Resources & IT Competencies → IT-Enabled Capabilities → Firm Performance	Ravichandran & Lertwongsatien, 2005; Wang et al., 2012; Wong et al., 2015	Chuang & Lin, 2013; Saraf et al., 2007; Real et al., 2006

IT-Enabled Capabilities → Firm Performance	Drnevich & Kriauciunas, 2011; Kim et al., 2012; Oh et al., 2014	Im & Rai, 2013; Jin et al., 2014; Pavlou & El Sawy, 2006; Rai & Tang, 2010; Rai et al., 2006; Rivald et al., 2006;

The impact of IT resources

Several research studies have grounded their hypotheses on the RBV in order to explain how different IT resources add value. Yet, there is considerable variation in the way they conceptualize IT resources and link them to performance indicators. Years of studies have led to some commonly acknowledged facts. It is generally accepted in IS literature that IT resources do not create value in isolation (Kohli & Grover, 2008). The value of IT resources can only be discerned if there are sufficient IT competencies capable of mobilizing and deploying them. Additionally, IT resources are susceptible to erosion and imitation, especially in markets characterized by increased dynamism. Particularly purchasable IT resources such as IT infrastructure cannot constitute the basis of sustainable rents, simply because they can be traded in the market (Spanos & Lioukas, 2001). Hence, there is limited heterogeneity with IT resources that competitors own or can access.

As an extension of the RBV, the knowledge based view (KBV) promotes the idea that a firm's most strategically significant resource is its knowledge base. The main argument of the KBV is that unlike physical resources, knowledge-based resources are usually difficult to imitate and therefore can constitute the basis of a competitive advantage (Grant, 1996). Studies have demonstrated that human skills and knowledge, and especially managerial ones, are important components in attaining a competitive advantage (Fink, 2011). These findings are consistent with what the RBV suggests. However, the increasing institutionalization of IT service markets, enables the sourcing of such IT-related human skills and knowledge.

Therefore, even if a competitive advantage can be achieved, it is likely that it will be short-lived. Recent attempts recognize the value of the different types of IT resources; however, the emphasis has shifted on the complementarities that are developed between IT infrastructure, and IT human skills and knowledge, as well as the relational resources that enable the blending of resources (Bharadwaj, 2000; Sambamurthy et al., 2003; Chen & Tsou, 2012).

In the attempt to demonstrate the value of IT, early studies adopted the approach of examining the direct association of IT resources on organizational performance. This relied on the simplistic idea that IT provides the necessary tools for transforming inputs to outputs effectively (Orlikowski & Iacono, 2001). Such direct associations of IT resources with firm performance lack consistency in explaining how IT effectuates change (Kim et al., 2011). Additionally, the statistical power in confirming the association between IT resources and performance attenuates due to the distance between cause and effect. Some researchers argue that this type of direct relationship assumes that IT resources are always applied to their best uses, saying little about how this is done (Melville et al., 2004). As such, the main limitation of this approach is that it accepts that the attainment of a competitive advantage is built on the basis of owning an appropriate bundle of IT resources, but does not specify the underlying mechanisms by which this is accomplished (Kim et al., 2011).

The impact of IT competencies

IT capability literature recognizes that the competence of mobilizing and deploying IT-based resources is what explains the conversion of IT resources into potentially strategic assets (Sambamurthy et al., 2003; Fink, 2011). Several studies recognize the value of IT competencies and include certain dimensions in their conceptualizations. These studies provide a step forward since they not only specify the IT resources necessary to attain a desired outcome, but also describe the mechanisms of planning

and orchestrating them. It is through effective IT competencies that IT resources are tailored to a firm's strategic context in a time consuming, path-dependent, socially complex, and causally ambiguous processes (Zhu & Kraemer, 2002). Studies that explicitly distinguish between IT resources and competencies follow two different approaches in explaining IT-based value. The former follows a direct association of IT resources and IT competencies on competitive performance (Santhanam & Hartono, 2000; Bhat & Grover, 2005), while the latter uses a mediating approach in which the impact of IT resources is mediated by IT competencies (Pavlou & El Sawy, 2006; Fink & Neumann, 2009; Kim et al., 2011). Recent empirical studies favor the use of mediated models since they better capture the structural mechanisms that develop between the different levels of IT capabilities (Fink, 2011). This supports the notion that IT creates value through complex interrelationships and causally ambiguous processes that develop over time (Bharadwaj, 2000). In both cases however, there is a missing link of the synergy developed between IT and other complementary firm resources and how that translates to competitive gains.

The impact of IT-enabled capabilities

To better understand the mechanisms by which IT resources and competencies add value, arguments have been made that it is best to examine the effects of IT through a business process perspective (Melville et al., 2004; Ray et al., 2004). Proponents of this idea suggest that in certain circumstances, it may be more appropriate to explore the impact of IT resources and competencies on organizational capabilities, rather than linking them directly to firm performance. From this point of view, organizational capabilities, which can be decomposed into a series of business processes, provide a context within which it is easier to examine the locus of direct IT asset effects. The idea of examining the impact of IT investments on organizational capabilities is mainly performed in two complementary ways.

The first is by determining the effect that IT resources and competencies have on specific organizational capabilities. In this way, the organizational capabilities under examination are developed as separate constructs, and associations are drawn to determine the level to which IT resources and competencies can potentially enhance them. By opting for this approach it is assumed that a positive and significant association between IT resources and IT competencies, and organizational capabilities, means that IT creates differential value to the organizational capability. IT in this sense plays a role of magnifying and accelerating existing organizational capabilities, even when these capabilities do not directly involve IT (Kohli et al., 2008). This has been the predominant way of examining the impact of IT on competitive performance, with studies employing mediating organizational capabilities such as organizational learning (Tippins & Sohi, 2003; Real et al., 2006), market and supply chain intelligence (Bendoly et al., 2012), proactive corporate stance (Benitez-Amado & Walczuch, 2012), organizational agility (Lu & Ramamurthy, 2011; Chen et al., 2014), marketing capability (Chen, 2012), and absorptive capacity (Cepeda-Carrion et al., 2012; Liu et al., 2013) amongst others.

Despite a long tradition in IT value research of separating out IT investments and examining their interaction with other organizational resources, recent studies examine IT as the driver of organizational capabilities and not as subordinate to business strategy (Bharadwaj et al., 2013). Hence, the second view reflects the digitization of the business infrastructure and the increased embeddedness of IT in organizational capabilities (Kim et al., 2011). With IT being increasingly pervasive in organizational capabilities, it is more important to ask what IT-enabled capabilities are more useful, and then decompose them into the necessary IT resources and competencies. Desired business capabilities therefore should drive IT embeddedness (Kohli & Grover, 2008). In this view, researchers directly examine a firm's effectiveness in leveraging IT to support or enable organizational capabilities through a single construct (Ravichandran & Lertwongsatien, 2005; Rivald et al., 2006; Drnevich

& Kriauciunas, 2011; Wang et al., 2012; Jin et al., 2014; Wong et al., 2015). Following this approach, it is easier to identify the areas in which IT infusion is most valuable. Since there can be multiple paths in attaining an IT-enabled capability, the IT resources and competencies required may vary depending on context. Thus, viewing opportunities from the vantage point of IT resources and competences can restrict emergent business value from organizational capabilities enabled through IT (Kohli and Grover, 2008). By placing organizational capabilities as the driver of the model, it is possible to work backwards and study how to IT-*ize* a capability so that it can create differential value. In this way it is possible to identify the appropriate mix of IT resources and IT competencies to develop a specific IT-enabled capability in a given context.

Shifting the focus IT resources and competencies, to the potential of IT-enabled capabilities, allows us to move beyond the focal firm to an integrative view of the competitive environment. With firms being increasingly engaged in the global competitive market, and IT permeating firm boundaries, it is crucial to determine the conditions and limits to which the different types of IT-enabled capabilities can yield rents. Literature from the strategic management domain can provide the backbone to develop theorizations. A multitude of theoretical lenses exist which have been extensively employed in empirical studies and could serve to extend the existing discourse of IT capabilities research. In dynamic and rapidly changing business environments the dynamic capabilities view may be useful in understanding the IT-enabled capabilities that facilitate competitive survival. Although there have been some studies that attempt to examine the impact of IT through the dynamic capabilities lens, they are still scarce in number.

2.6 Conclusion

It seems clear from the literature that there are at least two distinct conceptualizations of IT capabilities. The first is that of IT capability as a set of resources and competencies that are necessary to proficiently deliver IT solutions. The second is IT capability as an end state. The later view examines the effectiveness in infusing or enabling organizational capabilities by means of IT. The authors see the value of both streams and consider both IT capability perspectives to be necessary. Future research that examines IT capabilities should build on appropriate theoretical foundations which are briefly discussed below. In addition, work that links these two perspectives is likely to be the most difficult but the most beneficial for the discourse of IT-base value literature.

The conceptualization of IT capabilities as an ability to deliver and manage IT solutions has been the predominant way of including the concept in IS research. This approach has seen a growing realization of the importance of IT competencies in delivering IT solutions, rather than examining the impact of IT resources in isolation *per se*. Despite this, we still know very little about how IT competencies are developed, what aspects promote their effectiveness, and how the different dimension in which they are decomposed are associated. Although researchers have made strides in distinguishing IT competencies from other concepts, and have set solid foundations in recognizing their diversified nature, their antecedents and effects could benefit from further theoretical grounding to consolidate their position in IS research. Emergent from the RBV, the competency-based perspective emphasizes the importance of managing human resource systems to facilitate the development and utilization of organizational competencies (Lado & Wilson, 1994). The increasing embeddedness of IT in the business infrastructure, requires a clear understanding of the dynamics that evolve between various stakeholders involved in the development of IT competencies. The competency-based perspective can potentially serve as the theoretical basis in explaining how individual human resources can effectively be

transformed through human management practices to unit level dynamics. This area of research could also benefit by input from bounded rationality theory to explain how the limits imposed by given conditions (information, resources, partners etc.) shape IT competencies. A predominant force influencing IT competencies are path dependencies, meaning that current and future decisions are imprinted by past decisions and their underlying patterns (Cowan & Gunby, 1996). In many cases, a path dependency can reflect increasing returns. That is, once IT competencies generate positive feedback loops they become self-reinforcing processes (Bulgerman, 2002). Therefore the patterns of factors that promote the emergence of IT competencies are likely to be determined by contextual factors, rendering a contingency theory approach as a viable solution in isolating them.

The second conceptualization, that of IT capabilities as IT-infused organizational capabilities, is an emerging one. Only recently researchers have suggested that it is more beneficial to examine IT capabilities from the vantage point of the organizational capabilities they enable. Strategic management literature has seen a bulk of research revolving around the different types and levels of organizational capabilities, their limits and strengths in facilitating competitive returns, as well as the complex synergies that characterize their associations. By clearly defining the different types of organizational capabilities, it is possible to determine their rent-yielding properties in combination with other competitive pressures (Helfat & Winter, 2011). Research in the IS domain has largely treated organizational capabilities in an *ad-hoc* manner, therefore not explicitly differentiating between operational and dynamic. The accumulated knowledge from the strategic management domain could be applied in the IS context to inform future research about what outcomes can be expected from each digitized organizational capability. Additionally, it would be interesting to investigate how digitization of organizational capabilities changes their dynamics in the face of different environmental uncertainty conditions. The outcomes of such a study would be very interesting for managers in

order to prioritize the digitization of their firms' capabilities to stay in top of competition.

Finally, one of the most complex but also most promising research areas would be towards identifying the resource and competency mix that is necessary for the development of specific IT-enabled capabilities. In their essay, Kohli and Grover (2008) suggest that researchers should work backwards by first isolating the IT-enabled capabilities that are most important for each type of firm. Then, the attention should be shifted to determine how these IT-enabled capabilities can be developed, which may likely differ from firm to firm. This suggests that there are multiple paths in effectuating IT-based change.

2.7 Summary

This chapter provided a review of the most influential empirical and conceptual publications relating to IT capabilities. The ultimate purpose was to clarify the concept of IT capabilities by decomposing it from a theoretical standpoint into distinct and comprehensible levels. The derived framework distinguishes between (1) IT resources, (2) IT competencies, and (3) IT-enabled capabilities. Each of these concepts, represents a distinct level of a firms overall IT capability. Then, by surveying how these levels have been employed in empirical studies we found that there are two predominant views of IT capabilities in IT-business value research, (a) as a set of resources and competencies that are necessary to proficiently deliver IT solutions, and (b) as an end state of infusing or enabling organizational capabilities by means of IT. We adopt the later perspective since it best reflects the objectives of the study. In particular, we emphasize on the role of IT-enabled dynamic capabilities which represents an under-researched area of IS, and can potentially explain how IT can lead to competitive advantage in uncertain and constantly changing business

environments. As such, the following chapter expands on the dynamic capabilities view of the firm as the theoretical backbone of this research.

CHAPTER 3

THE DYNAMIC CAPABILITIES VIEW

Building on the theoretical and empirical gaps identified in Chapter 2, this chapter aims at developing a theoretically grounded outline that will serve as the basis of our research model. As such, the dynamic capability view of the firm is delineated. Section 3.1, briefly advocates the use of dynamic capabilities view as a suitable theoretical perspective for contemporary IT business value research. Section 3.2 provides a thorough review of the dynamic capabilities view, including definitions and conceptualizations; while section 3.3 outlines conditions that promote their development from a modularity perspective. In section 3.4, the relationship of dynamic capabilities with competitive performance is analyzed, while in section 3.5 the impact of environmental uncertainty is discussed. The chapter concludes with an outline of the research model, which serves as the input for the development of a conceptual model in Chapter 4.

3.1 Introduction

Chapter 2 presented the main theoretical foundations upon which IT capabilities have been developed and examined in past literature. The shortcomings of building predominantly on the RBV, as aforementioned, include the inability to explain how IT produces value, and even more, how this is achieved under rapidly changing conditions (Tanriverdi et al., 2010; Merali et al., 2012). In effect, the RBV is bounded by its theoretical limits, rendering it is increasingly less relevant considering the context in which IT is examined. The main focus of IS researchers over the past decade

has been to explain how IT can help a firm develop a competitive advantage, which in effect, necessitates the inclusion of the external environment to the equation. In addition, the insufficiency of just mentioning the types of IT resources required for achieving a state of competitive edge, hints for a transition in terms of theoretical grounding. Future researchers are urged to demonstrate the mechanisms through which IT investments add value (Kohli & Grover, 2008).

In the literature review presented in chapter 2, several researchers have been noted as employing the dynamic capabilities view of the firm as a means of explaining IT-based business value (Drnevich & Kriauciunas, 2011; Oh et al., 2014). The dynamic capabilities view (DCV) essentially underscores how a firm adapts adequately to changes that can have an impact on its functioning. When applied to the IS context, the DCV is better suited in explaining how IT should be used, rather than what IT resources a firm should own or have under its control. Despite many calls urging a paradigm shift in IT business value studies (Tanriverdi et al., 2010; Merali et al., 2012), researchers have only recently began to build on the groundwork of the DCV. Yet, even in circumstances which build on the DCV, the developments and assumptions that now constitute the general consensus in strategic management are loosely followed. Therefore, the purpose of this chapter is to overview the notion of dynamic capabilities, examine the conditions that facilitate their development, and outline the mechanisms and conditions under which they contribute towards augmented competitive performance. By surveying past literature of dynamic capabilities in strategic management, the goal is to develop an outline of the research model, that will be discussed in relation to the IT context in chapter 4.

3.2 Dynamic Capabilities View of the Firm

The dynamic capabilities view of the firm has emerged as one of the most influential theoretical perspectives in the study of strategic management over the past decade (Schilke, 2014). Extending the resource based view of the firm, which posits that a firm may achieve sustained competitive advantage based on the bundles of resources and capabilities it has under its control, the dynamic capabilities view attempts to explain how a firm maintains a competitive advantage in changing environments (Priem & Butler, 2001). Originating from the Schumpeterian logic of creative destruction, dynamic capabilities enable firms to integrate, build, and reconfigure their resources and competencies in the face of changing conditions (Teece et al., 1997). Several alternative conceptualizations of dynamic capabilities have subsequently been presented. Some follow an approach closer to the resource based view which stresses the importance of strategic management (Teece & Pisano, 1994), while others approximate the logic of evolutionary economics which enunciates the role of routines, path dependencies, and organizational learning (Barreto, 2010). The definitions presented in **Table 3-1** are indicative of this variation.

Table 3-1 Main Definitions of Dynamic Capabilities

Reference	Definition
Teece & Pisano, 1994	The subset of the competences and capabilities that allow the firm to create new products and processes and respond to changing market circumstances
Teece, Pisano, & Shuen, 1997	The firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments
Eisenhardt & Martin, 2000	The firm's processes that use resources—specifically the processes to integrate, reconfigure, gain, and release resources—to match and even create market change; dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die

Teece, 2000	The ability to sense and then seize opportunities quickly and proficiently
Zollo & Winter, 2002	A dynamic capability is a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness
Winter, 2003	Those (capabilities) that operate to extend, modify, or create ordinary capabilities
Zahra, Sapienza, & Davidson, 2006	The abilities to reconfigure a firm's resources and routines in the manner envisioned and deemed appropriate by its principal decision maker(s)
Helfat et al., 2007	The capacity of an organization to purposefully create, extend, or modify its resource base
Teece, 2007	Dynamic capabilities can be disaggregated into the capacity (a) to sense and shape opportunities and threats, (b) to seize opportunities, and (c) to maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets
Wang & Pervaiz, 2007	A firm's behavioural orientation to constantly integrate, reconfigure, renew and recreate its resources and capabilities, and most importantly, upgrade and reconstruct its core capabilities in response to the changing environment to attain and sustain competitive advantage
Baretto, 2010	A dynamic capability is the firm's potential to systematically solve problems, formed by its propensity to sense opportunities and threats, to make timely and market-oriented decisions, and to change its resource base.
Pavlou & El Sawy, 2011	Those capabilities that help units extend, modify, and reconfigure their existing operational capabilities into new ones that better match the changing environment
Salunke, Weerawardena, McColl-Kenedy, 2011	The capacity of an organization to purposefully create, extend or modify its knowledge-related resources, capabilities or routines to pursue improved effectiveness
Protogerou, Caloghirou, Lioukas, 2012	Dynamic capabilities are defined as higher order capabilities that allow firms to exploit existing lower order capabilities and more importantly to identify and acquire new technological and/or marketing capabilities

Despite considerable variation in defining dynamic capabilities, a growing consensus in literature describes them as a set of identifiable and specific routines that often have been subject of extensive empirical research in their own right (Eisenhardt

& Martin, 2000). This approach seems to be gaining ground in empirical studies, since it is feasible to identify and prescribe a set of operating routines that jointly constitute firm-level dynamic capabilities (Zollo & Winter, 2002). These routines are commonly understood as learned, highly patterned, and repetitious, directed towards independent corporate actions (Winter, 2003). Hence, to better understand dynamic capabilities it is possible to focus on the set of routines that underpin them, which are also commonly referred to as capabilities.

Past studies have followed this approach by building on Teece et al.`s (1997) (reconfiguring, learning, integrating, and coordinating), and Teece`s (2007) (sensing the environment to seize opportunities and reconfigure assets) definitions of dynamic capabilities to distinguish the dimensions of which they consist (Pavlou & El Sawy, 2011; Protogerou et al., 2012; Wilden et al., 2013). Using definitions and past studies as a starting point, the next step was to reconcile the different labels and meanings of the underlying routines in order to better describe the original conceptualization of Teece et al. (1997) and our own understanding of the literature. Our ultimate purpose is to isolate the key routines that can then be empirically tested. Following the approach described above, the routines/capabilities that are identified include: (i) sensing, (ii) coordinating, (iii) learning, (iv) integrating, and (v) reconfiguring.

A sensing capability is defined as the ability to spot, interpret, and pursue opportunities in the environment. As Teece et al., (1997) note: "The ability to calibrate the requirements for change and to effectuate the necessary adjustments would appear to depend on the ability to scan the environment, to evaluate markets and competitors, and to quickly accomplish reconfiguration ahead of competition." It is perceived as imperative for firms to gather intelligence on market needs, competitor moves, and new technologies in order to proactively reposition strategic offerings (Zahra & George, 2002). The importance of a strong sensing capability can be related to the fact that it serves as the trigger to initiate response. Contrarily, the effect of an

underperforming sensing routine could result in a slow response in potential opportunities and threats (Zahra & George, 2002).

A coordinating capability is defined as the ability to orchestrate and deploy tasks and resources, and synchronize activities with involved stakeholders. By developing a strong coordination capability, firms can easily identify complementarities and synergies, reduce task redundancies, and promote effective collaboration (Helfat & Petaraf, 2003). In effect, a coordination capability is the process of creating, adapting, and re-creating organizations, and is particularly important since it regulates efforts of adaptation (Quinn & Dutton, 2005). With firm boundaries becoming ever more permeable, and structure favoring a de-centralized mode, a coordinating capability is necessary to effectively orchestrate tasks and knowledge flows internally and externally of the firm (Bendoly et al., 2012).

A learning capability is defined as the capacity to acquire, assimilate, and exploit new knowledge that enables informed decision making. Learning is argued as being a very important process, which through experimentation and repetitions leads to better and swifter problem resolution (Teece et al., 1997). Although insight and innovative ideas may occur at the individual level, when they are shared within the organizations context, they become institutionalized as organizational artifacts (Protogerou et al., 2012). Therefore, it is important to develop effective routines that promote organizational learning, since it is argued to be the principal means of attaining strategic renewal (Alegre & Chiva, 2008).

An integrating capability concerns the evaluation of firm and partner resources and capabilities, and the capacity to embed and exploit them in new or revamped operational capabilities. The capacity to integrate dispersed resources is seen as the foundation of dynamic capabilities since it consolidates a firm's revamped resource and asset base (Teece, 2007). This is because the development of a dynamic capability, facilitates the acquisition of non-tradable assets that can lead to novel value-

enhancing combinations that cannot be easily replicated in a market (Teece, 2007). An integrating capability, however, does not only pertain to the external environment, but is seen as an important routine in assembling internal knowledge and information. The lack of efficient integration routines may explain why apparently slight innovations may have a devastating impact on a firm competitive positioning (Huang & Newell, 2003).

A reconfiguration capability is defined as the capacity of firms to effectuate strategic moves. Even when well-established firms are aware of a need to change in order to cope with the shifting business environment, it is often difficult to respond effectively. A reconfiguration capability requires that change in operational capabilities is performed in a rapid manner, preventing them from becoming core rigidities (Eisenhardt & Martin, 2000).

3.3 Modularity as an antecedent of Dynamic Capabilities

Modularity is defined as a general systems concept, describing the degree to which a system's components can be separated and recombined. It refers both to the tightness of coupling between system components, as well as the degree to which it enables or prohibits the mixing and matching of components (Schilling, 2000). Modular elements can revolve autonomously without altering the overall structure of the system (Pil & Cohen, 2006). Although most attention was originally directed towards products, scholars have noted increasing modularity in many different kinds of systems. For instance, recent studies have examined the disaggregation of many large, integrated, hierarchical organizations into loosely coupled productions arrangements, such as contract manufacturing, alternative work arrangements, and strategic alliances (Schilling & Steensma, 2001). Modularity essentially increases at an exponential level

the number of possible configurations achievable from a given set of inputs, greatly increasing flexibility of a system (Schilling, 2000).

In an attempt to describe why some systems migrate towards increased modularity, as well as what aspects underlie modular systems, Schilling (2000) proposed a general theory. According to the general modular systems theory, many systems opt towards modular forms in order to enable greater flexibility in end configurations. This tendency is necessitated by frequent changes in the environment (D'Aveni & Ravenscraft, 1994). The fitness of the system refers to the degree to which the system and its context are mutually acceptable. The assumption is that many complex systems adapt or evolve in response to changes in their context. A system may adapt purposefully, as when organizations alter themselves to better seek value (Kim & Pae, 2007). When abstracting modularity to an organizational level, it pertains its importance since changing customer demands and frequent shifts in the competitive landscape challenge the development of capabilities that support a competitive advantage (Schilling & Steensma, 2001). To enable agile and timely organizational and strategic responses, scholars advocate the use of modular design principles at multiple levels (Levinthal, 1997).

Modularity in the form of systems, technologies, processes, and organizational forms can facilitate the creation and development of dynamic capabilities (Sanchez & Mahoney, 1996; Worren et al., 2002; Sinha & van de Ven, 2005; Ravishankar & Pan, 2013). Despite most attention being focused on the potential value of dynamic capabilities, and more recently, on their boundary effect; to date few research attempts have embarked on the quest of explaining how they are developed and enhanced. Most studies have either emphasized on learning mechanisms, which among others include knowledge codification and knowledge articulation (Zollo & Winter, 2002), or on managerial cognitions (Hodgkinson & Healey, 2011). However, in the seminal paper of Teece (2007) concerning the micro-foundations of dynamic capabilities, the

authors emphasizes the importance of modularity in promoting their development (Pil & Cohen, 2006).

At an organizational level, modularity improves strategic flexibility, which put differently can be described as the condition of having strategic options that emerge through the combined effects of using flexible resources (Worren et al., 2002). In other words, modular design in the form of systems, enables greater agility and makes it possible to recombine components in novel ways to provide different functions in organizational units (Shah, 2006). Modularity also enables organizations to better adapt to changing environmental conditions through patching, a strategic process by which organizations routinely remap businesses to changing market opportunities. Patching entails adding, splitting, transferring, exiting, or combining chunks of businesses (Campbell et al., 1999).

Loosely coupled components, however, are insufficient by themselves without matching structures to leverage them. Inter-temporal economies of scope in dynamic markets can benefit from an organizational form that consists of modular, decentralized organizational structure (Helfat & Eisenhardt, 2004). Teece and colleagues (1997) note that decentralized organizational structure and local autonomy help develop dynamic capabilities. Decentralization helps build dynamic capabilities, since it brings management close to new technologies, customers, and the market (Teece, 2007). In this way it enables flexibility in scanning the environment, evaluating market and competition, and quickly accomplishing reconfiguration and transformation ahead of competition (Teece & Pisano, 1994).

This notion is supported in the study of Rindova and Kotha (2001), in which analyzing the cases of Yahoo and Excite, find that dynamic capabilities are contingent on decentralized structures and local autonomy. According to their findings, organizational form is related to dynamic capabilities, and can be used as a strategic tool to support the rapid changes in strategy required to compete in dynamic

environments. The appropriate structure for developing dynamic capabilities is highly organic and responsive, which requires a series of attributes. Organizational decentralization may lead to more effective, efficient, and adaptive strategy-making, as a result of greater flexibility and responsiveness (Andersen & Nielsen, 2009).

Despite the importance of modular design and decentralized organizational forms, the combined effect and interactions between these aspects on dynamic capabilities remains underexplored. In a recent literature review on antecedents of dynamic capabilities, flexibility is noted as being a prerequisite for their development (Eriksson, 2013). In line with this rationale, we consider modular design of systems and decentralization of governance as being two prime conditions of flexibility, thus, comprising key antecedents of dynamic capabilities (Judge, 2009).

3.4 Dynamic Capabilities and Competitive Performance

Interest in dynamic capabilities stems from their potential to enhance competitive performance (Teece et al., 1997). A firm is considered to have a competitive advantage when it enjoys greater success in terms of performance indicators in relation to industry rivals (Peteraf & Barney, 2003). Consistent with theoretical suggestions, literature assumes a positive overall impact of dynamic capabilities on competitive performance (Teece & Pisano, 1994; Schilke, 2014). This suggestion has been verified by numerous empirical studies (Drnevich & Kriauciunas, 2011; Protogerou et al., 2012; Wilden et al., 2013; Lin & Wu, 2014), however, there has been considerable debate concerning the mechanisms through which dynamic capabilities act (Wilden et al., 2013).

The early developments of the dynamic capabilities view, lead to two parallel schools of thought (Teece et al., 1997 and Eisenhardt & Martin, 2000) concerning the nature of dynamic capabilities, as well as the impact and sustainability on competitive

performance (Peteraf et al., 2013). This lead to conceptual developments according to which dynamic capabilities can influence competitive performance in multiple ways; by matching the resource base with the changing business environment (Teece et al., 1997); by creating market change (Eisenhardt & Martin, 2000); by supporting both resource-picking and capability-building rent-generating mechanisms (Makadok, 2001); by improving inter-firm performance (Gudergan et al., 2012); or by supporting marketing strategies (Fang & Zou, 2009). Dynamic capabilities improve the effectiveness, speed, and efficiency of a firm's responses to external stimuli, which ultimately strengthens their competitive performance (Chmielewski & Paladino, 2007). Through a series of routines as described earlier, dynamic capabilities provide the firm with a novel series of decision options, which have the potential to increase competitive performance (Eisenhardt & Martin, 2000, Teece, 2007).

Yet, empirical work is divided between proponents of a direct association of dynamic capabilities on competitive performance, and recent work which favors an indirect effect (Baretto, 2010). Zollo and Winter (2002) assert that, in changing environmental conditions, superiority and viability will prove transient for an organization that has no dynamic capabilities. In contrast, the latest work on dynamic capabilities has favored the idea of an indirect effect (Protogerou et. al., 2012). This idea has been initiated by Eisenhardt's and Martin's (2000) argument, that dynamic capabilities are necessary, but not sufficient conditions for competitive advantage. According to this perspective, competitive performance does not rely on dynamic capabilities *per se*, but rather, on the resource configurations created by dynamic capabilities. In this sense, dynamic capabilities are perceived as strategic options that allow firms to renew their existing operational capabilities when the opportunity or need arises (Pavlou & El Sawy, 2006). Zahra et al. (2006) supported this view proposing that dynamic capabilities impact competitive performance by facilitating changes in substantive capabilities. Protegerou et al. (2012) also adopt this perspective, demonstrating that dynamic capabilities create value indirectly by

changing operational capabilities. Following this line of thinking, in the present thesis, dynamic capabilities are conceived as the capacity of a firm to purposefully adapt capabilities and deploy new ones to address changing business requirements (Teece, 2007). This definition specifies that, regardless of the ultimate effect, the impact of dynamic capabilities is primarily effectuated on a firms capabilities (Protogerou et al., 2012). Hence, the properties of dynamic capabilities can be realized indirectly, by governing the rate to which capabilities change, and are valuable to the extent that the resulting capabilities are rent-yielding.

Following the conceptual refinement, the focus of studies on dynamic capabilities has been to define and empirically validate the mechanisms and means through which competitive performance gains are realized, as well as specify the boundary conditions that confine their impact. The contributions of dynamic capabilities can occur in several ways. Particular emphasis has been attributed to their potential to increase (a) innovativeness (Eisenhardt & Martin, 2000; Verona & Ravasi, 2003; Lazonick & Prencipe, 2005; Rothaermel & Hess, 2007; Agarwal & Selen, 2009) and (b) responsiveness to match/address changing environments and improve effectiveness (Zott, 2003; Teece et al., 1997; Zollo & Winter, 2002; Ambrosini & Bowman, 2009; Drnevich & Kriaciunas, 2011).

First, dynamic capabilities can positively affect competitive performance by enabling a firm to identify and respond to opportunities, by developing new processes, products, and services (Makadok, 2010). Investing in routines that foster a firm's innovative capability is perceived as a primary source of gaining a competitive edge (Lawson & Samson, 2001). Verona and Ravasi (2003) were one of the first to empirically demonstrate the knowledge-based nature of dynamic capabilities, which facilitate the strengthening of an innovative capability. Subsequently, the potential of dynamic capabilities to confer an innovation-oriented competitive advantage has been accentuated is numerous studies (Weerawardena et al., 2007; Pavlou & El Sawy, 2011).

Second, dynamic capabilities can improve the speed, effectiveness, and efficiency with which a firm operates and responds to changes in its environment (Zahra & George, 2002; Tallon, 2008). Essentially, the routines that underlie dynamic capabilities can enable firms to respond to market changes in an agile manner, developing as such, an organizational agility (Overby et al., 2006). Firms that are flexible and can rapidly reconfigure their resource and capability base, can out-compete their competitors; hence, agility can be seen as a proxy of dynamic capabilities (Sher & Lee, 2004).

3.5 The Conditioning Impact of Environmental Uncertainty

Despite the gaining popularity of the dynamic capabilities view, criticism has been directed for its ill-defined boundary conditions (Schilke, 2014). Proponents of a contingent perspective of dynamic capabilities, posit that the value they deliver does not only depend on the routines they are comprised of, but also on the context in which they are deployed (Sirmon & Hitt, 2009). Much research emphasizes the importance of examining how the external environment influences the value of dynamic capabilities (Eisendhardt & Martin, 2000; Protogerou et al., 2012; Wilden et al., 2013). The general consensus advocates that environmental uncertainty positively moderates the relationship between dynamic capabilities and performance gains (Helfat et al., 2007). Teece and colleagues were one of the first to develop this view (Teece et al., 1997; Teece, 2007) seeing the value of dynamic capabilities as being more discernible under conditions of high environmental uncertainty.

Including aspects of the external environment is not something new in strategy research. Porter (1980) underscored the importance of the external environment in explaining differential outcomes in terms of firm performance. In defining the degree of environmental uncertainty, this research builds on Miller and Friesen's (1983)

conceptualization, and Aragon-Correa and Sharma's (2003) further refinement. According to these studies, environmental uncertainty can be featured in light of three main dimensions: dynamism, heterogeneity, and hostility. Dynamism concerns the rate and unpredictability of environmental changes and is especially challenging for managers, since it forces them to make rational decisions with limited information. Heterogeneity is the complexity and diversity of the market in terms of substitute services and products. Finally, hostility refers to the scarcity of core resources and the degree of competition in the industry.

Despite common acknowledgment that environmental uncertainty influences strategic behavior and performance, it not well understood whether, and if so how, it conditions the impact of dynamic capabilities on competitive performance (Drnevich & Kriauciunas, 2011; Wilden et al., 2013). Currently there are two competing perspectives concerning the influence that environmental uncertainty has on the relationship of dynamic capabilities with competitive performance.

The first perspective argues that there has to be a need to change in order to realize the value of dynamic capabilities (Zollo & Winter, 2002). Firms that do not face any type of competitive pressures will not be inclined to change, and thus, will not implement any alteration in their resource and capability base as a result of dynamic capabilities (Winter, 2003). This is because building and utilizing dynamic capabilities is usually costly, since their use is also associated with devising new resources, reconfiguring or altering existing ones (Schilke, 2014). Acknowledging the associated costs incurred by developing and utilizing dynamic capabilities, renders them as strategic options (Kogut & Zander, 1996). Following this line of thinking, in environments characterized by low uncertainty, dynamic capabilities can be expected to be of less importance to a firm's competitive performance.

The second perspective argues that a routine-based conceptualization of dynamic capabilities may not be a sufficient means of change (Eisenhardt & Martin,

2000; Schreyögg & Kliesch-Eberl, 2007). An important characteristic of dynamic capabilities manifested through routines is that they are path dependent, meaning that they are based on interpretations and outcomes of past actions (Vergne & Durand, 2011). Routine-based dynamic capabilities may be effective for adapting to local and incremental changes, however, this perspective advocates that experiential learning may prove problematic when unknown competitive pressures alter the basis of competitive success (Levinthal & Rerup, 2006). Under such circumstances, the patterned nature of routines may prove insufficient for radical change, and the structural inertia inherent may further inhibit the capacity to adapt (Schilke, 2014). In such circumstance several researchers argue that improvisational capabilities, rather than dynamic capabilities, may be more suitable (El Sawy et al., 2010).

The aforementioned differences in the boundaries of dynamic capabilities as well as current research conceptualizations of environmental uncertainty has led researcher to propose that we should work on a contingency perspective on dynamic capabilities, and recognize that different environmental conditions influence their potential effectiveness (Aragon-Correa & Sharma, 2003; Sirmon et al., 2007). It is suggested that rather than looking for generic formulas of effectiveness, researchers should recognize that the value of dynamic capabilities is context specific (Barreto, 2010). Therefore, in this research we examine the configurations of environmental uncertainty conditions that foster value appropriation of dynamic capabilities. Doing so, we recognize that varying levels of uncertainty, as well as different combinations of circumstances, hinder or promote their value. This quest is also propelled by the suggestions of Barreto (2010), whom emphasizes the need for more empirical studies on the impact of dynamic capabilities under diverse environmental conditions.

3.6 Summary

Chapter 3 discussed the grounding theorizations of the model to be developed in the following chapter. The backbone of this research is guided theoretically by the dynamic capabilities view of the firm, which was selected based on the shortcoming of theories that support existing IT studies. However, prior to adapting the DCV to the IT context, it is important to understand what dynamic capabilities are, how they can be conceptualized and measured, as well as delineate their antecedents, effect on competitive performance, and boundary conditions. As such, dynamic capabilities are conceptualized through the routine view proposed by Eisenhardt and Martin (2000). This view makes it possible to empirically measure a complex and multi-dimensional concept such as dynamic capabilities. Since the inception of the DCV many researchers have been engaged with proposing how they are associated with competitive performance as well as what aspects enable their formation. To understand the nature of the associations in the IT context we have overviewed antecedents through a modular systems theory perspective, and identified the mechanisms through which dynamic capabilities enhance a firm's competitive performance. Furthermore, the impact of environmental uncertainty conditions on realizing the value of dynamic capabilities is discussed. The overview of the associations as described in the dynamic capabilities literature is presented in **Figure 3-1**. This outline will be used to guide the construction of model of IT-enabled competitive performance.

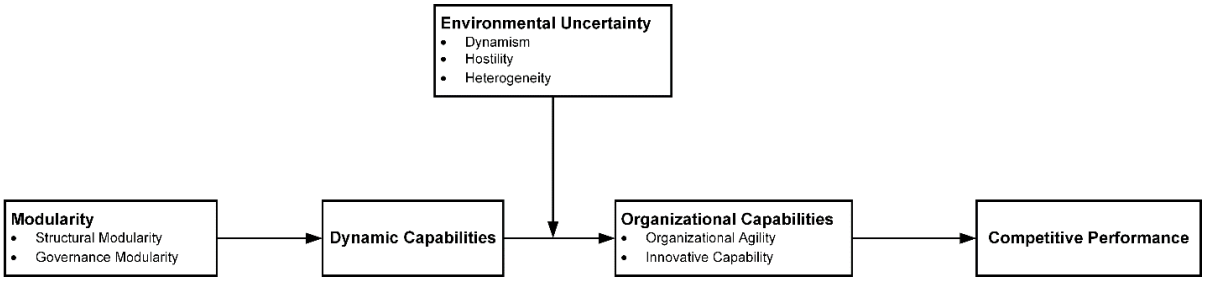


Figure 3-1 Nomological network of associations of Dynamic Capabilities

CHAPTER 4

IT-ENABLED DYNAMIC CAPABILITIES: ANTECEDENTS & IMPACT ON COMPETITIVE PERFORMANCE

Building on the empirical gaps identified in Chapter 2 and the theorizations of the dynamic capabilities view outlined in Chapter 3, this chapter aims at developing a validated construct of IT-enabled dynamic capabilities and constructing a conceptual model capable of explaining how competitive advantage can be attained. The introductory chapter, i.e. 4.1, presents the rationale of the research model, highlighting the main contributions that this thesis aims to address. Section 4.2 explains the scale development and validation process for the novel construct IT-enabled dynamic capabilities. Section 4.3 provides some examples of how organizational capabilities can be enabled or augmented by targeted use of IT, in order to clarify how the notions captured in the construct are applicable in practice. In section 4.4 the main hypotheses that underlie this study are developed, starting from the antecedents that shape IT-enabled dynamic capabilities, and then proceeding on the mechanisms through which they result in competitive performance. The impact of environmental uncertainty is also discussed, and propositions are drawn accordingly.

4.1 Introduction

The relationship between Information Technology (IT) and a firm's competitive performance is a crucial topic that has dominated information systems research over the past couple of decades (Tanriverdi, 2005; Kim et al., 2011). Many studies have

attempted to understand the role of IT in reinforcing a firm's competitive position, with a growing body of literature emphasizing on the importance of IT capabilities, including their potential to transform IT resources and IT competencies into business value (Kohli & Grover, 2008; Pavlou & El Sawy, 2010; Kim et al., 2011; Joshi et al., 2011). Extending this logic, the purpose of this research is to examine IT capabilities as dynamic capabilities, hereafter mentioned as IT-enabled dynamic capabilities, and explore the mechanisms through which they enable a firm to sustain competitive performance, as well as factors that contribute to their development.

IT-enabled dynamic capabilities are defined as a firm's ability to leverage its IT resources and IT competencies, in combination with other organizational resources and capabilities, in order to address rapidly changing business environments. The idea of developing a construct that can potentially explain the mechanisms through which IT must be leveraged in order to face fierce and constantly changing market conditions, is largely based on the shortcomings identified in the review of IT business value research presented in Chapter 2. The dynamic capabilities view of the firm is deemed as an appropriate theoretical framework to explain how firms differentiate and compete, taking into account the conditions of the external environment. In contrast with the resource based view of the firm that largely disregards the impact of the external environment, the dynamic capabilities view emphasizes on activities that range from incremental adjustments to radical reconfigurations and alterations when the situation or need arises (Ambrosini et al., 2009).

Our research therefore aims ta contributing in four main areas. First, it identifies the areas in which IT should be leveraged guided theoretically by advancements in dynamic capabilities literature. The idea of examining the value of IT in the processes it is embedded, that is IT-enabled capabilities, is also promoted in IS literature (Kohli & Grover, 2008). Second, it explores the characteristics of the related IT resources that contribute towards the development of IT-enabled dynamic capabilities. Third, it elucidates the mechanisms through which IT-enabled dynamic

capabilities ultimately lead to competitive performance gains. Fourth, adding to an emerging body of literature on the limits of dynamic capabilities, this study attempts to explore the environmental conditions that extrapolate the positive effect of IT-enabled dynamic capabilities.

4.2 Towards a Validated Construct of IT-Enabled Dynamic Capabilities

The development of a measurement instrument is formally known as construct development or scale development. According to DeVellis (2003), construct development is used to "*develop scales when we want to measure phenomena that we believe to exist because of our theoretical understanding of the world, but we cannot assess directly*". For example, age does not require a multi-item scale (and hence a construct) as it stands on a concrete and unambiguous event (one's date of birth). On the other hand, phenomena like IT-enabled dynamic capabilities are rather abstract and cannot be observed or assessed directly. Such phenomena need carefully constructed and validated scales. Despite the fact that developing and validating constructs is critical to building cumulative knowledge in information systems research, the process of scale development and validation continues to be a challenging activity (MacKenzie et al., 2011).

To develop the construct of IT-enabled dynamic capabilities, we have relied on the principles proposed by DeVellis (2003), Lewis et al. (2005), and MacKenzie et al. (2011). These are considered seminal works regarding construct development and have repeatedly been employed in various disciplines, including information systems (Byrd & Turner, 2000) and business management (Govindarajan and Kopalle 2006). According to these principles, construct development is divided into five sequential phases: (a) conceptualization, (b) development of measures, (c) model specification,

(d) scale evaluation and refinement, and (e) validation, as presented in **Figure 4-1** below. For each phase a number of steps are defined and discussed. We then proceed to report the results we have obtained through the first four phases, while the final phases, i.e. construct validation, is reported in the main study.

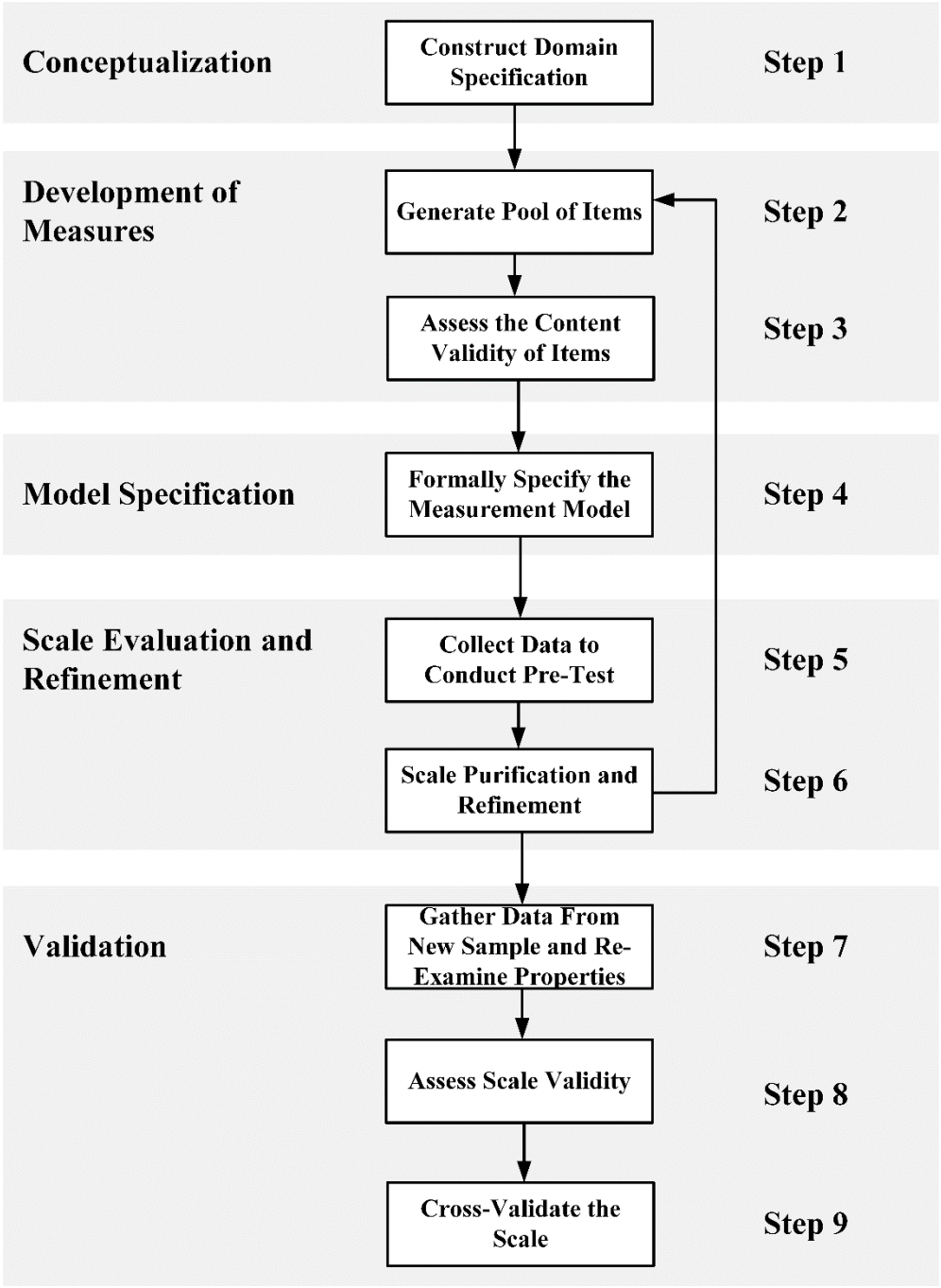


Figure 4-1 Overview of Scale Development Procedure

4.2.1. Conceptualization

According to Nunnally and Bernstein (1994), "*To the extent that a variable is abstract and latent rather than concrete and observable (such as the rating itself), it is called a "construct." Such a variable is literally something that scientists "construct" (put together from their own imaginations) and which does not exist as an observable dimension of behavior….Nearly all theories concern statements about constructs rather than about specific, observable variables because constructs are more general than specific behaviors by definition.* ". Therefore, the first step aims at establishing the domain of the new construct. This step includes the establishment of a conceptual definition of the construct, as well as the dimensions that comprise it (Lewis et al., 2005). In the introductory section we provided an operational definition of IT-enabled dynamic capabilities, while in Chapter 3 we identified the five dimensions of which the construct is comprised, namely: sensing, coordinating, learning, integrating, and reconfiguring. In addition, researchers argue that during the conceptualization phase, it is important to define the conceptual domain in which the construct applies and the entity-level at which it is measured (MacKenzie et al., 2011). Our overview of the DCV of the firm outlined the phenomena at which the general concept of dynamic capabilities refers to, thus, the notion of IT-enabled dynamic capabilities is similarly examined at the firm-level.

4.2.2. Development of Measures

The development of measures phase aims at producing a draft instrument of the new construct. The first step of this phase is to generate a pool of items that fully represent the conceptual domain of the construct, and consequently, the dimensions of which it is comprised. Past studies on scale development dictate that these items may come from a variety of sources such as literature reviews, deduction from the theoretical

definitions of the construct, previous theoretical and empirical research, suggestions from experts in the field, and examination of other existing measures of the construct/dimensions. Regardless of whether the construct is unidimensional or multidimensional, the goal is to produce a pool of items that capture the essential aspects of the domain of the focal construct. Specifically for the construct of IT-enabled dynamic capabilities we used several methods to generate the initial pool of items which include adapting existing measures from empirical studies in the domains of strategic management (Agarwal & Selen, 2009; Drnevich & Kriauciunas, 2011; Protogerou et al., 2012) and information systems (Zhang, 2005; Pavlou & El Sawy, 2006; Rai & Tang, 2010; Palvou & El Sawy, 2011; Rajaguru & Matanda, 2013), new item construction from conceptual definitions, as well as expert recommendations. The initial pool of items are presented in **Table 4-1**, in which the questions asked respondents to assess the degree to which their firm was effective in leveraging their IT investments for the following purposes.

Table 4-1 The Initial Pool of Items for the IT-Enabled Dynamic Capabilities Construct

Dimension	Items
Sensing	**S1.** Scanning the environment and identifying new business opportunities
	S2. Reviewing our product development efforts to ensure they are in line with what the customers want.
	S3. Implementing new ideas for new products and improving existing products or services.
	S4. Anticipating discontinuities arising in our business domain by developing greater reactive and proactive strength
	S5. Understanding how the competitive landscape evolves
	S6. Gathering intelligence that is important to us
Coordinating	**C1.** Providing more effective coordination among different functional activities
	C2. Providing more effective coordination with customers, business partners and distributors
	C3. Ensuring that the output of work is synchronized with the work of other functional units or business partners.

	C4. Reducing redundant tasks, or overlapping activities performed by different operational units
	C5. Synchronizing tasks and activities with functional units in dispersed geographical locations
	C6. Managing to effectively orchestrate operations in real-time
Learning	**L1.** Identifying, evaluating, and importing new information and knowledge
	L2. Transforming existing information into new knowledge
	L3. Assimilating new information and knowledge
	L4. Using accumulated information and knowledge to assist decision making
Integrating	**I1.** Easily accessing data and other valuable resources in real time from business partners
	I2. Aggregating relevant information from business partners, suppliers and customers. (e.g. operating information, business customer performance)
	I3. Collaborating in demand forecasting and planning between our firm and our business partners
	I4. Streamlining business processes with suppliers, distributors, and customers
	I5. Collecting and incorporating information that is important to us from key partners
Reconfiguring	**R1.** Adjusting for and responding to unexpected changes easily
	R2. Easily adding an eligible new partner that you want to do business with, or removing ones which you have terminated your partnership
	R3. Adjusting our business processes in response to shifts in our business priorities
	R4. Reconfiguring our business processes in order to come up with new productive assets
	R5. Adapting internal resource and competence configurations

Following the generation of a sufficient amount of items to capture each underlying dimension of the IT-enabled dynamic capabilities construct, the third step involved evaluating their content validity. According to Straub et al. (2004), content validity concerns the degree to which items in an instrument reflect the content universe to which the instrument will be generalized. Thus, two related judgments must be made when assessing content validity, (a) if the individual items are representative of an aspect of the content domain of the construct, and (b) if the items as a set are collectively representative of the entire content domain of the construct.

Although the most commonly employed validation method of content validity is judgmental and subjective, to increase the robustness of our results we performed an empirical assessment of content validity. More specifically, we used a combination of the q-sort methodology and the Content Validity Ratio (CVR) relaxed technique (Straub et al., 2004). To perform these tests a group of five academics and four executives were selected that had extensive experience in the field of IT management. At a first stage, the q-sort test was employed during which respondents were given an excel file with five columns representing the dimensions of the IT-enabled dynamic capabilities construct along with operational definitions for each, and 26 post-it`s with the various items as pooled in the previous stage. Respondents were then asked to drag and drop the post-it`s to the area (column) they believed the item best matched. From the completed excel files we then calculated the item placement ratio, which measures how many items were correctly placed in the intended category by the respondents (Moore & Benbasat, 1991). The item placement ratio was calculated by dividing the number of items correctly assigned on to their respective constructs, by the total number of items for each respondent. From the ratios computed by each respondent, an average is then computed presented in **Table 4-2**. These results indicate that items are to a large extent easily identifiable and distinguishable regarding the dimension they belong to.

Table 4-2 Item Placement Ratios

Dimension	Item Placement Ratio
Sensing	92%
Coordinating	82%
Learning	87%
Integrating	82%
Reconfiguring	85%

The second part of the content validity testing asked respondents to rate the importance they thought each item had on each dimension. To execute this test, respondents were provided with a matrix in which on the left side of the horizontal axis items were listed in random order, while at the top in the form of five columns the dimensions of IT-enabled dynamic capabilities were presented. The expert group was then asked to rate how relevant they thought each item was to the construct it was intended to measure using the scale 1 – Not relevant, 2 – Important, and 3 – Essential. The CVR was then computed using the following formula:

$$\mathrm{CVR} = \frac{\mathrm{Ne} + \frac{\mathrm{Ni}}{2} - \frac{N}{2}}{\frac{\mathrm{N}}{2}}$$

Where N_e is the number of experts indicating an item as essential, N_i is the number of experts indicating an item as important, and N representing the total number of experts. Items that have a CVR score above a threshold, which depends on the number of experts rating each item, are retained. According to Lawshe (1975), for a group of 9 experts the minimum required CVR score is 0.78. As **Table 4-3** shows, six items are rejected as having insufficient CVR values and are thus omitted, while another seven that are retained do not have absolute values of 1.00, meaning that some experts did not mark them as essential. For those items we asked for specific feedback and ways that they could be improved. In addition Content Validity Indices (CVI) were calculated for each dimension by the same formula as the CVR but at the dimension level, with overall values exceeding the set threshold. Subsequently, the items corresponding to each dimension were purified and improved for the next stage of the construct validation.

Table 4-3 Frequencies of Judgments and CVR per item

Dimension	Item	Irrelevant	Important	Essential	CVR ***(N = 9, $CVR_{thresh.}$ = 0.78)***

Sensing ***CVI_S = 0.83***	S1	0	0	9	1.00	Accepted
	S2	0	0	9	1.00	Accepted
	S3	0	1	8	0.88	Accepted
	S4	0	0	9	1.00	Accepted
	S5	1	1	7	0.66	Rejected
	S6	1	3	5	0.44	Rejected
Coordinating ***CVI_C = 0.80***	C1	0	1	8	0.88	Accepted
	C2	0	0	9	1.00	Accepted
	C3	0	0	9	1.00	Accepted
	C4	0	1	8	0.88	Accepted
	C5	2	2	5	0.33	Rejected
	C6	1	1	7	0.66	Rejected
Learning ***CVI_L = 0.97***	L1	0	0	9	1.00	Accepted
	L2	0	0	9	1.00	Accepted
	L3	0	1	8	0.88	Accepted
	L4	0	0	9	1.00	Accepted
Integrating ***CVI_I = 0.91***	I1	0	0	9	1.00	Accepted
	I2	0	0	9	1.00	Accepted
	I3	0	0	9	1.00	Accepted
	I4	0	1	8	0.88	Accepted
	I5	0	3	6	0.44	Rejected
Reconfiguring ***CVI_R = 0.86***	R1	0	1	8	0.88	Accepted
	R2	0	1	8	0.88	Accepted
	R3	0	0	9	1.00	Accepted
	R4	0	1	8	0.88	Accepted
	R5	0	3	6	0.66	Rejected

In parallel with responses of the content validity procedure, we also asked respondents on suggestions they had to improve item clarity or any further propositions they may have on including additional items.

4.2.3. Model Specification

The next step was to formally specify the measurement model that best captures the indicators, the dimensions, and the focal construct. We followed the recommendations of Jarvis et. al. (2003) and MacKenzie et. al. (2005) and specify the IT-enabled dynamic capabilities construct as a Type II second-order factor. According

to the taxonomy of Jarvis et. al. (2003), a Type II second-order factor is one that has a first-order reflective measurement model, while the second-order factor (IT-enabled dynamic capabilities) is modeled through a formative mode. Essentially, this means that each of the five dimensions are modeled through reflective indicators, since each item is a manifestation of the dimension, and dropping an indicator would not alter the conceptual domain of the dimension. Contrarily, the higher-order latent variable, i.e. IT-enabled dynamic capabilities, is measured through a formative mode, since each dimension represents a unique element of the construct, and dropping a dimension would significantly alter the conceptual domain of the construct.

4.2.4. Scale Evaluation and Refinement

The next step after the measurement model has been formally specified, includes the measurement of the properties of the scale and the evaluation of convergent, discriminant, and nomological validity. By gathering a sample of 17 Greek companies, a pre-test of the statistical properties of the IT-enabled dynamic capabilities is executed. Reliability is assessed at both the construct and item level (Hair et al., 2011). To examine internal consistency reliability, Composite Reliability (CR) values were examined, with all values exceeding the threshold of .70. At the item level, reliability was confirmed by examining item loadings to be above .70. With regard to convergent validity, each dimensions Average Variance Extracted (AVE) was assessed to validate that it exceeded the threshold of .50. Finally, to examine that discriminant validity is established, we tested square roots of AVE`s against each latent constructs cross-correlations (Fornell-Larcker criterion). In addition, at the item level, discriminant validity was confirmed by examining that item loadings had their highest values on the construct they were intended to be assigned. In **Table 4-4** depicted below, all measurement properties for the dimensions that comprise IT-enabled dynamic capabilities are presented. The outcomes of these tests demonstrate that the items

match their respective constructs (dimensions) and that they are distinct at both the item and construct level.

Table 4-4 Measurement Properties of IT-Enabled Dynamic Capabilities

Construct & Items	Items Loadings	Composite Reliability	AVE	Root AVE	Mean	Standard Deviation
Sensing		.903	.754	.868		
S1	.841				4.99	1.41
S2	.865				5.01	1.32
S3	.859				5.11	1.31
S4	.872				4.97	1.33
Coordinating		.916	.730	.854		
C1	.872				5.02	1.37
C2	.831				5.09	1.23
C3	.859				4.99	1.37
C4	.823				4.95	1.36
Learning		.958	.858	.926		
L1	.903				4.99	1.43
L2	.924				5.01	1.37
L3	.926				5.03	1.34
L4	.901				5.05	1.38
Integrating		.921	.767	.875		
I1	.845				4.92	1.42
I2	.903				4.97	1.39
I3	.874				4.73	1.35
I4	.889				4.84	1.45
Reconfiguring		.913	.744	.862		
R1	.882				4.87	1.39
R2	.843				4.92	1.45
R3	.894				4.98	1.38
R4	.911				4.74	1.37

According to MacKenzie et. al. (2011), the first step in scale purification for Type II second-order constructs is to eliminate problematic indicators of each individual first-order sub-dimension. The criteria for elimination include: (a) non-significant loadings on the sub-dimension, (b) squared completely standardized loadings that are less than .50, (c) large and significant cross-loadings of non-

hypothesized sub-dimension, and (d) large and significant measurement error covariance's with other measures. In addition, first-order sub-dimensions that have weak or non-significant relationships with the second-order construct may be candidates for elimination, since this may suggest that the sub-dimension lacks validity. However, because this could also be due to multicollinearity, it is important to calculate the Variance Inflation Factor (VIF) to examine multicollinearity among the sub-dimensions before deciding whether to eliminate any of them. Sub-dimensions with a non-significant relationship with the second-order construct and a VIF value greater than 10 are redundant and should be considered for elimination (Diamantopoulos et al., 2008). From **Table 4-5** presented below, it is evident that there are no issues concerning the sub-dimensions of IT-enabled dynamic capabilities since all have significant weights and VIF values are well below the threshold of 10. Thus, there is no need for removing any sub-dimension.

Table 4-5 Path weights of sub-dimensions on IT-enabled dynamic capabilities

Sub-dimension	Weight	VIF
Sensing	0.212***	2.736
Coordinating	0.224***	2.583
Learning	0.265***	2.688
Integrating	0.210***	2.583
Reconfiguring	0.235***	2.488

4.2.5. Validation

Since items are often added, dropped, or reworded in the scale purification process, to ensure that validity at construct and item level is established, it is advisable that a re-estimation is performed using a new data sample. This is important since the properties of the construct as analyzed in the previous steps, may be based on

idiosyncrasies of the particular data sample. Since no items were dropped during the previous phase, the validation of the construct was completed as part of the main study of this research which is detailed in the subsequent chapters. More specifically Chapter 5 describes the data collection procedure for the main study, while Chapter 6 includes the scale re-evaluation. The aforementioned stages, as well as the ones performed as part of the main study lead us to the conclusion that the IT-enabled dynamic capabilities construct is well grounded and represents a valid measure for researchers to use.

4.3 IT-Enabled Dynamic Capabilities in Practice

To introduce clarity concerning the notion of IT-enabled dynamic capabilities, this section attempts to highlight a set of specific capabilities that firms could develop or exercise with the use of IT. Building on the dimensions described in dynamic capabilities literature, we seek to illustrate how IT can enable or induce these underlying capabilities through a series of examples. There is a growing consensus that IT-enabled capabilities are more valuable in today's competitive landscape, since they facilitate the exchange and processing of real-time information (Vera & Crossan, 2005; Pavlou & El Sawy, 2006; Pavlou & El Sawy, 2010). It is critical, however, to distinguish and differentiate the notion of IT-enabled dynamic capabilities from other concepts presented in Chapter 2. First, IT-enabled dynamic capabilities are different from IT resources and IT competencies since they reflect the effective use of IT for a desired activity, and not merely their existence. Second, IT-enabled dynamic capabilities are different from IT investments or IT spending, since solely investing in IT resources and competences does not guarantee that they will be effectively used. Finally, it should be underscored that leveraging IT for certain purposes may be an enabler of more than one capabilities.

A prominent example of a firm that has managed to develop a strong IT-enabled sensing capability is the online lottery company ZEAL. By effectively leveraging its IT investments, ZEAL is able to analyze billions of transactions and customer profiles, and develop predictive models which target specific consumers by personalizing marketing messages. In this way ZEAL can better sense customer preferences and respond in a swifter manner than competitors to fulfil these demands. Another example of effectively leveraging IT to enhance sensing is that of Unilever. Unilever needed to monitor online feedback associated with the launch of its Men+Care line of products, analyzing consumer feelings about the product line as well as the ad campaign. Although the company initially used social media analytics to detect customer sentiments, the accuracy rate accounted for less than 30%. In response, Unilever launched a crowdsourcing platform that enabled human reviewers to analyze, distinguish, process multiple sources of data, and submit this information. The crowdsourced effort achieved an accuracy rate greater than 90%, enabling the statistical quality control technologies to derive more targeted customer intelligence and modify some of the products of the line accordingly. In essence, the two aforementioned examples not only demonstrate how effective IT utilization strengthens a firms sensing capability, but also describe how this information helps firms learn more about their customers and their demands; therefore promoting an IT-enabled learning capability.

Another striking example is the case of Siemens, which implemented a web-based knowledge management system, making explicit and tacit knowledge available to all employees globally. Through the web-based knowledge management system, employees from geographically dispersed locations in over 100 countries could access information in various formats (text, audio, and video), and also contribute freely to the existing body of knowledge. In order to promote employee contribution to the online platform, Siemens also used an incentive-based system through which employees received "Shares" or bonus points for contributing on their area of

expertise. By developing an IT-enabled capability of learning, Siemens also prompted online collaboration and coordination of activities, which resulted in increased revenues estimated at $122m in two years. IT-enabled coordination capabilities have also been directed in promoting collaboration amongst geographically dispersed business units in order to synchronize and reduce redundant tasks. In this direction, Dow Chemical co. has developed strong IT-enabled coordination capabilities, enabling the workforce to flexibly coordinate activities in the attainment of common organizational goals. Even though Dow scientists could search an electronic database with the currently implemented system, they had to wait from five to seven days for older documents to be located and manually retrieved from storage facilities. Collaborating with Xerox, Dow management to digitize all documents in appropriate forms, and develop a platform that allowed common use of documents, commenting, and collaboration on new products, using proprietary R&D knowledge. The company perceived increased innovativeness as a result of the IT-enabled coordination capability, and access levels immediately quadrupled and continued to rise from there.

The case of Cisco is one of the most renowned concerning the leveraging of IT for rapidly integrating resources with business partners. Cisco has managed to outsource to its business partners all manufacturing activity, 90% of subassembly work, and 55% of final assembly. This has been made possible through Cisco's virtual manufacturing system, which allows information system integration to be done seamlessly and data flows to permeate firm boundaries. Partners can easily access Cisco's resources of product development specifications, and coordinate activities with other co-producers. The virtual platform on which Cisco bases its manufacturing activities also enables rapid reconfiguration of business partners when new products need to be developed, as such, promoting an IT-enabled reconfiguration capability.

Another example of effectively leveraging IT to achieve rapid integration and reconfiguration is Black & Veatch's telecom unit. In order to accommodate diverse

processes and the need to quickly adapt to new contractual obligations and changing client requirements, Black & Veatch developed a detailed architecture approach emphasizing the guiding principles of service-oriented architecture. This move enabled Black & Veatch to reconfigure business processes in an easier manner and in accordance with client needs.

Although these examples are not exhaustive, and are highly contingent upon the industry and context of application, they illustrate how each one of the five dimensions of dynamic capabilities can be enabled or strengthened by leveraging IT. The argument put forth in this research is that the abovementioned IT-enabled capabilities present complementarities, which if harnessed effectively, can constitute the source of competitive performance gains.

4.4 A Model of IT-Enabled Dynamic Capabilities

4.4.1. IT Flexibility, Governance Decentralization and IT-Enabled Dynamic Capabilities

An organization's IT architecture refers to the arrangement through which various software applications and subsystems are interlinked (Kruchten et al., 2006). According to the definition of Byrd and Turner (2000), the degree of shareability and reusability of an IT architecture define what is known as IT flexibility. In essence, the principles that underlie the notion of IT flexibility are grounded on the ideas put forth in modular systems theory (Tiwana & Konsynski, 2010). Past studies have defined and subsequently refined technical IT infrastructure through the dimensions of modularity, standardization and transparency (Duncan, 1995; Byrd & Turner, 2000; Joachim et al., 2013; Tafti et al., 2013). Chanopas et al. (2006) extended these works and proposed another dimension, scalability, to be an important facet of IT flexibility.

Modularity refers to the degree to which it is possible to add, modify, and remove any software, hardware, or data components of the infrastructure with ease and with no major overall effect. Examples of commercialized modular IT architectures include web services, Simple Object Access Protocol (SOAP), XML, and CORBA (Papazoglou, 2003; Tiwana & Konsynski, 2010). Modularity ultimately enables the firm to decompose the IT architecture into atomic, fine-grained units of functionality, referred to as software components, modules, objects, or services, which can then be easily recombined and restructured, to quickly construct new solutions (Tafti et al., 2013).

Standardization refers to the establishment of syntax, semantics, and policies on how applications connect and interoperate with each other (Weill & Ross, 2005). For example, Web Service Description Language (WSDL) provides an XML-based interface definition language that is used for describing the functionality offered by a web service. An important evolution in terms of standardization is the adoption of open standards instead of proprietary or bilaterally established standards. Proprietary standards can lead to inflexibility in connecting or switching to new partners, whereas open standards allow for greater flexibility in establishing automated communication between firms (Zhu et al., 2006).

Transparency refers to the degree to which data and system interfaces are visible, accessible, and deployable across different functions within the firm and outside its boundaries (Tafti et al., 2013). Transparency builds on prior related work of information systems that describes digital reach (Sambamurthy et al., 2003), data transparency (Byrd & Turner, 2000), and discoverability (Erl, 2008). Technologies such as Service Oriented Architectures (SOA), strongly emphasize the importance of transparency, rendering all services developed available on a virtual computing platform, as discoverable and easily accessible regardless of geographical boundaries. This characteristic allows the service consumer to invoke a service regardless of its actual location in the network (Pautasso et al., 2008).

Scalability refers to the degree to which hardware/software can be scaled and upgraded on existing infrastructure in order to handle larger volumes of users, workload, or transaction volume (Kumar, 2004; Chanopas et al., 2006). Infrastructures that enable scalability also handle the problem of rapidly increasing complexity, when a rising number of systems need to be integrated (Papazoglou & van den Heuvel, 2007). Scalability issues can be accommodated by novel technological solutions, such as Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) (Tsai et al., 2010).

Although each individual dimension of IT flexibility may to some extent strengthen a firm's armory of digital options, it is conceivable that these dimensions in isolation may not be sufficient to drive IT-enabled dynamic capabilities. The combination of the underlying dimensions of IT flexibility enable a firm to develop the IT-enabled dynamic capabilities that are necessary to cope with changing conditions. Since the routines that underlie IT-enabled dynamic capabilities are built on digital infrastructures, modifying interconnected, customized IT application is difficult and time-consuming. Modification could incur when a firm needs to scan new sources to gain competitive intelligence, develop new partnerships with business collaborators, or alter or modify its business processes. Legacy, highly integrated, and monolithic IT architectures have been consistently reported by IS researchers as hindrances in developing capabilities targeted towards competitive response (Rai & Tang, 2010).

A flexible IT architecture can mitigate bottleneck and inertia issues related to developing or restructuring IT-enabled capabilities in multiple ways. For instance, the cost and time required for forming new partnerships or developing digital links within the firm, are considerably lower when applications are loosely coupled and less constrained by dependencies with others (Tafti et al., 2013). In addition, using open standards for information system interfaces and data, details information exchange and automates communication, thus, diminishing time-consuming iteration and overt coordination among the line functions that applications span (Tiwana &

Konsynski, 2010). Transparency promotes the processes necessary for alliance and collaborative work formation, since it exposes the mutual capabilities among partners and hence creates opportunities for joint development (Hagel & Brown, 2001). Finally, a scalable IT infrastructure allows for easier handling of large amounts of data, workload in transaction volumes, and users; thus, providing the fluidity to cope with peaks due to changing business conditions. For instance, at any given time a firm may need more or less data storage space to accommodate unstructured data, with the aim to analyze it and extract knowledge that will drive decision making, which also requires scalable processing power.

Flexible IT enables business processes to be broken down and modularized into individual activities, which can be recombined to create new business processes (Wagner et al., 2014). Specifically, IT flexibility can facilitate the development of the underlying dimensions of the IT-enabled dynamic capabilities construct in several ways. In terms of strengthening a firms IT-enabled sensing, Demirkan and Delen (2013) exemplify the value of service-oriented cloud-based decision support systems. These technologies allow the development of standardized interfaces with other systems, thus increasing the amount of information received by sources internally and externally of the firm. Being on a cloud-based infrastructure allows scalability in terms of how much data needs to be stored, as well as how much processing power is required to analyze data and provide timely business intelligence (e.g. data mining, text mining, and simulation). IT-enabled coordination capabilities are also suggested to be augmented by flexible IT architectures (Joachim et al., 2013).

Synchronizing activities and reducing task redundancy, requires the ability of identifying complementary resources and easily accessing them. Technologies such as SOA facilitate transparency of digitized services, and by means of open standards (SOAP messages) enable seamless coordination of activities. Flexible IT architecture also promote IT-enabled learning. Using open standards promotes easy coupling and decoupling with business partners, rendering the development of knowledge flows

between firms as much easier to accomplish (Sambamurthy et al., 2003). In addition, cloud-based knowledge repositories and collaborative platforms provide the necessary scalability to accommodate large amounts of information when necessary, and enable multiple users to work simultaneously on the development of new knowledge or products/services (Kim & Lee, 2006), and even crowdsourcing initiatives and on-demand workforce (Kaganer et al., 2013).

A firm's IT-enabled integration capability is also greatly enhanced by flexible IT architectures. Open standards in terms of system interoperability and data formats, combined with modular and transparent digital processes, allow firms to broaden their scope of business partners, and seamlessly integrate systems (Rai et al., 2010). Finally, in terms of the impact of flexible IT architectures on IT-enabled reconfiguration capabilities, numerous studies have argued that digitized granular business process can be reused or locally extended if business needs change or new needs arise (Yoon & Carter, 2007). As such, the louse coupling facilitated through modular IT architectures, allows greater adaptability and reconfiguration of organizational capabilities (Rai & Tang, 2010). Based on the foregoing discussion, we expect that greater IT architecture flexibility enhances IT-enabled dynamic capabilities.

H1: IT flexibility positively affects IT-enabled dynamic capabilities

A complementary facet of modularity, and an equally important antecedent of dynamic capabilities development, is governance structure. A modular organization structure is one in which decision making is intentionally decentralized among departments (Karim, 2006). In the context of IT decision making this is presented as IT governance decentralization, an aspect also presented in Byrd & Turners conceptualization of IT flexibility. IT governance decision rights are responsible in determining what objectives IT should accomplish and how this should be done. For instance, decisions pertaining to IT governance include specifications about

objectives, priorities, and performance, as well as implementations of methods, programming languages, platforms, IT standards, and policies. Centralization and decentralization represent two ends of a continuum since IT decision rights are usually shared between the corporate IT unit and the line functions units (Tiwana & Konsynski, 2010). A centralized IT governance structure therefore is present when design authority resides primarily with a central corporate IT unit, whereas a decentralized decision-making structure is present when decision authority resides primarily with business units (Boh & Yellin, 2006). Centralizing IT governance facilitates greater efficiencies of economies of scale, while decentralization provides local control and ownership of resources and better responsiveness to business unit needs (Boh & Yellin, 2006).

Although IT architecture flexibility enhances IT-enabled dynamic capabilities, the value-adding properties are amplified when it is complemented with a decentralized IT governance structure. In congruence with what is also argued by Teece (2007), business units are usually more alert of operational realities, and are therefore better positioned to recognize opportunities and problems that IT solutions can help them address (Sambamurthy & Zmud, 2000). By decentralizing IT governance, business units are empowered to initiate changes to support existing applications or deploy new ones to address emerging opportunities. For instance, a firm may need to incorporate new suppliers to introduce a new product to the market. Such an action would require that efficient coordination mechanisms are established, IT applications that support collaborative work are deployed, and repositories and structures for storing and disseminating newly acquired or co-developed knowledge are assimilated.

Despite IT governance decentralization being more efficient and effective in rapidly deploying solutions that match these needs, the absence of a flexible IT infrastructure may diminish a successful reaction. Organizational IT systems are often used by such heterogeneous user communities with diverse needs, and require

interoperability across constellations of systems spanning business units and firm boundaries (Weill and Ross, 2005). Therefore, IT governance is argued to exert positive loopbacks when decentralizations works in tandem with flexible IT architectures. A flexible IT architecture, combined with decentralized IT governance therefore allows individual line functions to deploy IT applications without been constrained by an extensive need for coordination with other line functions. Decentralizing IT governance, basically, raises organizational alertness to new opportunities at the line function level, and IT architecture flexibility lower the need for interdepartmental coordination in initiating changes in response to such opportunities (Tiwana & Konsynski, 2010).

A prominent such example is the Hong Kong-based apparel manufacturer Li & Fung. Li & Fung uses a flexible IT infrastructure (cloud-based SOA) to electronically coordinate production processes with 7.500 suppliers in 40 countries and develop new products. By decentralizing IT governance to business units, Li & Fung can easily develop new IT solutions to coordinate efforts globally, seamlessly integrate with suppliers IT systems, analyze customer feedback and identify emerging preferences, and learn from consumer feedback. As such, the flexibility offered by Li & Fung's IT architecture, combined with a decentralized IT governance scheme, allows for continuous alignment of IT with business priorities. Overall, the combined effect of alertness by decentralizing IT governance, and versatility offered by flexible IT architectures, is posited to enhance a firms IT-enabled dynamic capabilities.

H2: IT governance decentralization positively moderates the effect of IT flexibility on IT-enabled dynamic capabilities

4.4.2. Competitive Performance through Organizational Agility

In the contemporary knowledge-intensive business environment, characterized by rapid, relentless, and highly unpredictable changes, firms must be able to detect and capitalize on market shifts and avoid emerging threats with speed in order to survive (Sambamurthy et al., 2003). A firm's competitive survival in such turbulent conditions is widely considered to be a result of its ability to remain agile (Wilden et al., 2013). Organizational agility has been conceptualized as a firm-wide capability to rapidly deal with unexpected changes that arise in the business environment exploiting them as opportunities to grow and prosper (van Oosterhout et al. 2006). In a recent survey conducted by the Economist Intelligence Unit, the vast majority of executives (88%) identified organizational agility as the key to global success (Glenn, 2009). Literature recognizes two main types of organizational agility, *market capitalizing agility* and *operational adjustment agility* (Sanchez, 1995; Lu & Ramamurthy, 2011).

Market capitalizing agility is defined as an ability to rapidly improve product/service offerings in response to shifting customer needs through continuous monitoring and exploitation of changes. Market capitalizing agility is characterized by growth-orientation and entrepreneurial mind, perceiving volatile environments as fertile opportunities to enact new strategic direction and decision making (Sambamurthy et al., 2003). Operational adjustment agility, on the other hand, is primarily concerned with internal business processes and their rapid adaptation triggered by market and other stimuli. This agility emphasizes on rapidly adapting operations and on enabling a loose, but not lax, coupling with business partners in circumstances that require change. The two types of agility represent distinct, yet complementary aspects of a capacity geared towards continual readiness to change.

Correspondingly, there has been a growing research interest on how IT can promote organizational agility and ultimately lead to competitive performance (Santhanam & Hartono, 2003; Zhang, 2005; Lu & Ramamurthy, 2011; Liu et al., 2013).

Many conceptual frameworks, case studies, and anecdotal evidence have been put forth to show how firms can use IT to support organizational agility (Byrd, 2001). However, the mechanisms through which IT enhances organizational agility still remain unclear due to little empirical work (Zhang, 2005). Adopting a dynamic capabilities perspective, several researchers have argued that IT can contribute to a firm's competitive performance by serving as a platform for building dynamic capabilities (Byrd, 2001; Sambamurthy et al., 2003). From this perspective IT investments can be linked to competitive performance through their influence on organizational agility. As such, IT-enabled dynamic capabilities are argued to positively contribute to competitive performance by enhancing the two aforementioned types of agility.

First, IT-enabled sensing capabilities can help gain rich knowledge through processes of real time monitoring, pattern recognition, and strategic scenario modeling (Overby et al., 2006). This newly derived knowledge on customer purchase behavior can help managers identify new profitable market segments before competitors (Bughin et al., 2010). In addition, IT-enabled capabilities of coordination and learning, foster the efficient generation, dissemination, and responding to market intelligence, allowing a firm to introduce products that better correspond to changing customer demands while simultaneously reducing reaction time (Swafford et al., 2008). Entering new markets or modifying existing product, however, often requires opting for a different set of partners and collaborators (Daugherty et al., 2005). An IT-enabled integration capability forms the basis for acquiring, transforming, mixing, and matching objects across firms and business partners (Saraf et al., 2007). A prominent example being the electronic reservation system of American Airlines, which facilitated the exploitation of travel agent expertise (Christiaanse & Venkatraman, 2002). In effect, IT-enabled dynamic capabilities can contribute towards competitive performance, by strengthening a firms market capitalizing agility.

Nevertheless, IT-enabled dynamic capabilities are not limited to producing competitive gains solely through rapid market capitalizing actions. Fostering IT-enabled dynamic capabilities can also help increase operational efficiency, ultimately contributing towards competitive gains. IT-enabled sensing can help firms detect areas, supply chain activities, or business processes that create bottlenecks, and take corrective actions to increase efficiency (Estampe et al., 2013; LaValle & Lesser, 2013). In addition, IT-enabled integration and reconfiguration capabilities allow firms' to closely collaborate with business partners, while at the same time rapidly adapt inter-organizational relationships when the need arises (Gosain et al., 2004). When firms operate in uncertain environments, they need to be able to engage and disengage in partnerships, while maintaining a tightly coupled exchange of information with counterparts (Rai & Tang, 2010). Furthermore, firms can reduce their information asymmetries between buyers and sellers through rapid up-to-date supply of information, facilitated by the development of IT-enabled learning capabilities.

A well-known example of harnessing its IT-enabled capabilities to promote operational adjustment agility is PASSUR aerospace. PASSUR develops decision-support technologies that combine publicly available data about weather and flight schedules with proprietary data such as feeds from passive radar stations, and provides airlines with more accurate estimations of actual arrival times (McAfee et al., 2012). Through a series of IT-enabled capabilities, PASSUR offers its clients increased responsiveness, which is estimated to being worth several million dollars a year at each hub for major airlines. In addition, process-oriented activities such as procurement, production, distribution, and billing can be benefited by IT-enabled capabilities. As demonstrated by the example of Ingram Micro, a global wholesaler, developing IT-enabled capabilities of integration, reconfiguration, and coordination, allows its customers and suppliers to directly connect to its procurement and ERP systems, driving costs down, increasing order accuracy fulfillment, and promoting partnering flexibility (Sambamurthy et al., 2003). The capacity to modify operations

agilely by means of IT-enabled dynamic capabilities is regarded as a source of a competitive advantage (Ngai et al., 2011). From the above we can hypothesize that:

H3: Organizational agility mediates the effect of IT-enabled dynamic capabilities on competitive performance

4.4.3. Competitive Performance through Innovation

Developing an innovative capability is considered to be a cornerstone of success in contemporary companies, and comprises of a series of complex activities in which new knowledge is applied for commercial ends. Through an iterative process of adding, deleting, transforming or simply reinterpreting knowledge, new insights and directions emerge (Escribano et al., 2009). With the importance of external knowledge rising dramatically, companies are faced with the challenge of harnessing its potential (Cassiman & Veugelers, 2006). However, firms exposed to the same amount of knowledge might not benefit to an equal extent due to their differential ability to integrate and exploit it (Giuliani & Bell, 2005). Mere exposure to external knowledge is not sufficient to internalize it successfully, which places emphasis on the development of an absorptive capacity (Cohen & Levinthal, 1990). Many scholars recognize that absorptive capacity is not a goal in itself, but that it influences important organizational outcomes such as a company's capability to innovate (Escribano et al., 2009).

An absorptive capacity is defined as a set of organizational routines and processes by which firms acquire, assimilate, transform, and apply knowledge to commercial ends (Cohen & Levinthal, 1990). While possessing prior knowledge is an important but not sufficient condition for a firm to have an absorptive capacity, past literature clearly distinguishes between the two concepts (Lane et al., 2006). This view considers absorptive capacity as an organizational capability and not as an asset.

Zahra and George (2002) refined the perspective of absorptive capacity as an organizational capability, and distinguish between four dimensions that comprise the construct, i.e. acquisition, assimilation, transformation, and exploitation. Acquisition refers to t a firm's capability to identify and acquire externally generated knowledge that is crucial to operations (Zahra & George, 2002). Assimilation refers to the firm's routines and processes that allow it to analyze, process, interpret, and understand the information obtained from external sources (Phene & Almeida, 2008). Transformation denotes a firm's capability to develop and refine the routines that facilitate combining existing knowledge with the newly acquired and assimilated knowledge (Zahra & George, 2002). Exploitation on the other hand refers to a firm's capability to refine, extend, and leverage existing competencies or to create new ones by incorporating acquired and transformed knowledge into operations.

Firms focusing on acquisition and assimilation of new external knowledge are able to have up to date knowledge, but may be hindered in their capacity to successfully exploit it. Transformation and exploitation are the main activities for deriving new insights and consequences from the combination of existing and newly acquired knowledge and incorporating transformed knowledge into operations, but may suffer if there is insufficient renewal of the knowledge stock. Thus, heterogeneity in the levels of the dimensions that comprise absorptive capacity translates into differences in the benefits from otherwise similar external knowledge flows; both because the firm can identify more of them, and because it can harness them more efficiently (Escribano et al., 2009).

Despite the growing interest in absorptive capacity, most studies have focused on the competitive benefits that the capability can deliver, largely disregarding the antecedents that shape it. In their seminal work, Cohen and Levinthal (1990) emphasize the importance of understanding the organizational mechanisms that shape an absorptive capacity. Since then, there have been several empirical studies that consider the impact of organizational antecedents on the different dimensions of

absorptive capacity (Jansen et al., 2005). The idea of examining differential effects of antecedents on absorptive capacity, not only allows for a clarification of how absorptive capacity is developed, but also reveals why difficulties are perceived in managing the different dimensions successfully (Jansen et al., 2005).

Investments in IT are argued to expand computational and communication abilities, thus amplifying the limits of rationality and subsequently the limits of absorptive capacity (Roberts et al., 2012). With organizational boundaries being increasingly more permeable, and employee tasks increasingly divided, it is critical to create, transfer, and integrate heterogeneous knowledge across boundaries to continue learning and encourage interactions in groups and networks (Kogut & Zander, 1992). IT-enabled dynamic capabilities can improve absorptive capacity by enhancing knowledge reach and richness (Sambamurthy et al., 2003; Kumar, 2004). More specifically, developing IT-enabled dynamic capabilities enables the firm to communicate and exchange knowledge with partners, and more precisely capture shifting customer demands, thereby expanding knowledge reach (Ray et al., 2005). Furthermore, IT-enabled dynamic capabilities facilitate the deployment of the required processes that help break down organizational silos, promoting as such the transfer and recombination of knowledge across functional units (Fosfuri & Tribo, 2008; Liu et al., 2013). The underlying processes that comprise IT-enabled dynamic capabilities also help identify customer needs, untapped profitable market segments, and the product requirements of these consumers so that targeted efforts for innovation can be initiated (Newey & Zahra, 2009). Moreover, IT-enabled coordination capabilities ensure that a firm can effectively orchestrate the exchange of explicit knowledge in the form of text and data, and also provide the means to transfer tacit knowledge through picture, video, audio, and synchronous collaborative applications, thus enhancing knowledge richness (Sambamurthy et al., 2003). Apart from promoting active knowledge sharing, a firm with strong IT-enabled dynamic capabilities will be in place to promote real-time collaboration, aimed at

transforming and exploiting newly acquired knowledge (Nambisan, 2009). Investing in IT-enabling dynamic capabilities to foster boundary-spanning activity between departments and external environments and horizontal communication among departments, is crucial in eliciting learning and problem solving, which ultimately leads to innovation and competitive performance (Cohen & Levinthal, 1990). As such, strong IT-enabled dynamic capabilities foster the development of a boundary-spanning capability, by which firms can broaden their scope of collecting and making sense of internal and external knowledge sources. Hence, we hypothesize that:

H4**:** *IT-enabled dynamic capabilities positively affect absorptive capacity*

Many scholars argue that the ability to acquire, assimilate, transform, and exploit available knowledge sources is a critical component of innovative capabilities (Cohen & Levinthal, 1990; Liao et al., 2007). As discussed earlier, receptiveness to external knowledge coupled with the ability to transform and exploit this knowledge constitutes the basis of developing an innovative capability (Kostopoulos et al., 2011). Firms that consistently invest on assimilating and exploiting new external knowledge are more likely to capitalize on changing environmental conditions by generating innovative products are services (Chen & Huang, 2009; Lichtenthaler, 2009). In a similar vein, Nonaka and Takeuchi (1995) argued that via the exchange and combination of newly acquired with existing knowledge, novel concepts convert into innovation outcomes. According to this line of thinking, absorptive capacity has an impact on the speed, frequency, and magnitude of a firm's innovative capability (Zahra & George, 2002). By developing a strong absorptive capacity, firms are able to achieve first mover advantages, quick responsiveness to customers, and avoid lock-out effects and competency traps (Zahra & George, 2002). Thus, we hypothesize that:

H5: A*bsorptive capacity positively affect a firm's innovative capability*

Firms develop the capability to innovate to cope with external competitive pressures, changing customer demands, and the constant requirement for new and

better products and services (Jansen et al., 2006). By effectively exploiting their capability to innovate, firms aim to address shifting market requirements, and ultimately maintain and improve their competitive positioning (Weerawardena, 2003). As grounded by different theories and observed in past empirical studies, innovation is what distinguishes more successful from less successful enterprises (Cassiman & Veugelers, 2006; García-Morales et al., 2012). Because knowledge of the innovation is not available to competitors, profit margins are protected, enabling competitive gains (Guan & Ma, 2003). Ultimately, organizations that develop a strong innovative capability will achieve a better response to the environment due to their ability of capturing customer demands, and thus, be more capable of consolidating a competitive edge by strengthening their place in the market (Camisón & Villar-López, 2014). In addition, firms that foster a strong innovative capability may realize competitive gains by increasing their customer base in segments of high financial margins, through the introduction of radical innovations (Bayus et al., 2003). Thus, we hypothesize that:

H6**:** *A firm's innovative capability positively affects competitive performance*

In effect, this study ultimately argues that a firm's absorptive capacity and innovative capability mediate the relationship between IT-enabled dynamic capabilities and competitive performance. The dimensions that comprise IT-enabled dynamic capabilities, facilitate the development of new mental models and practices. These changes promote the strengthening of an innovative capability, which, in turn, serve as the basis for competitive performance gains. These actions denote a series of progression, since merely the transformation and exploitation of knowledge, without the effective introduction and commercialization of products and services, cannot lead to any substantial competitive performance gains for the firm.

The conceptual model devised, as presented in the aforementioned hypotheses is depicted in **Figure 4-2**.

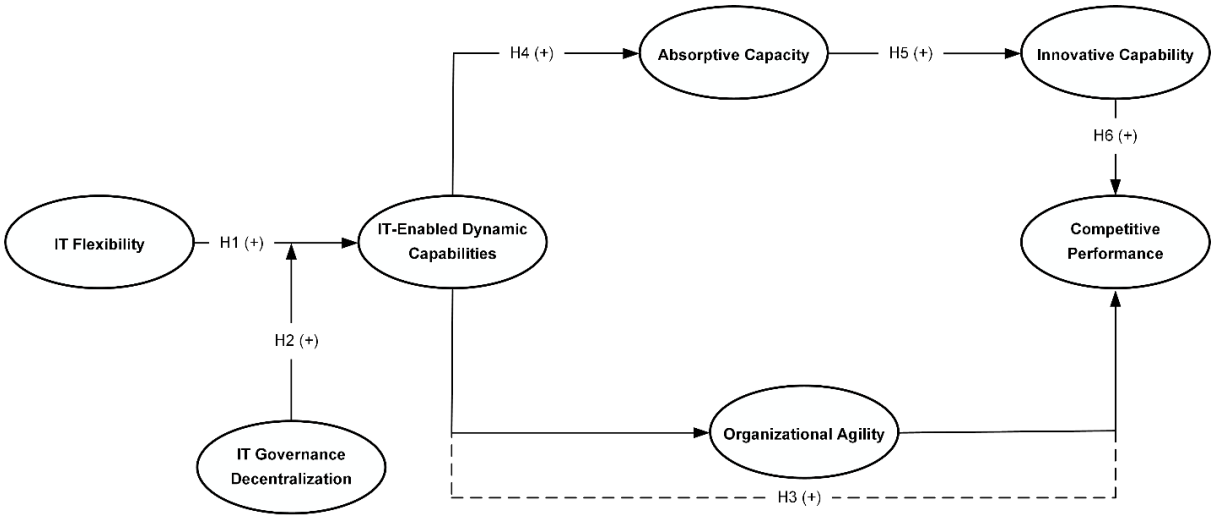


Figure 4-2 Conceptual Model

4.4.4. The Conditioning Effect of Environmental Uncertainty

Our previous hypotheses assume that IT-enabled dynamic capabilities can effectuate competitive performance gains by increasing organizational agility and by strengthening a firm's absorptive capacity. Many authors however, stress that most observable relationships are not 100% linear, and thus, correlation coefficients cannot accurately capture them (Woodside, 2013; Skarmeas et al., 2014). Consequently, the presumption that a firm which fosters the development of IT-enabled dynamic capabilities will automatically realize continuous improvements in terms of organizational agility and absorptive capacity is inherently limited in perspective. Cases that run counter to a main effect nearly always occur and are worth investigating. It has been suggested that the existence of such asymmetrical conditions should be explored through a contrarian case analysis (Woodside, 2014). Possible contrarian cases may hint that strengthening IT-enabled dynamic capabilities may not always result in improved organizational agility and absorptive capacity and *vice versa*.

As discussed in Chapter 3, the conditioning impact of environmental factors may well be the cause of these asymmetries in the case of IT-enabled dynamic capabilities. The equivocal findings in empirical studies concerning the moderating effect of environmental uncertainty could hint to what Barreto (2010) proposes; i.e., that the value of dynamic capabilities is context specific. One of the main limitations of empirical studies in this respect, is that they fail to examine the synergies of different environmental conditions on the impact of dynamic capabilities (Ambrosini & Bowman, 2009). What we know to date is that a certain level of environmental uncertainty is required to recognize their value. Therefore, it is pertinent to argue that different combination of environmental factors will augment the impact of IT-enabled dynamic capabilities, and that under certain circumstances, desired outcomes may even be achieved at an absence of IT-enabled dynamic capabilities. Based on the above we formulate the following propositions:

> *Proposition 1. The value of IT-enabled dynamic capabilities on improving organizational agility is contingent upon configurations of factors of the external environment.*

> *Proposition 2. The value of IT-enabled dynamic capabilities on enhancing absorptive capacity is contingent upon configurations of factors of the external environment.*

4.5 Summary

Chapter 4 discussed the assumptions and relationships that underpin the development of the conceptual model to be tested as part of this research. At a first stage however, the construct of IT-enabled dynamic capabilities was developed and validated. Prior to the present research, no other empirical studies have embarked on the quest of developing a construct in accordance to the definitions of the dynamic capabilities view of the firm in an IT context. In this sense, our devised construct

represents a novel concept that can be applied in IT-business value research. Extending on the backbone of associations as defined by the dynamic capabilities view of the firm, we then proceed to construct a conceptual model for the IT context. The models relationships, including antecedents of IT-enabled dynamic capabilities, mechanisms of action, as well as boundary conditions and limitations, are built on latest developments of the dynamic capabilities view. The need to provide a model of higher-order IT-enabled competitive advantage is largely propelled by contemporary suggestions of IS literature which emphasize on the importance of explaining how firms evolve and prosper in turbulent and highly dynamic environments. The hypothesized conceptual model presents the core capabilities that should be strengthened through targeted IT use, as well as the mechanisms by which they enable a firm to strengthen its competitive positioning. Both direct as well as indirect effects are specified through the formulation of six hypotheses and two propositions. Chapter 5 discusses the design of the empirical study that was conducted to test the propositions and hypotheses of the research model. In Chapter 6, these models are put to test, with results of the statistical analyses presented.

CHAPTER 5

RESEARCH DESIGN AND DATA

This chapter describes the research design employed to empirically actualize the objectives of Chapter 4. Section 5.1 outlines the data requirements, the unit of analysis which this research opts to focus on, as well as the maturity of the environment in terms of IT adoption. Section 5.2 describes the data collection process, while section 5.3 delineates the constructs along with their measurement items. Finally, Section 5.4 provides a brief analysis of the sample gathered, accompanied with some descriptive statistics of firm and respondent profiles.

5.1 Data Requirements

To address the questions relating to IT-enabled competitive advantage, as defined in Chapter 3, this research focuses on companies that invest in IT in order to support or enact their operations. Specifically, our research is focused on companies that compete in global, rather than local markets, characterized by moderate to high environmental uncertainty. In effect, the companies that constitute ideal candidates for the study are those that recognize the changing business landscape, and utilize the functionality of their IT systems in order to survive and even strive, as opportunities or threats arise. During the establishment of the database of companies and respondents to participate in this research, these criteria were used in order to decide if a firm should be included or omitted.

5.1.1. Unit of Analysis

The unit of analysis adopted in the present research in the firm. Rather than focusing on a specific business unit, we chose to examine IT-enabled competitive advantage at the firm level for several reasons. First, the rationale we adopt in this study is that IT, embedded in dynamic capabilities, can impact firm-level competitive performance. In this sense, the effect of IT is not isolated within the boundaries of a specific business unit, but rather permeates functional units. Hence, the competitive value of IT is better realized by high-level executives, capable of having an overview of the firm as a whole. Second, by restricting the focus to a specific business unit, the full impact of IT investments may not be wholly understood. For example, investments in IT may prove to be ineffective for promoting innovation in a R&D department, but could enable other departments to rapidly adapt their operations, allowing them to respond faster than competition to changes in the environment. Since the types of agile responses may vary, it may be the case that specific business units may realize agility improvements while other do not. For instance, a product production unit may realize no effect as a result of IT- enabled dynamic capabilities, while the marketing department could gain better customer insight and reposition advertising campaigns appropriately.

However, we must clarify what we mean when referring to the firm as the unit of analysis. Since terms such as firm, enterprise, business, and company are often used interchangeably, we define the firm as a legally incorporated entity with the purpose of conducting business. By focusing on the firm level of analysis, it is easier to apprehend the impact of IT-enabled dynamic capabilities. The main methodological advantage of this unit of analysis is the availability of well-understood and widely-utilized analytical tools, such as indicators of competitive performance, and firm-wide capabilities. In addition, the theoretical standpoint employed in this research, i.e. dynamic capabilities view of the firm, places particular emphasis on viewing

phenomena and their cause-effect at the firm level, rather than on a business unit or individual level.

5.1.2. Characteristics of Information Technology Adoption Population

The focus of the study is not restricted to any particular type of IT investment, but rather, emphasizes on capabilities that are strengthened or enabled by means of IT regardless of their type (e.g. Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), or Decision Support Systems (DSS)). Especially with the maturing status of cloud computing, and the increasing use of Software-as-a-Service (SaaS), the once distinct types of Information Systems are becoming ever more blurred. However, finding and selecting firms that employ IT in at least some part of their operations is a necessity for this study. The non-IT-driven firm therefore is out of the scope of this research.

Based on statistics from multiple sources on firm level IT adoption, it can be asserted that the time is more appropriate than ever to conduct such an empirical investigation. According to the latest survey on information and communication technologies (ICT) in enterprises[1], just 3% of firms did not have internet access, with 66% equipping their staff with portable computers, smart phones, and other mobile devices. The past five years have also seen a large number of firms engaging in the cloud computing paradigm. From the statistics in the EU area compiled by Eurostat, it is clearly visible that cloud computing is gaining momentum, with an EU average of 19% of firms being adopters. Finland, Italy, Sweden, and Denmark are leading in adoption, with over 35% of firms already having adopted cloud computing services as presented in **Table 5-1**.

[1] http://ec.europa.eu/eurostat/web/information-society/data/main-tables

Table 5-1 Cloud Computing Services in Firms 2014 (EU area)

	Use of cloud computing	E-mail	Storage of files	Hosting the enterprise's database(s)	Office software	Financial or accounting software applications	CRM software applications	Computing power for enterprise's own software
	(% of enterprises)	(% of enterprises using the cloud)						
EU-28	19	66	53	39	34	31	21	17
Belgium	21	52	62	45	31	33	26	23
Bulgaria	8	74	50	53	58	50	24	16
Czech Republic	15	79	41	34	38	35	18	20
Denmark	38	63	70	55	42	49	34	34
Germany	11	46	56	33	21	25	18	20
Estonia	15	58	41	18	41	47	17	7
Ireland	28	57	74	37	36	25	23	17
Greece	8	67	50	36	31	32	25	26
Spain	14	61	69	54	28	21	24	25
France	12	62	61	49	32	26	23	14
Croatia	22	85	49	46	52	50	13	26
Italy	40	86	32	28	41	33	14	8
Cyprus	10	68	70	26	39	23	29	16
Latvia	6	58	58	55	42	47	19	26
Lithuania	13	70	50	47	34	45	33	38
Luxembourg	13	46	61	41	32	19	18	14
Hungary	8	64	46	33	43	35	25	20
Malta	17	60	57	44	31	17	19	19
Netherlands	28	55	63	64	40	52	37	18
Austria	12	51	54	31	33	23	23	16
Poland	6	69	54	41	31	27	22	19
Portugal	13	78	49	31	36	31	18	30
Romania	5	76	36	37	37	33	0	19
Slovenia	15	67	44	39	35	33	20	29
Slovakia	19	84	34	31	46	54	13	22
Finland	51	66	54	38	39	39	29	13
Sweden	39	55	65	43	32	37	26	25
United Kingdom	24	51	71	44	29	25	24	22
Iceland	43	69	74	73	45	62	25	26
Norway	29	63	66	54	41	41	33	31
FYR of Macedonia	12	74	48	47	57	63	27	31

Source: Eurostat (online data code: isoc_cicce_use)

However, the increase of cloud computing services adoption is not solely indicative of a new trend. The embeddedness of IT in various industries, and specifically cloud computing services, is clearly illustrated in **Chart 5-1** below. Particularly, in terms of information and communication, administrative and support service activities, and wholesale and retail trade, firms have become highly dependent on the affordances enabled through cloud computing. Even in activities that predominantly do not rely upon IT such as manufacturing and construction, the dependence (medium-level) on cloud computing solutions is indicated at over 50%. One of the primary reasons firms are employing more IT solutions in their operations, and are particularly oriented towards cloud computing, is the fact that costs are dramatically decreased. With cloud solutions firms no longer have to acquire expensive infrastructure and specialized

staff to maintain seamless operations. The reduction in cost and complexity has enabled more firms to incorporate IT solutions as part of their operations.

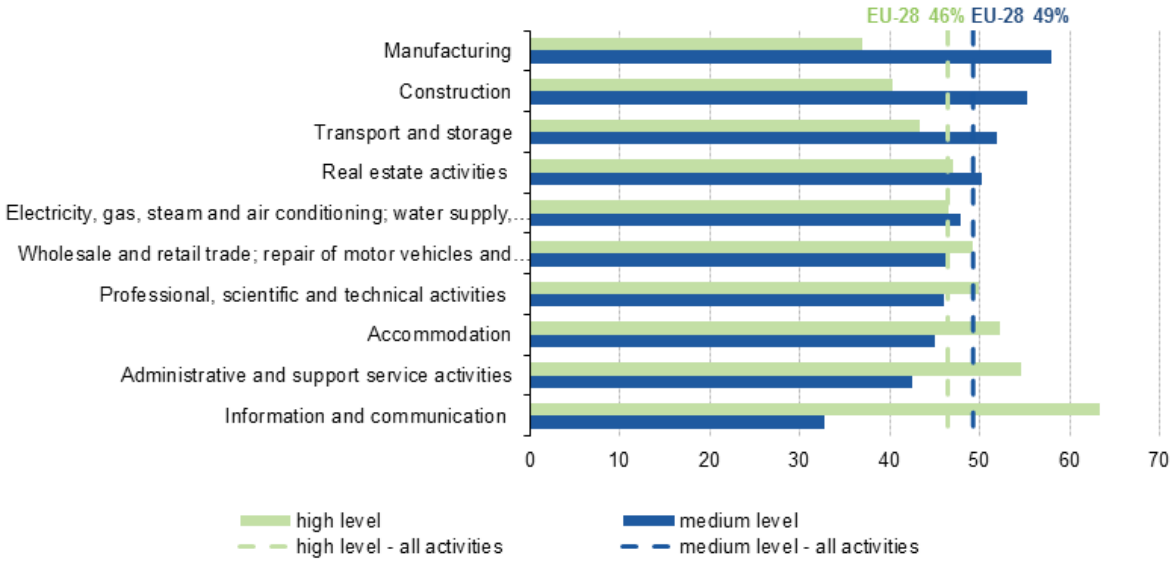


Chart 5-1 Degree of Dependence on Cloud Computing (EU area 2014); Source: Eurostat

Notwithstanding the rapid growth of cloud computing, firms are also engaging in other forms of IT solutions and platforms to enact their operations. For instance, there is a growing population of firms that use social media for corporate purposes as presented in **Chart 5-2** and grouped by firm size. Extending on the activities over social media, a growing proportion of companies are also employing big data intelligence and analytics tools to make sense of the large volume of information present on social media platforms[2]. The underlying realization, is that firms, are now more than ever leveraging the full spectrum of available IT solutions in order to gain a competitive edge. Whether it be for sensing, coordinating, learning, integrating, or reconfiguring activities, IT solutions are been utilized in an increasing amount of areas.

[2] http://www.forbes.com/sites/gilpress/2013/09/12/surveys-find-rising-adoption-of-big-data/

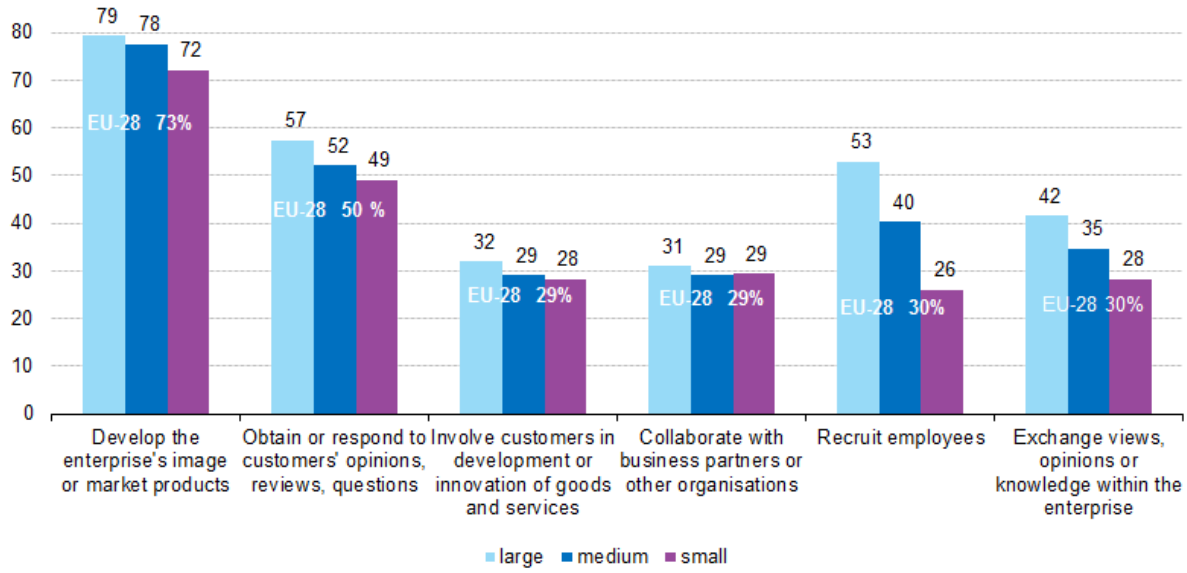


Chart 5-2 Firms using Social Media, by Purpose of Use (EU area 2014); Source: Eurostat

5.2 Data Collection

A survey was developed and administered to key informants within firms to collect data and measure the constructs in the research model. Since high level executives are the typical employees that are aware of technical and business aspects contained in the survey, they were the main target respondents. Amongst others, key informants included Chief Information Officers (CIO), IT managers, Chief Technology Officers (CTO), enterprise architects, and Chief Executive Officers (CEO).

As part of the main study, a population of 1300 firms was randomly selected from the ICAP business directory, comprising of firms from almost all sectors. From each of these firms, one senior executive (e.g. chief information officer, chief technology officer, and chief operations officer) was selected as the key informant. The process of finding contact details of key respondents for each of these companies was done in multiple ways. Personal contacts were sought after, directories were

searched, professional social media platforms were used, and clusters of companies were contacted. Once contact details had been gathered the survey instrument was sent out to key respondents. To assure a collective response, the instructions asked executives to consult other members of their firm for information they were not highly knowledgeable about. The duration of the data gathering process was approximately four months (January 2015 – May 2015). A total of 291 firms accepted to participate in the study providing 274 usable questionnaires, yielding a valid response rate of 21.07% which is consistent with comparable studies using key informant methodology (Capron & Mitchell, 2009).

Since non-response bias is a common problem in large scale survey studies, actions were taken both during the data collection to ensure a representative response rate, as well as after its completion to validate the absence of bias. To provide an incentive for participating in the study, during the data collection phase, respondents were promised personalized reports benchmarking their firms' performance in various functional areas to industry averages (Sax et al., 2003). Following the initial invitation to participate in the survey, three email reminders were sent out with a three week interval between them.

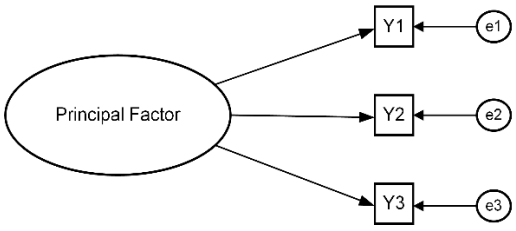
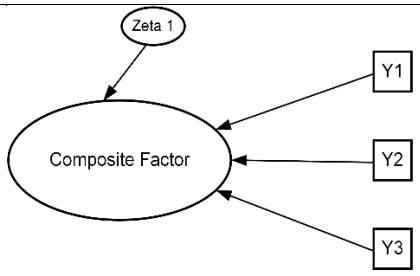
After the completion of the data collection phase, early and late responses were compared to confirm that respondents did not differ significantly in their answers. Two groups of responses were selected, those that replied within the first three weeks, and those that answered within the final three weeks. For each construct used in the study, t-test comparisons were performed between group means, with results indicating no significant differences amongst them. In addition, no significant differences were identified between responding and non-responding firms with regard to their age, size, and ownerships type (private or public). Given that all data were perceptual and collected from a single source at one point in time, common method bias was controlled in accordance with suggestions of Chang et al. (2010). E*x-ante*, respondents were assured that data collected would remain anonymous and

would be analyzed for research purposes solely at an aggregate level. *Ex-post*, Harman's one factor test was used, indicating that one construct did not account for the majority of variance. To perform Harman's one factor test, we loaded all item on to one construct in an Exploratory Factor Analysis (EFA) and examined if the un-rotated solution accounted for the majority of variance.

5.3 Construct Definition and Measurement

Since a large number of notions used in this research are unobservable, latent variables were employed which use multiple indicators to measure constructs. In nearly all cases, latent variables are measured using reflective (effect) indicators (Diamantopoulos & Siguaw, 2006). Thus, indicators are seen as functions of the latent variable, whereby changes in the latent variable are reflected in changes in the observable indicators. However, in many cases indicators could be viewed as causing rather than being caused by the latent variable. In such circumstances, the indicators are known as formative (causal), denoting that changes in the indicators determine changes in the value of the latent variable.

Figure 5-1 illustrates the differences between the two measurement models (reflective and formative) (Jarvis et al., 2003).

Principal Factor (Reflective) Model	**Composite Latent Variable (Formative) Model**
	

• Direction of causality is from construct to measure • Measures expected to be correlated (Measures should possess internal consistency reliability) • Dropping an indicator from the measurement model does not alter the meaning of the construct • Takes measurement error into account at the item level	• Direction of causality is from measure to construct • No reason to expect the measures are correlated (Internal consistency is not implied) • Dropping an indicator from the measurement model may alter the meaning of the construct • Takes measurement error into account at the construct level

Figure 5-1 Differences between reflective and formative indicators

Although these specifications are pertinent to what are referred to as first-order latent constructs, in many cases conceptual definitions of constructs are specified at a more abstract level, which may include multiple formative and/or reflective first-order dimensions. In effect, to deal with the complexity of these notions it is advisable to consider them as second-order latent constructs. According to Jarvis et al (2003), second-order latent constructs can be categorized into four main types (Types I-IV) as depicted in **Figure 5-2**. The use of second-order latent constructs is widely used in both strategic management and information systems literature (Tiwana & Konsynski, 2010; Protogerou et al., 2012; Liu et al., 2013).

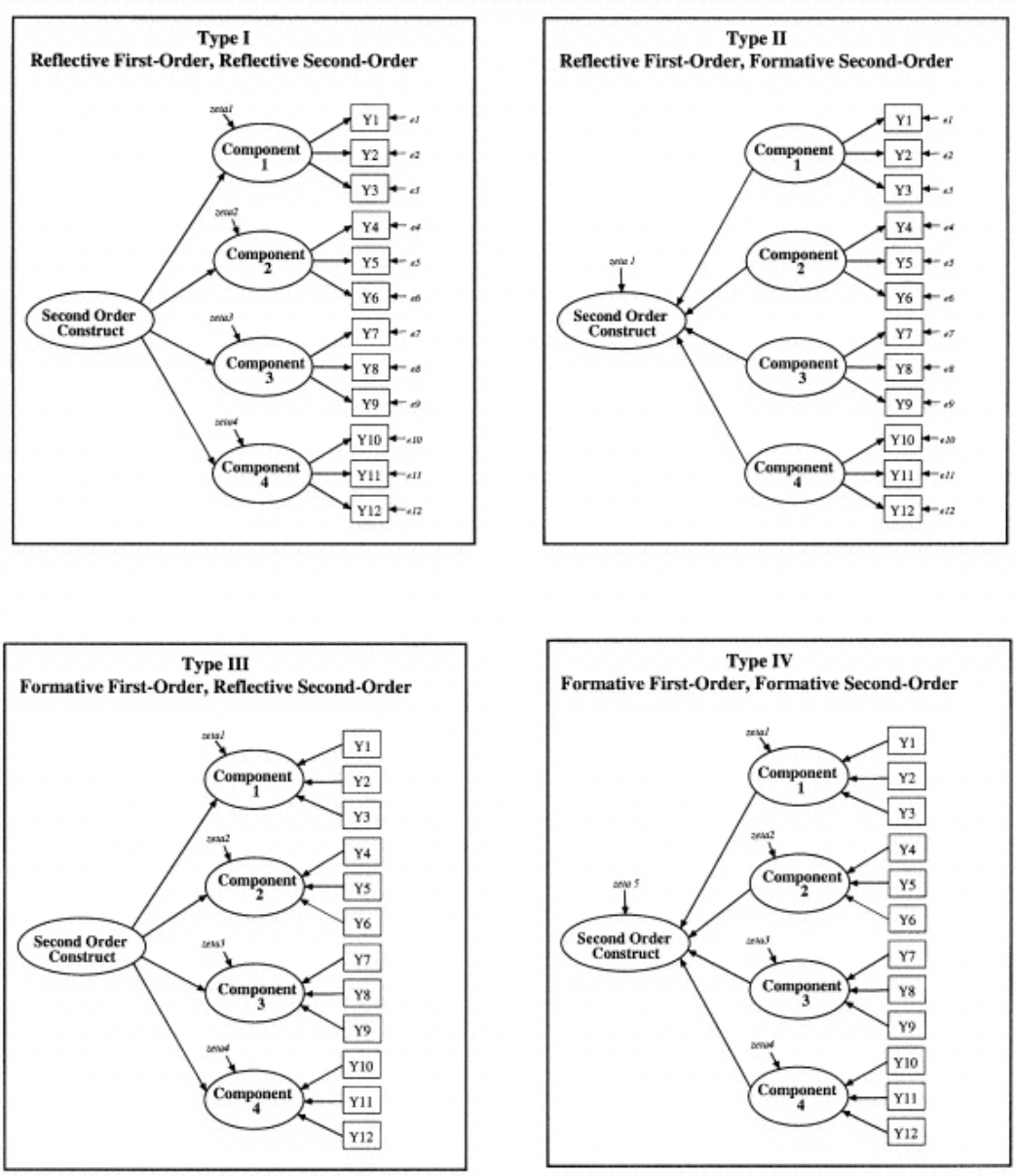


Figure 5-2 Alternative second-order factor specifications (Jarvis et al. 2003)

Both reflective and formative latent variables, as well as second-order factors have been used in studies of strategic management (Protogerou et al. 2012), and more specifically in IT business values research (Pavlou & El Sawy, 2010; Chen et al., 2014). Construct definitions and measurement methods used to develop them are described

below. In addition, empirical studies from which items were adapted/selected from are presented.

Firm Size

Firm size is operationalized as an observable categorical variable which captures the size-class of a firm in terms of its active full-time employees. The scale development has been based on the European Commission's (2003/361/EC) index for micro (0-9 employees), small (10-49 employees), medium (50-249 employees), and large firms (more than 250 employees).

IT Flexibility

IT flexibility is defined as the degree of decomposition of an organizations IT portfolio into loosely coupled subsystems that communicate through standardized interfaces. IT flexibility is developed as type II second order construct, with first-order dimensions being, *modularity*, *standardization*, *transparency*, and *scalability*. *Modularity* refers to the degree to which it is possible to add, modify, and remove any software, hardware, or data components of the infrastructure with ease and with no major overall effect (Byrd & Turner, 2000). *Standardization* concerns the level to which open standards are employed on syntax, and semantics of data and systems (Tiwana & Konsynski, 2010). Transparency refers to the degree to which data and system interfaces are visible, accessible, and deployable across different functions within the firm and outside its boundaries (Tafti et al., 2013). Finally, scalability deals with the degree to which hardware/software can be scaled and upgraded on existing infrastructure in order to handle larger volumes of users, workload or transaction volume (Joachim et al., 2013). Items are presented in **Table 5-2** below.

Table 5-2 Dimensions and Items of IT Flexibility

Dimensions and Items	Item Code
Modularity (6 Items)	
To what extent do you agree with the following statements? (1 – totally disagree 7 – totally agree)	
1. Our information systems are highly modular.	IT_MOD1
2. The manner in which the components of our information systems are organized and integrated allows for rapid changes.	IT_MOD2
3. Functionality can be quickly added to critical applications based on end-user requests.	IT_MOD3
4. Exchanging or modifying single components does not affect our IT infrastructure.	IT_MOD4
5. Organizational IT infrastructure and applications are developed on the basis of minimal unnecessary interdependencies.	IT_MOD5
6. Organizational IT infrastructure and applications are loosely coupled.	IT_MOD6
Standardization (5 Items)	
To what extent do you agree with the following statements? (1 – totally disagree 7 – totally agree)	
1. We have established corporate rules and standards for hardware and operating systems to ensure platform compatibility.	IT_STAND1
2. We have identified and standardized data to be shared across systems and business units.	IT_STAND2
3. Our systems are developed based on specifications that enable electronic links to external parties.	IT_STAND3
4. Organizational IT infrastructure are developed based on compliance guidelines.	IT_STAND4
5. Organizational IT applications are developed based on compliance guidelines.	IT_STAND5

Transparency (5 Items)	
To what extent do you agree with the following statements? (1 – totally disagree 7 – totally agree)	
1. Remote users can seamlessly access centralized data and processes.	IT_TRANS1
2. Our user interfaces provides transparent access to all platforms and applications.	IT_TRANS2
3. Software applications can be easily transported and used across multiple platforms.	IT_TRANS3
4. Data of one system can be easily used in other systems.	IT_TRANS4
5. Our firm offers multiple interfaces or entry points (e.g., web access) to external users.	IT_TRANS5
Scalability (4 Items)	
To what extent do you agree with the following statements? (1 – totally disagree 7 – totally agree)	
1. Our IT infrastructure easily compensates peaks in transaction volumes.	IT_SCAL1
2. Our information systems are scalable.	IT_SCAL2
3. Our IT infrastructure offers sufficient capacity in order to fulfill additional orders.	IT_SCAL3
4. The performance of our IT infrastructure completely fulfills our business needs regardless of usage magnitude.	IT_SCAL4

IT Governance

IT governance is defined as the distribution of IT decision-making rights and responsibilities among enterprise stakeholders, and the procedures and mechanisms for making and monitoring strategic decisions regarding IT (Boh & Yellin, 2007). The construct is based on a continuum between centralization of IT decision rights and decentralization. A centralized IT governance structure is present when design authority resides primarily with a central corporate IT unit, whereas a decentralized

decision-making structure is present when decision authority resides primarily with business units. The construct is developed as a reflective first-order latent variable comprising of three items as presented in **Table 5-3** below.

Table 5-3 IT Governance Items

Items	Item Code
IT Governance (3 Items)	
What is the extent of centralization regarding decision making for the following IT services in your company? (1 - Centralized in corporate IT group 5 – Decentralized in lines of business)	
1. Infrastructure planning and management.	IT_GOV1
2. Application development, project prioritization and approval.	IT_GOV2
3. IT development and implementation.	IT_GOV3

IT-Enabled Dynamic Capabilities

IT-enabled dynamic capabilities were measured as a Type II second order construct (reflective first-order, formative second-order), comprised of five first order constructs. The proposed formative model is consistent with Diamantopoulos and Winklhofer`s (2001) guidelines. Thus, first-order constructs are theoretical distinct and contribute a unique component to the second-order construct. The dimensions that comprise IT-enabled dynamic capabilities are adapted measures of: (1) sensing, (2) coordinating, (3) learning, (4) integrating, and (5) reconfiguring routines as described in Chapter 3 (Pavlou & El Sawy, 2011; Protogerou et al., 2012). Since the construct of IT-enabled dynamic capabilities is a novel one, developed specifically for the purposes of this study, past empirical literature was referenced in order to create adapted measures. Literature from the areas of strategic management, information systems, and organizational science literature were used to formulate adapted items

as presented in **Table 5-4** (Pavlou & El Sawy, 2006; Rai et al., 2006; Saraf et al., 2007; Pavlou & El Sawy, 2011; Protogerou et al., 2012; Liu & Ravichandran, 2015;).

Table 5-4 Dimensions and Items of IT-Enabled Dynamic Capabilities

Dimensions and Items	Item Code
Sensing (4 Items)	
Please indicate how effective your company is in using IT systems for the following purposes: (1-Not effective at all, 7-Highly effective)	
1. Scanning the environment and identifying new business opportunities.	ITDC_SNS1
2. Reviewing our product development efforts to ensure they are in line with what the customers want.	ITDC_SNS2
3. Implementing ideas for new products and improving existing products or services.	ITDC_SNS3
4. Anticipating discontinuities arising in our business domain by developing greater reactive and proactive strength.	ITDC_SNS4
Coordinating (4 Items)	
Please indicate how effective your company is in using IT systems for the following purposes: (1-Not effective at all, 7-Highly effective)	
1. Providing more effective coordination among different functional activities	ITDC_CRD1
2. Providing more effective coordination with customers, business partners and distributors	ITDC_CRD2
3. Ensuring that the output of work is synchronized with the work of other functional units or business partners	ITDC_CRD3
4. Reducing redundant tasks, or overlapping activities performed by different operational units	ITDC_CRD4
Learning (4 Items)	
Please indicate how effective your company is in using IT systems for the following purposes: (1-Not effective at all, 7-Highly effective)	

1. Identifying, evaluating, and importing new information and knowledge	ITDC_LRN1
2. Transforming existing information into new knowledge	ITDC_LRN2
3. Assimilating new information and knowledge	ITDC_LRN3
4. Using accumulated information and knowledge to assist decision making	ITDC_LRN4
Integrating (4 Items)	
Please indicate how effective your company is in using IT systems for the following purposes: (1-Not effective at all, 7-Highly effective)	
1. Easily accessing data and other valuable resources in real time from business partners	ITDC_INT1
2. Aggregating relevant information from business partners, suppliers and customers. (e.g. operating information, business customer performance)	ITDC_INT2
3. Collaborating in demand forecasting and planning between our firm and our business partners	ITDC_INT3
4. Streamlining business processes with suppliers, distributors, and customers	ITDC_INT4
Reconfiguring (4 Items)	
Please indicate how effective your company is in using IT systems for the following purposes: (1-Not effective at all, 7-Highly effective)	
1. Adjusting for and responding to unexpected changes easily	ITDC_REC1
2. Easily adding an eligible new partner that you want to do business with, or removing ones which you have terminated your partnership	ITDC_REC2
3. Adjusting our business processes in response to shifts in our business priorities	ITDC_REC3
4. Reconfiguring our business processes in order to come up with new productive assets	ITDC_REC4

Environmental Uncertainty

The degree of environmental uncertainty was assessed through three constructs, *dynamism*, *heterogeneity*, and *hostility* (Newkirk & Lederer, 2006). Dynamism is defined as the rate and unpredictability of environmental change. Heterogeneity reflects the complexity and diversity of external factors, such as the variety of customer buying habits and the nature of competition. Hostility is defined as the availability of key resources and the level of competition in the external environment. Each of these constructs is developed as a reflective first-order latent variable with the items assigned to each presented in **Table 5-5**.

Table 5-5 Dimensions and Items of Environmental Uncertainty

Dimensions and Items	**Item Code**
Dynamism (4 Items)	
With respect to the uncertainty of your environment, please indicate how much you agree or disagree with the following statements: (1 – totally disagree 7 – totally agree)	
1. Products and services in our industry become obsolete very quickly	ENV_DYN1
2. The product/services technologies in our industry change very quickly	ENV_DYN2
3. We can predict what our competitors are going to do next (R)	ENV_DYN3
4. We can predict when our products/services demand changes (R)	ENV_DYN4
Heterogeneity (3 Items)	
With respect to the uncertainty of your environment, please indicate how much you agree or disagree with the following statements: (1 – totally disagree 7 – totally agree)	
In our industry, there is considerable diversity in:	
1. Customer buying habits	ENV_HET1
2. Nature of competition	ENV_HET2
3. Product lines	ENV_HET3

Hostility (5 Items)	
With respect to the uncertainty of your environment, please indicate how much you agree or disagree with the following statements: (1 – totally disagree 7 – totally agree)	
The survival of this organization is currently threatened by:	
1. Scarce supply of labor	ENV_HOS1
2. Scarce supply of materials	ENV_HOS2
3. Tough price competition	ENV_HOS3
4. Tough competition in product/service quality	ENV_HOS4
5. Tough competition in product/service differentiation	ENV_HOS5

Organizational Agility

Organizational agility is measured as a Type II second-order construct comprising of two dimensions, *market capitalizing agility*, and *operational adjustment agility*. Each dimension (first-order construct) is developed as a reflective latent variable comprising of three items (Lu & Ramamurthy, 2011). Market capitalizing agility is defined as the firm's ability to quickly respond and capitalize on market changes by improving products and services to address customer needs. Operational adjustment agility is defined as the firm's ability to rapidly restructure its internal business processes in response to market or demand changes. The items that comprise each of the two constructs are presented in **Table 5-10Table 5-6**.

Table 5-6 Dimensions and Items of Organizational Agility

Dimensions and Items	**Item Code**
Market Capitalizing Agility (3 Items)	
Relative to your competitors, please indicate how well your organizations performs or is positioned to perform in the following activities (1 – totally disagree 7 – totally agree)	

1. We are quick to make and implement appropriate decisions in the face of market/customer-changes	AGI_MCA1
2. We constantly look for ways to reinvent/reengineer our organization to better serve our market place	AGI_MCA2
3. We treat market-related changes and apparent chaos as opportunities to capitalize quickly	AGI_MCA3
Operational Adjustment Agility (3 Items)	
Relative to your competitors, please indicate how well your organizations performs or is positioned to perform in the following activities (1 – totally disagree 7 – totally agree)	
1. We can quickly scale up or scale down our production/service levels to support fluctuations in demand from the market	AGI_OAA1
2. Whenever there is a disruption in supply from our suppliers we can quickly make necessary alternative arrangements and internal adjustments	AGI_OAA2
3. We fulfill demands for rapid-response, special requests of our customers whenever such demands arise; our customers have confidence in our ability	AGI_OAA3

Absorptive Capacity

Absorptive capacity was developed as a Type II second-order construct comprised of four first-order latent variables. The first-order dimensions included acquisition, assimilation, transformation, and exploitation as defined in Chapter 4 (Zahra & George, 2002). The four first-order constructs were measured through 12 indicators, with three indicators assigned to each as presented in **Table 5-7** (Jansen et al., 2005; Liu et al., 2012).

Table 5-7 Dimensions and Items of Absorptive Capacity

Dimensions and Items	Item Code
Acquisition (3 Items)	
To what extent do you agree with the following statements? (1 – totally disagree 7 – totally agree)	
1. We are successful in learning new things	ABS_ACQ1
2. We are effective in developing new knowledge or insights that have the potential to influence product/service development	ABS_ACQ2
3. We are able to identify and acquire internal (e.g., within the firm) and external (e.g., market) knowledge	ABS_ACQ3
Assimilation (3 Items)	
To what extent do you agree with the following statements? (1 – totally disagree 7 – totally agree)	
1. We have effective routines to identify, value, and import new information and knowledge from channel partners	ABS_ASM1
2. We have adequate routines to analyze the information and knowledge obtained	ABS_ASM2
3. We have adequate routines to assimilate new information and knowledge	ABS_ASM3
Transformation (3 Items)	
To what extent do you agree with the following statements? (1 – totally disagree 7 – totally agree)	
1. We can successfully integrate our existing knowledge with the new information and knowledge acquired	ABS_TRA1
2. We are effective in transforming existing information into new knowledge	ABS_TRA2
3. We can successfully grasp the opportunities for our firm from new external knowledge	ABS_TRA3
Exploitation (3 Items)	
To what extent do you agree with the following statements? (1 – totally disagree 7 – totally agree)	

1. We can successfully exploit the new integrated information and knowledge into concrete applications	ABS_EXP1
2. We are effective in utilizing knowledge into new products	ABS_EXP2
3. We constantly consider better ways to exploit knowledge	ABS_EXP3

Innovative Capability

Innovative capability was measured as a Type II second-order formative construct, consisting of two first-order constructs, incremental innovative capability and radical innovative capability. Incremental innovative capability was measured with three indicators assessing an organizations capability to reinforce and extend its existing expertise and product/service lines. Likewise, radical innovative capability was assessed through three indicators that asked respondents to evaluate their organizations ability to make current product/service lines obsolete (Subramaniam & Youndt, 2005). The items that operationalize dimensions of the construct are presented in **Table 5-8**.

Table 5-8 Dimensions and Items of Innovative Capability

Dimensions and Items	**Item Code**
Incremental (3 Items)	
How would you rate your organizations capability to generate the following types of innovations in the products/services you introduce (1 – much weaker than competition 7 – much stronger than competition)	
1. Innovations that reinforce your prevailing product/service lines	INN_INC1
2. Innovations that reinforce your existing expertise in prevailing products/services	INN_INC2
3. Innovations that reinforce how you currently compete	INN_INC3
Radical (3 Items)	

How would you rate your organizations capability to generate the following types of innovations in the products/services you introduce (1 – much weaker than competition 7 – much stronger than competition)	
1. Innovations that make your prevailing product/service lines obsolete	INN_RAD1
2. Innovations that fundamentally change your prevailing products/services	INN_RAD2
3. Innovations that make your existing expertise in prevailing products/services obsolete	INN_RAD3

Competitive Performance

Competitive performance refers to the degree to which a firm performs better than its key competitors (Rai & Tang, 2010). Specifically, respondents were asked to evaluate on a 7 point likert scale (1 – much weaker than competition, 7 – much stronger than competition) the relative performance of their firm in a number of key performance indicators (Rai & Tang, 2010; Li & Zhou, 2010; Liu et al., 2013). Following the argument that competitive advantage can be measured by subjective data, this study operationalized the construct as a formative latent variable comprising of 10 indicators as illustrated in **Table 5-9** (Spanos & Lioukas, 2001).

Table 5-9 Items of Competitive Performance

Items	Item Code
Competitive Performance (3 Items)	
We perform much better than our main competitors in: (1 – totally disagree 7 – totally agree)	
1. Return on investment (ROI)	CP1
2. Profits as percentage of sales	CP2
3. Decreasing product or service delivery cycle time	CP3

4. Rapid response to market demand	CP4
5. Rapid confirmation of customer orders	CP5
6. Increasing customer satisfaction	CP6
7. In profit growth rates	CP7
8. In reducing operating costs	CP8
9. Providing better product and service quality	CP9
10. Increasing our market share	CP10

5.4 Data Description

This section presents a summary of the information of participating companies and a brief description of the respondents that completed the survey. The findings from the statistical analyses as well as the theoretical and managerial implications that arise, will be discussed under the limitations and contingencies present in the demographics of the survey.

5.4.1. Key Respondent Profiles

The positions held by respondents that participated in the survey are presented in **Table 5-10**. The majority of respondents occupy high level executive positions, rendering them knowledgeable about aspects pertaining to strategy and technology investments. When administering the survey, particular emphasis was given on the profile of respondents that should partake in the study. The main criteria included: (a) being centrally involved in decision making concerning IT operations, and (b) having deep knowledge of the company's strategy, current operations, and future directions.

Table 5-10 Respondent Position

Position	No. of Responses
Chief Information Officer (CIO)	68
Chief Technology Officer (CTO)	56
IT Manager	45
Chief Executive Officer (CEO)	32
Enterprise Architect	24
Business Analyst	13
Chief Operations Officer (COO)	9
Director of IT	8
IT Consultant	8
Business Manager	6
Project Leader	5
Total Responses	**274**

5.4.2. Firm Profiles

The categorization of companies was done using the European Commission's scale, which distinguishes between micro (0-9 employees), small (10-49 employees), medium (50-249 employees), and large (250+ employees). From participating companies the largest proportion belonged to large size class (39%) as presented in **Chart 5-3**, which is justified from the selection criteria established in the previous section. The second largest group were small firms (25%), followed by medium (20%), and finally micro firms (16%). The cumulative percentage of Small-Medium Enterprises (SMEs) as defined by the European Commission (micro, small, and medium), accounted for 61% of the sample. The number of responses from each size-class can be considered sufficient to have a representative sample from each.

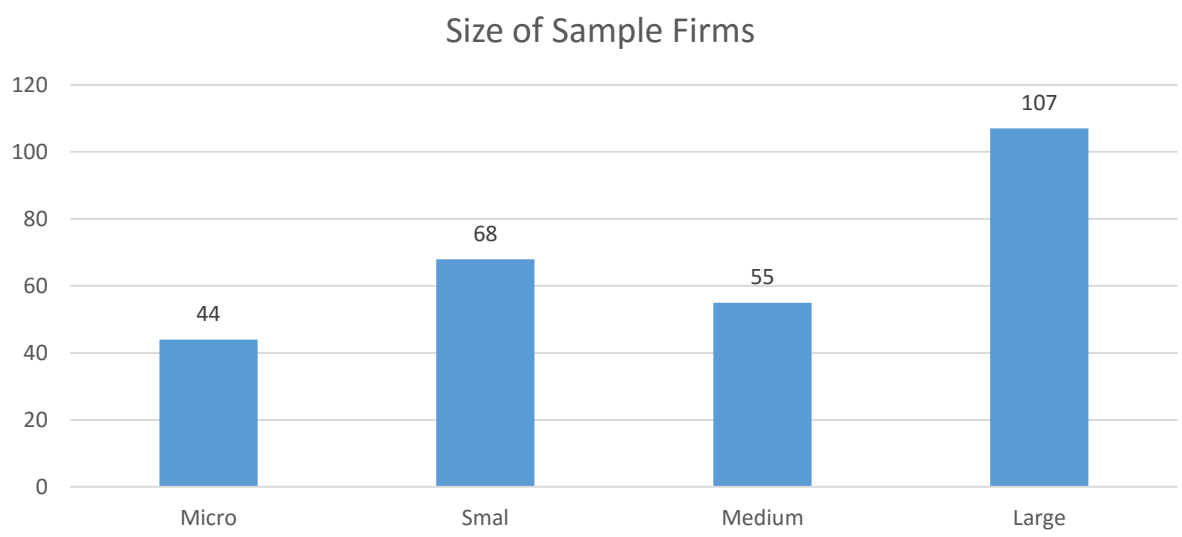


Chart 5-3 No. of Firms by Size-class

Regarding the industry in which main operations are targeted, **Chart 5-4** presents in ascending order the frequency of responses of the sample. The two most highly represented industries include consulting services (25%) and high-tech companies (25%). Following in responses are the industries of financials (13%) consumer goods (9%), telecommunications (6%), industrials (6%), and consumer services (5%). The least represented industries on the other hand are education (1%), transportation (1%), and oil & gas (1%). Therefore, in our sample we have captured industries characterized by global competition and moderately to highly uncertain operating conditions. These industries are identified as highly competitive, dominated by many large players, and subject to unforeseen changes due to regulations and global market changes.

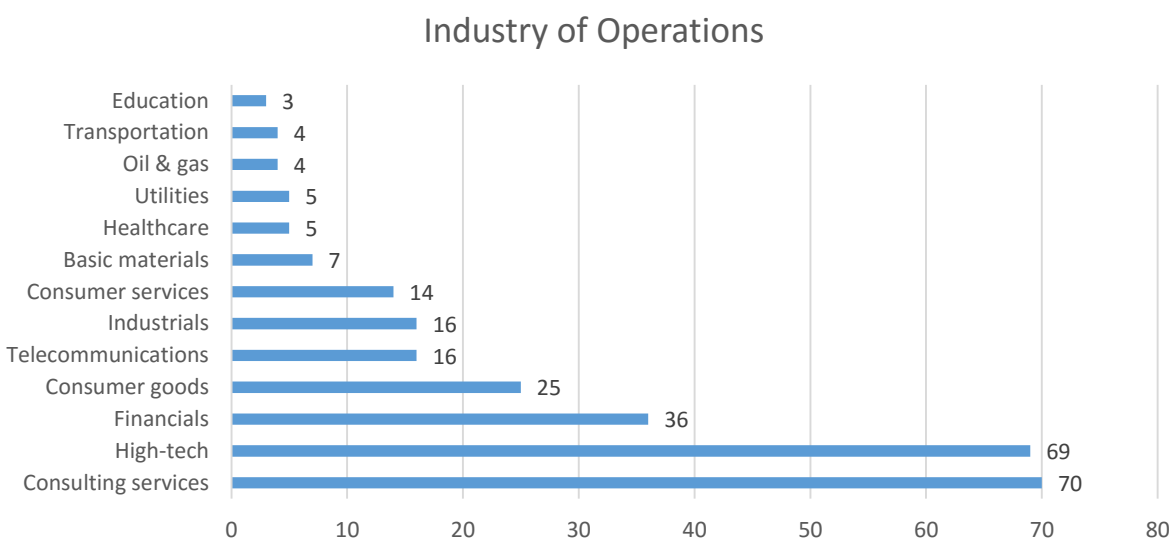


Chart 5-4 Industry distribution of the sample

In **Chart 5-5** presented below, the year of operations of firms in the sample are depicted. The vast majority are well established companies, with the class of over 50 years having the largest proportion of responses (41%), and the second largest being companies that have been in business for 10 to 50 years (35%). Our sample also includes newly established companies which can be considered as start-ups. The diversity of companies in terms of the years they have been doing business is interesting, since it is expected that well established firms will have solid mechanisms to cope with changes in the business environment, whereas start-ups and newly founded companies will rely on their innovative products/services to infiltrate the market.

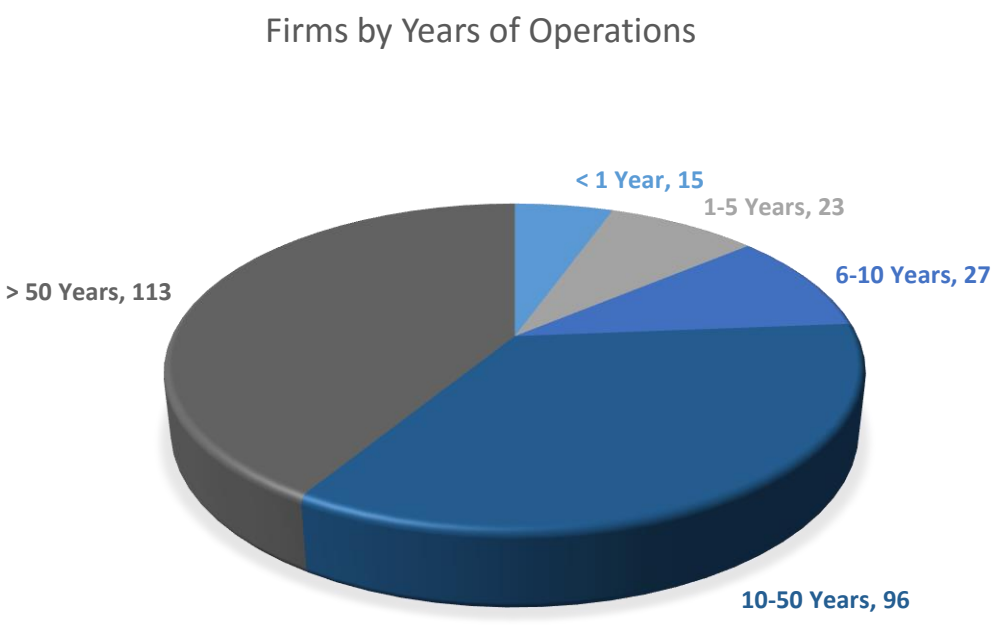


Chart 5-5 Distribution of Firms by Years of Operations

In terms of geographical location, since many companies are compete on a global scale, respondents were asked to indicate the country in which they are based. By opting for multiple sources of company and respondent contact information, our sample includes firms located in a range of countries. More specifically, in **Chart 5-6** it is distinguishable that the largest proportion of responses were received by companies and respondents located in Greece (24%). Next in sequence are highly advanced economies such as the United States of America (14%), the Netherlands (9%), the United Kingdom (8%), and Germany (7%). Although responses may be gathered by companies operating in one country, their headquarters are possibly located in another, as is the case with many multinational companies. The geographical diversity of responses is something that was aimed for in order to have a greater breadth of environmental conditions in which firms operate. For instance, Greece is subject to very frequent changes in regulations, a declining trust of investors, and fierce market competition due to a rapidly shrinking GDP. The United States of

America on the hand, have more stable economic regulations, but are characterized by relentless competition and new companies entering the market in a growing rate. Another example is Ireland, which serves as the headquarters for many multi-national companies due to low taxation. Competition from companies' within Ireland cannot be considered a threat to multinational companies, which are mostly concerned with global competition, and emerging economies such as India, Brazil, and Mexico. As such our sample contains companies from different geographical locations which can be grouped into Greek (24%), other European (51%), and outside Europe (25%).

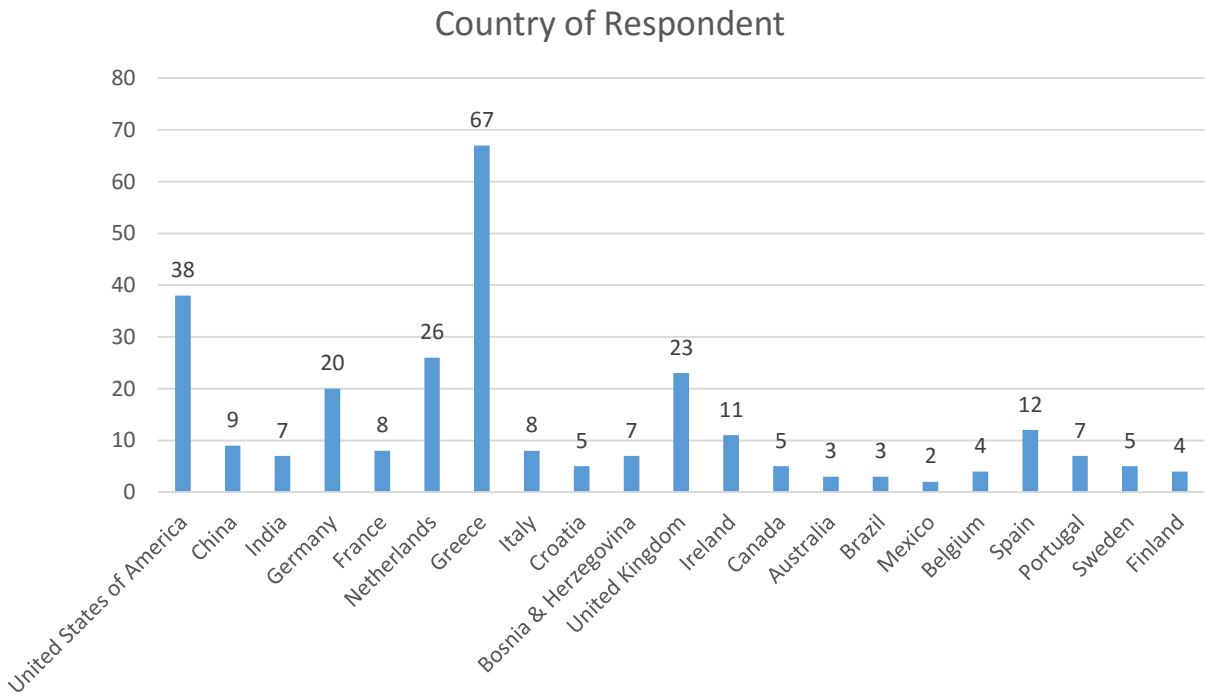


Chart 5-6 Frequency of Responses by Country of Origin

5.4.3. Environment Assessment

The final set of descriptive statistics concerns respondents' perceptions regarding the environment in which their firm operates. The very basis on which this research is directed is to understand how firms can gain a competitive advantage by leveraging

their IT investments in conditions characterized by frequent and unforeseen discontinuities. The features that characterize such uncertain environments include the dynamism, hostility, and heterogeneity of the environment. As aforementioned, the survey administered to respondents included items that sought to quantify their perceptions of these conditions.

In **Chart 5-7** responses are categorized in into low, medium, and high environmental uncertainty as perceived by key informants. These scales were developed by clustering each dimension of environmental uncertainty into three clusters. As is evident from the chart, most firms face medium to high uncertainty, with heterogeneity being the most frequently reported issue. Second is dynamism with 126 respondents indicating that their firm operates in highly dynamic conditions. The least fierce dimension according to respondents seems to be hostility, with 101 respondents positioning their firm in a highly hostile environment. These descriptive statistics indicate that our sample is appropriate for examining the impact of IT-enabled dynamic capabilities on competitive performance since in it are companies that operate in moderate to highly uncertain conditions.

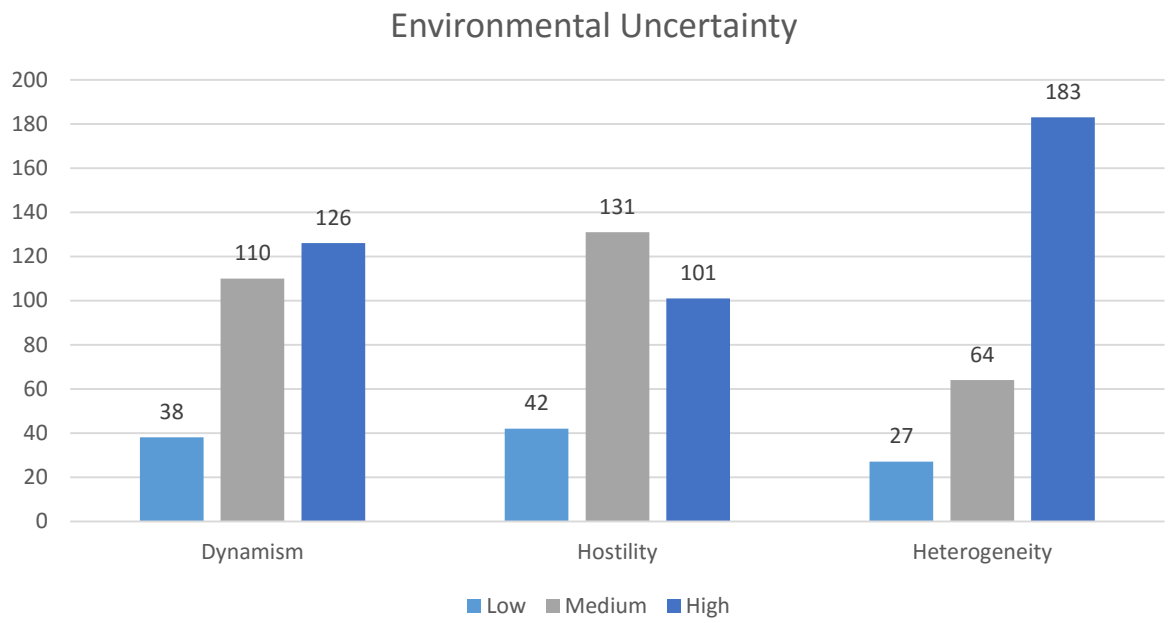


Chart 5-7 Environmental Uncertainty as Perceived by Frequency of Response

5.5 Summary

This chapter was aimed on describing both the requirements for and the nature of empirical data that will be used to empirically test the research model presented in Chapter 3. The analysis of the current adoption level of IT at the firm level demonstrates that a vast proportion of firms rely on IT in order to perform a broad spectrum of activities. This reinforces our argument that now is an appropriate time to examine how firms harness the potential of their IT investments and understand how IT-enabled dynamic capabilities can impact their competitive performance. By delineating the data collections process as well as how constructs were defined and measured, this chapter serves to verify that the research objectives are met through rigorous and well defined steps. The descriptive statistics from the collected sample of respondents illustrates that firms of all size-classes and industries are represented in the data-set. In addition, with regard to the environment of operation, there is

diversity in the conditions with a slight inclination towards moderate to highly uncertain environments. These conditions of operations are of particular interest in examining the impact of IT-enabled dynamic capabilities. Further and more sophisticated analyses that allow testing the research hypotheses and positions of Chapter 4, are described in the next chapter.

CHAPTER 6

ANALYSIS AND RESULTS

Chapter 6 describes in detail the statistical analyses conducted on our empirical data. The next section presents the two methodologies used, Partial Least Squares Structural Equation Modeling (PLS-SEM) and Fuzzy Set Qualitative Comparative Analysis (fsQCA), and then defines the sample size requirements of each. Section 6.3 includes pre-analysis tests and transformations for the PLS-SEM, while sections 6.4 and 6.5 describe the actual analyses.

6.1 Data Analysis Methodologies

As described in Chapter 5, the proposed research model includes a number of causal associations manifested as hypotheses, as well as two research propositions. The data analysis methods used to test our hypotheses and propositions are described in detail in the following sub-sections. To answer the formulated hypotheses of our conceptual model, we employ the PLS-SEM methodology. Accordingly, to explore the research propositions we use the novel methodology fsQCA.

6.1.1. Partial Least Squares - Structural Equation Modeling (PLS-SEM)

Research on complex phenomena of strategic management and information systems literature is often featured by variables that are not directly observable (latent), meaning that they are composed of a number of items or dimensions, entailing much observational error. Furthermore, associations tend to be rather complex increasing

noise and complexity of research models. In effect, these issues render standard statistical techniques, such as factor analysis, discriminant analysis, or multiple regression analysis, difficult but also inappropriate to apply.

Structural Equation Modeling (SEM) is a widely used family of statistical methods that enables conceptual or theoretical model testing. Structural equation modeling requires testing of two models, (a) a *measurement model* that defines latent variables using one or more observed items, and (b) a *structural model* that associates multiple latent variables in a single, systematic and comprehensive analysis (Hair et al., 1998). The two main types of SEM analyses are Covariance-Based SEM (CB-SEM), and Partial Least Squares SEM (PLS-SEM). The most widely used CB-SEM applications include LISREL and IBM-AMOS, while for PLS-SEM, SmartPLS and WarpPLS are mostly employed by researchers. The philosophical differences between CB-SEM and PLS-SEM are rather straightforward. If the research objective is to confirm that the data fits the model, then the appropriate method is CB-SEM. In contrast, if the research objective is prediction and theory development, then the appropriate method is PLS-SEM (Hair et al., 2011). PLS-SEM is also more appropriate at early-stage theory development and testing, since it permits examination of constructs and relationships in complex structural models (Astrachan et al., 2014). **Table 6-1** displays some of the major types of statistical methods associated with multivariate analysis (Hair et al., 2013).

Table 6-1 Classification of Multivariate Methods

	Primarily exploratory	*Primarily confirmatory*
First-generation techniques	• Cluster analysis • Exploratory factor analysis	• Analysis of variance • Logistic regression • Multiple regression

	• Multidimensional scaling	
Second-generation techniques	• PLS-SEM	• CB-SEM, *including* • Confirmatory factor analysis

In terms of requirements, CB-SEM involved numerous constraints in the form of parametric assumptions (multivariate normality), sample size (five times the number of indicators included in the original model), model complexity (e.g. less than 100 indicators), identification (at least 3 indicators per latent variable), and factor indeterminacy (not possible to estimate score of the latent variables in order to predict the observed indicators) (Astrachan et al., 2014). Moreover, CB-SEM analysis restricts latent variable formation to a reflective mode, meaning that indicators are viewed as being influenced or affected by the underlying latent variable (Chin & Newsted, 1999). A general rule of thumb for selecting between CB-SEM and PLS-SEM is presented in **Table 6-2** (Hair et al., 2011).

Table 6-2 Rules of Thumb for Selecting CB-SEM and PLS-SEM

Criteria	**CB-SEM**	**PLS-SEM**
Research Goals	• If the goal is theory testing, theory confirmation, or comparison of alternative theories	• If the goal is predicting key target constructs or identifying key "driver" constructs • If the research is exploratory or an extension of an existing structural theory

Measurement Model Specification	• If error terms require additional specification, such as covariation	• If formative constructs are part of the structural model
Structural Model	• If the model is non-recursive	• If the structural model is complex (many constructs and many indicators)
Data Characteristics and Algorithm	• If data meet the CB-SEM assumptions exactly, for example, with respect to the minimum sample size and the distributional assumptions	• If the aforementioned characteristics don't apply • If the sample size is relatively low (With large data sets, CB-SEM and PLS-SEM results are similar, provided that a large number of indicator variables are used to measure the latent constructs (consistency at large)) • If the data are to some extent non-normal
Model Evaluation	• If the research requires a global goodness-of-fit criterion • If there is a need to test for measurement model invariance	• If latent variable scores are needed in subsequent analyses

Given PLS-SEM's ability to work efficiently with a much wider range of sample sizes, increased model complexity, and its less restrictive assumptions about the data, it can be used to address a broader range of problems than CB-SEM. As such, PLS-SEM is the approach that has been established as a viable alternative to CB-SEM in marketing, information systems, and business research (Henseler et al., 2009). The PLS-SEM algorithm follows a two-stage approach. In the first stage, the latent variable scores are estimated through a four-step process. The second stage calculates the final estimates of the outer weights and loadings, as well as the structural models path coefficients. Using the iterative estimation technique, PLS develops a general model which encompasses a mix of dependence and multivariate techniques, canonical correlation, redundancy analysis, multiple regression, multivariate analysis of variance, and principal component analysis (Chin & Newsted, 1999).

In contrast with the CB-SEM approach, PLS-SEM avoids the indeterminacy problem (difficulty with estimating stable factor scores) and develops more precise estimates of factor scores (Fornell, 1982), as the algorithm calculates latent variable scores as exact linear combinations of the observed indicator variables. Although CB-SEM and PLS-SEM methodologies differ from a statistical point of view, PLS-SEM estimates can be good proxies of CB-SEM results, when CB-SEM assumptions are violated. In cases of non-conformity to assumptions such as normality of distributions, minimum sample sizes, and maximum model complexity, or when related methodological matters emerge, such as Heywood cases and inflated parameter estimates' standard errors (Rindskopf, 1984), PLS-SEM is a good methodological alternative for theory testing (Hair et al., 2011). Another attractive characteristic for theory testing is PLS-SEM's higher level of statistical power compared to CB-SEM.

Hence, the reasons for selecting a PLS-SEM methodology over a CB-SEM approach in this research include:

- The research model is based on theory exploration. Despite being grounded on a theoretical level of the dynamic capabilities view, the theory itself does not include well-defined associations and empirically tested models that require verification. Being at an early stage of empirical investigation, the focus is on exploring the validity of associations as sketched by past theoretical work.

- The relationships between latent variables and their indicators (including higher-order latent variables), are in different modes (i.e. formative and reflective measurements).

- There are several second-order factors, which are caused by first order factors (Type II higher-order constructs) and therefore can only be modeled using PLS-SEM.

- The data conditions pertaining to normality of distribution, independence are not met.

Although the PLS-SEM approach estimates both outer and inner model simultaneously, the analysis and interpretation is conducted in two stages. First the measurement model is assessed, and then the structural model is studied. The methodological issues relevant to each stage are described in detail in the respective sub-sections.

6.1.2. Fuzzy set Qualitative Comparative Analysis (fsQCA)

Fuzzy set qualitative comparative analysis (fsQCA) is a novel methodology for modelling causal relations that follows the principles of configuration theory, a newly applied approach in the field of IS, best suited for studying holistic interplays between elements of a messy nature (Fiss, 2007). Such approaches were until recently predominantly employed in organizational research studies. The aim of configuration

theory is to identify patterns and combinations of variables and reveal how their synergistic effects lead to specific outcomes. Configurations occur by different combinations of causal variables that affect an outcome of interest (Rihoux & Ragin, 2009).

The main feature of configuration theory is that it views elements through a holistic lens that must be examined simultaneously, and is therefore particularly attractive for context-related studies of the IS strategy field examining complex causality. In contrast with variance and process theories applied in IS research, configuration theory supports the concept of equifinality, meaning that the same outcome can be a result of one or more sets of configuration patterns (Fiss, 2007). Additionally, configuration theory includes the notion of causal asymmetry, meaning that the combination of elements leading to the presence of an outcome may be quite different than those leading to an absence of the outcome (Fiss, 2007).

The limited application of configuration theory in academic literature to date can be credited to the lack of appropriate methodologies for rigorous and meaningful data analysis. Despite these shortcomings, recent advances in methodologies and statistical tools go beyond identifying effective configurations, and enable researchers to extract core elements of configurations along with their interdependencies. Thus, it is feasible to analyse data that correspond to a greater degree to reality. These improvements allow for a more detailed understanding through fine-grained results that are applicable in practice. In the recent work of Fiss (2011), the author makes a comparison between typologies, which are the dominant way of explaining complex causalities, and configuration theory which allows for the identification of the necessary and sufficient elements of those configurations. The main disadvantage of typologies is that they are primarily based on observations of the researchers, and that they do not explicitly distinguish the elements that are causally relevant with those that are not.

Fuzzy set qualitative comparative analysis (fsQCA) makes use of Boolean algebra (set membership) techniques in order to define how configurations are linked to outcomes. FsQCA allows for the inclusion of the degree of membership of both dependent and independent variables, on a continuous scale (fuzzy sets) in contrast with other QCA methods that only support dichotomous states (crisp sets). Research applying fsQCA is still in its infancy, mainly due to the relatively recent introduction of the methodology. However, lately there has been a stream of research in this direction, with a small number of papers focused on the IS management discipline (El Sawy et. al., 2010; Park & El Sawy, 2012; Mikalef et al., 2015). These types of articles are particularly powerful in determining the impact of IT when considering the holistic perspective of configurations of the internal and external environment.

6.2 Sample Size Requirements

Prior to proceeding to the PLS-SEM and fsQCA analysis, it is necessary to ensure that the sample size available is sufficient to provide valid results. In terms of PLS-SEM sample size requirements, many researchers wrongly believe that sample size does not play a role in the application PLS-SEM methodologies. This idea is fostered by the often-cited 10 times rule (Barclay et al., 1995), which indicates that the sample size should be equal to the larger of:

1. 10 times the largest number of formative indicators used to measure a single construct, or

2. 10 times the largest number of structural paths directed at a particular construct in the structural model

While the 10 times rule offers a rough guideline for minimum sample size requirements, PLS-SEM, requires that the researchers consider the sample size against

the background of the model and data characteristics (Hair et al., 2011). Specifically, the minimum sample size should be determined by means of a power analysis on the fragment of the model with the largest number of predictors (Hair et al., 2013). According to Green (1991), to conduct a power analysis choices of alpha, power, and effect size have to be made. In his assessment the value set are the following:

1. Alpha (Type I error) was set at .05, the traditional level of significance.

2. Power (Type II error) was set at 0.80, a value proposed by Cohen (1988) as appropriate for a wider range of research areas

3. Cohen (1988) proposes two indexes for effect size of regression analysis f^2 and the better known R^2. The two indexes are related through the equation $f^2=R^2/(1-R^2)$. Although Cohen argues that the choice of values for effect size (f^2 or R^2) should depend on the research area, he proposes, as a convention R^2s .02, .13, and, 26 (f^2 of .02, .15, and .35) to serve as anchors of small, medium, and large effect sizes respectively.

Using the power analysis approach, Hair and colleagues (2013) developed a sample size recommendation matrix (**Table 6-3**) necessary for detecting minimum R^2 values of .10, .25, .50 and .75 in any of the endogenous constructs in the structural model for significance levels of 1%, 5%, and 10%. For instance, when the maximum number of independent variables in the measurement model and structural models is five, one would need at least 70 observations to achieve a statistical power of 80% for detecting R^2 values of at least 0.25 (With a 5% probability error).

Table 6-3 Sample Size Recommendation in a PLS-SEM for a statistical power of 80%

Maximum number of arrows	*Significance Level*		
	1%	5%	10%
	Minimum R^2	*Minimum R^2*	*Minimum R^2*

pointing at a construct	*.10*	*.25*	*.50*	*.75*	*.10*	*.25*	*.50*	*.75*	*.10*	*.25*	*.50*	*.75*
2	158	75	47	38	110	52	33	26	88	41	26	21
3	176	84	53	42	124	59	38	30	100	48	30	25
4	191	91	58	46	137	65	42	33	111	53	34	27
5	205	98	62	50	147	70	45	36	120	58	37	30
6	217	103	66	53	157	75	48	39	128	62	40	32
7	228	109	69	56	166	80	51	41	136	66	42	35
8	238	114	73	59	174	84	54	44	143	69	45	37
9	247	119	76	62	181	88	57	46	150	73	47	39
10	256	123	79	64	189	91	59	48	156	76	49	41

In the current research model, assuming an effect size equal or greater than R^2 = .25 at a significance level of 1% error, and with a maximum of 3 predictors to determine the value of the ultimate dependent variable (competitive performance), a minimum of **84** cases is required. As such, the sample of this study greatly surpasses the required threshold.

With regard to the fsQCA analysis no specific requirements have been established. The use of fsQCA is particularly promoted with the organization as the unit of analysis, which often involves a small or intermediate number of cases. However, fsQCA draws on analyses of set relations to support small-N studies and to identify the conditions or combination of conditions that are necessary or sufficient for an outcome of interest and may yield results when probabilistic methods cannot (Kane, 2014). The idea of using fsQCA on small samples (n<50) is one that resonates predominantly in empirical work. Despite this, Fiss and colleagues (2013) recently argued that the use of fsQCA could be applicable to large samples studies also. According to the authors integrating, integrating fsQCA with PLS-SEM type approaches, could enhance robustness of results and also provide complementary explanations of outcomes. As such, there are no formal restrictions in terms of sample size requirements when using fsQCA, and the application in small and large samples is equally warranted.

6.3 Measurement Model

The model features 22 first-order latent variables, measured through a reflective mode. The first-order reflective latent variables have been subjected to reliability, convergent validity, and discriminant validity tests. The 17 of these first-order latent variables are then used to formulate five higher-order constructs, through Type II measurement types.

6.3.1. First-Order Reflective Measurement Models

Reliability is gauged at the construct (internal consistency) and item level respectively (Hair et al., 2011). To determine the internal consistency reliability at the construct level, Composite Reliability (CR) values were examined, a measure of the overall validity of a collection of similar items. In accordance with suggestions for PLS-SEM analysis (Hair et al., 2011), all first-order latent variables present values above the threshold of .70, with the lowest being .769 (ENV_HOST). The use of Composite Reliability instead of the Cronbach Alpha value is preferred in PLS-SEM since it does not assume that parallelity is present, i.e. all factor loadings are constrained to be equal, and all error variances are constrained to be equal.

To assess reliability at the item level, item loadings were inspected on their assigned constructs. To ensure that items present high levels of reliability, minimum loadings are set to .70 as advised by Chin and colleagues (2003). An examination of the initial measurement model revealed that out of the total 98 items in total, 5 had loadings less than .70, and were subsequently removed. From the 5 items omitted, 1 was from the CP construct, 2 from the ENV_DYN construct, and 2 from the ENV_HOS construct. After dropping the 5 unreliable items, the new measurement model was

quite improved, and consequently was considered as robust for the purposes of this research.

When forming latent variables using a reflective measurement mode, an important aspects is to demonstrate that items that should be related, are indeed related, i.e. convergent validity. Conventionally, in PLS-SEM approaches researchers report Average Variance Extracted (AVE) as a measure of convergent validity (Gefen & Straub, 2005). According to suggestions (Fornell & Larcker, 1981; Hair et al., 2011) all construct AVE's must be above the threshold of .50. After dropping items that did not demonstrate acceptable loading on to their respective constructs, all AVE values exceeded the set limit, with the lowest being .523 for ENV_HOS. **Table 6-4** contains the PLS parameter estimates of the final measurement model.

Table 6-4 Final Measurement Model (Reflective Indicators)

Construct & Items	Items Loadings	Composite Reliability	AVE	Root AVE	Mean	Standard Deviation
Modularity (IT_MOD)		.932	.659	.812		
IT_MOD1	.866				5.05	1.13
IT_MOD2	.869				4.83	1.41
IT_MOD3	.821				4.83	1.52
IT_MOD4	.844				4.84	1.59
IT_MOD5	.818				4.67	1.47
IT_MOD6	.783				4.59	1.50
Standardization (IT_STAND)		.917	.689	.830		
IT_STAND1	.812				5.17	1.54
IT_STAND2	.839				4.99	1.51
IT_STAND3	.728				4.80	1.66
IT_STAND4	.891				5.20	1.56
IT_STAND5	.872				5.09	1.62
Transparency (IT_TRANS)		.911	.672	.819		
IT_TRANS1	.793				5.34	1.61
IT_TRANS2	.881				5.20	1.51
IT_TRANS3	.850				4.67	1.59
IT_TRANS4	.793				4.75	1.60
IT_TRANS5	.777				4.91	1.68
Scalability (IT_SCAL)		.950	.827	.909		

IT_SCAL1	.899				5.26	1.43
IT_SCAL2	.933				5.49	1.38
IT_SCAL3	.937				5.51	1.38
IT_SCAL4	.867				5.23	1.47
IT Governance (IT_GOV)		.924	.803	.896		
IT_GOV1	.853				3.90	1.01
IT_GOV2	.926				4.12	1.09
IT_GOV3	.909				4.13	1.10
Sensing (ITDC_SNS)		.917	.734	.856		
ITDC_SNS1	.835				4.88	1.51
ITDC_SNS2	.854				5.06	1.36
ITDC_SNS3	.858				5.29	1.32
ITDC_SNS4	.881				4.82	1.32
Coordinating (ITDC_CRD)		.911	.720	.848		
ITDC_CRD1	.883				5.12	1.35
ITDC_CRD2	.830				5.24	1.20
ITDC_CRD3	.864				5.03	1.30
ITDC_CRD4	.817				4.90	1.48
Learning (ITDC_LRN)		.955	.843	.918		
ITDC_LRN1	.916				5.14	1.40
ITDC_LRN2	.935				5.01	1.34
ITDC_LRN3	.936				5.09	1.38
ITDC_LRN4	.886				5.08	1.35
Integrating (ITDC_INT)		.926	.757	.870		
ITDC_INT1	.838				4.92	1.43
ITDC_INT2	.912				4.99	1.37
ITDC_INT3	.865				4.68	1.49
ITDC_INT4	.865				4.87	1.40
Reconfiguring (ITDC_REC)		.935	.783	.885		
ITDC_REC1	.871				4.82	1.37
ITDC_REC2	.832				4.95	1.41
ITDC_REC3	.915				4.91	1.33
ITDC_REC4	.920				4.74	1.40
Market Capitalizing Agility (AGI_MCA)		.914	.781	.883		
AGI_MCA1	.884				4.94	1.44
AGI_MCA2	.899				5.25	1.46
AGI_MCA3	.868				5.07	1.41
Operational Adjustment Agility (AGI_OAA)		.868	.687	.829		
AGI_OAA1	.840				4.84	1.33
AGI_OAA2	.822				4.40	1.53
AGI_OAA3	.824				5.14	1.42
Acquisition (ABS_ACQ)		.924	.803	.896		
ABS_ACQ1	.863				5.52	1.17
ABS_ACQ2	.904				5.61	1.10
ABS_ACQ3	.921				5.51	1.52

Assimilation (ABS_ASM)		.939	.838	.915		
ABS_ASM1	.891				4.80	1.26
ABS_ASM2	.922				4.73	1.33
ABS_ASM3	.932				4.79	1.36
Transformation (ABS_TRA)		.918	.789	.888		
ABS_TRA1	.900				5.29	1.11
ABS_TRA2	.884				5.20	1.20
ABS_TRA3	.881				5.12	1.22
Exploitation (ABS_EXP)		.916	.785	.886		
ABS_EXP1	.902				5.17	1.34
ABS_EXP2	.908				5.30	1.34
ABS_EXP3	.847				5.30	1.32
Incremental (INN_INC)		.936	.831	.911		
INN_INC1	.917				5.05	1.13
INN_INC2	.935				5.13	1.29
INN_INC3	.882				5.02	1.31
Radical (INN_RAD)		.943	.846	.920		
INN_RAD1	.916				4.43	1.40
INN_RAD2	.913				4.63	1.39
INN_RAD3	.932				4.44	1.41
Dynamism (ENV_DYN)		.869	.769	.877		
ENV_DYN3 (R)	.844				4.78	1.23
ENV_DYN4 (R)	.909				5.26	1.10
Heterogeneity (ENV_HET)		.876	.702	.837		
ENV_HET1	.835				4.52	1.66
ENV_HET2	.858				4.66	1.66
ENV_HET3	.822				4.54	1.65
Hostility (ENV_HOS)		.767	.523	.723		
ENV_HOS2	.723				2.47	1.63
ENV_HOS4	.760				4.67	1.56
ENV_HOS5	.702				4.69	1.64
Competitive Performance (CP)		.942	.643	.802		
CP1	.772				4.63	1.45
CP2	.768				4.54	1.42
CP3	.761				4.41	1.57
CP4	.852				4.72	1.67
CP5	.815				4.80	1.61
CP6	.799				5.01	1.62
CP7	.831				4.52	1.50
CP9	.829				5.01	1.70
CP10	.788				4.85	1.62

The final criterion that was assessed was discriminant validity. In essence, discriminant validity evaluates the opposite of convergent validity, meaning that it examines whether concepts or measurements that are supposed to be unrelated are, in face, unrelated. In PLS-SEM analyses discriminant validity is assessed at the construct and item level. At the construct level discriminant validity is verified by checking that the square root AVE of each latent construct is greater than the construct's highest correlation with any other latent construct (Fornell-Larcker criterion). This is demonstrated in a correlation matrix which includes the correlations between all constructs in the lower left off-diagonal, and the square roots of AVE's of each construct on the diagonal. As is demonstrated in **Table 6-5** all constructs present sufficient discriminant validity. The second level at which discriminant validity is assessed is at the item level. Specifically, item loadings should be higher that all of its cross-loadings, meaning that the item should demonstrate the strongest loading value on the construct it was assigned to rather than on any other (Farrell, 2010). The results (Appendix B.) support the appropriateness of the first-order reflective measures and suggest that all items are good indicators for their respective latent variables (Ruiz et al., 2008).

Table 6-5 Correlation Matrices of Reflective First-Order Constructs

Constructs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
(1) IT_MOD	**.812**																					
(2) IT_STAND	.463	**.830**																				
(3) IT_TRANS	.696	.563	**.819**																			
(4) IT_SCAL	.646	.656	.699	**.909**																		
(5) IT_GOV	.363	.451	.380	.417	**.896**																	
(6) ITDC_SNS	.664	.555	.502	.550	.461	**.856**																
(7) ITDC_CRD	.664	.554	.521	.641	.425	.748	**.848**															
(8) ITDC_LRN	.608	.521	.455	.584	.457	.716	.726	**.918**														
(9) ITDC_INT	.516	.563	.426	.525	.461	.737	.694	.646	**.870**													
(10) ITDC_REC	.570	.482	.476	.496	.429	.697	.689	.740	.650	**.885**												
(11) AGI_MCA	.540	.396	.507	.424	.314	.603	.591	.525	.521	.633	**.883**											
(12) AGI_OAA	.365	.384	.359	.281	.306	.470	.381	.473	.416	.520	.627	**.829**										
(13) ABS_ACQ	.469	.380	.384	.451	.439	.527	.509	.587	.496	.479	.489	.439	**.896**									
(14) ABS_ASM	.430	.470	.305	.380	.434	.598	.530	.566	.585	.529	.441	.462	.643	**.915**								
(15) ABS_TRA	.573	.384	.428	.486	.407	.599	.594	.643	.558	.549	.561	.537	.768	.665	**.888**							
(16) ABS_EXP	.510	.418	.460	.478	.389	.616	.622	.698	.560	.628	.577	.580	.733	.635	.802	**.886**						
(17) INN_INC	.491	.471	.433	.494	.389	.557	.558	.520	.459	.481	.570	.389	.527	.438	.531	.588	**.911**					
(18) INN_RAD	.487	.456	.455	.413	.373	.495	.517	.522	.426	.470	.390	.297	.472	.456	.439	.512	.689	**.920**				
(19) ENV_DYN	.344	.470	.356	.413	.322	.382	.412	.410	.415	.331	.354	.334	.427	.301	.386	.387	.325	.210	**.877**			
(20) ENV_HET	.233	.120	.193	.090	.065	.273	.227	.321	.191	.350	.288	.308	.218	.261	.245	.338	.195	.215	.154	**.837**		
(21) ENV_HOS	.155	.082	.073	.037	.126	.267	.225	.208	.235	.252	.178	.140	.141	.283	.167	.219	.187	.263	.144	.470	**.723**	
(22) CP	.486	.362	.365	.277	.325	.475	.467	.389	.358	.459	.570	.447	.432	.472	.408	.417	.548	.477	.247	.285	.304	**.802**

6.3.2. Second-Order Factors

The development of the higher-order constructs is based on the logic that each dimension (Type II measurement model) must contribute to the understanding of the construct. Unlike reflective constructs which are usually viewed as producing a behavior that is captured by its indicators; formative constructs are formed by their indicators, and therefore have inversed causality. Additionally, since formative second order constructs are constructed by their underlying first-order factors, omitting a dimension may result in the omission of part of the construct (Roberts & Thatcher, 2009). In our analysis, we make use of five second-order formative constructs, as described in the previous chapter.

To operationalize the second-order constructs, a mixture of the repeated indicator approach and the use of latent variable scores in a two-stage approach was applied (Ringle et al., 2012). In the first stage, the repeated indicator approach was used to obtain latent variable scores for the first-order constructs, which in the second stage served as manifest variables in the measurement model of the higher-order construct. Since each first-order construct was composed of an equal number of items, there was no bias stemming from unequal number of indicators (Ringle et al., 2012). Path weights were estimated through the path weighting scheme of SmartPLS. In accordance with suggestions by Becker et al. (2012), we examined the weights of the first-order factor on the second-order factors. By examining path weights and significance levels of first-order constructs it is revealed that each component is an important determinant of their assigned second-order construct. In addition, variance inflation factors (VIF) were below the threshold of 3.3 indicating low multicollinearity as presented in **Table 6-6** (Petter et al., 2007).

Table 6-6 Multicollinearity Diagnostics and Path Weights of First-Order Constructs on Second-Order Constructs

Construct	Weight	VIF
IT Flexibility (IT)		
Modularity (IT_MOD)	0.304***	2.135
Standardization (IT_STAND)	0.400***	1.831
Transparency (IT_TRANS)	0.174**	2.526
Scalability (IT_SCAL)	0.167**	2.261
IT-Enabled Dynamic Capabilities (ITDC)		
Sensing (ITDC_SNS)	0.226***	2.936
Coordinating (ITDC_CRD)	0.212***	2.981
Learning (ITDC_LRN)	0.249***	2.938
Integrating (ITDC_INT)	0.212***	2.543
Reconfiguring (ITDC_RCF)	0.245***	2.692
Organizational Agility (AGI)		
Market Capitalizing Agility (AGI_MCA)	0.205***	1.623
Operational Adjustment Agility (AGI_OAA)	0.282***	1.623
Absorptive Capacity (ABS)		
Acquisition (ABS_ACQ)	0.557***	2.796
Assimilation (ABS_ASM)	0.547***	1.979
Transformation (ABS_TRA)	0.519***	3.146
Exploitation (ABS_EXP)	0.535***	3.162
Innovative Capability (INN)		
Incremental (INN_INC)	0.549***	1.891
Radical (INN_RAD)	0.539***	1.891

*** $p < 0.001$, ** $p < 0.01$

6.4 Structural Model

The structural model from the PLS analysis is summarized in **Figure 6-1**, where the explained variance of endogenous variables (R^2) and the standardized path coefficients (β) are depicted. Contrary to covariance structure analysis modelling approaches that rely on goodness-of-fit measures to evaluate the structural model, in PLS the structural model is assessed by examining coefficient of determination (R^2) values, predictive relevance (*Stone-Geisser* Q^2), and effect size of path coefficients. The significance of estimates (*t*-statistics) are obtained by performing a bootstrap analysis with 5000 resamples. To determine if the impact of IT-enabled dynamic capabilities is better explained through the two theorized causal paths, two models were developed. In Model A, the direct affect is evaluated, while in Model B, the multi-step multiple mediation design is introduced.

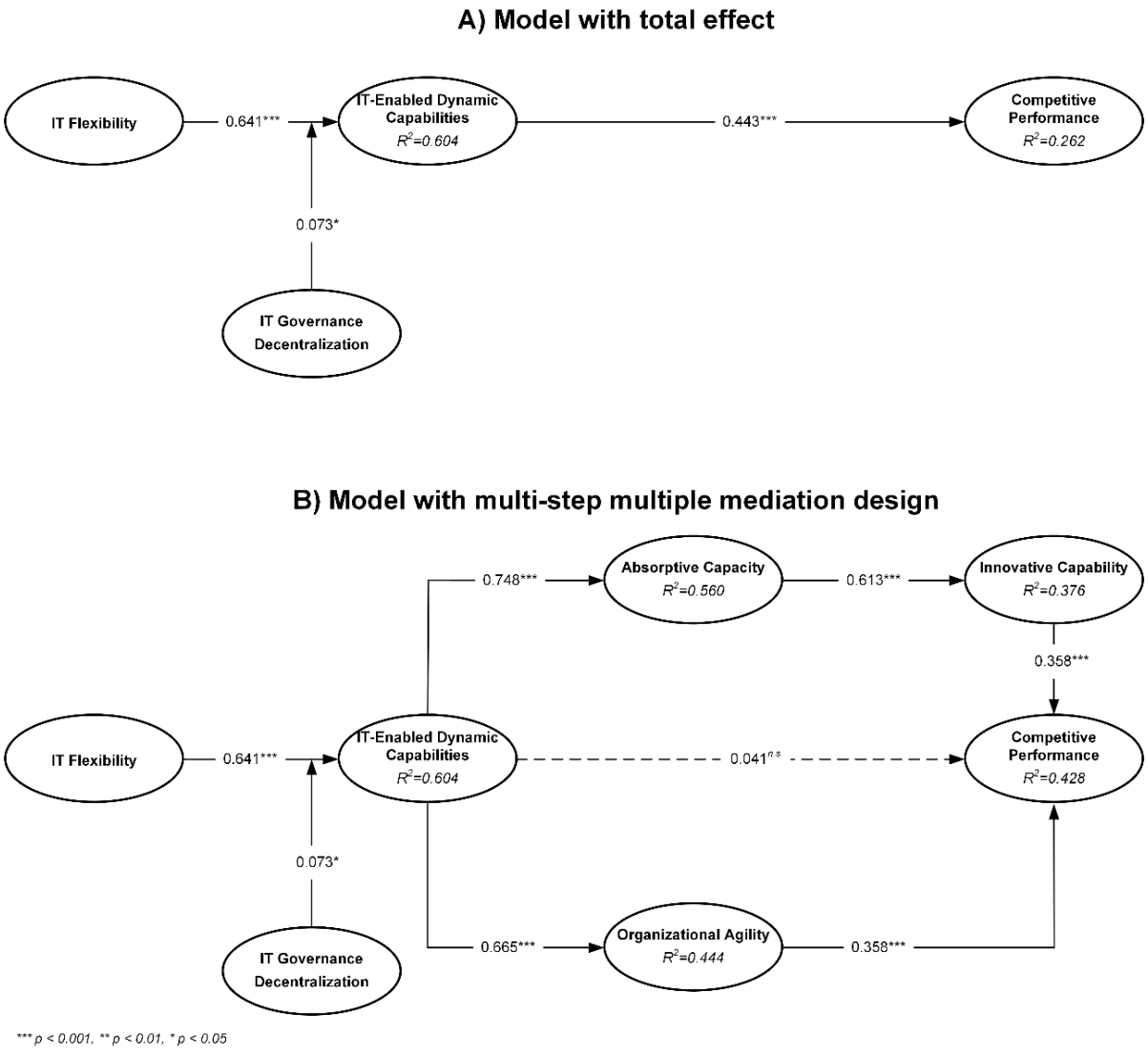


Figure 6-1 Estimated causal relationships of structural models

As depicted in **Figure 6-1B**, all seven hypotheses were supported. IT flexibility is found to positively impact IT-enabled dynamic capabilities (β=0.641, t=8.196, p < 0.001), while IT governance decentralization slightly enhances the strength of the association (β=0.073, t=2.268, p < 0.05). To examine if the impact of IT-enabled dynamic capabilities on competitive performance is mediated, a bootstrapping approach is employed; a non-parametric resampling procedure that imposes no assumptions on normality of sampling distribution (Preacher & Hayes, 2008). **Figure**

6-1A shows that IT-enabled dynamic capabilities have a significant total effect of competitive performance ($d = 0.443$ $t = 8.761$ $p < 0.001$). When adding the mediators (Fig. 1.B), the effect of IT-enabled dynamic capabilities is rendered insignificant ($d' = 0.041$ $t = 0.613$ $p > 0.05$). IT-enabled dynamic capabilities are found to have a positive effect on absorptive capacity (a_1=0.748, t=22.820, p < 0.001), which in sequence positively impacts innovative capability (b_1=0.613, t=12.959, p < 0.001), and competitive performance (c_1=0.358, t=6.198, p < 0.001). Additionally, IT-enabled dynamic capabilities enhance organizational agility (a_2=0.665, t=11.215, p < 0.001), which in turn positively affects competitive performance (b_2=0.358, t=6.874, p < 0.001). These outcomes serve to demonstrate that the two mechanisms fully mediate the impact of IT-enabled dynamic capabilities on competitive performance as presented in **Table 6-7**.

Table 6-7 Mediation results

Model A *Total effect (d)*			*Model B* *Direct effect (d')*			*Model B* *Indirect effects*			
Path	*Coefficient*	*t-value*	*Path*	*Coefficient*	*t-value*	*Path*	*Point estimate*	*Bias corrected bootstrap 95% confidence interval*	
								Lower	*Upper*
ITDC → CP	0.44***	8.47	ITDC → CP	0.04	0.61	Total	0.40	0.32	0.49
						$a_1b_1c_1$ (via ABS)	0.16	0.13	0.20
						a_2b_2 (via AGI)	0.23	0.18	0.27

ITDC: IT-enabled dynamic capabilities, ABS: Absorptive capacity, AGI: Organizational agility, CP: Competitive performance
Bootstrapping 95% confidence interval based on 5000 samples. Two-tailed test *** p < 0.001 (t=3.291), ** p < 0.01 (t=2.576), * p < 0.05 (t=1.960)

The structural model explains 60.4% of variance for IT-enabled dynamic capabilities, 56.0% for absorptive capacity, 37.6% for innovative capability, 44.4% for

organizational agility, and 42.8% for competitive performance. In addition to examining the R^2, the model is evaluated by looking at the Q^2 predictive relevance of exogenous constructs. This test is a measure of how well observed values are reproduced by the model and its parameter estimates, assessing the model`s predictive validity through sample re-use (Chin, 1998). The technique is a synthesis of cross-validation and function fitting, and examines individuals' constructs predictive relevance by omitting selected inner model relationships and computing changes in the criterion estimates (q^2) (Hair et al., 2012). Results of the blindfolding procedure demonstrate that IT-enabled dynamic capabilities (Q^2 = 0.347), absorptive capacity (Q^2 = 0.337), innovative capability (Q^2 = 0.264), organizational agility (Q^2 = 0.261), and competitive performance (Q^2 = 0.262) have satisfactory predictive relevance since they are greater than 0. The following table (**Table 6-8**) presents the total set of research hypotheses, as formulated in Chapter 4. In total, all six hypotheses are accepted, supporting as such the research model.

Table 6-8 Test Results of Research Hypotheses

ID	Research Hypotheses	Status
H1	*IT flexibility positively affects IT-enabled dynamic capabilities*	Accepted
H2	*IT governance decentralization positively moderates the effect of IT flexibility on IT-enabled dynamic capabilities*	Accepted
H3	*Organizational agility mediates the effect of IT-enabled dynamic capabilities on competitive performance*	Accepted
H4	*IT-enabled dynamic capabilities positively affect absorptive capacity*	Accepted

H5	*Absorptive capacity positively affect a firm's innovative capability*	Accepted
H6	*A firm's innovative capability positively affects competitive performance*	Accepted

6.5 Fuzzy Set Qualitative Comparative Calibration and Analysis

The first step of fsQCA analysis is to calibrate dependent and independent variables into fuzzy sets. Consequently, values can be on a continuous scale [0-1] indicating the level of membership to the variable at hand. The procedure of calibration is based on the method introduced by Ragin (2008). To determine the degree of membership for each variable three anchors are defined denoting full membership (fuzzy score = 0.95), full non-membership (fuzzy score = 0.05), and the crossover point (fuzzy score = 0.50) (Woodside, 2013). Since this study uses a 7-point likert scale to quantify constructs, the procedure described by Ordanini et al. (2014) is employed to transform them into fuzzy sets. Full membership thresholds are set at values over 6, crossover points at 4.5, and full non-membership scores at 3 (Tho & Trang, 2014). Opting for a full non-membership of 3 instead of 2 is due to the bias of respondents to answer on the right side (strongly agree). Descriptive statistics of construct means confirm this bias (left-skewness). Firm size is transformed into a crisp set with 1 denoting a large firm (+ 250 employees), and 0 a SME (1 – 249 employees).

By applying the fsQCA algorithm a truth table of 2^k rows is produced, where k is the number of predictor elements, and each row indicates a possible combination. Based on Ragin`s recommendation, consistency levels should not be below 0.75. Consistency measures the degree to which a subset relation has been approximated. It resembles the notion of significance in statistical models (Schneider & Wagemann, 2010). Thus, solutions that do not adhere to this threshold are not included in the

analysis. Solution coverage, on the other hand, assesses the empirical relevance of a consistent subset, an analogous measure of R^2 in regression analysis (Ragin, 2006; Mendel and Korjani, 2012).

A minimum of three cases for each solution is set (Ragin, 2006). Two separate fsQCA analyses are performed, one for absorptive capacity, and the other for organizational agility as the dependent variable. Outcomes of the fuzzy set analysis for high levels of organizational agility and absorptive capacity are presented in **Table 6-9**. The black circles (●) denote the presence of a condition, while the crossed-out circles (⊗) indicate the absence of it (Ragin, 2008). Core elements of a configuration are marked with large circles (prime implicants), peripheral elements with small ones, and blank spaces are an indication of a "don't care" situation, in which the causal condition may be either present or absent. In the solutions of the present study, no peripheral elements exist.

Table 6-9 Configurations for achieving high levels of organizational agility and absorptive capacity

Configuration	Solution								
	Organizational Agility				Absorptive Capacity				
	1	2	3	4	1	2	3	4	5
Dynamism		●	●	●		●	●	⊗	●
Heterogeneity				●			●	⊗	⊗
Hostility	⊗		⊗		⊗			⊗	⊗
IT-enabled dynamic capabilities	●	●	●	●	●	●	●		
Firm Size	⊗	⊗			⊗	⊗			●
Consistency	0.903	0.912	0.914	0.916	0.911	0.945	0.961	0.824	0.829
Raw Coverage	0.437	0.429	0.508	0.495	0.425	0.420	0.496	0.238	0.135
Unique Coverage	0.115	0.013	0.054	0.033	0.040	0.014	0.096	0.033	0.064

Overall Solution Consistency	0.896	0.884
Overall Solution Coverage	0.767	0.794

The outcomes of the fsQCA analysis for achieving high levels of organizational agility produce four solutions in total. In all cases IT-enabled dynamic capabilities are present as a core condition, reinforcing findings of the structural model. This outcome not only proves that high levels of IT-enabled dynamic capabilities are associated with augmented levels of organizational agility, but also that they are necessary conditions. Therefore, no contrarian cases exist in which firms may present a weak IT-enabled dynamic capability but a strong organizational agility. More specifically, solution 1 applies for SME`s who operate in conditions characterized by an absence of hostility. This is the only solution in which the presence of IT-enabled capabilities is not accompanied with some aspect of environmental uncertainty. The remaining three solutions illustrate that high organizational agility can be achieved under varying conditions of environmental uncertainty. Solution 2, shows that SMEs which operate under conditions of high environmental dynamism can have high levels of organizational agility providing they have developed IT-enabled dynamic capabilities. Solutions 3 and 4 are size-independent and suggest that under conditions of high dynamism and an absence of hostility, or high dynamism and heterogeneity, organizational agility can be attained with the presence of strong IT-enabled dynamic capabilities.

The outcomes of the fsQCA analysis for achieving high levels of absorptive capacity results in five different solutions. Although some solutions cohere with outcomes of the PLS-SEM analysis, i.e. strong IT-enabled dynamic capabilities leads to high absorptive capacity, there are two solutions that run counter to this suggestion. The introduction of environmental uncertainty factors into the equation helps refine the conditions under which strong IT-enabled dynamic capabilities is

necessary. Solutions 1, 2, and 3 illustrate that the presence of strong IT-enabled dynamic capabilities is necessary for achieving a high levels of absorptive capacity under conditions of moderate to high environmental uncertainty. Specifically solutions 1 and 2 apply for SMEs and demonstrate that in the absence of a hostile environment or under conditions of high environmental dynamism, if a firm has developed strong IT-enabled dynamic capabilities. Solution 3 is size-class independent, meaning that applies equally to SMEs and large companies. This solutions exemplifies that in circumstances of high dynamism and heterogeneity, having strong IT-enabled dynamic capabilities facilitates the development of an augment absorptive capacity. Solutions 4 and 5 on the other hand, indicate that when certain environmental conditions coincide, the presence of strong IT-enabled dynamic capabilities may be rendered as non-important. Specifically, these include an absence of heterogeneity and hostility, and either an absence of dynamisms regardless of firms' size, or high dynamism for large firms.

To verify that the sample and results have sufficient predictive validity, the sample is split into two equal sub-samples through random selection, a modeling sub-sample (sub-sample 1) and a holdout sample (sub-sample 2). An fsQCA analysis is performed for the modeling sub-sample using the same observation number and consistency criteria as in the main analysis. The solutions (models) of the analysis for the modeling sub-sample are presented in **Table 6-10**.

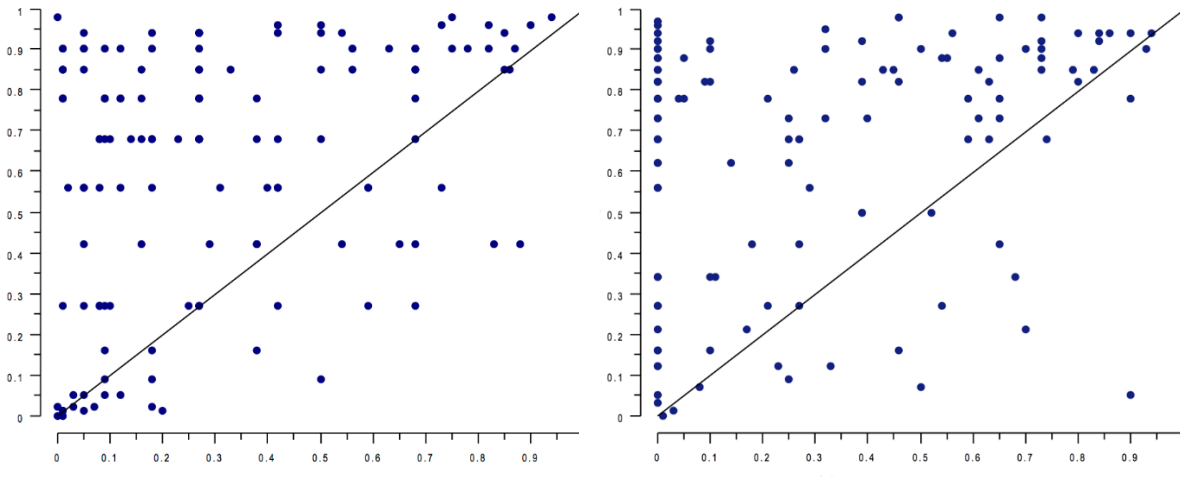
Table 6-10 Solutions of high organizational agility and absorptive capacity for sub-sample 1

Organizational Agility				Absorptive Capacity			
	Raw coverage	Unique coverage	Consistency		Raw coverage	Unique coverage	Consistency
1. ITDC*DYN*HET	0.531	0.140	0.928	1. ITDC*~SZE *~HOS	0.436	0.181	0.918
2. ITDC*DYN*~HOS	0.529	0.046	0.921	2. ITDC*DYN*HET	0.522	0.211	0.963
3. ITDC*~SZE*~HOS	0.463	0.051	0.909	3. SZE*~HET*~HOS	0.113	0.023	0.768

4. ~SZE*~HOS*~HET*~DYN	0.232	0.012	0.843	4. SZE*DYN*~HOS*~HET	0.137	0.035	0.874
Solution coverage: 0.792				Solution coverage: 0.811			
Solution consistency: 0.881				Solution consistency: 0.891			

IT-enabled dynamic capabilities (ITDC); Size (SZE); Dynamism (DYN); Heterogeneity (HET); Hostility (HOS)

The models produced by the modeling sub-sample, are then tested on the data of the holdout sample. Plotting each model on its respective outcome variable produce highly consistent models with high coverage. **Chart 6-1** illustrates how data from the holdout sub-sample plot on model 1 produced by the modeling sub-sample for market capitalizing and operational adjustment agility respectively. Additional predictive test findings for the remaining models suggest that highly consistent models for the modeling sub-sample have high predictive abilities for the holdout sub-sample.



Organizational Agility (Model 1)
Consistency = 0.898Coverage = 0.435

Absorptive Capacity (Model 1)
Consistency = 0.912 Coverage = 0.415

Chart 6-1 Test of Model 1 for organizational agility and absorptive capacity in sub-sample 1 using data from sub-sample 2

Table 6-11 presents the propositions as formulated in Chapter 4. The outcomes of the fsQCA analyses demonstrate that under the presence of strong IT-enabled

dynamic capabilities, different constellations of environmental uncertainty conditions facilitate organizational agility and absorptive capacity. The combinations of external conditions demonstrate that IT-enabled dynamic capabilities can be of value in circumstances of low, moderate, and high environmental uncertainty.

Table 6-11 Tests Results of Research Propositions

ID	Proposition	Status
P1	*The value of IT-enabled dynamic capabilities on improving organizational agility is contingent upon configurations of factors of the external environment.*	Accepted
P2	*The value of IT-enabled dynamic capabilities on enhancing absorptive capacity is contingent upon configurations of factors of the external environment.*	Accepted

6.6 Summary

The chapter discussed the methodologies as well as the outcomes of the empirical data analysis, using PLS-SEM and fsQCA techniques. The chapter opened with a short introduction of the features of SEM, and distinguished between the two main types of analysis that follow this approach, i.e. CB-SEM and PLS-SEM. In sequence, the prime criteria for selecting either type of SEM approach were presented, justifying as such our choice of method. This chapter also introduced the fsQCA methodology, describing the theoretical approach on which it builds, and the main differences with variance and process theory methods. The sample size requirements of PLS-SEM were then discussed to determine if the gathered data-set had a sufficient amount of responses to test the proposed conceptual model. According to the power analysis

technique of Green (1991), the sample size of 274 is rendered as sufficient to empirical test our research model

As part of the PLS-SEM methodology, a separate set of tests were performed to examine the measures employed (measurement model), and then the relationship of constructs (structural model). The measurement model included analyses of reliability and validity at both indicator and construct level. After making the necessary revisions and thus improving the measurement model, the analysis continued with the path model, and more specifically with the direct, indirect, and total effects. The outcomes of the structural model confirmed all six hypotheses, thus validating the associations formulated in the research model. In addition to the PLS-SEM analysis the chapter also included the results of the fsQCA analysis. At first stage the calibration procedure was described oh how constructs on a continuous or categorical scale were transformed into fuzzy sets. Following the calibration procedure, two fsQCA analyses were performed, with organizational agility and absorptive capacity as outcome conditions. The outcomes of the analyses demonstrated that IT-enabled dynamic capabilities can be of value in conditions of varying environmental uncertainty, thus supporting the choice of opting for a contingency approach. Specifically, strong organizational as a result of IT-enabled dynamic capabilities can be attained in conditions of low hostility, high dynamism, high dynamism and low hostility, and high dynamism accompanied with high heterogeneity. For realizing a strong absorptive capacity, conditions of low hostility, high dynamism, and high dynamism accompanied with high heterogeneity are favorable in the presence of strong IT-enabled dynamic capabilities. Strikingly, a strong absorptive capacity can be achieved regardless of the presence of solid IT-enabled dynamic capabilities under conditions of low dynamism low heterogeneity and low hostility, or for large firms at high dynamism low heterogeneity and low hostility. Solutions are presented along with predictive validity tests to ensure that outcomes are well grounded.

CHAPTER 7

DISCUSSION AND IMPLICATIONS

This chapter discusses the contribution of our work and analyzes the main implications that arise. We begin by summarizing the most important findings of our research study, and highlighting the research disciplines and subject areas in which this work adds to. We then proceed to describe the implications of this research from a theoretical perspective. Next, we discuss the practical implications that and how they can influence decisions made by practitioners. We conclude by describing the novelty of our study in terms of its research contribution.

7.1 Summary of Research

This research was primarily concerned with explaining how IT investments ultimately result in competitive performance gains under conditions of environmental uncertainty. The importance of IT as a tool of strategic differentiation and a means of attaining a competitive edge has motivated researchers since the early 1980s to explain the mechanisms and conditions through which such performance gains can be realized. With IT entering a commodity-like status in the contemporary age, research has strived to explore how IT investments can be leveraged and deployed effectively in order to realize strategic goals. Recent commentaries have stressed the importance of examining the value of IT under the prism of constantly shifting business requirements. One of the main points made in these commentaries

is that the there is a need for a fundamental shift concerning the way IT-business value is examined and the theoretical lens through which this is done.

The majority of current studies in the area of IT-business value research have grounded their arguments on the Resource-Based View (RBV) of the firm. According to these studies, firms that possess IT resources that are valuable, rare, in-imitable, and non-substitutable will be more likely to outperform competitors. Although a RBV perspective may provide some important insights on the necessary types of IT resources that a firm must own or have under its control, it does not define how they should be leveraged in order to derive value from them. In addition, one of the shortcomings of the RBV perspective is that it does not take into consideration the competitive environment when examining the value of IT resources. In this thesis, we argued that there is a need to re-frame the theoretical standpoint from which IT-business value is examined.

To do so, we adopted a Dynamic Capabilities View (DCV) of the firm. The choice of the DCV was made due to its applicability to conditions that necessitate continuous change, as well as the inclusion of the external environment when examining organizational-wide phenomena. Although several past IT studies have used the DCV to ground their hypotheses, to date there has been no holistic incorporation of the theory within the IT context. In effect, the associations, conditions, and limits set by the DCV have been loosely followed. Ober the past decades, research on DCV has transitioned from a theoretical level, to empirical studies testing the arguments put forth through large-scale quantitative studies. The maturing of DCV research renders the theory as a relevant and well defined perspective to be applied in the IT context.

The primary output of this research concerns a research model theorizing the antecedents of IT-enabled dynamic capabilities, as well as the mechanisms through which they affect competitive performance. We draw on modular systems theory and

posit that modularity in the form of IT architecture complemented by IT governance decentralization facilitate the development of IT-enabled dynamic capabilities. In addition, our conceptual model posits that the impact of IT-enabled dynamic capabilities on competitive performance is actualized by increasing organizational agility, and by improving a firm's innovative capability. This research also examines the role of environmental uncertainty in realizing organizational agility, and absorptive capacity. The underlying proposition of this study is that the dimensions that comprise environmental uncertainty present a contingent impact on the value of IT-enabled dynamic capabilities. Subsequently, their value, i.e. of IT-enabled dynamic capabilities, can be realized under different combinations of environmental conditions.

To enable empirical testing of our theoretical propositions, this research performed a quantitative study on a sample of 274 international companies. The data was thereafter analyzed with the aid of the Partial Least Squares Structural Equation Modeling (PLS-SEM) and the Fuzzy Set Qualitative Comparative Analysis (fsQCA) methodologies. Empirical findings support our hypotheses that IT flexibility, coupled with a decentralized IT governance scheme, promote the formation of IT-enabled dynamic capabilities. The impact of IT-enabled dynamic capabilities on competitive performance is found to be fully mediated by two mechanisms; by fostering organizational agility, and by improving a firm's absorptive capacity and in sequence its innovative capability. The patterns of the fsQCA analysis demonstrate that IT-enabled dynamic capabilities result in superior organizational agility and absorptive capacity in a variety of environmental uncertainty conditions.

7.2 Implications for Theory

The primary contribution of our research is to the field of information systems strategy, and particularly to the area of IT-business value. Through our theoretical and empirical investigations, we demonstrated the different levels at which the IT capabilities notion is decomposed, explained how these levels are associated, and focused specifically on IT-enabled dynamic capabilities, demonstrating its critical antecedents as well as the mechanisms through which it affects competitive performance. As such, this thesis contributes to theory in several ways.

First, it decomposes the notion of IT capabilities from a theoretical standpoint into three distinct and identifiable levels; IT resources, IT competencies, and IT-enabled capabilities. One of the main issues with IT-business value research, as noted in chapter 2, is that, although it uses the RBV as the theoretical grounding for explaining how IT adds value, this is done in a rather loose manner. Strategic management literature has performed great strides in conceptualizing, refining, distinguishing, and empirically testing all notions related to the RBV. In contrast, IT-business value research has largely disregarded these advancements and often groups dissimilar aspects under the overarching term of IT resources or IT capabilities. Guided by the RBV, as well as other related theories such as the Knowledge Based View (KBV), the Competence Based Perspective (CBP), as well as the Dynamic Capabilities View (DCV), our literature review clearly defines the levels at which IT capabilities have been studied in literature. By mapping studies conducted over the past 15 years on IT-business value, we were able to comprehend what we already know, what we should seek to examine, and how this should be done. Hence, the conceptual framework provides an illustration of areas that are under-researched as well as the theoretical perspectives that underpin them, providing as such a holistic view of IT capabilities studies.

The second major contribution stems from the outcomes of the literature review. By surveying past studies, the area of IT-enabled dynamic capabilities is found to be under-researched. By reviewing past literature on dynamic capabilities we develop an adapted construct of IT-enabled dynamic capabilities. Based on the approach of conceptualizing dynamic capabilities as a set of specific and identifiable routines, we demonstrate how the IT-enabled dynamic capabilities construct can be operationalized and measured. It is only until recently that strategic management literature has attempted to operationalize the dynamic capabilities construct, following theoretical debates. Our research follows past empirical studies and relies on recognizing the underlying routines and developing IT-enabled dynamic capabilities as a higher-order construct. Hence, we provide IT-business value researchers with a useful and construct that can help explain how IT investments affect competitive performance. The proposed construct is the put to test to validate its properties and create a measurement scale for each of its underlying dimensions (sensing, coordinating, learning, integrating, and reconfiguring). Through a multi-stage approach, a validate construct of IT-enabled dynamic capabilities is created which is then used in our conceptual model.

A third important theoretical implication drawn from the findings of this research concerns the mechanisms through which IT-enabled dynamic capabilities affect a firm's competitive performance. Our theoretical arguments posit and our empirical analysis confirm, that the impact of IT-enabled dynamic capabilities on competitive performance in indirect. More specifically, we show that the value of IT-enabled dynamic capabilities is realized through two primary mechanisms. The first is by increasing organizational agility, meaning that it provides the firm with the necessary routines to rapidly adapt internal and external positioning to better fit the changing requirements. Whether IT enables or inhibits organizational agility has been a subject of much debate (Lu & Ramamurthy, 2011). Several researchers have argued that investments in IT hinder a firm's capacity to respond to change since a globally

integrated IT infrastructure may be a source of unintended rigidity (Goodhue et. al., 2009). Our research shows that in the form of IT-enabled capabilities (routines), a firm is capable of achieving competitive performance by strengthening its organizational agility. In effect, it is not IT resources *per se* that promote agility, but rather fusing IT with certain organizational capabilities that allow sensing and responding in a timely manner. By developing strong IT-enabled dynamic capabilities, firms are able to adapt their internal business processes to accommodate change, as well as readdress their market propositions. A second mechanism through which IT-enabled dynamic capabilities affect competitive performance is by triggering a firm's innovative capability. As our empirical results demonstrate, having strong IT-enabled dynamic capabilities promotes a firms absorptive capacity, which in sequence enhances its innovative capability. As such, IT-enabled dynamic capabilities operate as boundary spanning capabilities that allow firms to acquire and exploit resources beyond organizational silos. The power of IT-enabled dynamic capabilities lies in their capacity to alleviate communication barriers, thus fostering collaboration and knowledge exchange. By developing IT-enabled dynamic capabilities, firms are able to sense emerging technological trends, integrate critical resources and collaborate swiftly with business partners with the aim of developing novel products or services. This study is one of the first to examine the impact of IT-enabled dynamic capabilities on both promoting an innovative capability and organizational agility. In addition it is one of the few in the dynamic capabilities literature to simultaneously examine two different mechanisms of impact on competitive performance.

A fourth theoretical contribution of this research concerns the antecedents of IT-enabled dynamic capabilities from a modular systems theory perspective. Basing our argumentation on the dynamic capabilities view, we posit that modular forms of IT architecture and IT governance (decentralization) promote IT-enabled dynamic capabilities formation. Recent studies on modular systems theory and the dynamic capabilities view recognize the complementary nature of the two perspectives and

argue that modular systems in terms of organizational structure and product/process componentization facilitate the development of dynamic capabilities. The novelty of our study lies in that it demonstrates how characteristics of an IT architecture, coupled with a modular governance mode, are associated with IT-enabled dynamic capabilities. This view is in coherence with the associations described in chapter 2 concerning the different levels of analysis of IT capabilities. The complementarities of modular systems theory and the dynamic capabilities view of the firm is a subject that has not been addressed much in empirical studies, although regularly described in theoretical argumentations (Pil & Cohen, 2006; Teece, 2007).

Last, the findings of our research also contribute to the discussion on the limits and conditions under which dynamic capabilities add value. Much discussion has revolved around the environmental conditions that facilitate the impact of dynamic capabilities to be realized. In this study, we followed a contingency approach and assumed that the value of IT-enabled dynamic capabilities would not be restricted to highly uncertain environments, but rather, their impact is context dependent. Our findings confirm this assumption, since the impact of IT-enabled dynamic capabilities on absorptive capacity and organizational agility is realized under diverse conditions of environmental uncertainty. Specifically, we find that having strong IT-enabled dynamic capabilities is a core requirement under any environmental conditions in realizing high levels of organizational agility. The value of IT-enabled dynamic capabilities is particularly evident under circumstances of high dynamism, in which, regardless of firm size, organizational agility is attained. In realizing a strong absorptive capacity, outcomes differ to some extent. Again, we find that having IT-enabled dynamic capabilities is a core pre-requisite under conditions of high dynamism. Nevertheless, they are regarded as a non-important condition in the absence of dynamism, heterogeneity, and hostility. This outcome has implications to both the information systems and the strategic management domains. For information systems researchers, it demonstrates that the value of strengthening

organizational capabilities through IT can potentially affect firms that compete in industries of varying turbulence. Yet, in certain circumstances it is possible to attain absorptive capacity even in the absence of strong IT-enabled dynamic capabilities. For strategic management literature, it shows that dynamic capabilities can be of value in a range of environmental conditions; however, these have to be examined in combination with other factors such as firm size and industry for instance.

Summarizing, this research work has contributed to multiple theoretical fields; (a) to the emerging literature on information systems strategy in highly uncertain environments, by demonstrating that IT-enabled dynamic capabilities can be a significant source of competitive advantage through two mediating mechanisms, i.e. by enhancing organizational agility and absorptive capacity, (b) to the field of IT-business value research by describing the levels through which the IT capabilities construct has been examined, and (c) to the strategic management literature, by empirically exploring the indirect impact of IT-enabled dynamic capabilities through two mechanisms, and the antecedents that shape them.

7.3 Implications for Practice

The theoretical associations and the empirical outcomes of this research have several practical implications. In practice, the results of this study provide managers with a set of guidelines on the areas in which they should focus their IT deployments and the IT-enabled capabilities they should aim to strengthen.

For IT managers, the review of past literature and the mapping on our devised taxonomy serves to illustrate the various levels on which IT capabilities are measured. The practical value of this mapping lies in the identification of the rent-yielding properties of each level, thus prompting practitioners to change their mind-set from thinking in terms of IT resources to IT-enabled capabilities. As such, practitioners are

provided with a classification of IT-enabled capabilities, which they can develop by selecting their own set of IT resources and IT competencies. The argumentation of our literature review and taxonomy is that IT-enabled capabilities can be fostered through a multitude of combinations of IT resources and IT capabilities. This perspective allows practitioners to select their own way of realizing specific IT-enabled capabilities. This is in line with real business conditions, since companies first define a business demand and then select IT solutions that fulfil that demand. Consequently, our taxonomy demonstrates that it is more appropriable in terms of deriving IT-business value to think of the IT-enabled capabilities that should be strengthened, and then selecting the appropriate IT resources and IT competencies to develop them. In effect, the nature of dependencies demonstrates that there are more "steps" to realizing competitive performance gains as part of IT than directly linking IT resources to performance measures.

In addition to the previous, our work provides practitioners with a clear understanding of the conditions and limits to which each IT-enabled capability can add value. Our emphasis however, is predominantly on IT-enabled dynamic capabilities which are presented as managerially amendable options that can be exploited to cope with changing environments. Specifically, by developing IT-enabled dynamic capabilities through the five underlying dimensions (sensing, coordinating, learning ,integrating, and reconfiguring), practitioners are provided with the core areas on which they should target their IT investments for competitive survival in uncertain environments. Our work provides a number of examples to demonstrate how each dimension of IT-enabled dynamic capabilities can be strengthened by targeted use of IT. Of particular relevance over the next few years will be technologies such as Big Data and Analytics, especially in strengthening sensing and learning capabilities. Big data provide managers with a strategic tool, which providing they are leveraged effectively, can provide real-time information that can guide future moves. In addition, technologies that build on open standards, are reusable, and

facilitate modularity and scalability, such as cloud-based Service Oriented Architectures, provide digital platforms which can strengthen integration, coordination and reconfiguration capabilities.

The outcomes of our empirical work also provide practitioners with an outlook on how IT-enabled dynamic capabilities can help them realize competitive performance gains. The two primary mechanisms through which IT-enabled dynamic capabilities act, are by strengthening a firm's innovative capability and improving organizational agility. The overall impact of the dimensions that comprise the IT-enabled dynamic capabilities construct shows that by targeted use of IT in specific routines both intermediary outcomes can be attained. Therefore, by investing in IT-enabled dynamic capabilities, practitioners are provided with mechanisms that can potentially be of strategic value. Yet, attaining a competitive advantage will be subject to how these mechanisms are harnessed, and on the strategic focus of the firm.

In addition, our research demonstrates the facilitating conditions that promote the establishment of IT-enabled dynamic capabilities. More specifically, our findings direct practitioners to certain aspects that should be inherent in their IT architecture rather than proposing specific information systems or technologies. Aspects such as modularity, transparency, standardization and scalability are important drivers in realizing IT-enabled dynamic capabilities. In effect, an IT architecture that presents the aforementioned characteristics enables a greater plethora of strategic moves of targeted IT deployments. Cloud-based platforms are a good example of flexible IT infrastructures, since they provide the necessary scalability in a pay-as-you-use manner, and build on modular designs such as web services, that use open standard interfaces such as SOAP, and provide transparent descriptions of input, output and operations through protocols such as WSDL. Through this view, the architectural elements are also decoupled from the IT-enabled dynamic capabilities. This perspective serves to illustrate that IT resources cannot automatically be translated into strategic options, but rather, that they must be infused with other organizational

capabilities to form IT-enabled dynamic capabilities. Our findings hint to practitioners that the value of flexible IT architectures are better transformed into IT-enabled dynamic capabilities in the presence of a decentralized IT governance scheme. Although a decentralized IT governance structure may not be the best option when considering costs due to lack of scale, the benefits are contrasted in terms of better responsiveness and more focused deployments. A decentralized IT governance structure therefore facilitates reduced communication efforts among the hierarchy and allows more timely responses and adjustments to the capabilities enabled through IT.

The development of the IT-enabled dynamic capabilities construct along with empirical findings also raises several practical implications in combination with new and emerging technologies. More specifically, by means of novel technological options, managers can aim to strengthen the particular sub-set of capabilities in accordance with their strategic orientation. Big data tools and applications comprise a particularly interesting set of options, especially for high velocity markets, and can promote sense making, decision supporting, and even real-time forecasting, termed as now-casting (Banbura et al., 2011). In conjunction with service-oriented technologies that enable scale, scope, speed, and agile integration with business and cross-functional partners, firms can aim for technology induced competitive gains (Demirkan & Delen, 2013). Effectively, IT practitioners are presented with a multitude of technological options on which they can enact and develop their IT-enabled dynamic capabilities. This contrasts the situation of less than two decades ago during which large-scale, costly, and highly proprietary information systems were the main option.

In effect, the development of IT-enabled dynamic capabilities can be achieved through different ways and are dependent on several internal and external factors. One of the main dependencies on the form which these IT-enabled dynamic capabilities may take includes the degree of environmental uncertainty faced by firms.

Literature suggests that in highly uncertain environments, dynamic capabilities are expressed as experimental and unstable processes that rely on newly developed knowledge. Thus, Knowledge could be in the form of social media feed analytics to gain customer behavior, preferences, and product perceptions. In moderately uncertain conditions IT-enabled dynamic capabilities can be identified through slightly adjusted routines and analytic processes that produce mostly predicable outcomes, such as improving speed, accuracy, and reach through digital business processes. While in relatively stable environments, where external changes are largely predictable, there is always a need to adapt and improve existing operational capabilities so that they can maintain their value (Eisenhardt & Martin, 2000; Protogerou et al., 2012).

7.4 Implications for Research

An important research contribution of this study concerns the application of fsQCA techniques to examine the impact of IT-enabled dynamic capabilities under varying conditions of environmental uncertainty; dynamism, heterogeneity, and hostility. Using fsQCA enables a different point-of-view concerning the impact of IT, since it allows for equifinality, meaning that an outcome of interest may be explained by one or more solutions. In this study, we use fsQCA to demonstrate how IT-enabled dynamic capabilities perform under different combinations of environmental uncertainty conditions. Conventionally, researchers would either examine the impact of environmental uncertainty as a moderator of an association or through a split sample analysis. These approaches however do not capture the synergies that may exist between the aforementioned environmental uncertainty conditions, and assume that their impact is linear. Yet, information systems and strategic management literatures have recurrently reported that associations when examined under the prism of environmental uncertainty are very rarely linear. Hence, using fsQCA allows

for a more detailed look on the specific combinations of environmental conditions under which IT is of value.

In effect, the PLS-SEM and the fsQCA techniques produce virtuous complementarities, since the former provide an indication of general tendencies in complex cause-effect associations, while the latter allows the examination of specific conditions as well as possible contrarian cases. In our study, no such examples existed. However, there were instances in which firms managed to attain high levels of absorptive capacity regardless of their presence or absence of IT-enabled dynamic capabilities. This serves to demonstrate that even in cases characterized by highly significant associations there may cases in which the value of IT is rendered as non-important. Outcomes such as these are important, since they reflect situations in which investing in developing IT-enabled dynamic capabilities, which are costly and require considerable resources, may not be of particular importance.

7.5 Summary

In this chapter, we have discussed the most important theoretical, practical, and research implications that emerge from our research findings. In terms of theoretical contribution, this study has added to the emerging literature of IT-business value under uncertain environments. Building on the dynamic capabilities perspective, our findings show how IT infused in organizational capabilities can indirectly influence competitive performance. In addition it illustrates the relationship that exists between IT-enabled dynamic capabilities and aspects of a firms IT architecture and governance structure. From a strategic management perspective, our empirical findings shed light on the mechanisms and conditions under which dynamic capabilities lead to competitive performance gains. However, the outcomes of this study are not limited to providing theoretical implications. By concentrating on IT investments in terms of

the organizational capabilities they enable, it is easier to guide practitioners on how to actualize them through targeted IT deployments. Our work therefore provides practitioners with the core capabilities they should build, leaving them to select the IT resources and IT competencies that are most appropriate for actualizing them in each case. We comment on how the conceptual development of the IT-enabled dynamic capabilities construct can help IS researchers in future IT-business value studies. Finally, we raise the importance of using a mixed methods approach to provide an alternative view on research outcomes.

CHAPTER 8

FUTURE DIRECTIONS AND THE WAY AHEAD

This chapter provides directions for future research. We begin by highlighting the main research limitations, on the research content, the design, and the execution. Having outlined the main limitations of this study, we then proceed to propose how future research studies can contribute and answer research questions that were not within the scope of the present research. In closing, we provide an ultimate reflection on IT-business value domain and discuss how future research could inform practice.

8.1 Research Limitations

To actualize the objectives set by this research study, we have set several restrictions on both the content and the design. Next, we present the principal limitations regarding the scope of our study and the boundaries in terms of objectives addressed in this study. We then proceed to delineate the main constraints as part of the methodology selected, and its applicability to the objectives of the study.

8.1.1. On Research Content

The main objective of this research was to specify how IT investments can be leveraged in order to help a firm gain a competitive advantage under uncertain environmental conditions. Towards this aim, the research adopted a firm-level perspective on the impact of IT, examining how IT-enabled dynamic capabilities are developed, and how they impact competitive performance. As described in chapter

2, the IT capabilities construct can be decomposed into three main levels, IT resources, IT competencies, and IT-enabled capabilities. The nature of dependencies posits that individual IT resources are brought together by roles, structures, and processes to form IT competencies, and then it is IT competencies that ultimately form IT-enabled capabilities by infusing and strengthening existing organizational capabilities. Due to the complexity of the different types of IT competencies and their diverse nature, depending on the context of application, our research model has not included them as an intermediary step mediating the relationship of IT flexibility and IT-enabled dynamic capabilities. As such, one of the limitations of this research is that it does not explicitly examine the impact of IT competencies in translating flexible IT architectures into IT-enabled dynamic capabilities. Our study only includes two aspects of modularity, namely IT flexibility and governance decentralization, whereas literature indicates that the transformation into IT-enabled capabilities is dependent upon a nexus of factors. Hence, defining the IT competencies that are required to transform IT resources into IT-enabled dynamic capabilities is not within the scope of this study.

The choice of not including the effect of IT competencies in this study was also due to the choice of the firm as the level of analysis, which makes it difficult to isolate the different types of IT competencies, as well as the roles, structures, and processes that actualize them. Both the level of analysis and the nature of examination through quantitative analysis hinder the possibility of determining the types of IT competencies that help to develop IT-enabled dynamic capabilities. A more appropriate approach would be to perform a qualitative study through interviews with key personnel in business units, and examine the combination of factors that lead to the development of strong IT-enabled dynamic capabilities. Hence, a rigorous qualitative approach would most likely shed light on the process of converting flexible IT architectures into IT-infused organizational capabilities. Of course, such an approach would require examining the process of IT-enabled dynamic capabilities

development in a context specific way, taking into account the industry, firm size, scope of operations, and other factors. The internal and external elements that shape dynamic capabilities have also been described in strategic management literature. However, these factors exceed the objectives and boundaries set by this study. These factors that are considered as antecedents of dynamic capabilities are specified in the literature on the so-called micro-foundations.

8.1.2. On Research Design and Methodology

We have chosen to adopt a quantitative analysis approach to explore the associations and propositions of our conceptual model. Despite its contributions, the present study includes a number of methodological limitations that future research should seek to address. First, as noted already, self-reported data are used to test hypotheses and propositions. Although considerable efforts are undertaken to ensure data quality, the potential of biases cannot be excluded. The perceptual nature of the data, in combination with the use of a single key informant, could mean that there is bias and that factual data do not coincide with respondents' perceptions. Although this study relies on top management respondents as key informants, sampling multiple respondents within a single firm would be useful to check for inter-rater validity and to improve internal validity.

Second, the conceptualization and measurement of IT-enabled dynamic capabilities as a higher order construct comprising of five dimensions is derived by theoretical suggestions. Therefore, the underlying IT-based routines cannot be considered exhaustive, but merely representative of the core areas. Future, context specific work, can be directed towards novel areas of interest such as that of IT-enabled information generating capabilities; meaning the opportunities facilitated by unstructured data processing, and the knowledge that can be extracted through focused use of IT. To verify the existence of other core dimensions in which IT can be

infused, an auxiliary to the literature review method approach would be to perform qualitative interviews with key stakeholders within firms.

Finally, a larger sample of firms would provide more robust results and enable cross-country comparisons as well as identification of differences between industries. As such, a limitation of this study is that it examines the antecedents and impacts of IT-enabled dynamic capabilities in an aggregate manner, seeking general tendencies inherent in firms from a diversity of backgrounds. Differential outcomes may be identified if samples of firms were compared between countries. The different conditions under which firms operate, such as those competing in countries facing financial crises, may indicate that IT-enabled dynamic capabilities may be of increased importance in certain contexts.

8.2 The Way Ahead

Having summarized the main contributions of this study as well as its main limitations, we intend to illustrate some avenues for further research. Since this research bridges the areas of IT-business value and strategic management, we are able to identify how our research outcomes encourage future research.

8.2.1. IT-Business Value Research

One of the most interesting areas of future research would be to investigate how combinations of IT resources under specific roles, structures and processes are amalgamated to form IT competencies. Since the ultimate outcomes variable is the IT-enabled dynamic capabilities construct, it is important to include findings from the micro-foundations literature of dynamic capabilities, which deals a lot with mental models and cognitive perceptions of top managers. Empirical studies linking the three

levels at which IT capabilities are measured are scarce in IT-business value research, yet, they are important since they have the capacity to demonstrate how inputs can be effectively transformed into strategic outputs. While IT-business value research has predominantly considered that just by accumulating IT resources will suffice to achieve competitive returns, the commoditization of IT in the industry sphere necessitates a shift in explaining how IT resources are utilized.

In this direction, our study has contributed by demonstrating the organizational capabilities in which IT can be infused to strengthen them. It is important however to go into more detail, and specifically examine how each of the dimensions of the IT-enabled dynamic capabilities construct is developed. As mentioned in Chapter 7, IT-enabled dynamic capabilities may take different forms depending on a multitude of different factors. In this direction, future ventures could explore how emerging technologies can change firms operations, and particularly how they influence each IT-enabled capability. Hence, it would be pertinent to examine how these technologies can be optimally leveraged to produce or strengthen certain organizational capabilities. As our previous discussion dictates, this does not only require that the physical infrastructure is taken into account, but also how the human resources and relational capital are transformed into IT competencies that foster the development of IT-enabled dynamic capabilities.

Finally, future studies can build on the limitation of the present research and focus on specific industries or domains for explaining the impact of IT-enabled dynamic capabilities on competitive performance. Such an approach would provide additional details on how IT-enabled dynamic capabilities act in different contexts as well as how their impact may vary. It is quite reasonable to assume that IT-enabled dynamic capabilities may not be of high importance in certain industries, while in others their value may be accentuated.

8.2.2. Dynamic Capabilities Research

Although our research was adapted to the IT context, several theoretical implications that result from findings can be taken into consideration for future studies on dynamic capabilities. First, it is important to understand how dynamic capabilities are developed. In our research, we have used a set of antecedent factors based on the modular systems theory. Although the value of decentralization and modular forms has been mentioned in several dynamic capabilities studies, there are few empirical studies that examine their impact. Future research studies could delve into the complementarities of the DCV and modular systems theory and explain how modularization of structures, designs, and processes are associated with dynamic capabilities.

Furthermore, dynamic capabilities literature could benefit by adopting a contingency approach. What our findings showed was that dynamic capabilities manifested through IT-enabled organizational capabilities, can be of value in a range of different environmental uncertainty conditions, from dynamic and heterogeneous environments, to relatively stable environments which are characterized by an absence of hostility and heterogeneity. Following this approach, future studies could include additional internal and/or external factors such as industry, top management support, past knowledge etc., to better capture the conditions that promote the rent-yielding properties of dynamic capabilities. These type of studies could have important practical implications, since they would pinpoint managers if it is viable for them to invest in developing dynamic capabilities.

8.3 An Ultimate Reflection

In the global competitive landscape, the pace of change, the constantly changing market dynamics, and the unpredictability of future technological developments,

forces companies to develop mechanisms to ensure their firms survival. As a result, practitioners are relying now more than ever on IT investments to help them make informed decisions, and ultimately outperform rivals. First, they have to be alert for changing business requirements and able to swiftly update their strategic and operational plans. Second, they should be capable of producing innovative products and services. Third, they must be capable of tightly monitoring operations within their firm, and be able in real-time to implement improvements in operations that slice unnecessary costs.

An emerging body of IT-business value research examines the impact that IT investments may have on the competitive survival of firms taking into account the external environment. Nevertheless, there is less research on the mechanisms through which IT investments can confer value, but also largely disregarded the influence of the external environment. Recent calls urge researchers to engage in empirical work towards this direction.

Recognizing the aforementioned points, our study demonstrated how IT should be leveraged to form IT-enabled dynamic capabilities, and examined the mechanisms and conditions upon which they contribute towards competitive performance. The outcomes of our study serve to illustrate that IT capabilities should be examined at different levels, and that achieving competitive performance gains through IT requires that a series of capabilities are triggered.

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APPENDIX A.

SURVEY INSTRUMENT

THE IMPACT OF IT-ENABLED CAPABILITIES ON COMPETITIVE ADVANTAGE

The present survey is part of a Ph.D. research project coordinated by the Ionian University. Data collected will remain anonymous and will be used for research purposes solely at an aggregate level.

The aim of our project is to determine the impact of IT-enabled capabilities on attaining and sustaining a competitive advantage in conditions of moderate to high environmental turbulence. Specifically, we aim to understand the paths of causal conditions through which firms can realize performance improvements as a result of their IT investments.

Respondents should be employed in the positions of CIO, CTO, CEO, or high level IT or business executives that are knowledgeable about IT investments made within their company and performance outcomes.

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Respondent Information

Name:_____

Surname:_____

Email:_____

Company Name:_____

Title of position held:_____

Country:_____

1. Background Information

[BG1] Please indicate the size-class of your company. (Number of employees)

1. 1 - 9
2. 10 - 49
3. 50 - 249
4. 250 +

[BG2] In which industry does your organization operate (considering only the core-business of your organization)?

1 Oil & Gas
2 Basic Materials (Chemicals, paper, industrial metals & mining)
3 Industrials (Construction & industrial goods)
4 Consumer Goods
5 Health Care
6 Consumer Services
7 Telecommunications
8 Utilities
9 Financials
10 Technology
11 Consulting Services
12 Education
13 Other:_____

[BG3] Please indicate what percentage of revenues you spend on Information Communication Technology (ICT) and consulting services during the last year.

% of revenues

[BG4] Please indicate the age of your company.

1. < 1 Year
2. 1-5 Years
3. 6-10 Years
4. 10-50 Years
5. > 50 Years

[BG5] Please select the category under which your organization falls under.

1. Private Sector
2. Public Sector
3. Non-Governmental Organization (NGO)
4. Non-Profit Organization (NPO)
5. Other (Please Specify):_____

2. Information Technology

2.1 IT-Enabled Dynamic Capabilities

Please indicate the degree to which you are effective in leveraging your IT systems for the following purposes: (1-Not effective at all, 7-Highly effective)

Sensing	1	2	3	4	5	6	7
Scanning the environment and identifying new business opportunities							
Reviewing our product development efforts to ensure they are in line with what the customers want.							
Implementing new ideas for new products and improving existing products or services.							
Anticipating discontinuities arising in our business domain by developing greater reactive and proactive strength							

Coordinating	1	2	3	4	5	6	7
Providing more effective coordination among different functional activities							
Providing more effective coordination with customers, business partners and distributors							

Ensuring that the output of work is synchronized with the work of other functional units or business partners.							
Reducing redundant tasks, or overlapping activities performed by different operational units							

Learning	1	2	3	4	5	6	7
Identifying, evaluating, and importing new information and knowledge							
Transforming existing information into new knowledge							
Assimilating new information and knowledge							
Using accumulated information and knowledge to assist decision making							

Integrating	1	2	3	4	5	6	7
Easily accessing data and other valuable resources in real time from business partners							
Aggregating relevant information from business partners, suppliers and customers. (e.g. operating information, business customer performance)							
Collaborating in demand forecasting and planning between our firm and our business partners							
Streamlining business processes with suppliers, distributors, and customers							

Reconfiguring	1	2	3	4	5	6	7
Adjusting for and responding to unexpected changes easily							
Easily adding an eligible new partner that you want to do business with, or removing ones which you have terminated your partnership							
Adjusting our business processes in response to shifts in our business priorities							
Reconfiguring our business processes in order to come up with new productive assets							

2.2 IT Flexibility

To what extent do you agree with the following statements? (1 – totally disagree 7 – totally agree)

Modularity	1	2	3	4	5	6	7
Our information systems are highly modular.							
The manner in which the components of our information systems are organized and integrated allows for rapid changes.							
Functionality can be quickly added to critical applications based on end-user requests							

Exchanging or modifying single components does not affect our IT infrastructure.							
Organizational IT infrastructure and applications are developed on the basis of minimal unnecessary interdependencies							
Organizational IT infrastructure and applications are loosely coupled.							

Transparency	1	2	3	4	5	6	7
Remote users can seamlessly access centralized data and processes							
Our user interfaces provides transparent access to all platforms and applications							
Software applications can be easily transported and used across multiple platforms							
Data of one system can be easily used in other systems.							

Standardization	1	2	3	4	5	6	7
We have established corporate rules and standards for hardware and operating systems to ensure platform compatibility							
We have identified and standardized data to be shared across systems and business units.							
Our systems are developed in order to incorporate electronic links to external parties							
Organizational IT infrastructure and applications are highly interoperable							

Scalability	1	2	3	4	5	6	7
Our IT infrastructure easily compensates peaks in transaction volumes.							
Our information systems are scalable.							
Our IT infrastructure offers sufficient capacity in order to fulfill additional orders.							
The performance of our IT infrastructure completely fulfills our business needs regardless of usage magnitude							

2.3 IT Governance Centralization

What is the extent of centralization regarding decision making for the following IT services in your company? (1 – Decentralized in lines of business 5 – Centralized in corporate IT group)

	1	2	3	4	5
Infrastructure planning and management					
Application development, project prioritization and approval					
IT development and implementation					

3. Organizational Capabilities

3.1 Absorptive Capacity

To what extent do you agree with the following statements? (1 – totally disagree 7 – totally agree)

Acquisition	1	2	3	4	5	6	7
We are successful in learning new things.							
We are effective in developing new knowledge or insights that have the potential to influence product/service development.							
We are able to identify and acquire internal (e.g., within the firm) and external (e.g., market) knowledge.							

Assimilation	1	2	3	4	5	6	7
We have effective routines to identify, value, and import new information and knowledge from channel partners.							
We have adequate routines to analyze the information and knowledge obtained.							
We have adequate routines to assimilate new information and knowledge.							

Transformation	1	2	3	4	5	6	7
We can successfully integrate our existing knowledge with the new information and knowledge acquired.							
We are effective in transforming existing information into new knowledge.							
We can successfully grasp the opportunities for our firm from new external knowledge.							

Exploitation	1	2	3	4	5	6	7
We can successfully exploit the new integrated information and knowledge into concrete applications.							
We are effective in utilizing knowledge into new products.							
We constantly consider better ways to exploit knowledge.							

3.2 Organizational Agility

Relative to your competitors, please indicate how well your organizations performs or is positioned to perform the following activities? (1 – totally disagree 7 – totally agree)

Operational Agility	1	2	3	4	5	6	7
We can quickly scale up or scale down our production/service levels to support fluctuations in demand from the market.							
Whenever there is a disruption in supply from our suppliers we can quickly make necessary alternative arrangements and internal adjustments.							
We fulfill demands for rapid-response, special requests of our customers whenever such demands arise; our customers have confidence in our ability.							

Market Capitalizing Agility	1	2	3	4	5	6	7
We are quick to make and implement appropriate decisions in the face of market/customer-changes.							
We constantly look for ways to reinvent/reengineer our organization to better serve our market place.							
We treat market-related changes and apparent chaos as opportunities to capitalize quickly.							

3.2 Networking

Please rate the extent of your company`s collaborations with the following linkages (1 – very low 7 – very high)

	1	2	3	4	5	6	7
Suppliers							
Customers							
Infrastructure and service providers							
Other firms, for technology development							
Universities or research institutions							

4. Environmental Uncertainty

With respect to the uncertainty of your environment, please indicate how much you agree or disagree with the following statements: (1 – totally disagree 7 – totally agree)

Dynamic	1	2	3	4	5	6	7
Products and services in our industry become obsolete very quickly							
The product/services technologies in our industry change very quickly							
We can predict what our competitors are going to do next							
We can predict when our products/services demand changes							

Heterogenous	1	2	3	4	5	6	7
In our industry, there is considerable diversity in: customer buying habits							
In our industry, there is considerable diversity in: nature of competition							
In our industry, there is considerable diversity in: product lines							

Hostile	1	2	3	4	5	6	7
The survival of this organization is currently threatened by: scarce supply of labor							
The survival of this organization is currently threatened by: scarce supply of materials							
The survival of this organization is currently threatened by: tough price competition							
The survival of this organization is currently threatened by: tough competition in product/service quality							
The survival of this organization is currently threatened by: tough competition in product/service differentiation							

5. Performance

5.1 Competitive Performance

Compared with your key competitors, please indicate how much you agree or disagree with the following statements regarding the degree to which you perform better than them: (1 – totally disagree 7 – totally agree)

	1	2	3	4	5	6	7
Return on investment (ROI)							
Profits as percentage of sales							
Decreasing product or service delivery cycle time							
Rapid response to market demand							
Rapid confirmation of customer orders							
Increasing customer satisfaction							
In profit growth rates							
In reducing operating costs							
Providing better product and service quality							

Increasing our market share							

5.2 Innovative Capability

How would you rate your organizations capability to generate the following types of innovations in the products/services you introduce (1 = much weaker than competition; 7 = much stronger than competition)?

Incremental Innovative Capability	1	2	3	4	5	6	7
Innovations that reinforce your prevailing product/service lines							
Innovations that reinforce your existing expertise in prevailing products/services							
Innovations that reinforce how you currently compete							

Radical Innovative Capability	1	2	3	4	5	6	7
Innovations that make your prevailing product/service lines obsolete							
Innovations that fundamentally change your prevailing products/services							
Innovations that make your existing expertise in prevailing products/services obsolete							

APPENDIX B.

FACTOR LOADINGS AND CROSS-LOADINGS

	IT_MOD	IT_STAND	IT_TRANS	IT_SCAL	IT_GOV	ITDC_SNS	ITDC_CRD	ITDC_LRN	ITDC_INT	ITDC_REC	AGI_MCA	AGI_OAA	ABS_ACQ	ABS_ASM	ABS_TRA	ABS_EXP	INN_INC	INN_RAD	ENV_DYN	ENV_HET	ENV_HOS	CP
IT_MOD1	**0.87**	0.43	0.63	0.65	0.42	0.62	0.61	0.57	0.46	0.53	0.46	0.38	0.46	0.42	0.54	0.50	0.43	0.39	0.29	0.06	0.03	0.37
IT_MOD2	**0.87**	0.37	0.53	0.54	0.32	0.61	0.63	0.58	0.51	0.53	0.46	0.35	0.46	0.42	0.58	0.52	0.44	0.44	0.24	0.19	0.13	0.37
IT_MOD3	**0.82**	0.36	0.55	0.55	0.30	0.59	0.58	0.54	0.48	0.49	0.45	0.29	0.34	0.35	0.47	0.42	0.40	0.34	0.35	0.27	0.20	0.38
IT_MOD4	**0.84**	0.37	0.65	0.52	0.32	0.51	0.55	0.41	0.36	0.47	0.52	0.28	0.33	0.27	0.44	0.36	0.43	0.37	0.33	0.20	0.16	0.46
IT_MOD5	**0.82**	0.44	0.55	0.52	0.25	0.52	0.54	0.49	0.43	0.49	0.46	0.28	0.38	0.41	0.45	0.38	0.44	0.47	0.24	0.22	0.16	0.49
IT_MOD6	**0.78**	0.35	0.58	0.44	0.19	0.47	0.40	0.45	0.34	0.34	0.36	0.24	0.37	0.28	0.38	0.36	0.32	0.43	0.27	0.25	0.11	0.36
IT_STAND1	0.40	**0.81**	0.45	0.60	0.41	0.48	0.50	0.44	0.42	0.44	0.32	0.33	0.33	0.38	0.36	0.39	0.41	0.34	0.33	0.05	0.02	0.28
IT_STAND2	0.46	**0.84**	0.45	0.56	0.40	0.52	0.49	0.53	0.50	0.43	0.32	0.36	0.30	0.38	0.35	0.38	0.42	0.43	0.41	0.17	0.06	0.32
IT_STAND3	0.38	**0.73**	0.49	0.48	0.30	0.56	0.49	0.44	0.49	0.43	0.40	0.35	0.31	0.45	0.37	0.38	0.40	0.38	0.37	0.15	0.10	0.29
IT_STAND4	0.32	**0.89**	0.46	0.54	0.38	0.36	0.39	0.37	0.44	0.33	0.29	0.26	0.32	0.36	0.26	0.29	0.32	0.34	0.43	0.05	0.09	0.28
IT_STAND5	0.35	**0.87**	0.49	0.54	0.37	0.39	0.43	0.38	0.48	0.37	0.32	0.29	0.33	0.39	0.25	0.29	0.41	0.39	0.40	0.08	0.08	0.32
IT_TRANS1	0.54	0.43	**0.79**	0.55	0.39	0.30	0.32	0.36	0.25	0.34	0.45	0.37	0.45	0.28	0.40	0.40	0.30	0.30	0.33	0.06	-0.03	0.28
IT_TRANS2	0.59	0.51	**0.88**	0.68	0.38	0.41	0.48	0.43	0.39	0.39	0.47	0.32	0.35	0.28	0.42	0.42	0.36	0.39	0.34	0.12	0.05	0.28
IT_TRANS3	0.62	0.45	**0.85**	0.54	0.27	0.44	0.49	0.38	0.37	0.38	0.40	0.30	0.26	0.27	0.31	0.38	0.38	0.42	0.29	0.21	0.13	0.36
IT_TRANS4	0.61	0.44	**0.79**	0.57	0.22	0.46	0.42	0.36	0.36	0.40	0.31	0.17	0.23	0.19	0.30	0.32	0.36	0.39	0.27	0.24	0.06	0.23
IT_TRANS5	0.47	0.49	**0.78**	0.51	0.30	0.44	0.41	0.34	0.37	0.45	0.46	0.32	0.29	0.22	0.32	0.36	0.38	0.36	0.22	0.16	0.10	0.36
IT_SCAL1	0.53	0.58	0.61	**0.90**	0.38	0.50	0.55	0.49	0.47	0.44	0.39	0.23	0.38	0.37	0.45	0.42	0.46	0.34	0.32	0.10	0.01	0.24
IT_SCAL2	0.62	0.59	0.68	**0.93**	0.40	0.53	0.57	0.53	0.46	0.50	0.42	0.27	0.41	0.36	0.46	0.47	0.48	0.38	0.36	0.08	0.06	0.28
IT_SCAL3	0.55	0.58	0.61	**0.94**	0.38	0.46	0.57	0.52	0.43	0.40	0.35	0.23	0.41	0.30	0.40	0.39	0.42	0.36	0.38	0.08	0.04	0.21
IT_SCAL4	0.65	0.64	0.64	**0.87**	0.35	0.50	0.63	0.59	0.54	0.46	0.38	0.28	0.44	0.35	0.46	0.45	0.44	0.41	0.43	0.06	0.03	0.27
IT_GOV1	0.28	0.40	0.34	0.40	**0.85**	0.34	0.36	0.38	0.38	0.35	0.29	0.26	0.35	0.33	0.35	0.33	0.29	0.28	0.32	-0.02	0.10	0.23
IT_GOV2	0.35	0.36	0.35	0.36	**0.93**	0.47	0.42	0.42	0.46	0.41	0.34	0.27	0.43	0.41	0.37	0.36	0.39	0.37	0.29	0.12	0.11	0.35
IT_GOV3	0.34	0.46	0.33	0.37	**0.91**	0.42	0.37	0.43	0.40	0.39	0.21	0.30	0.40	0.42	0.38	0.35	0.36	0.35	0.26	0.06	0.12	0.28
ITDC_SNS1	0.50	0.41	0.38	0.39	0.32	**0.84**	0.60	0.56	0.58	0.59	0.49	0.39	0.39	0.50	0.45	0.43	0.42	0.41	0.31	0.24	0.21	0.38
ITDC_SNS2	0.50	0.50	0.39	0.42	0.46	**0.85**	0.58	0.60	0.68	0.56	0.50	0.39	0.51	0.54	0.49	0.52	0.43	0.34	0.37	0.18	0.24	0.37
ITDC_SNS3	0.66	0.48	0.47	0.54	0.39	**0.86**	0.71	0.65	0.59	0.57	0.51	0.44	0.48	0.53	0.61	0.62	0.55	0.50	0.27	0.23	0.21	0.46
ITDC_SNS4	0.62	0.51	0.47	0.52	0.41	**0.88**	0.68	0.64	0.67	0.66	0.56	0.39	0.43	0.49	0.50	0.53	0.51	0.43	0.35	0.29	0.25	0.41
ITDC_CRD1	0.59	0.46	0.49	0.61	0.41	0.67	**0.88**	0.64	0.57	0.59	0.53	0.32	0.46	0.50	0.52	0.57	0.53	0.50	0.35	0.18	0.17	0.42

ITDC_CRD2	0.51	0.42	0.43	0.52	0.26	0.61	**0.83**	0.57	0.62	0.52	0.47	0.26	0.41	0.35	0.48	0.46	0.41	0.35	0.38	0.15	0.14	0.33
ITDC_CRD3	0.57	0.56	0.43	0.56	0.42	0.65	**0.86**	0.65	0.59	0.62	0.50	0.37	0.48	0.50	0.52	0.54	0.51	0.53	0.36	0.23	0.20	0.41
ITDC_CRD4	0.58	0.44	0.42	0.49	0.34	0.62	**0.82**	0.60	0.58	0.62	0.51	0.35	0.38	0.44	0.49	0.53	0.44	0.37	0.32	0.21	0.25	0.43
ITDC_LRN1	0.56	0.51	0.46	0.56	0.41	0.68	0.65	**0.92**	0.59	0.67	0.49	0.44	0.56	0.52	0.57	0.63	0.51	0.52	0.37	0.30	0.18	0.38
ITDC_LRN2	0.56	0.47	0.40	0.53	0.43	0.65	0.65	**0.93**	0.60	0.69	0.48	0.42	0.53	0.49	0.61	0.66	0.47	0.46	0.41	0.29	0.21	0.34
ITDC_LRN3	0.59	0.46	0.40	0.53	0.41	0.65	0.69	**0.94**	0.58	0.67	0.49	0.44	0.56	0.56	0.63	0.66	0.47	0.49	0.35	0.32	0.22	0.36
ITDC_LRN4	0.53	0.48	0.41	0.53	0.43	0.66	0.68	**0.89**	0.60	0.68	0.48	0.44	0.51	0.51	0.56	0.61	0.46	0.45	0.37	0.27	0.16	0.35
ITDC_INT1	0.55	0.45	0.50	0.53	0.42	0.65	0.61	0.56	**0.84**	0.58	0.49	0.39	0.46	0.49	0.51	0.48	0.40	0.40	0.44	0.12	0.14	0.32
ITDC_INT2	0.50	0.54	0.41	0.48	0.42	0.69	0.62	0.59	**0.91**	0.58	0.46	0.42	0.45	0.49	0.49	0.51	0.41	0.39	0.36	0.15	0.22	0.34
ITDC_INT3	0.33	0.51	0.23	0.37	0.40	0.61	0.54	0.53	**0.86**	0.57	0.41	0.31	0.38	0.51	0.42	0.45	0.38	0.37	0.33	0.22	0.23	0.24
ITDC_INT4	0.41	0.47	0.33	0.45	0.38	0.62	0.64	0.57	**0.87**	0.53	0.45	0.32	0.44	0.55	0.52	0.50	0.42	0.33	0.31	0.18	0.23	0.34
ITDC_REC1	0.58	0.40	0.43	0.49	0.41	0.60	0.64	0.65	0.56	**0.87**	0.63	0.49	0.41	0.45	0.49	0.52	0.50	0.48	0.26	0.34	0.27	0.44
ITDC_REC2	0.43	0.39	0.40	0.40	0.34	0.58	0.56	0.60	0.51	**0.83**	0.51	0.52	0.44	0.43	0.51	0.57	0.36	0.33	0.24	0.21	0.20	0.34
ITDC_REC3	0.46	0.42	0.36	0.37	0.36	0.61	0.60	0.66	0.62	**0.91**	0.53	0.43	0.39	0.48	0.46	0.55	0.40	0.40	0.32	0.33	0.21	0.42
ITDC_REC4	0.55	0.49	0.49	0.49	0.41	0.68	0.64	0.71	0.61	**0.92**	0.57	0.42	0.46	0.51	0.49	0.59	0.44	0.45	0.34	0.35	0.22	0.42
AGI_MCA1	0.50	0.30	0.41	0.33	0.28	0.54	0.51	0.48	0.41	0.58	**0.88**	0.64	0.43	0.42	0.53	0.51	0.54	0.31	0.31	0.25	0.16	0.52
AGI_MCA2	0.42	0.40	0.44	0.41	0.35	0.56	0.55	0.49	0.51	0.55	**0.90**	0.51	0.49	0.40	0.50	0.54	0.53	0.38	0.41	0.27	0.16	0.52
AGI_MCA3	0.51	0.35	0.50	0.38	0.20	0.50	0.51	0.42	0.47	0.55	**0.87**	0.51	0.38	0.34	0.45	0.48	0.45	0.35	0.22	0.25	0.15	0.47
AGI_OAA1	0.38	0.32	0.36	0.29	0.22	0.43	0.35	0.47	0.37	0.50	0.53	**0.84**	0.41	0.47	0.46	0.54	0.37	0.28	0.22	0.22	0.09	0.36
AGI_OAA2	0.20	0.33	0.25	0.16	0.26	0.36	0.24	0.33	0.30	0.40	0.45	**0.82**	0.25	0.36	0.38	0.39	0.26	0.20	0.22	0.25	0.17	0.42
AGI_OAA3	0.32	0.30	0.28	0.24	0.28	0.38	0.35	0.37	0.36	0.39	0.58	**0.82**	0.42	0.32	0.49	0.51	0.34	0.25	0.38	0.29	0.09	0.34
ABS_ACQ1	0.39	0.28	0.31	0.37	0.28	0.48	0.48	0.48	0.43	0.40	0.43	0.34	**0.86**	0.54	0.61	0.57	0.40	0.37	0.36	0.16	0.11	0.39
ABS_ACQ2	0.44	0.35	0.36	0.41	0.40	0.45	0.43	0.51	0.44	0.41	0.44	0.42	**0.90**	0.59	0.71	0.70	0.51	0.42	0.42	0.21	0.11	0.38
ABS_ACQ3	0.42	0.38	0.37	0.43	0.48	0.50	0.46	0.58	0.47	0.48	0.44	0.42	**0.92**	0.60	0.74	0.70	0.51	0.47	0.37	0.21	0.16	0.39
ABS_ASM1	0.35	0.45	0.23	0.32	0.38	0.54	0.49	0.50	0.54	0.50	0.41	0.43	0.58	**0.89**	0.59	0.57	0.41	0.40	0.26	0.27	0.23	0.41
ABS_ASM2	0.38	0.46	0.28	0.36	0.38	0.54	0.48	0.48	0.53	0.48	0.38	0.41	0.53	**0.92**	0.58	0.54	0.38	0.41	0.23	0.22	0.31	0.45
ABS_ASM3	0.44	0.39	0.32	0.36	0.43	0.56	0.49	0.56	0.54	0.47	0.42	0.43	0.66	**0.93**	0.65	0.63	0.42	0.44	0.33	0.23	0.25	0.44
ABS_TRA1	0.51	0.38	0.31	0.41	0.34	0.54	0.54	0.62	0.49	0.51	0.47	0.53	0.69	0.64	**0.90**	0.74	0.48	0.43	0.35	0.25	0.15	0.35
ABS_TRA2	0.49	0.30	0.40	0.43	0.40	0.51	0.52	0.58	0.51	0.51	0.49	0.45	0.67	0.57	**0.88**	0.68	0.43	0.37	0.34	0.21	0.15	0.37
ABS_TRA3	0.52	0.34	0.44	0.46	0.35	0.54	0.53	0.51	0.49	0.45	0.54	0.44	0.69	0.56	**0.88**	0.71	0.51	0.37	0.34	0.19	0.14	0.37
ABS_EXP1	0.50	0.41	0.47	0.48	0.34	0.54	0.57	0.65	0.49	0.55	0.48	0.51	0.65	0.57	0.74	**0.90**	0.50	0.49	0.36	0.33	0.18	0.34
ABS_EXP2	0.42	0.33	0.36	0.41	0.40	0.51	0.52	0.59	0.49	0.55	0.47	0.47	0.67	0.55	0.70	**0.91**	0.54	0.46	0.36	0.28	0.13	0.33
ABS_EXP3	0.44	0.37	0.39	0.38	0.29	0.59	0.57	0.61	0.51	0.58	0.59	0.57	0.64	0.57	0.69	**0.85**	0.52	0.42	0.30	0.30	0.28	0.44
INN_INC1	0.47	0.45	0.43	0.48	0.37	0.51	0.53	0.50	0.45	0.48	0.55	0.38	0.50	0.39	0.48	0.53	**0.92**	0.61	0.36	0.16	0.14	0.51
INN_INC2	0.43	0.42	0.32	0.40	0.37	0.51	0.52	0.49	0.41	0.42	0.52	0.37	0.51	0.40	0.53	0.56	**0.93**	0.66	0.26	0.20	0.19	0.51
INN_INC3	0.44	0.42	0.44	0.48	0.33	0.50	0.48	0.43	0.40	0.41	0.49	0.32	0.43	0.40	0.44	0.51	**0.88**	0.61	0.27	0.17	0.17	0.48
INN_RAD1	0.47	0.37	0.42	0.35	0.31	0.47	0.48	0.48	0.36	0.43	0.34	0.28	0.43	0.40	0.38	0.46	0.59	**0.92**	0.14	0.17	0.25	0.44
INN_RAD2	0.43	0.46	0.44	0.41	0.36	0.44	0.46	0.46	0.36	0.43	0.43	0.30	0.44	0.39	0.41	0.49	0.71	**0.91**	0.25	0.20	0.23	0.44
INN_RAD3	0.45	0.42	0.39	0.38	0.36	0.46	0.49	0.51	0.46	0.44	0.31	0.25	0.43	0.46	0.43	0.46	0.60	**0.93**	0.19	0.22	0.25	0.44
ENV_DYN3	0.24	0.38	0.23	0.28	0.20	0.29	0.31	0.30	0.33	0.26	0.16	0.24	0.27	0.22	0.21	0.22	0.23	0.19	**0.84**	0.08	0.11	0.21
ENV_DYN4	0.35	0.44	0.38	0.43	0.35	0.37	0.41	0.41	0.39	0.32	0.43	0.34	0.46	0.30	0.44	0.44	0.33	0.18	**0.91**	0.18	0.14	0.23
ENV_HET1	0.13	0.08	0.13	0.06	0.09	0.20	0.18	0.30	0.20	0.31	0.27	0.34	0.27	0.26	0.28	0.30	0.12	0.11	0.13	**0.84**	0.37	0.22
ENV_HET2	0.28	0.14	0.26	0.14	0.02	0.28	0.22	0.30	0.16	0.30	0.24	0.19	0.16	0.23	0.19	0.28	0.22	0.27	0.15	**0.86**	0.42	0.29
ENV_HET3	0.17	0.07	0.08	0.01	0.06	0.20	0.16	0.20	0.12	0.26	0.20	0.24	0.11	0.16	0.13	0.27	0.15	0.15	0.10	**0.82**	0.40	0.20
ENV_HOS2	0.12	0.01	0.04	0.02	0.09	0.21	0.21	0.21	0.24	0.20	0.04	0.08	0.04	0.18	0.04	0.05	0.07	0.16	0.01	0.26	**0.72**	0.18

ENV_HOS4	0.12	0.12	0.07	0.04	0.10	0.22	0.16	0.11	0.16	0.16	0.19	0.08	0.10	0.24	0.16	0.22	0.19	0.23	0.23	0.37	**0.76**	0.25
ENV_HOS5	0.09	0.07	0.05	0.03	0.10	0.13	0.09	0.11	0.06	0.17	0.21	0.18	0.22	0.21	0.23	0.28	0.18	0.20	0.11	0.46	**0.70**	0.26
CP1	0.41	0.31	0.35	0.26	0.28	0.44	0.41	0.29	0.32	0.40	0.50	0.41	0.35	0.46	0.36	0.35	0.43	0.39	0.19	0.28	0.23	**0.77**
CP2	0.36	0.28	0.32	0.23	0.28	0.41	0.39	0.29	0.34	0.33	0.49	0.37	0.32	0.37	0.35	0.34	0.48	0.36	0.20	0.20	0.28	**0.77**
CP3	0.39	0.25	0.27	0.25	0.34	0.41	0.35	0.33	0.32	0.45	0.40	0.32	0.38	0.41	0.36	0.32	0.44	0.39	0.17	0.26	0.23	**0.76**
CP4	0.44	0.29	0.28	0.24	0.30	0.42	0.40	0.38	0.34	0.49	0.51	0.37	0.40	0.45	0.38	0.37	0.46	0.40	0.20	0.19	0.21	**0.85**
CP5	0.38	0.20	0.35	0.19	0.21	0.35	0.34	0.27	0.25	0.41	0.51	0.44	0.31	0.34	0.27	0.31	0.34	0.31	0.21	0.27	0.26	**0.82**
CP6	0.37	0.33	0.26	0.22	0.23	0.36	0.36	0.30	0.24	0.30	0.38	0.30	0.29	0.34	0.25	0.25	0.40	0.40	0.24	0.16	0.23	**0.80**
CP7	0.33	0.33	0.25	0.15	0.14	0.32	0.31	0.27	0.25	0.31	0.47	0.38	0.27	0.32	0.29	0.32	0.49	0.44	0.09	0.24	0.31	**0.83**
CP9	0.40	0.32	0.24	0.23	0.28	0.39	0.41	0.32	0.25	0.30	0.38	0.29	0.38	0.35	0.30	0.31	0.46	0.40	0.25	0.15	0.20	**0.83**
CP10	0.43	0.31	0.31	0.23	0.31	0.33	0.40	0.36	0.26	0.31	0.47	0.33	0.44	0.37	0.38	0.43	0.44	0.37	0.26	0.30	0.25	**0.79**

APPENDIX C.

CONTRARIAN CASE ANALYSES

Quantile cross-tabulation for IT-enabled capabilities and Organizational agility

IT-enabled dynamic capabilities \ Organizational Agility	1	2	3	4	5	Total
1	31 (11.3%)	16 (5.8%)	4 (1.5%)	**4 (1.5%)**	**0 (0%)**	55 (20.1%)
2	9 (3.3%)	21 (7.7%)	9 (3.3%)	**8 (2.9%)**	**9 (3.3%)**	56 (20.4%)
3	6 (2.2%)	20 (7.3%)	9 (3.3%)	11 (4.0%)	9 (3.3%)	55 (20.1%)
4	**0 (0%)**	**20 (7.3%)**	8 (2.9%)	16 (5.8%)	9 (3.3%)	53 (19.3%)
5	**2 (0.7%)**	**0 (0%)**	0 (0%)	19 (6.9%)	34 (12.4%)	55 (20.1%)
Total	48 (17.5%)	77 (28.1%)	30 (10.9%)	58 (21.2%)	61 (22.3%)	274 (100%)

Note. The significant main effect relationship indicates a large effect size, $\varphi^2 = .588$ ($p < 0.001$). However, contrarian cases still occur (marked in light grey bolded squares).

Quantile cross-tabulation for IT-enabled capabilities and Absorptive capacity

IT-enabled dynamic capabilities	Absorptive Capacity 1	2	3	4	5	Total
1	18 (6.6%)	27 (9.9%)	3 (1.1%)	**4 (1.5%)**	**3 (1.1%)**	55 (20.1%)
2	17 (6.2%)	16 (5.8%)	7 (2.6%)	**11 (4.0%)**	**5 (1.8%)**	56 (20.4%)
3	5 (1.8%)	22 (8.0%)	6 (2.2%)	10 (3.6%)	12 (4.4%)	55 (20.1%)
4	**4 (1.5%)**	**10 (3.6%)**	6 (2.2%)	19 (6.9%)	14 (5.1%)	53 (19.3%)
5	**3 (1.1%)**	**0 (0%)**	10 (3.6%)	12 (4.4%)	30 (10.9%)	55 (20.1%)
Total	47 (17.2%)	75 (27.4%)	32 (11.7%)	56 (20.4%)	64 (23.4%)	274 (100%)

Note. The significant main effect relationship indicates a medium-to-large effect size, $\varphi^2 = .374$ ($p < 0.001$). However, contrarian cases still occur (marked in light grey bolded squares).