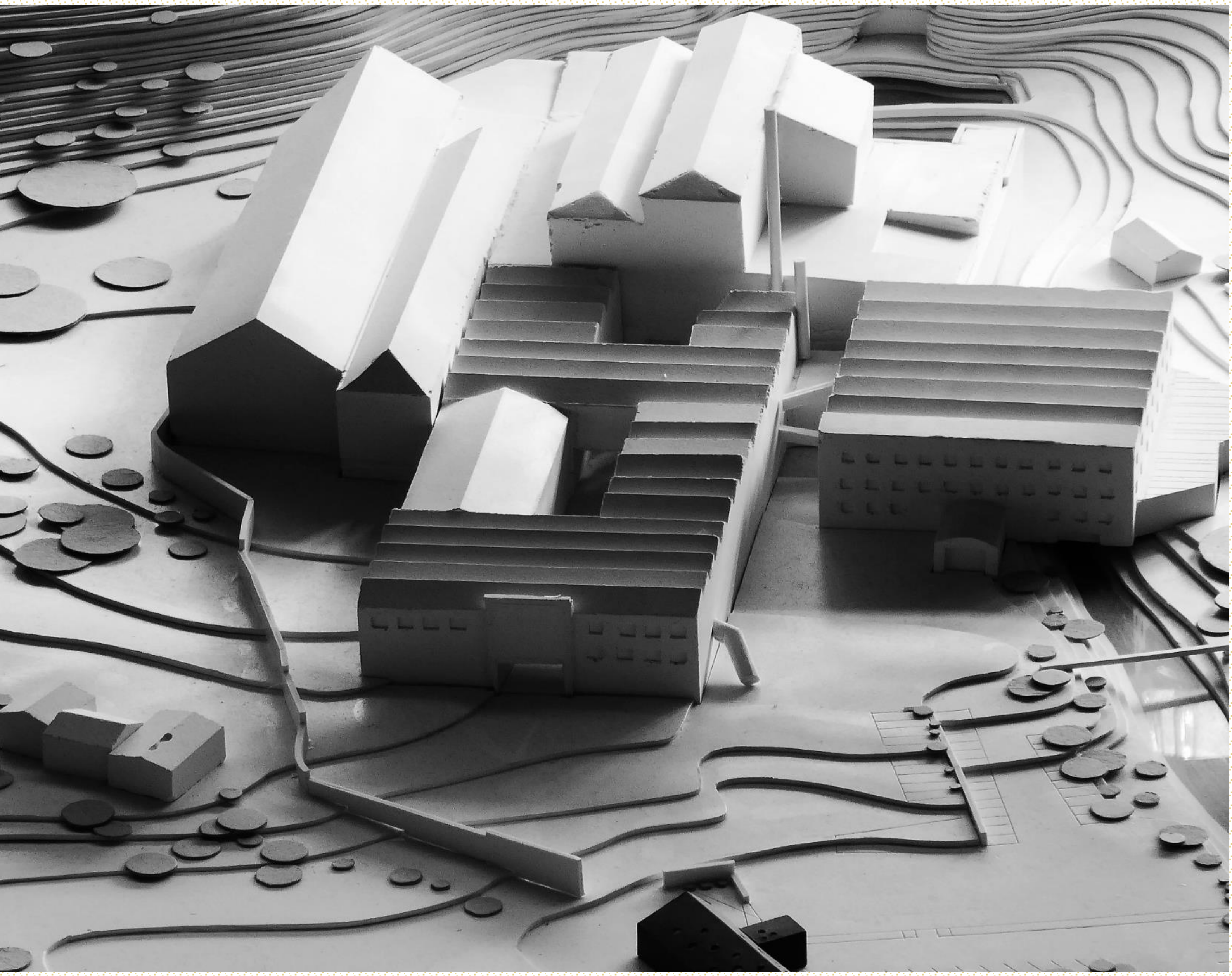

José Manuel Marques Pinheiro

Strategic Determinants of Adaptability

Doctoral Thesis of the Doctoral Program in Business Management, specialization in Strategy, supervised by Professor Miguel Torres Preto, Professor Luís Filipe Lages and Professor Filipe Coelho and submitted to the Faculty of Economics of the University of Coimbra

February 2018

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FEUC FACULDADE DE ECONOMIA
UNIVERSIDADE DE COIMBRA

José Manuel Marques Pinheiro

Determinantes Estratégicas de Adaptabilidade

Tese de Doutoramento em Gestão de Empresas, na especialidade de Estratégia, apresentada à Faculdade de Economia da Universidade de Coimbra para obtenção do grau de Doutor.

Orientadores: Professor Doutor Miguel Torres Preto, Professor Doutor Luís Filipe Lages e Professor Doutor Filipe Coelho.

Coimbra, Fevereiro de 2018

Dedicatory

To Valentina.

Acknowledgements

I am grateful to my wife Valentina for being able to withstand so many hours of physical and mind absence without ever being any less loving and supportive.

I am equally grateful to my PhD advisors, Professors Miguel Torres Preto (Instituto Superior Técnico, Lisbon), Luís Filipe Lages (NOVA School of Business and Economics, Lisbon) and Filipe Coelho (Faculty of Economics, University of Coimbra). In particular, I highlight the guidance and warm openness of Professor Miguel Torres Preto, and the welcoming generosity, open mind and sharp foresight of Professor Luís Filipe Lages, who pulled me back to surface during tribulation and decisively helped set up this thesis.

Additionally, I express my profound gratitude to Professor Graça Miranda Silva (School of Economics and Management, University of Lisbon) for the many detailed exchanges, availability, pragmatism, good heart, precision and friendship. I also thank Professor Carlos Gomes (Faculty of Economics, University of Coimbra) for the early guidance in the process.

My gratitude extends to Professor Elias Soukiazis and to Miguel Machado (CFO, Grupo GLN) who has been a brother in arms throughout the whole process, making difficult times easier to endure, and to the board of Renova SA (Engr. Paulo Miguel Pereira da Silva, Engr. Andrade Tavares, Dr. João Gorjão Clara, Engr. Carlos Santos, Engr. João Manuel Tavares and Mr. Miguel Simão) for having granted time to develop and complete this thesis amidst challenging professional responsibilities.

The cover photo depicts a scale model of Renova SA Factory No. 1, a building located at the spring of the Almonda river, and its current headquarters location. The photo was taken by myself under authorization of the President of the Board of Renova SA. The scale model credits and authorship are of *PhyD Arquitectura*, currently headed by architect Paulo Henrique Durão.

Epigraph

A essência do universo é a contradição.

Fernando Pessoa, 'A Nova Poesia Portuguesa no Seu Aspeto Psicológico', in *A Águia* (1912).

Abstract

Manufacturing firms are challenged by the paradox of aligning to their environment while exploring new ways to innovate, in their efforts to enhance business performance. They also need to develop manufacturing flexibility to address varying demand and embrace the paradox of change *versus* preservation. These firms have to face the competition, a growing plethora of complex technological solutions, fast changing customer trends and occasional economic shocks. In such a dynamic context, a growing volume of external information needs to be accessed, assimilated and transformed into firm-specific applicable knowledge enabling developments in core capabilities. This thesis focuses on the Portuguese industry and explores the relationships between absorptive capacity, market and innovation competences orientations, and manufacturing flexibility, to understand the balances resulting in higher business and operations performance. Overall, the findings support the key role of absorptive capacity for firms to cope with the paradoxes of exploitation-exploration (innovation flexibility) and change-preservation (manufacturing flexibility). Additionally, innovation competences orientation (exploitation-exploration) are more important than market orientation (responsive-proactive) to improve business performance – chapter 3. Moreover, knowledge creation helps explaining why some firms are better than others at enhancing operations performance through manufacturing flexibility – chapter 4. Lastly, an innovation reliability strategy is found to positively affect manufacturing flexibility (chapter 5), while innovation competences orientation (exploitation-exploration) and manufacturing flexibility are shown to be essential for the performance of firms under higher environmental turbulence (chapters 3 and 4).

Keywords: absorptive capacity, market orientation, innovation competences orientation, manufacturing flexibility, business performance, operations performance.

Sumário

Para melhorar o seu desempenho, as empresas transformadoras enfrentam o paradoxo da escolha entre o alinhamento com o contexto externo e a exploração de novas formas de inovar. Acresce a necessidade de desenvolverem flexibilidade produtiva para enfrentar uma procura variável. Estas empresas deparam-se com concorrência, gamas crescentes de complexas soluções tecnológicas, tendências de mercado em mudança e ocasionais choques económicos externos. Neste contexto, acedem a conhecimento externo, que assimilam e transformam em conhecimentos específicos aplicáveis ao desenvolvimento das suas capacidades internas. Esta tese foca a indústria portuguesa e explora as relações entre a capacidade absortiva, orientações para o mercado, orientações das competências de inovação e flexibilidade produtiva, para compreender o balanço que traduz melhor desempenho de negócio e de operações. Os resultados realçam o papel da capacidade absortiva na abordagem aos paradoxos *exploitation-exploration* (flexibilidade de inovação) e da mudança-conservação (flexibilidade produtiva). Adicionalmente, a orientação das competências de inovação (*exploitation-exploration*) revela-se mais importante para o desempenho de negócio do que a orientação para o mercado (reativa-proativa) - capítulo 3 - ao passo que a criação de conhecimento contribui para explicar um melhor desempenho através da flexibilidade produtiva (capítulo 4). Finalmente, uma estratégia de fiabilidade na inovação afeta positivamente a flexibilidade produtiva (capítulo 5), enquanto as orientações das competências de inovação (*exploitation-exploration*) e a flexibilidade produtiva se revelam essenciais ao desempenho sob condições de maior turbulência (capítulos 3 e 4).

Palavras-chave: capacidade absortiva, orientação para o mercado, orientação das competências de inovação, flexibilidade produtiva, desempenho de negócio, desempenho de operações.

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List of Abbreviations

ACAP - Absorptive Capacity

BPERF - Business Performance

CR - Composite Reliability

Df. - Degrees of freedom

Est. - Estimate

INE - Instituto Nacional de Estatística

INXPLOIT - Innovation Competence Exploitation

INXPLOR - Innovation Competence Exploration

KCRE - Knowledge Creation

M - Mean

MANFLEX - Manufacturing Flexibility

MTURB - Market Turbulence

OPERF - Operations Performance

Pop. - Population

PROMKTOR - Proactive Market Orientation

REMKTOR - Responsive Market Orientation

SC - Standardized Coefficient

SD - Standard Deviation

SE - Standard Error

TTECH - Technological Turbulence

TTURB - Technological Turbulence

List of Acronyms

AGFI - Adjusted Goodness of Fit
AMOS - Analysis of Moment Structures
ANOVA - Analysis of Variance
APA - American Psychological Association
ASV - Average Shared Variance
AVE - Average Variance Extracted
CEO - Chief Executive Officer
CFA - Confirmatory Factor Analysis
CFI - Comparative Fit Index
CFO - Chief Financial Officer
fsQCA - Fuzzy Set Qualitative Comparative Analysis
GFI - Goodness of Fit Index
HR - Human Resources
IO - Industrial Organization
KBV - Knowledge Based View
KMO - Keiser-Meyer-Olkin
MSV - Maximum Shared Variance
NFI - Normed Fit Index
R&D - Research and Development
RBV - Resource Based View
RMR - Root Mean Square Residual
RMSEA - Root Mean Square Error of Approximation
ROA - Return on Assets
ROE - Return on Equity
SEM - Structural Equations Modeling
SMEs - Small and Medium-Sized Enterprises
TLI - Tucker-Lewis Index
VIF - Variable Inflation Factor
VRIN - Value, Rarity, Imitability, Non-substitutability
VRIO - Value, Rarity, Imitability, Organization

Chapter 1 Introduction

1.1. Preamble

1.1.1. About this thesis

This thesis addresses strategic, knowledge management and innovation questions which contribute to explain manufacturing flexibility, as well as business and operations performance, with implications for both theory and managerial practice. The core of the thesis is developed along three empirical studies that together contribute to explain differential firm performance, a central object of research in strategic management. Specifically, the Portuguese industry is under focus. The relations of absorptive capacity with innovation reliability and variability strategies toward the improvement of business performance and manufacturing flexibility are examined (chapters 3 and 5, respectively). Additionally, the role of knowledge creation in the explanation of developments in manufacturing flexibility leading to improved business and operations performance is equally examined (chapter 4).

This thesis sheds light over a few literature gaps. First, it is unclear from extant literature which of the following orientations is more impactful on business performance: market orientation (responsive-proactive) or innovation competences orientation (exploitation-exploration). Answering this question is relevant to the resource allocation decision of managers between marketing and innovation as well as to assess the relative firm's proficiency at the use of marketing for innovation purposes (chapter 3). Secondly, there is another literature gap in the explanation of why the impact of some firms manufacturing flexibility on the firms' performance is higher than in others. This question is relevant for firm managers to understand how they can obtain more powerful performance impacts out of their investments in manufacturing flexibility (chapter 4). Finally, the last gap is addressed: that of understanding the separate impacts of exploitative and explorative market and innovation orientations on manufacturing flexibility. A better understanding of the spill over mechanisms and effects of innovation reliability and variability strategies on manufacturing flexibility is helpful for managers to more adequately align their firms' innovation and manufacturing flexibility (chapter 5).

This thesis advocates for (i) open, externally oriented learning cultures in the form of high levels of absorptive capacity in manufacturing firms; (ii) the simultaneous pursuit of reliability and variability innovation strategies in manufacturing firms, and (iii) the importance of information-processing antecedents of manufacturing flexibility. It also defends that absorptive capacity, innovation flexibility and manufacturing flexibility are key capabilities for the firms' alignment-flexibility-adaptability and that such capabilities are relevant to partly explain the observed variance of the firm's business and operations performance.

The text is structured as follows. Chapter 1 lays out the theoretical background, the theoretical views shared by the studies and a description of the constructs of interest and their relevance for the research problem. Chapter 2 presents the sampling frame, data collection, sample characterization and data analysis methods. Its contents are shared by chapters 3 to 5. Chapter 3 presents a conceptual model (model 1) explaining business performance as a function of innovation flexibility and the firm's organizational willingness and ability to grow its knowledge-base by seeking and using external knowledge (absorptive capacity). Chapter 4 investigates the role of knowledge creation (a sub-dimension of absorptive capacity, in this work) in enhancing manufacturing flexibility's impact on business and operations performance (model 2). Chapter 5 examines how absorptive capacity and innovation flexibility relate to manufacturing flexibility (model 3). Taken together, the studies contribute to explain how business and operations performance depend on the firms' manufacturing flexibility, innovation flexibility and absorptive capacity. Since part of the hypotheses theoretical support are shared (chapters 3 to 5), several nearly identical paragraphs and argumentation can be found throughout such chapters. Chapter 6 concludes with a summary of the main findings, its managerial and theoretical implications, the limitations and possible pathways for further research. The bibliographical references used throughout the text follow American Psychological Association (APA) standards (6th edition) and can be found after chapter 6. The contents of the thesis are concluded by Appendix I, containing complementary technical information. This thesis is written in English to make its contents available to a wider audience and as part of the effort for submitting its contents to international business and management journals.

A theoretical background section is presented next, followed by a section relating the thesis' adopted theoretical views and the description and relevance of the main constructs.

1.1.2. Research production

This document was a goal in my PhD, started in September 2012 out of my will to pursue studies in management, to which my professional life has been related since 1997. Most of this thesis has been developed between September 2012 and December 2017, accumulating to my professional duties in Renova SA. The contents are being adapted for submission to academic journals in innovation, knowledge management, and operations.

A version of chapter 3 has been accepted and presented at leading international conferences: EMAC, the *European Marketing Academy* (Oslo, 2016) and AMA, the *American Marketing Association* (Havana, 2017). Equally, a version of chapter 4 has been accepted and presented at the *Knowledge Management Conference* (Lisbon, 2016), where it was distinguished with the best research in progress student award. A version of chapter 5 has been accepted and presented at EIBA, the *European International Business Academy* (Vienna, 2016), and the *DRUID Academy* (Odense, 2017). Finally, another version of chapter 5 comparing SEM and fsQCA techniques, has been presented at EDSI, the *Conference of the European Decision Sciences Institute* (Granada, 2017). Parts of this thesis were also presented at the Faculty of Economics of Coimbra (FEUC), in the 'EADGE' seminars (2014, 2016 and 2017), and in the CeBER seminars (2017).

The works presented in international conferences are as follows:

Pinheiro, J. M., Silva, G. M., J. M, Preto, M. T., & Lages, L. F. (2017, May). *Market Orientations, Innovation Competence, and Absorptive Capacity as Antecedents of Manufacturing Flexibility: SEM and fsQCA findings.* Paper presented at the Conference of the European Decision Sciences Institute (EDSI), Granada, Spain.

Pinheiro, J. M, Preto, M. T., Lages, L. F., & Silva, G. M. (2017, April). *Innovation reliability and variability strategies: leveraging absorptive capacity to excel in business performance.* Paper presented at the American Marketing Association Global Special Interest Group (AMA SIG Conference), Havana, Cuba.

Pinheiro, J. M, Preto, M. T., Lages, L. F., & Silva, G. M. (2017, January). *Innovation reliability and variability strategies in the relation between absorptive capacity and*

manufacturing flexibility. Paper presented at the DRUID Academy Conference, Odense, Denmark.

Pinheiro, J. M, Preto, M. T., Lages, L. F., & Silva, G. M. (2016, December). *Exploitative and explorative strategies in the relation of absorptive capacity with manufacturing flexibility*. Paper presented at the Conference of the European International Business Academy (EIBA), Vienna, Austria.

Pinheiro, J. M., Preto, M. T., Lages, L. F., & Silva, G. M. (2016, June). *Knowledge creation, turbulence, and manufacturing flexibility roles in business performance and operations performance. Proceedings of the KM Conference 2016.* Lisboa, Portugal.

Pinheiro, J. M., Preto, M. T., Lages, L. F., & Silva, G. M. (2016, May). *Alignment and adaptability in manufacturing firms: absorptive capacity and ambidexterity of market and innovation orientations impacts on business performance,* Poster presented at the European Marketing Academy Conference, Oslo, Norway.

1.2. Theoretical Background

In this section, the fundamental theoretical background underpinning the research goal of the thesis is summarized. It focuses on the resource based view (RBV), the dynamic capabilities framework, the linkage between dynamic capabilities and knowledge based view (KBV), and paradox theory.

1.2.1. Resource Based View

The RBV emerged as a complement to industrial organization (IO) theory. While IO places the keys for firm performance externally to the firm, the RBV places it internally to the firm (Bain, 1968; Porter, 1979; Porter, 1980; Porter, 1985).

Penrose (1959) stated that the growth of a firm is determined by the manner its resources are employed, and that they can only be useful to a firm's competitive position if they are exploited to make their value accessible. Rubin (1973) reinforced such a view by stating that resources are of no use *per se* if not adequately processed. Wernerfelt (1984) first formalized the RBV defending that firms could perform above-average by identifying and acquiring key resources for their product development. Wernerfeld (1984) and Barney (1991) unified these views into a comprehensive and testable theoretical framework with the fundamental beliefs of the RBV: that resources are heterogeneously distributed among firms and are not perfectly mobile. The persistence of such combination finally enables the firm's competitive advantage, meaning a better relative performance in relation to rivals (Peteraf & Barney, 2003). Furthermore, social complexity, opacity regarding the inner functioning and specific path dependencies (history), increases the difficulty for competitors to access similar resources (Dierickx & Cool, 1989). Such barriers contribute to sustain the heterogeneity of resources (Rumelt, 1984). Specifically, Barney (1991) stated that firms with valuable and rare resources can reach a short-term competitive advantage, sustainable in time if such resources are also inimitable and non-substitutable. Barney's suggestion was that resources, when leveraged, create competitive advantage leading to performance gains.

Mahoney and Pandian (1992) soon presented the criticism that competitive advantage does not forcefully come from resources but from a firm's competence to make better use of it through resource allocation resulting in better productivity and financial results. In response, Barney (1997) extended the characterization of key value, rarity, imitability, non-substitutability (VRIN) resources by adding the organizational characteristics, in what became known as the value, rarity, imitability, organization (VRIO) framework. He defended that the firm's structure, control systems, and compensations had to be adequate for an effective key resource exploitation.

According to Newbert (2007) the firm's performance is directly driven by its products and indirectly by its resources. Systematic assessment of the RBV (Newbert, 2007) found evidence that inimitability is the most important resources attribute in the theory, but also that only 37% of the tests linking resources to competitive advantage or performance received empirical support. The author concluded that a VRIN resource is necessary but not sufficient to reach competitive advantage, meaning that something else was missing in the picture to explain competitive advantage and differential firm performance more extensively. The literature review carried out by Armstrong and Shimizo (2007) focusing on empirical studies has concluded that the RBV needs to set its boundary conditions with more clarity, suggesting the incorporation of moderating conditions like industry and time, and the effects of consumer preferences on resource value.

A complementary perspective to Barney's emerged from the work of Teece, Pisano, and Shuen (1997), who proposed the dynamic capabilities framework to explain how combinations of competences and resources can be integrated, built and reconfigured to address changing environments.

1.2.2. Dynamic Capabilities

Distinguishing resources from capabilities, Amit and Schoemaker (1993) defined resources as available factors controlled by the firm and capabilities as the firm's capacity to deploy resources, sometimes in combination, using organizational processes toward a desired outcome. The term 'dynamic' adds the time element to the definition of capabilities. Dynamic capabilities were first defined as "the firm's ability to integrate, build, and reconfigure internal and external competences to rapidly address changing environments" (Teece et al., 1997, p. 516). Zahra and George (2002) summarized what dynamic capabilities need to be called as such: experience accumulation, knowledge articulation, and knowledge codification processes. Dynamic capabilities have been more recently defined as the abilities to reconfigure the firm's resources and routines in a manner envisioned by management (Zahra, Sapienza, & Davidsson, 2006). While the first two types of definition aim at the reconfiguration of routines and competences (Teece et al., 1997; Zahra et al., 2006), the third type deals with processing information toward a similar purpose, being a more general definition intersecting the KBV (Kogut & Zander, 1992; Nonaka & Takeuchi, 1995; Spender, 1996). Both views involve knowledge and time factors, addressing the need to develop and change internal and external processes affecting the firm's performance.

The concept of dynamic capabilities emerged as complementary to the RBV. For example, Priem and Butler (2001) stated that the RBV essentially deals with a static concept and the processes through which resources are turned into competitive advantages are unclear. Fast paced business environments have challenged the original RBV premises, classified as static and neglecting market dynamism (Wang & Ahmed, 2007). After the seminal work of Teece et al. (1997), the dynamic capabilities framework clarified the evolutionary nature of resources and capabilities, complementing the RBV. While the RBV is essentially a static theoretical framework failing to address the market dynamism and the evolution of the firm over time, dynamic capabilities emerged to complementarily address those two aspects (Wang & Ahmed, 2007). Furthermore, while the RBV does not explain how future resources can be created nor how the current stock of the firm's resources can be renewed, dynamic capabilities do (Ambrosini & Bowman, 2009). The link between dynamic capabilities and dynamic business environments is reinforced by the finding that competitive advantages are held for decreasing time periods (Wiggins & Ruefli, 2005). The more resources and capabilities need to evolve and be recombined to keep competitive advantages valid, the more the dynamic capabilities framework becomes important to consider.

Unfortunately, if the RBV terminology for resources, processes, capabilities and core capabilities lacks clarity (Thomas & Pollock, 1999), dynamic capabilities definitions have inherited a similar problem (Wang & Ahmed, 2007). Dynamic capabilities were notably defined, subsequently to Teece et al. (1997) as: (i) processes to integrate, reconfigure, gain and release resources enabling the firm to align with the market or create market change (Eisenhardt & Martin, 2000); (ii) organizational and strategic routines to achieve new resources configurations in face of market dynamism (Eisenhardt & Martin, 2000); (iii) abilities to timely and effectively sense and seize opportunities (Teece, 2000); (iv) learned and stable patterns of collective activity enabling the firm to generate and modify its operating routines while pursuing effectiveness (Zollo & Winter, 2002); (v) capabilities to extend, modify, or generate ordinary capabilities (Winter, 2003); (vi) abilities to reconfigure resources and routines as deemed appropriate by management (Zahra et al., 2006); (vii) capacity to purposefully create, extend, or modify the resource base (Helfat et al., 2007); and, (viii) as combined capacities to sense and shape opportunities and threats, to seize opportunities, and to maintain competitiveness by combining, protecting and reconfiguring the firm's tangible and intangible asset base (Teece, 2007). The roots of such a profusion of definitions relate to the theoretical origins of dynamic capabilities, which according to Wang and Ahmed (2007) go as far back as the works of Selznick (1957) on distinctive capabilities, Nelson and Winter (1982) on organizational routines, Henderson and Clark (1990) on architectural knowledge, Prahalad and Hamel (1990) on core competences, Leonard-Barton (1992) on core capabilities and rigidities, Kogut and Zander (1992) on combinative capabilities and Henderson and Cockburn (1994) on architectural competences. All the definitions, however, share the idea that dynamic capabilities enable the change of substantive (herein core) capabilities (Rindova & Kotha, 2001). This notion seems to be at the heart of the dynamic capabilities framework, whatever the definition variant.

Zahra et al. (2006) referred that another important source of confusion was the lack of agreement in the literature over if a dynamic capability referred to core capabilities facing uncertain environments or the firm's ability to alter existing core capabilities. Although a dynamic capability may be valuable when the firm faces a dynamic environment, such type of external context is not a necessary condition for a dynamic capability to exist. The authors see a dynamic capability as an ability to reconfigure the firm's resources and routines according to the choice of decision-makers, which is a position followed in this thesis. They do not necessarily tie dynamic capabilities to better financial performance but to the ability to reconfigure as desired by a management choice. This means that market and innovation competences orientations for example, or even the levels of absorptive capacity displayed by a firm, are primarily the reflection of managerial choices, and thus, strategies. Manager's skills are thus a key difference in directing the development of core capabilities through dynamic capabilities. At the same time, this implies that firms face a constant challenge to review and improve their core capabilities through learning (Zahra et al., 2006).

Notable attempts toward further theoretical congruence of the dynamic capabilities framework have come up, such as Wang and Ahmed's (2007), defining dynamic capabilities as the firm's behavioral orientation to integrate, reconfigure, renew and recreate its resources, capabilities and core capabilities, in response to a changing environment and while seeking competitive advantages. More importantly, in order to clarify the context of the definition, they used an order ranking to classify and distinguish between resources, capabilities, core capabilities and dynamic capabilities. Such order ranks resources at the base of the firm as the 'zero-order' element. Above that level, emerge capabilities as the 'first-order' element, the ability to deploy and use resources purposely toward a goal. Another order above appear core capabilities, the 'second-order' element, constituting the strategic bundle of resources and capabilities required to achieve competitive advantage. Finally, governing the rate of change of capabilities, emerge dynamic capabilities as a 'third-order' element. In such perspective, dynamic capabilities are the most important organizational capabilities leading to long-term performance. With regard to impact, dynamic capabilities are thought to affect performance mainly indirectly through bundles of resources or core capabilities (Zahra et al., 2006; Zott, 2003).

Wang and Ahmed (2007), as well as Eisenhardt and Martin (2000), stated that common characteristics of dynamic capabilities could be found across firms (commonalities). Based on third party empirical studies, they identified three types: absorptive capacity, adaptive capability, and innovation capability. As some inter-relations between these commonalities are addressed throughout this thesis, it is especially worthwhile to further refer what these authors stated about them. Wang and Ahmed (2007) defended that absorptive capacity can explain why some firms more easily adapt externally sought solutions than others, better learn from partners and are better able to create proprietary knowledge, can better analyze technologies or more easily find complementarities between them. In turn, adaptive capability is the firm's ability to identify and capitalize on emerging market opportunities (Chakravarthy, 1982). More specifically, adaptive capability is about the search and balance of the firm's exploitation and exploration strategies (Staber & Sydow, 2002). Finally, innovative capability is the firm's ability to develop products and markets through the alignment of strategic innovation orientation with innovation processes (Wang & Ahmed, 2004). The theoretical propositions of Wang and Ahmed's model (2007) regard absorptive capacity, adaptive capability and innovation capability as commonalities of dynamic capabilities across firms, and perceive integration, reconfiguration, renewal, and recreation as its underlying processes. In such perspective, dynamic capabilities develop the firm's core capabilities as directed by strategy. Their model defends that the firm's core capabilities affect the market and financial firm performance directly, while dynamic capabilities affect the market and financial firm performance directly and indirectly through the firm's core capabilities. The steering role of the firm's strategy in the type of development that dynamic capabilities perform on the firm's capabilities means that the firm faces a challenging choice between alternative capability developments (Teng & Cummings, 2002). This observation hints that the separate evaluation of competing capabilities within a firm could be interesting.

As a warning note to the limitations of the framework, several authors underlined that dynamic capabilities are not a panacea for achieving competitive advantage nor high performance levels, despite possibly playing a key role in explaining the differential performance of firms. While Wang and Ahmed (2007) introduced the firm's strategy role and therefore implied that its firm-specific adequacy and managerial skills are keys for the success of dynamic capabilities, Zahra et al. (2006) warned against the tautological thinking that successful firm outcomes necessarily require the action of dynamic capabilities. More recent studies such as that of Wang, Senaratne, and Rafiq (2015) state that the development of dynamic capabilities such as absorptive capacity is more related to internal factors, namely success traps negatively affecting it, than to external factors like market dynamism.

1.2.3. Knowledge Based View

The KBV can been regarded as an extension of the RBV for intangible assets and knowledge-based resources and capabilities (Decarolis & Deeds, 1999; Grant, 1996a). Heterogeneous knowledge bases and capabilities are the key factors of the KBV to understand differential competitive advantage and firm performance (Decarolis & Deeds, 1999). Some authors in the field, however, regard knowledge as an ever-developing social construction and not a resource (Spender, 1996). While KBV sees knowledge as the most important strategic asset of the firm (Grant, 1996a), more recent studies defend that it is tacit knowledge (non-explicit knowledge) that is the most important strategic asset of the firm, given its inimitability attributes (Gupta & Govindarajan, 2000).

Accumulating and protecting valuable knowledge is an important task for managers (Wernerfelt, 1984). Such knowledge allows the firm to convert inputs into valuable outputs (Nelson & Winter, 1982). While knowledge is dynamic and distinctively different from data and information (Sveiby, 2001), dynamic capabilities transform the firm's knowledge resources and routines to come up with new configurations (Cepeda & Vera, 2007). Zollo and Winter (2002), for example, proposed a knowledge evolution cycle comprising four phases: generative variation, internal selection, replication and retention. The four phases describe the development of dynamic capabilities and operational routines: employees and teams generate ideas in the variation phase, to which an evaluation phase follows to select the highest potential ideas, which are then replicated, codified and shared with the relevant parties within the firm. In developing dynamic capabilities, knowledge and knowledge management play a bridging role in the firm's knowledge gap (Cepeda & Vera, 2007). As employees learn, knowledge search tools and knowledge sharing practices become channels to create an open internal environment where people can freely exchange information and thoughts about further knowledge requirements to support the firm's objectives (Cepeda & Vera, 2007).

Easterby-Smith and Prieto (2008) have connected the KBV to the dynamic capabilities framework by claiming that learning capabilities are the source of dynamic capabilities, as reflected in extant literature. This means learning can be seen as the very core, the essence, of dynamic capabilities. This theoretical perspective is adopted in this thesis.

1.2.4. Paradox Theory

According to Lewis (2000), paradox identifies interrelated yet contradictory elements. To profit from paradox means to capture its positive broader potential, as linear problem-solving models can be negative to managers. Smith and Lewis (2011, p. 382) defined paradox as "contradictory yet interrelated elements that exist simultaneously and persist over time", and characterized two components: (i) the underlying tensions that may seem individually logical but look inconsistent when combined; and (ii), the responses to address them simultaneously. Eisenhardt and Westcott (1988) stated that paradox contributes to management by generating creative insight and change.

Schneider (1990) identified three inter-related ways to cope with paradox: acceptance, confrontation and transcendence. Acceptance is about learning to live with paradox while avoiding debates that spur confusion around it (Lewis, 2000), whereas confrontation is about discussing the paradox tensions so that more understanding over it is gained (Smith & Berg, 1987). Humor, for example, is a way to confront paradox (Hatch & Ehrlich, 1993). Finally, transcendence implies questioning assumptions to build a more integrated and rich view of the paradox, looking at tensions as complementary and inter-dependent (Lewis, 2000). Six defensive reactions to paradox have been identified by Vince and Broussine (1996): (i) splitting, or taking the polarization to the extremes (good/bad); (ii) projection, the dumping of the negatives onto a repository of negative feelings (a scapegoat); (iii) repression, the blocking of unwanted memories or experiences; (iv) regression, a return to the old ways, understanding and actions associated with security; (v) reaction formation, an excessive manifestation of the feeling associated with paradoxical tensions or a practice opposite to the threatening feeling; and (vi) ambivalence, a compromise of conflicting emotions smoothening the emergence of extreme feelings. Vince and Broussine (1996) stated that accepting paradox instead of fighting it makes common links between its poles to emerge, enabling the perceived contradictions to gradually become meaningful.

Lewis (2000) identified three types of paradoxes affecting organizations: paradoxes of learning, organizing and belonging. Learning paradoxes are about the tensions involved in superseding the past to create the future, involving for example the tensions between radical and incremental innovation. Organizing paradoxes are about tensions such as those between collaboration and competition, or empowerment and direction. Belonging paradoxes involve identity tensions associated with the individual affirmation *vis-à-vis* the collective. Lewis advocated that organizational paradoxes should be recognized, regarded as thought provoking tools and used as lenses to examine apparently absurd aspects of organizational life in a meaningful and non-defensive manner. Smith and Lewis (2011) contributed with yet another type of paradox: the paradox of performing, involving the tensions associated with the diversity of demands and goals of internal and external stakeholders.

While contingency theory (Lawrence & Lorsch, 1967) focuses on the conditions influencing the firm's choices in situations of the type cooperative-competitive, flexibility-efficiency, centralization-decentralization, and exploitation-exploration, paradox theory defends that organizations should embrace paradoxical tensions and attend to competing demands simultaneously to ensure long-term sustainability (Lewis, 2000). Smith and Lewis (2011) defended that cyclical responses to paradoxical tensions lead to sustainability. They stated that organizations need cognitive and behavioral complexity, emotional equanimity and dynamic organizational capabilities to address competing demands. As an example, they pointed out the ambidexterity literature defending simultaneous exploration and exploitation (Gibson & Birkinshaw, 2004; O'Reilly & Tushman, 2008; Raisch & Birkinshaw, 2008). In their dynamic equilibrium concept, the awareness of tensions and management strategies to cope lead to acceptance instead of defensiveness. Such a dynamic equilibrium should allow for better learning and creativity, fostering flexibility and resilience and freeing human potential. In the light of paradox theory, exploitation and exploration behaviors can reinforce one another through the interrelations of complementary organizational learning that each involves.

In summary, the paradox theory perspective offers a complementary view to contingency theory, recognizing that tensions are persistent across phenomena and organizational levels (Smith & Lewis, 2011).

1.3. Thesis Positioning

1.3.1. Theoretical Views Adopted

The common trace to all the capabilities in the conceptual models of chapter 3 to 5 is knowledge, hence the importance of the KBV-dynamic capabilities theoretical perspectives. The perspective of Zahra et al. (2006), for whom management skills are a key difference in directing the development of core capabilities through higher order dynamic capabilities is implicitly assumed. Consequently, observed market orientations and innovation competences orientations reflect firm behaviors, implicitly reflecting management strategic choices.

The thesis shares the view of Wang and Ahmed (2007), which considers absorptive capacity and adaptive capability as commonalities: dynamic capabilities shared to some extent by all firms. Absorptive capacity is thus seen as a dynamic capability governing the change of capabilities, in line with the definitions of Teece et al. (1997), Eisenhardt and Martin (2000) and Rindova and Kotha (2001). The level of absorptive capacity of a firm is regarded as an indication of its open learning culture, namely toward exterior knowledge to the firm, in line with the view of Easterby-Smith and Prieto (2008) portraying learning capabilities at the source of dynamic capabilities.

Lastly, the perspective of Lewis (2000) is shared in this thesis. Lewis (2000) stated that organizations should simultaneously embrace paradoxical tensions when addressing competing demands, in order to ensure long-term sustainability. Part of the ambidexterity literature shares an equivalent theoretical perspective, defending that the simultaneous pursuit of exploitation and exploration can result in the mutual reinforcement of both through the interrelations of the complementary learning that each involves (Gibson & Birkinshaw, 2004; O'Reilly & Tushman, 2008; Raisch & Birkinshaw, 2008).

1.3.2. Questions, Approach and Constructs

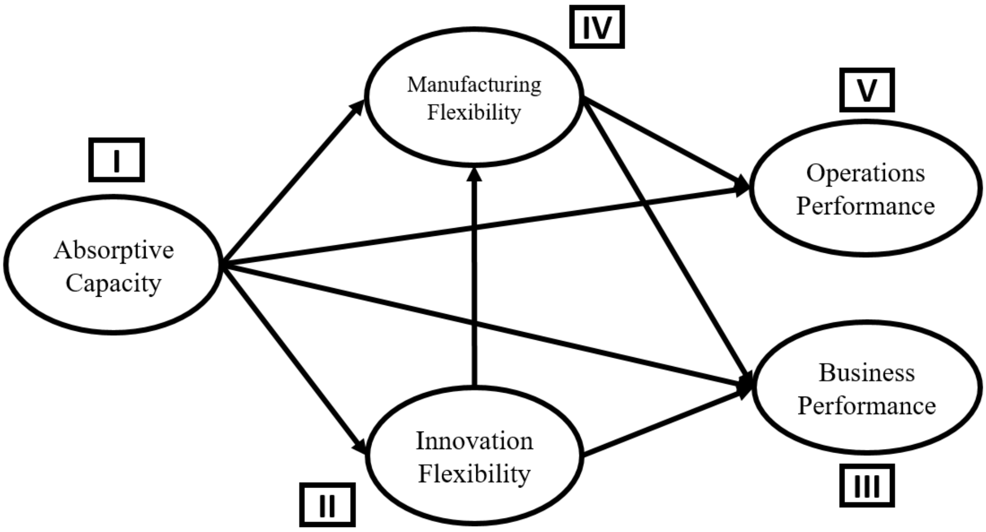
The goal of this thesis is to achieve better insight on how manufacturing firms articulate key dynamic and core knowledge-based capabilities to improve their manufacturing flexibility, as well as their business and operations performance.

What is the dominant innovation competence orientation (exploitation-exploration) leading to business performance and to manufacturing flexibility? Is market orientation (responsive-proactive) more (or less) important than innovation competences orientation (exploitation-exploration) to enhance business performance? Is knowledge creation important to explain manufacturing flexibility's impacts on business and operations performance? How do absorptive capacity and innovation competences orientation relate to manufacturing flexibility? These are some of the questions addressed along the thesis.

In order to expand their knowledge base, firms need to seek external knowledge applicable to the development of their internal activities, in particular the activities related to innovation. Firms share a necessity of orientation to their markets as well as a necessity for innovation, as market orientation and innovation are essential for firms to acquire, defend and develop their market share. In addition, manufacturing firms need manufacturing flexibility to face varying demand and to respond timely and cost effectively to markets, while complying with quality standards. In parallel, during their quest to achieve higher performance, exploitation and exploration are two different strategies that firms may follow for their market and innovation orientations. This thesis explores the complex interplay of these aspects expressed in terms of relations between constructs such as absorptive capacity, market orientation (responsive-proactive) and innovation competences orientation (exploitation-exploration), manufacturing flexibility and business and operations performance. The objective is to understand how such constructs interrelate to improve the performance of real world firms.

The relatively high number of constructs and their inherent complexity enable an even higher number of relations among them to be hypothesized. As it would be hardly viable to test all hypothesized relations through a single conceptual model, three different studies and conceptual models were developed (chapters 3 to 5). The three main studies (chapters 3 to 5) have characteristics in common as well as important complementarities. While all the three studies share, as independent variable, a form of knowledge-based dynamic capability (absorptive capacity or one of its sub-dimensions, knowledge creation), the dependent variables differ (business performance, operations performance and manufacturing flexibility), as well as the core capabilities in between (manufacturing flexibility, innovation flexibility). Figure 1.1 shows the general conceptual research model. The first conceptual model (chapter 3) explores the relationships between constructs I, II and III, the second conceptual model (chapter 4) explores the relationships between a sub-dimension of construct I (knowledge creation), and constructs III, IV and V, and the third conceptual model (chapter 5) explores the relationships between constructs I, II and IV. Overall, the thesis contributes with a general conceptual model partly explaining manufacturing flexibility, as well as business and operations performance. A set of theoretical propositions induced by the results obtained in chapters 3 to 5 is presented in chapter 6 (Conclusions) for further research purposes.

Figure 1.1 General Conceptual Research Model



Source: own elaboration.

The main constructs and respective relevance for this thesis are briefly presented next.

Absorptive Capacity

Kline and Rosenberg (1986) stated that commercial innovations result from the interaction of two distinct forces: the market and technological progress. As more innovations result from transforming knowledge than from sheer and pure invention (Mansfield, 1986), external sources of knowledge are of great importance to the development of innovation activities within the firm (Cohen & Levinthal, 1990; Laursen & Salter, 2006). Knowledge can be sought from the outside of the firm through absorptive capacity (Zahra & George, 2002), or its inside through intra-firm knowledge sharing (Tsai, 2002). While organizational learning is considered a dynamic process of strategic renewal (Crossan, Lane, & White, 1999) involving tensions between knowledge exploitation (the use of existing knowledge) and knowledge exploration (the creation of new knowledge), absorptive capacity can be seen as a specific form of learning (Sun & Anderson, 2010), expressing the firm's ability to identify, assimilate and explore knowledge gained from external sources. Since the knowledge produced externally to the firm is far wider in scope and depth than the knowledge produced internally to the firm, this thesis takes particular interest in the ability of firms to seek external knowledge and use it in the benefit of their knowledge exploitation and exploration internal activities, namely those related to market orientation (responsive-proactive) and innovation competences orientation (exploitation-exploration). These orientations steer the firm's approach to markets as well as the way innovation competences are oriented.

Exploitation and Exploration

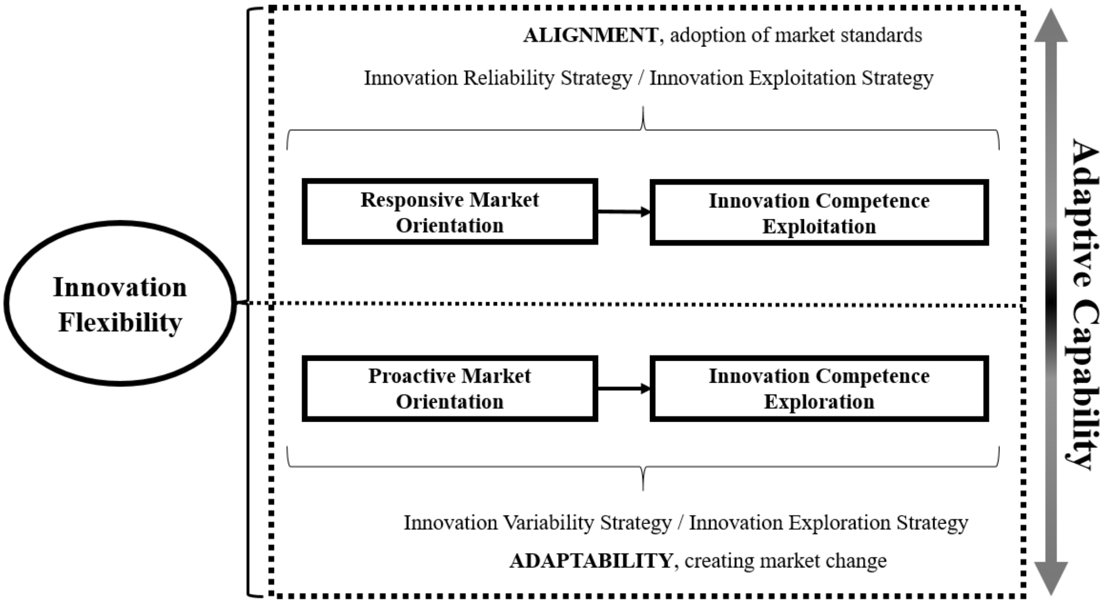
The reason to include exploitation and exploration as an object of study in the thesis relates to the positive association between organizational ambidexterity (exploitation, exploration, and their interaction) and firm growth (Patel, Messersmith, & Lepak, 2013). However, it is less clear how the activities involving exploitation and exploration separately contribute to firm performance. It seems therefore relevant to investigate not only how absorptive capacity relates to exploitation and exploration activities of the firm in separate, but also how these activities can separately affect business performance.

In this thesis, exploitation and exploration activities concern both market orientation and innovation competences. The exploitative perspective of market orientation is designated in the literature as responsive market orientation, whereas the explorative perspective takes the designation of proactive market orientation (Narver, Slater, & MacLachlan, 2004). While responsive market orientation is defined as the firm's activities to discover, understand and satisfy customers' explicit needs, proactive market orientation is defined as the firm's activities to discover, understand and satisfy customer's implicit (herein latent) needs (Narver et al., 2004). Additionally, innovation competences orientation (exploitation-exploration) is a construct borrowed from Atuahene-Gima's (2005): while innovation competence exploitation expresses incremental refinements in the firm's existing innovation knowledge, skills and processes, innovation competence exploration expresses more radical developments of such knowledge, skills and processes.

Throughout this thesis, and for better clarity: the exploitation arm of the conceptual models presented in chapters 3 and 5 (responsive market orientation together with innovation competence exploitation) is regarded as a capability with the purpose of aligning the firm with the market (innovation reliability strategy or innovation exploitation strategy). Similarly, the exploration arm of the models in chapters 3 and 5 (proactive market orientation together with innovation competence exploration) is regarded as a capability with the purpose to create market change (innovation variability strategy or innovation exploration strategy). Innovation reliability and variability strategies is a terminology borrowed from

Mom, Van den Bosch, and Volberda (2007). The set composed by both such strategies is coined in the text as 'innovation flexibility' while the search and balance of both strategies – which is implicit and not directly observed - as adaptive capability (Staber & Sydow, 2002; Wang & Ahmed, 2007). The terminology is depicted in Figure 1.2.

Figure 1.2 Constructs Terminology



Source: own elaboration.

Manufacturing Flexibility

Manufacturing flexibility has become a relevant factor for firms to achieve competitive advantage in a context of volatile demand and high levels of competition (Ojha, White, Rogers, & Kuo, 2015; Patel, Terjesen, & Li, 2012; Tamayo-Torres, Gutierrez-Gutierrez, & Ruiz-Moreno, 2014). Manufacturing flexibility is considered to be a strategic capability to achieve competitive advantage in the marketplace (Jain, Jain, Chan, & Sing, 2013) and has been defined as the firm's capability to address increasing variety in demand without excessive costs, time, organizational disruptions or performance losses (Zhang, Vonderembse, & Lim, 2003). More specifically, it has been defined as "the ability of the manufacturing function to make adjustments needed for coping with environmental change with little penalty in time, effort, cost or performance" (Pérez Pérez, Serrano Bedia, & López Fernández, 2016, p. 3133). The perspective of manufacturing flexibility as a strategic orientation has been on the rise in engineering and management literature (Brettel, Klein, &

Friderichsen, 2016). The relevance of manufacturing flexibility for the adaptability of manufacturing firms to their environment justifies the interest to include it in this thesis as another key construct.

Business and Operations Performance

The most important outcomes of the models in the thesis are business and operations performance. Business performance hereby expresses stakeholder's satisfaction as perceived and reported by the firm's top management. It evaluates the satisfaction of employees at all levels, the gap between the perceived and realized firm potential, and the top management power to do the best it can. This construct has been adapted from Gibson and Birkinshaw (2004). Operations performance is a construct inspired in the work of Ojha, White, and Rogers (2013), assessing relative throughput time to market, production efficiency (cost), and production output quality (time, cost, and quality).

Chapter 2 Methodology

The sampling frame, data collection, sample characterization, and data analysis methods are presented in this chapter. The studies presented in chapters 3 to 5 share this chapter's contents with regard to the topics herein presented. The research in this thesis involves measurement scales of latent constructs already available in the literature. A construct (or latent variable) designates a concept that cannot be directly observed but is rather expressed by other variables (scale items). The scales used are specific to and presented in each of the chapters 3 to 5.

2.1. Instrument of Research

A quantitative analysis was the technique chosen to pursue the research hereby presented. Specifically, an online survey was planned, developed and implemented as a vehicle to distribute an online questionnaire and gather the necessary data for the research. Questionnaires are an adequate instrument for quantitative research when objective hypotheses need to be tested and measurement scales are available in the literature. They allow the gathering of data about a population when the sample is representative of such population (Marconi & Lakatos, 2007). Questionnaires allow for the economy of research time, the targeting of a larger number of potential respondents simultaneously and the quick approach to wide geographical areas to obtain objective responses. Furthermore, when anonymity is granted to respondents, questionnaires involve a lesser bias risk (Marconi & Lakatos, 2007). There are also disadvantages in the use of questionnaires, such as the limitations involving the transversal intelligibility of the questions as well as the unawareness of the respondent's qualification and context when responding.

Some of the literature used to support the hypotheses in this thesis has used qualitative methods to arrive to conclusions. While qualitative methods such as direct interviews at one or more firm levels would be important to enrich, consolidate and confirm the data gathered through surveying, time and financial constraints dictate their lesser convenience.

2.2. Sampling Frame

The data collection was based on a large-scale cross-sectional survey conducted during early 2015 and comprising small, medium and large Portuguese manufacturing firms of diverse industry sectors. Specifically, the survey focuses on Portuguese manufacturing firms with 20 or more employees.

The chosen instrument of research to gather information on the constructs of choice at the firm level was an online questionnaire using theoretically and empirically grounded measurement scales for the constructs. The questionnaire was examined for contents validity by gathering the independent comments of four scholars and four managers. To enhance the contextual intelligibility of the Portuguese used, minor wording adaptations were performed after collecting the comments. This is important as some authors defend that construct clarity and validity are intimately related (Yaniv, 2011).

Additionally, some procedures to safeguard against common method bias were followed as suggested by Podsakoff, MacKenzie, Lee, and Podsakoff (2003): (i) the respondents' anonymity was protected to reduce evaluation apprehension; (ii) the assurance that no right or wrong answer was made explicit on the email body; (iii) the items writing was made as simple and concise as possible to avoid item characteristics effects; (iv) the conceptual models were kept concealed from the respondents to minimize correlation effects.

Chief executive officer (CEO) and chief financial officer (CFO) were targeted as respondents. The choice of CEOs and CFOs as key respondents is context-specific (Portugal), as such management roles usually benefit from a general perspective of their firms' capabilities. It is assumed that the CEOs and CFOs essentially have a similar and wide knowledge of their firms, being apt to respond to the questionnaire. This is an assumption of the author based on its own direct professional experience. As any assumption, it carries limitations since heterogeneity of CEOs and CFOs appraisal of their firms' competences and capabilities may be a source of measurement error. Although there is evidence supporting no substantial role conflicts between the CEO and CFO roles in family businesses (Gurd & Thomas, 2012), other evidence supports psychological diversity between CEOs and CFOs (Nicholson & Cannon, 2000). The latter suggest that while CFOs psychological dynamics favor risk control at the expense of creativity, a reverse pattern is in place for CEOs.

The survey was launched by emailing the 3728 Portuguese manufacturing firms with 20 or more employees registered in the Kompass International Neuenschwander SA Database (Kompass Diretório de Empresas para profissionais e solução de dados empresariais - Portugal, 2015). Of such 3728 manufacturing firms, 2082 firms had between 20 to 49 employees (55.9%), 1403 firms had between 50 to 249 employees (37.6%), and 243 firms had 250 or more employees (6.5%).

2.3. Population Coverage

To grasp how the sampling frame covered the population of Portuguese firms with 20 or more employees in 2015 a few additional estimates are required. 2012 has been the last year for which the number of manufacturing firms per size (number of employees) has been officially released. According to the figures relative to 2012 (FFMS, 2015) there were 6158 Portuguese manufacturing firms with 20 or more employees, of which 3902 firms with 20 to 49 employees (63.3%), 2009 firms with 50 to 249 employees (32.6%), and 247 firms with 250 employees or more (4%).

Since there is no publicly available data for 2015 on the number of Portuguese manufacturing firms with 20 to 49 employees, 50 to 249 employees, and 250 or more employees, computing the sampling's frame population coverage requires an estimate. It is known (FFMS, 2017) that the total number of Portuguese manufacturing firms of all sizes decreased between 2012 and 2015 from 67485 (2012) to 66729 (2015). A possible estimate can be made assuming that (i) the number of firms in the different firm size segments evolved in the same way that the total number of firms, thus by decreasing by -1.1% $(66729 / 67485) - 1$. This results in an estimate of 3858 manufacturing firms with 20 to 49 employees, 1986 firms with 50 to 249 employees, and 244 firms with 250 employees or more for 2015. It all sums up to a total of 6088 firms with 20 or more employees in 2015. One way to cross-check this estimate is to compute the real percentage of firms with 20 or more employees in 2012 $(6158 / 67485) = 9.1\%$ and estimate, assuming that (ii) the proportionality of this segment of firms has not changed for 2015, how many firms it would predict for that year. The result is 6072 firms $(9.1\% \times 66729)$. The two estimates for the total number of firms with 20 or more employees in 2015 differ by a minimum margin: 0.26%

$(6072 / 6088 - 1)$. Such small difference indicates that the estimate of this firm size population segment seems to be sound.

Dividing the total number of records used from Kompass (Kompass Diretório de Empresas para profissionais e solução de dados empresariais - Portugal, 2015) by the estimate of the total number of manufacturing firms with 20 or more employees in 2015 (3728/6088) returns the estimate of the sample's population coverage (61.2%) in 2015. The assumptions made also allow an estimate of the coverage of the sampling frame per firm size segment in the 2015 firm population, by dividing the real number of surveyed firms per size segment by the estimated total number of firms per size segment (2015). The estimate shows that the sampling frame seems to have a positive bias with regard to firm size: the larger the firms in the population the higher its relative representation in the sampling base seems to be. Table 2.1 contains these figures and estimates.

Table 2.1 ***Survey Coverage***

	Population 2012	**Population 2015**	**Survey**	**Coverage (est.)**
No. of firms with 20-49 employees	3902	3858 (est.)	2082	53.9%
No. of firms with 50-249 employees	2009	1986 (est.)	1403	70.6%
No. of firms with 250 or more	247	244 (est.)	243	99.6%
Total of firms with 20 or more	6158	6088 (est.)	3728	61.2%
Total of manufacturing firms of all	67485	66729	-	-
% firms w/ 20 or more employees	9,1%	9.1% (est.)	-	-

Sources: primary (questionnaires) and secondary (Kompass Diretório de Empresas para profissionais e solução de dados empresariais – Portugal, 2015); INE/PORDATA FFMS (2015, 2017).

Response Rates

In total, 515 responses were obtained for the questionnaire (response rate of 14%), with 370 responses validated (response rate of 10%). 145 responses were excluded due to incompleteness. Dividing the number of total responses obtained (515) by 6088 (the estimated size of the population for 2015) results in a rough estimate of the coverage of the total number of responses (8.5%), while dividing the number of total responses validated by 6088 returns a rough estimate of the study's valid coverage regarding the population (6.1%). Table 2.2 presents these figures and estimates.

Table 2.2 ***Response Rates***

	Survey	Population Est.	Response Rates
Total of firms	3728	6088	61.2%
Total of firms responding	515	-	8.5%
Total of valid responses	370	-	6.1%
Valid responses [20-49 employees]	167	3858	4.3%
Valid responses [50-249 employees]	168	1986	8.4%
Valid responses [250 or more employees]	35	244	14.3%

Sources: primary (questionnaires) and secondary (Kompass Diretório de Empresas para profissionais e solução de dados empresariais – Portugal, 2015).

2.4. Sample Characterization

Size, Age, Sales, and Exports Characteristics

Of the valid responses and regarding firm size, 167 firms (45.1%) had 20 to 49 employees, 168 firms (45.4%) 50 to 249 employees, and 35 firms (9.5%) 250 or more employees (Table 2.2). As to firm age, 22 of the firms (6%) were 10 years of activity or less, 104 firms (28%) were 11 to 25 years of activity, 200 firms (54%) were 26 to 65 years of activity, 22 firms (6%) were between 66 to 99 years of activity, and 22 firms (6%) were 100 or more years of activity. Regarding the split between CEOs and CFOs responses, 241 of the valid responses came from CEOs (65.1%) while 129 came from CFOs (34.9%) – Table 2.3.

Table 2.3 ***CEO/CFO Responses Split***

	Frequency	Percent
CEO	241	65.1
CFO	128	34.6
Total	370	100.0

Source: primary source (questionnaires).

Secondary source information obtained from the Kompass (Kompass Diretório de Empresas para profissionais e solução de dados empresariais - Portugal, 2015) informed that the newest firm was in business for 6 years and the oldest for 149 years. The mean firm age was of 34 years while the firm age standard deviation was of 20 years - Table 2.4. The median firm age was of 30 years.

Table 2.4 ***Firm Age Descriptive Statistics***

	Minimum	Maximum	M	SD
Age (Years)	6	149	34	20

Source: secondary source (Kompass Diretório de Empresas para profissionais e solução de dados empresariais – Portugal, 2015).

Sales (2014) ranged from 154.886 EUR a year to 10.866 million EUR a year, while exports ranged from zero to 4.178 million EUR a year – Table 2.5. The median value of sales was 3.8 million EUR a year, while the median value of exports was of 1.0 million EUR a year. 339 firms reported non-zero export sales (91.6% of the respondents).

Table 2.5 ***Sales and Exports Descriptive Statistics***

	Minimum	Maximum	M	SD
Sales	154 886 €	10 866 515 916 €	45 485 695 €	576 795 640 €
Exports	0 €	4 178 113 700 €	20 771 814 €	223 855 356 €

Source: secondary source (Kompass Diretório de Empresas para profissionais e solução de dados empresariais – Portugal, 2015).

Location and Activity Sectors

The location classification of the valid respondents has privileged the location of the main manufacturing site of the firms, classifying a firm as located in ‘northern Portugal’ if presenting a location to the north of the city of Aveiro, ‘central Portugal’ if presenting a location to the south of the city of Aveiro and to the north of the city of Lisbon, ‘southern Portugal’ if presenting a location to the south of Setúbal, and ‘Islands’ if located in either the Azores or the Madeira archipelagos. 93.7% of the valid respondent firms were located in ‘central Portugal’ (which includes Lisbon) and ‘northern Portugal’, the majority in ‘northern Portugal’ alone (54.1%).

The more populous sectors among the valid respondents were the automotive, ceramics, chemical, construction materials, food, machinery, metallurgy, textiles, printing, and furniture. These 10 activity sectors represent 77.3% of the valid respondents and 28.5% of the total of activity sectors in the respondents' sample (35 sectors overall). Data on the activity sectors of the 66729 Portuguese manufacturing firms existing in 2015, indicates 9337 firms (14%) in the food sector, 3480 firms (5.2%) in the textiles sector, 8594 firms (12.9%) in the clothing sector, 3182 firms (4.8%) in the leather products sector, 5208 firms (7.8%) in the wood and cork sector, 2500 firms (3.7%) in the printing sector, 3918 firms (5.9%) in the mineral non-metallic products sector, 11437 firms (17.1%) in the metallic products sector, 4446 firms (6.7%) in the furniture sector, 3583 firms (5.4%) in the repairs and maintenance sector, and 11044 firms (16.5%) in other sectors (FFMS, 2017).

Although the sectoral classification of the database used for the survey (Kompass Diretório de Empresas para profissionais e solução de dados empresariais - Portugal, 2015) and that of officially recognized data (FFMS, 2017) are different, some of the most important sectors in the country appear on the valid respondents' sample, such as food, textiles and metallic products sectors. The same is true about the location of the valid respondents' sample: most respondents are located in central and northern Portugal, where most of the manufacturing of the country is actually based. Despite such limitations, given the random character of the valid firm responses in the sampling frame and the sampling's frame high estimated coverage of the population of firms with 20 or more employees (61.2%), there is no reason to strongly object the valid firm's responses as fairly representative of the population, even if a positive bias on firm size exists.

Secondary information (Kompass Diretório de Empresas para profissionais e solução de dados empresariais - Portugal, 2015) about the activity sectors and the location of the validated respondent firms is presented in Tables 2.6. and 2.7.

Table 2.6 ***Firms Location Descriptive Statistics***

	Frequency	**Percent**
Central Portugal	147	39.7%
Islands (Azores, Madeira)	9	2.4%
Northern Portugal	202	54.6%
Southern Portugal	12	3.2%
Total	370	100.0%

Source: secondary source (Kompass Diretório de Empresas para profissionais e solução de dados empresariais – Portugal, 2015).

Table 2.7 ***Firms Activity Sectors***

	Frequency	**Percent**
Animal Foods	1	0.3%
Automotive	27	7.3%
Ceramics	12	3.2%
Chemical	13	3.5%
Construction Materials	49	13.2%
Cork Products	6	1.6%
Cosmetics	2	0.5%
Cutlery	3	0.8%
Electrical Appliances and Electronics	9	2.4%
Energy	3	0.8%
Food and Food Processing	48	13.0%
Footware	10	2.7%
Furniture	13	3.5%
Glass	3	0.8%
Hotel Supplies	1	0.3%
Hygiene	2	0.5%
Machinery	28	7.6%
Maintenance	3	0.8%
Med. Supplies	4	1.1%
Metallurgy and Metallic Products	29	7.8%
Mining	1	0.3%
Music Instruments	1	0.3%
Non-Determined	2	0.5%
Packaging	7	1.9%
Paper	4	1.1%
Pharma	2	0.5%
Plastics	6	1.6%
Printing	12	3.2%
Religious	1	0.3%
Robotics and Automation	1	0.3%
Textiles	55	14.9%
Tobacco	1	0.3%
Waste Processing	1	0.3%
Weaponery	1	0.3%
Wood Products	9	2.4%
Total	370	100.0%

Source: secondary source (Kompass Diretório de Empresas para profissionais e solução de dados empresariais – Portugal, 2015).

Knowledge Creation Characterization

For illustration purposes, the knowledge creation levels of the most representative activity sectors are exhibited in Table 2.8. This table allows portraying the knowledge creation intensity (a sub-dimension of absorptive capacity) of the most populous sectors in the sample in relation to the sample's average.

Table 2.8 ***Knowledge Creation in Top-10 Activity Sectors***

	Knowledge Creation Means
Printing	5.75
Automotive	5.67
Chemical	5.50
Construction Materials	5.50
Machinery	5.50
Furniture	5.50
Ceramics	5.38
Metallurgy and Mettalic Products	5.38
All activity sector's average	**5.25**
Food and Food Processing	5.00
Textiles	5.00

Source: primary source (questionnaires).

The 10 most representative activity sectors in the respondents' sample comprise 77.3% (286 firms) of the validated responding firms (370 firms). Two of such sectors (food and textiles) display a below-average level of knowledge creation. The sectors displaying higher knowledge creation intensity are the automotive and the printing sectors.

2.5. Data Collection and Analysis

Timing

The focus on Portuguese manufacturing firms allows observation of the predominant alignment-flexibility-adaptability strategies displayed by the aggregate of validated respondents, after an atypically adverse economic downturn.

Portuguese firms were affected by a major economic recession in the sequence of the Euro crisis (Reis, 2013). The crisis caused a shrinkage of internal demand and important restrictions to credit access (Proença, Laureano, & Laureano, 2014) while supposedly pushing firms to align-flexibilize-adapt to new markets and environmental conditions, especially during the period 2011-2014.

Archibugi, Filippetti, and Frenz (2013) showed that the European crisis caused firms to reduce investments in innovation with uncertain return, therefore cutting on exploration (a higher risk strategy). They found that incumbent firms expanded their innovation investments before the crisis and that only a few Small and Medium-Sized Enterprises (SMEs) and new entrants invested in innovation after the crisis.

The data collected for the current studies has been obtained after the exit of the recession (early 2015), allowing for an observation of the innovation strategies deployed by the firms at that time. Although the current study cannot offer a quantitative description of what the innovation levels would be were it not for the crisis, the latter has been a sufficiently important phenomena to have in consideration.

Data Analysis

Structural equations modeling (SEM) was used to test the proposed hypotheses in the study. SEM allows answering to interrelated research questions in a single, systematic and comprehensive analysis (Gefen, Straub, & Boudreau, 2000). Furthermore, while the sample size is adequate for SEM, the technique is also suitable to simultaneously test the theoretical hypotheses (Iacobucci, 2010). A two-level development of the structural models was adopted. In the first phase, the reliability, convergent validity and discriminant validity of the constructs in the models were evaluated. In the second phase, the structural equations models fit was evaluated. The mediating role of several of the constructs in the models was evaluated, as well as the relations changes in the models' paths for different conditions of market and technological turbulence, as well as firm age and size, through multi-group moderation.

Chapter 3 Innovation Reliability and Variability Strategies: the Importance of Absorptive Capacity on Systemic Outcomes

Abstract

The role of absorptive capacity has been widely recognized in the innovation literature. In this study the predictive role of absorptive capacity to business performance is examined, and the mediation of market orientation (responsive-proactive) and innovation competences orientation (exploitation-exploration) in such relationship is evaluated. A literature gap in the relative importance of innovation competences orientations *versus* market orientations is addressed. The data of an online survey targeting top management is analyzed with SEM. Based on a sample of 370 Portuguese manufacturing firms, the main findings are that innovation competences orientations are more important to business performance than market orientations and that innovation competences are better enhanced by absorptive capacity than by market orientations. Absorptive capacity is confirmed as an antecedent of ambidextrous market and innovation competences orientation, while also contributing to directly and indirectly explain business performance. Responsive market orientation and innovation competences orientation (exploitation-exploration) mediate the positive relation between absorptive capacity and business performance. The intensity and significance of the indirect effects evidence the specific knowledge-transformative roles of market and innovation competences orientations. The findings evidence a non-significant impact of proactive market orientation on innovation competence exploration, possibly signaling a structural marketing weakness somewhat prevalent on Portuguese manufacturing firms. Finally, multi-group moderation findings suggest that most firms prefer an innovation reliability strategy even when facing higher external turbulence. Firms seem to mitigate higher perceived external uncertainty by adjusting their preferences toward less risky innovation strategies. Managerial implications highlight the relevance of innovation competences orientation *versus* market orientation. Furthermore, firms seem to ineffectively use proactive market orientation, a finding that signals a structural marketing handicap.

Keywords: absorptive capacity, market orientation, innovation competences orientation, business performance.

3.1. Introduction

In a dynamic world marked by change and a maze of interrelated competitive dimensions, a firm resisting to foster organizational learning as a continuous structural process can hardly expect to achieve higher relative performance, given the importance of learning to innovation activities. Such activities benefit from internal as well as external knowledge to the firm. Absorptive capacity, and the way it relates to innovation exploitation and exploration, is therefore expected to be important for the firm's business performance. This study presents and tests a conceptual model integrating absorptive capacity, market orientation (responsive-proactive), innovation competences orientation (exploitation-exploration) and business performance, researching how the latter is affected by paradoxical firm orientations (responsiveness-proactivity and exploitation-exploration) as well as by absorptive capacity. Exploitation and exploration are separated in a set of market and innovation related constructs to understand which of the two orientations is more important to business performance: if market orientation (responsive-proactive) or innovation competences orientation (exploitation-exploration). This is the central research question of this study. Knowledge of a priority between the two has managerial relevance to the resource allocation decision of firms. The issue is not fully answered by the marketing literature as the studies aggregating and comparing competences belonging to both forces – market and innovation - are still scarce (Ge & Ding, 2005; Langerak, Hultink, & Robben, 2007; Olavarrieta & Friedmann, 2008), and antagonizing empirical evidence exists, especially for the impacts of market orientation on firm performance (Han, Kim, & Srivastava, 1998; Kirca, Jayachandran, & Bearden, 2005; Pelham, 2000).

The paradox of alignment *versus* adaptability in face of changing conditions is also examined: firms need efficiency today and renewal for the future. The current study designates by innovation reliability strategy a responsive market orientation together with an innovation competence exploitation orientation, and by innovation variability strategy a proactive market orientation together with an innovation competence exploration orientation. The innovation reliability strategy is considered to be responsible for the alignment of the firm with its environment (adopting market characteristics), while the innovation variability strategy is considered to be responsible for the adaptability of the firm to its environment (creating market change). The innovation reliability and innovation variability strategies terminology and meaning are borrowed from Mom et al. (2007).

Additionally, the study of mediation effects and the study of the influence of market and technological turbulence as well as the influence of firm size and age on the hypothesized relations of the model are performed. First, mediation analysis offers insights over the knowledge-transformative roles of market and innovation competences orientation. Second, it allows to grasp if the search for external knowledge dominates the early stages of innovation to be later followed by other internal firm processes, a question raised by Raisch, Birkinshaw, Probst, and Tushman (2009). The influence of market and technological turbulence as well as firm size and age on the model's relations is performed through multi-group moderation analysis.

Theoretical Background

The theoretical background of this study is the KBV of the firm (Grant, 1996b; Spender, 1996), highlighting knowledge as the most strategically significant firm resource, in combination with the dynamic capabilities perspective (Teece et al., 1997), which refers to an organization's ability to change its operations in an efficient and responsive way while striving for survival. In addition, paradox theory provides grounding to the theoretical expectation of finding simultaneous innovation reliability and variability strategies in firms.

The term 'dynamic capability' was first coined by Prahalad and Hamel (1990) in a work cited by Nonaka and Takeuchi (1995), and seminally defined by Teece et al. (1997, p. 516) as the firm's "ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments". While a capability designates a functional area of the firm enabling it to carry out specific actions, a competence refers to the knowledge, skills and resources shaping the firm's ability to deliver superior customer value (Day, 1994). In other words a competence designates the proficiency through which a capability is put into practice. A dynamic capability enables firms to change their core capabilities. Absorptive capacity can be regarded as a dynamic capability (Wang & Ahmed, 2007).

Paradox theory sustains that organizations should deal with paradoxical tensions by attending to competing demands simultaneously in order to achieve long-term sustainability (Lewis, 2000). Similarly, an important stream in ambidexterity literature defends the simultaneous exploration and exploitation (Gibson & Birkinshaw, 2004; O'Reilly & Tushman, 2008; Raisch & Birkinshaw, 2008).

Absorptive Capacity

Kline and Rosenberg (1986) stated that commercial innovations result from the interaction of two distinct forces: the market and technological progress. While the first relates to factors such as incomes, relative prices, needs and demographics, the second expresses the progress of scientific and technological frontiers enabling the development of new products, improving the performance of existing products and making products faster at a lower cost. As more innovations result from transforming knowledge than sheer and pure invention (Mansfield, 1986), external sources of knowledge are of great importance to the development of innovation processes within the firm (Cohen & Levinthal, 1990; Laursen & Salter, 2006). External knowledge is integrated in the firm through absorptive capacity, the ability of the firm to recognize the value of new external information, assimilate it and apply it to commercial ends (Cohen & Levinthal, 1990). This capability is required so that firms can be innovative. While its antecedents are knowledge stocks, knowledge flows, and communication, absorptive capacity is considered to be highly path dependent, needing regular rather than occasional investments to be effective (Cohen & Levinthal, 1990). The development of intra-firm diverse teams able to work together and exposing themselves to new perspectives is a way to foster absorptive capacity (Cohen & Levinthal, 1990). Employee's traits are also important for absorptive capacity as creativity and individual knowledge have been found important to individual absorptive capacity (Seo, Chae, & Lee, 2015). Moreover, absorptive capacity enables the firm to be proactive in building its internal competences, beyond just reacting to the environment (Daghfous, 2004).

Absorptive capacity is important to innovation (Lane, Koka, & Pathak, 2006), but it is not clear from the literature what is its impact on the firm's exploitation and exploration innovation strategies, in separate. The authors observed that the relationship between absorptive capacity and radical innovation had received little attention, despite the argument that radical innovation should involve novel combinations of existing technologies and know-how (Van den Bosch, Volberda, & De Boer, 1999). There is interest in analyzing exploitation and exploration as separate orientations rather than bundling the two (Kauppila, 2007), as uniting the two within a single process leads to a suboptimal balance with negative effects on the firm's efficiency (Gupta, Smith, & Shalley, 2006). The tensions between exploitation and exploration orientations resulting from trade-offs of resources allocation in the choice of predominance of one *versus* the other (He & Wong, 2004) can be better understood by separating such orientations. Moreover, given the positive association between organizational ambidexterity (exploitation and exploration firm behavior) and firm growth (Patel et al., 2013), it is relevant to investigate not only how absorptive capacity relates to the exploitation and exploration activities of the firm in separate, but also how do these processes separately affect business performance.

Market and Innovation Competences Orientations

This study considers the market as a driving force of innovation activities. Lamore, Berkowitz, and Farrington (2013) provided evidence that responsive and proactive market orientations were positively related to research and development (R&D) integration, suggesting that such conceptualization of market orientation would contribute to approach the marketing and R&D functions. The construct of responsive and proactive market orientation hereby used has originated from the criticisms raised against the more traditional perspective of the construct (customer-competitor view). Relatively few studies have yet empirically tested its effects on firm performance (Atuahene-Gima, Slater, & Olson, 2005) and on innovation competences orientation (Tan & Liu, 2014). In addition, innovation competences orientation (exploitation-exploration) express choices about how innovation processes are driven and can, therefore, be regarded as strategies. These constructs inter-relations are assessed against an outcome which this study elects as business performance (Gibson & Birkinshaw, 2004).

Approach

Pisano (2015) argued that the research on dynamic capabilities should be re-centered around the fundamental strategic problem facing firms: identifying and selecting the capabilities leading to competitive advantage. Following the model of Wang and Ahmed (2007), a conceptual model integrating absorptive capacity, market orientation (responsive-proactive), innovation competence orientation (exploitation-exploration) and business performance, is developed in this study. While the literature usually separates the constructs herein focused, a unification of their inter-relations is hereby proposed. A model aggregating such constructs simultaneously is able to illustrate the tensions among them and provide insights over its relative importance for business performance. Are innovation competences orientation (exploitation-exploration) as relevant to business performance as market orientation (responsive-proactive)? Are manufacturing firms aligning and adapting at the same time?

How important is an open learning culture, hinted by absorptive capacity, to business performance? While these constructs relate to the collection, transformation, and use of information and knowledge, making high correlations between them expectable, they do so through different inputs and with different aims, and are conceptually different from one another, acting as a sequence of information funnels progressively segmenting and treating knowledge with a gradually narrower purpose.

An extensive online survey addressing top management (CEOs and CFOs) and covering an estimated 61.2% of the Portuguese manufacturing firms with 20 or more employees is the main data source used to statistically test the conceptual model's hypotheses. SEM is used to fit the model.

Contributions

The contributions of the study are the following. First, to the literature of innovation and marketing by finding innovation competences orientation (exploitation-exploration) to be a priority over market orientation (responsive-proactive) when it comes to impacts on business performance. Second, to the literature of absorptive capacity, by establishing the priority of absorptive capacity over market orientation (responsive-proactive) in the development of innovation competences orientation (exploitation-exploration). Third, to the literature of ambidexterity, by establishing the relevance of absorptive capacity as an antecedent of exploitation and exploration innovation strategies and probing into each of these strategies impacts over business performance, highlighting their important mediating role in the relationship between absorptive capacity and business performance. Fourth, to the literature of dynamic capabilities and contingency theory, by providing insight on how firms adjust their capabilities preferences under higher turbulence, to smooth total risk (internal plus external) and off-set the external market and technological risks associated with higher turbulence.

In the following section, the study's hypotheses are presented as well as its theoretical foundations. A presentation of the methods and results follows. The chapter concludes with a discussion of the results, implications for both theory and practice, limitations and possible routes for further research.

3.2. Hypotheses

3.2.1. Absorptive Capacity and Market Orientation

Learning evolves from an individual or small group level toward advanced organizational learning, becoming in such case a dynamic capability (Brockman, 2013). Absorptive capacity, a specific form of learning (Sun & Anderson, 2010), expresses the firm's ability to identify, assimilate and explore knowledge gained from external sources. Knowledge is a central factor for both exploitation and exploration activities in firms (Mom et al., 2007). Absorptive capacity was first defined by Cohen and Levinthal (1989), who implicitly presented it as a capability by using the term 'ability' (Lane et al., 2006). Cohen and Levinthal (1990) refined the original definition, presenting absorptive capacity as the firm's ability to value, assimilate and commercially use new external knowledge. In such definition, the term 'commercially use' establishes the utility of absorptive capacity to the development of market related processes internal to the firm, namely market orientation. In order to benefit from externally acquired knowledge, firms need to translate it into market-oriented usable forms (Zahra & George, 2002). And yet, research involving absorptive capacity in a marketing context is yet limited (Rakthin, Calantone, & Wang, 2016).

Market orientation can also be seen as a dynamic capability (Zahra, 2008) with the purpose to achieve external alignment: that of the firm with its market context. Market orientation is defined by the firm's ability to follow and respond to changes in the marketplace while using intelligence generation and information dissemination (Zahra, 2008). It is about engaging with customers to deliver accordingly to their perceived needs in the present and in the future (He & Wei, 2011). It requires a systematic use of generated knowledge to guide strategy recognition, understanding, creation, selection, implementation, and modification, toward adaptation and response formulation (Hunt & Morgan, 1996). In this study the market orientation construct of Narver et al. (2004) is adopted, consisting of a dual set of behaviors (or strategies) comprising responsive market orientation and proactive market orientation.

Responsive market orientation is the firm's process aiming to discover, understand and satisfy expressed customers' needs, while proactive market orientation is the firm's process to discover, understand and satisfy latent customers' needs. Separating these two different behaviors within the market orientation construct is fundamental when also focusing on innovation (Narver et al., 2004). The nature of this definition allows the understanding that while responsive market orientation is an exploitative, less risky and less expensive perspective of market orientation, proactive market orientation is an explorative, more risky and costly perspective of market orientation. Building on explicit customer's needs certainly seems a more linear and straightforward process than venturing on exploring uncertain, not expressed, latent needs.

Non-narrow knowledge acquisition, sharing and creation, obtained through absorptive capacity, should be able to enhance market related information useful for responsive and proactive market orientation processes, by amplifying the knowledge combinations possibilities. For example, a firm absorbing knowledge on general market trends is likely to better orient itself not only in response to its explicit customer's needs, by confirming similar trends in the market, but also in response to latent, not yet expressed, customer's needs, possibly hinted by other markets already. This rationale is corroborated by recent findings confirming that the absorptive capacity of market knowledge positively affects firm performance through more powerful costumer acquisition and retention (Rakthin et al., 2016). The perspective of absorptive capacity taken here is in line with the view of Noble, Sinha, and Kumar (2002) when they suggest that cultural traits dictate capabilities. Absorptive capacity expresses an organizational cultural trait of broader scope than that expressed by market orientation alone. It illustrates the degree of organizational absorptiveness of a wide variety of knowledge domains (market, technology, trends, business models), allowing for more knowledge combination possibilities within specialized domains, such as that of market orientation. The resulting hypotheses are:

H_{1a}*: Absorptive capacity positively associates with responsive market orientation.*

And,

H_{1b}*: Absorptive capacity positively associates with proactive market orientation.*

3.2.2. Absorptive Capacity and Innovation Competences Orientation

Cohen and Levinthal (1994) stated that higher absorptive capacity enables firms to forecast trends and take advantage of opportunities earlier than competitors. Forecasting trends in order to act preemptively fundaments the interest of absorptive capacity for innovation processes, because innovation is concerned about the future. Previous studies showed the positive effect of absorptive capacity on innovation (Tsai, 2001). In fact, Lane et al. (2006), having examined 289 papers published between 1991 and 2002, noted that absorptive capacity was especially impactful on innovation. Absorptive capacity, while focusing on non-narrow knowledge domains, enables novel, firm-specific, knowledge combinations. Therefore, it can fuel radical innovation (Lane et al., 2006). Recent findings show that the effect of external knowledge on the generation of innovation is more positive when such knowledge is adequately shared across the organization (Tortoriello, 2015) – knowledge sharing is one of the sub-dimensions of absorptive capacity, as operationalized in this study.

Anderson and Tushman (1990) as well as Helfat (1997), supported that absorptive capacity increases the speed and frequency of incremental innovation based on the argument that incremental innovation develops primarily upon a base of existing knowledge. Similarly, Van den Bosch et al. (1999) supported that absorptive capacity fosters incremental innovation through a deeper understanding of a narrow range of closely related topics. Additionally, Lin and McDonough (2014) found that management teams could benefit from adopting ambidextrous cognitive frames to broaden their knowledge-base while integrating multiple sources of learning emanating from inside, as well as from business units or organizations outside. Such learning should enable the continuous development of incremental as well as more radical innovation activities, a thinking hereby transposed to the strategies of innovation competences exploitation and exploration, respectively.

The construct of innovation competences orientation hereby adopted is split between innovation competence exploitation and exploration. While innovation competence exploitation expresses incremental refinements of the firm's existing innovation knowledge, skills and processes, innovation competence exploration expresses more substantive overhauls of such knowledge, skills and processes (Atuahene-Gima's, 2005). For example: while learning, sharing and creating knowledge of a specific in-use manufacturing technology through absorptive capacity, firms could widen their knowledge-base by expanding on their knowledge, skills and processes underpinning their innovation competence exploitation orientation. At the same time, they could also examining alternative technologies and solutions not yet in use at the firm, enabling new knowledge combinations and application possibilities for their innovation competence exploration orientation.

Consequently, depending on their novelty degree, such new combinations could positively contribute to innovation competences orientation (exploitation-exploration). Recent findings show that absorptive capacity partially mediates the relation between R&D investments and the firm innovation (Huang, Lin, Wu, & Yu, 2015), suggesting that absorptive capacity plays a role in the orientation of innovation processes. The resulting hypotheses are:

H_{1c}: Absorptive capacity positively associates with innovation competence exploitation. And,

H_{1d}: Absorptive capacity positively associates with innovation competence exploration.

3.2.3. Absorptive Capacity and Business Performance

Lane et al. (2006) stated that the maintenance and development of absorptive capacity is of central importance to the firm's survival and success, due to its reinforcement, complementary and refocusing roles in the firm's knowledge-base. Salter, Wal, Criscuolo, and Alexy (2015), stating that firms growingly encourage their most qualified people to source for knowledge externally, suggested that fostering such openness benefits people alertness and contribution to ideation. In the same vein, Piening and Salge (2015), examining firms' abilities to introduce process innovations (production, supply chain and administrative processes), discovered that the external adoption and internal generation of innovation were among the key factors enabling a wide range of innovation activities. Hatch and Dyer (2004) showed that specific investments in human capital produce a significant impact not only on organizational learning but also on firm performance. The linkage between human capital and competitive advantage leading to better performance is based on intangible firm specificities and intertwined social relations difficult to imitate. If such intangible firm specificities, human capital and social relations, influence organizational learning, they also influence the sub-set of externally oriented learning: absorptive capacity. Therefore, an association between absorptive capacity and business performance is to be expected.

In summary, fostering absorptive capacity and enlarging the depth and breadth of knowledge in the firm should create novel knowledge combinations while fueling individual as well as group ideation, laying the ground for more sophisticated and complex knowledge transformation processes at other organizational levels beyond those of market or innovation competences alone. For example, it could contribute to develop better HR, supply chain, production policies, better general management practices, generating a higher sense of fulfillment in stakeholders, even if from a top management perspective (business performance, in this study). Recent findings support that in hi-tech firms, absorptive capacity leads to higher performance (new product performance, market performance and profitability) when used in tandem with customer relational and technological abilities (Tzokas, Kim, Akbar, & Al-Dajani, 2015). Findings also support that absorptive capacity mediates the depth of external knowledge search with the innovation and business performance of the firm (Ferreras-Méndez, Newell, Fernández-Mesa, & Alegre, 2015). Similarly, Winkelbach and Walter (2015), focusing on science-to-industry R&D project, showed that complexity and absorptive capacity are very relevant for the value creation process of the firm. According to them, prior knowledge has no significant effect on the firms' value creation process, leading to competence traps, while absorptive capacity enables the firm to deal with dynamic environments. The resulting hypothesis is:

H_{1e}: Absorptive capacity positively associates with business performance.

3.2.4. Market Orientation and Innovation Competences Orientation

When compared to short-term profit seeking firms, market oriented firms should likely invest more in innovation (Ge & Ding, 2005). Theoretically, market orientation contributes to innovation through gathering market intelligence while allowing the firm to make an appropriate use of it (Fang, Chou, Yang, & Ou, 2012).

Customer-Competitor View *versus* Responsive-Proactive View

Market orientation (customer-competitor orientation, inter-functional coordination; herein 'customer-competitor view') was identified as a critical factor to distinguish between successful and unsuccessful innovations (Han et al., 1998). Also, while using the traditional view of the construct (customer-competitor view), Atuahene-Gima (1995) found market orientation impacts to be more significant on incremental innovation than on radical innovation. In support of their finding, they presented the view that radical innovation was more likely related to technological expertise. More recently, Narver et al. (2004) argued that market orientation (responsive-proactive view) should be the basis of a firm's innovation, maintaining the congruency of the construct's effects even if under a different concept.

Balanced Exploitation-Exploration

Responsive and proactive market orientation aim at different goals and have different underlying logics that live in tension (Tan & Liu, 2014). A firm with an excessive responsive market orientation may become too inertial to anticipate and respond to quick market changes, while a firm with an excessive proactively market orientation may see its focus on developing products to current markets reduced. This means firms have to find how to balance between the two (Tan & Liu, 2014).

The current study shares the perspective that exploitation and exploration are not necessarily mutually exclusive, namely at the firm level (He & Wong, 2004). In this regard, O'Reilly and Tushman (2008) stated that for the firm to overcome the hardships of exploration activities, senior management teams had to challenge the status quo, be ready to accept failure and care about the integration and transfer of knowledge, all of this under the pressure to pursue exploitation activities. While exploitation involves optimizing existing capabilities (Greve, 2007), exploration is about building new capabilities (Chakravarthy & Lorange, 2008). The scarcity of resources is responsible for the tension between exploitation and exploration, making a balance between the two needed (He & Wong, 2004; Simsek, 2009).

Since market orientation addresses not only current but also future market conditions (Slater & Narver, 1994), the relations with innovation competence orientations are admissible. Atuahene-Gima (2005) found that exploiting existing product innovation competences (operational efficiency) and exploring new product innovation competences (strategic efficiency) required strong market orientation.

Responsive market orientation is about refinement and efficiency, fostering exploitative learning (Corso & Pellegrini, 2007) within the available knowledge-base and experience of the firm (Narver et al., 2004), thus contributing to exploitation (Baker & Sinkula, 2007). Proactive market orientation focuses on information and knowledge beyond the firm's experience, being marked by discovery, variation (Atuahene-Gima et al., 2005; Narver et al., 2004), and higher risk taking, which links it to exploration (Tan & Liu, 2014). It has been empirically shown before, although yet few confirmation studies exist, that responsive market orientation and proactive market orientation lead to innovation competence exploitation and innovation competence exploration, respectively (Li, Lin, & Chu, 2008; Tan & Liu, 2014).

According to Mom et al. (2007), at the base of exploitation activities is the creation of reliability in the existing firm's innovation experience, which the current study hypothesizes by associating responsive market orientation with innovation competence exploitation. Similarly, at the base of exploration activities is the creation of variability in such innovation experience, which is herein hypothesized as the association between proactive market orientation and innovation competence exploration. Recent findings support the idea that market orientation operates through the innovation process adding its effects to that of absorptive capacity (Rakthin et al., 2016).

The resulting hypotheses follow:

H_{2a}: Responsive market orientation positively associates with innovation competence exploitation.

And,

H_{2b}: Proactive market orientation positively associates with innovation competence exploration.

Market orientation is conceptualized in this study as a dual funnel (responsive-proactive) receiving not only customer's information but also absorptive capacity's information. It is assumed to combine both to feed innovation competences orientation (exploitation-exploration). These hypothesizes are:

M_{2a}: Responsive market orientation mediates the relationship between absorptive capacity and innovation competence exploitation.

And,

M_{2b}: Proactive market orientation mediates the relationship between absorptive capacity and innovation competence exploration.

3.2.5. Innovation Competences Orientation and Business Performance

Whereas exploitation is associated with refinement and efficiency, exploration is associated with variation, experimentation and higher risk (March, 1991). Exploitation is implemented through activities aiming to establish standardized processes, associated with short-term perspectives, while exploration creates entirely new ways to solve problems, being associated with the longer term (March, 1996). Exploitation has to do with experimental refinement and reuse of existing routines, while exploration concerns substantial changes in established processes (Baum, Li, & Usher, 2000).

Exploitation and exploration innovation strategies were found to positively impact business performance (Morgan & Berthon, 2008), while innovation ambidexterity was found to have a positive impact on subjective ratings of performance (Schulze, Heinemann, & Abedin, 2008), and the satisfaction of stakeholders (Simsek, 2009). More recently, Lin, McDonough, Lin, and Lin (2013) presented statistical evidence supporting that high levels in both innovation competences orientation (exploitation and exploration) have higher positive effects on firm performance.

Gibson and Birkinshaw (2004) established theoretical and empirical links between innovation competences orientations and business performance. In their view, if an adequate organizational support is in place, individuals can engage in innovation exploitation and exploration oriented activities simultaneously. They designated this by contextual ambidexterity. Mom et al. (2007) proposed a mechanism to explain it, suggesting that managerial exploitation activities are positively affected by top-down knowledge inflows, while managerial exploration activities are positively affected by bottom-up and horizontal knowledge inflows. If such findings clarify how exploitation and exploration can simultaneously be carried out, Lavie and Rosenkopf (2006), stated that firms must explore new possibilities for adapting to future environmental changes, besides exploiting existing capabilities, in order to compete in dynamic markets.

Atuahene-Gima et al. (2005) found that responsive market orientation is positively associated with new product performance when the strategic consensus among managers is high, whereas proactive market orientation positive effect on new product performance is higher when learning orientation and marketing power were high. While an innovation exploitation strategy can promote the accumulation of benefits (Figueiredo, 2002) through incremental innovations marginally differentiated from competitors (Roberts & Amit, 2003), an innovation exploration strategy can lead to business performance due to the benefits emerging from radical innovations, which are more differentiated from competitors (Rosenkopf & Nerkar, 2001).

Overall, the coexistence of both innovation competences orientations (exploitation-exploration) should allow the firm to better align with existing market demands (through innovation competence exploitation), while also attempting to create market changes (through innovation competence exploration). Both mechanisms should be expected to have a positive impact on business performance. The resulting hypotheses are:

H_{3a}: Innovation competence exploitation positively associates with business performance. And,

H_{3b}: Innovation competence exploration positively associates with business performance.

In light of the nature of absorptive capacity, it is expectable that innovation competences orientation (exploitation-exploration) act as a firm-specific knowledge-transformative channel, amplifying the effects of absorptive capacity on business performance. This study also hypothesizes that:

M_{3a}: Innovation competence exploitation mediates the relationship between absorptive capacity and business performance.

And,

M_{3b}: Innovation competence exploration mediates the relationship between absorptive capacity and business performance.

3.2.6. Market Orientation and Business Performance

Market orientation can be envisaged as the implementation of the marketing concept (Kohli & Jaworski, 1990) in such a way that the actions of a market oriented firm are expected to be consistent with its marketing concept. Some empirical studies examining the link between market orientation and business performance established a positive impact of market orientation on measures of business performance, such as profitability (Slater & Narver, 1994; Slater & Narver, 2000), customer retention, sales growth, and new product success (Slater & Narver, 1994). However, despite the strong argument for the positive effects of market orientation on performance (Kohli & Jaworski, 1990; Narver & Slater, 1990; Slater & Narver, 1994; Slater & Narver, 2000) the empirical evidence is not fully coherent (Han et al., 1998; Pelham, 2000). Recent marketing studies focusing on the link between market orientation (responsive-proactive) and firm outcomes do not allow unanimous conclusions either (Atuahene-Gima et al., 2005; Baker & Sinkula, 2007; Li et al., 2008; Tsai, Chou, & Kuo, 2008; Yannopoulos, Auh, & Menguc, 2012; Zhang & Duan, 2010). Furthermore, although the marketing literature supporting direct and indirect impacts of market orientation on several forms of performance is extensive, the relative importance of market orientation (responsive-proactive) *versus* innovation competences orientation (exploitation-exploration) has not been clarified. This is a main question in this study.

Suggestions that firms with high market orientation levels would have superior performance, partly because of better new product development processes, were made by Kirca et al. (2005). The authors claimed the market orientation relationship with firm performance to be stronger in manufacturing firms, low power distances, uncertainty-avoidance cultures and studies using subjective measures of performance. Kohli and Jaworski (1990), while finding that market orientation is likely to be related to business performance, admitted that it may not be critical to it if the benefits do not exceed the costs of the implicated resources. They identified circumstances under which market orientation could lose importance, such as limited competition, stable market preferences, technologically turbulent industries and booming economies. In such conditions, Kohli and Jaworski (1990) stated that market orientation may not be strongly related to business performance. Other factors possibly influencing the impact of market orientation are the quality of market intelligence, its dissemination, the organizational response to it and the quality of execution of marketing programs. Extensive product customization of small batches of products may lead to poor financial performance and excessive expectations projection to customers may result in uneconomical operations and even dissatisfied customers (Kohli & Jaworski, 1990).

Despite the diversity of the empirical evidence, this study takes the default position that an effective market orientation (responsive-proactive) should have a positive direct impact on the stakeholders satisfaction as seen by top management. The resulting hypotheses are:

H_{4a}: Responsive market orientation positively associates with business performance.

And,

H_{4b}: Proactive market orientation positively associates with business performance.

While firms displaying higher levels of market orientation (responsive-proactive) could directly and positively impact business performance, indirect effects through the mediation of innovation competences orientation (exploitation-exploration) could be also important. Han et al. (1998), for example, found innovation’s mediating role in the relation between market orientation and performance, but using the traditional view of market orientation (customer-competitor view) in the specific context of a non-manufacturing industry (banking). Baker and Sinkula (1999) provided empirical support to the notion that a firm’s market orientation enhances organizational innovativeness and new product success, in turn improving organizational performance. Ge and Ding (2005) evidenced the mediation role of innovation strategy in the relation between market orientation and performance. The impact of market orientation on performance was also shown to flow through proficiency in new product development performance (Langerak et al., 2007), while Olavarrieta and Friedmann (2008) found that the relation of market orientation with performance was mediated by organizational innovativeness.

Although the previous evidence is indirect, some recent evidence shows that market orientation (responsive-proactive) positively impacts innovation ambidexterity, the later partly mediating the relation between market orientation and business performance (Tan & Liu, 2014). The mediation of innovation-related constructs on the relationship between market orientation and performance is therefore expected, giving rise to the following set of hypotheses:

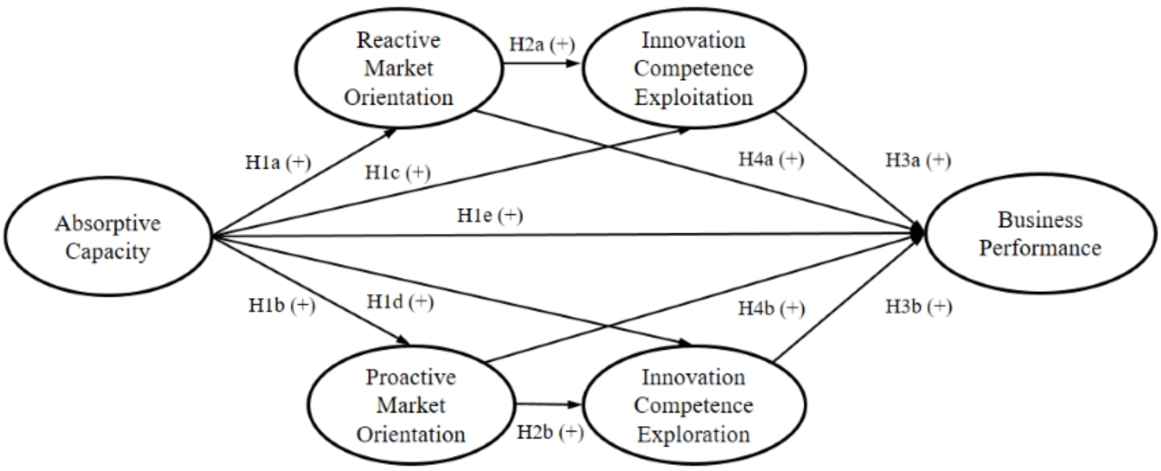
M_{4a}: Innovation competence exploitation mediates the relationship between responsive market orientation and business performance.

And,

M_{4b}: Innovation competence exploration mediates the relationship between proactive market orientation and business performance.

Recent literature shows that absorptive capacity results in higher firm performance (new product performance, market performance and profitability) when used in conjunction with customer relational and technological capabilities (Tzokas et al., 2015). This general finding converges with the conceptual model herein presented. The main hypotheses of the conceptual model developed in this study are depicted in Figure 3.1, as well as their theoretically expected signal.

Figure 3.1 Conceptual Model 1



Source: own elaboration.

3.3. Methodology

3.3.1. Data Collection

An online survey aimed at CEOs and CFOs was sent by email to the 3728 registries of Portuguese manufacturing firms with 20 or more employees available in the Kompass Database (Kompass Diretório de Empresas para profissionais e solução de dados empresariais - Portugal, 2015). The online questionnaire guaranteed the anonymity of the respondents. Overall, 515 responses were obtained and 370 responses were validated. The survey was performed during early 2015. The response rate was of 10% of the sampling frame used, and of an estimated 6.1% of the targeted population of firms. The questions used scale items grounded in the literature, adapted to Portuguese. Of the valid responses and regarding firm size, 167 firms (45.1%) had 20 to 49 employees, 168 firms (45.4%) 50 to 249 employees, and 35 firms (9.5%) 250 or more employees. As to firm age, 22 of the firms (6%) were 10 years of activity or less, 104 firms (28%) were 11 to 25 years of activity, 200 firms (54%) were 26 to 65 years of activity, 22 firms (6%) were between 66 to 99 years of activity, and 22 firms (6%) were 100 or more years of activity. Regarding the split between CEOs and CFOs responses, 241 of the valid responses came from CEOs (65.1%) while 129 came from CFOs (34.9%). Of the valid respondent firms, sales (2014) ranged from 154.886 EUR a year to 10.866 million EUR a year, while exports ranged from zero to 4.178 million EUR a year. The median value of sales was 3.8 million EUR a year, while the median value of exports was of 1.0 million EUR a year. 339 firms reported non-zero export sales (91.6% of the respondents). 54.6% of the valid respondent firms were located in northern Portugal, 39.7% in central Portugal, 3.2% in southern Portugal and 2.4% in the Portuguese archipelagos of Madeira and Azores. The valid respondent firms' sample encompassed a total of 34 activity sectors, with the 10 more frequent sectors being printing, automotive, chemical, construction materials, machinery, furniture, ceramics, metallurgy and metallic products, food and food processing and textiles.

The sampling frame, data collection and data analysis methods are shared for the studies in chapters 3 to 5. A detailed presentation of the instrument of research, the sampling frame, the population coverage, the response rates and the sample characterization is offered in chapter 2, to avoid an integral repetition of large portions of text.

3.3.2. Measures

All items asked respondents to rate the extent of their agreement with a specific statement on a seven point Likert-type scale (1 - *strongly disagree* to 7 - *strongly agree*), except for demographic variables (firm size and age). The constructs were measured by multiple items adapted from the literature (Appendix I, Table A.1.1).

Absorptive capacity's measure was operationalized as a second-order factor consisting of three first-order factors: (i) knowledge acquisition, the organizational practice of identifying, valuing and acquiring new knowledge concerning the market, technologies, trends and business models; (ii) knowledge sharing, the organizational practice of assimilating, adapting, codifying and disseminating such knowledge within the organization; and (iii) knowledge creation, the organizational practice of combining externally acquired knowledge with existing knowledge to create new knowledge. Such operationalization integrates knowledge assimilation, one of the dimensions of absorptive capacity in Cohen and Levinthal (1989, 1990), partly into knowledge sharing (in the codification of externally acquired knowledge), and partly into knowledge creation (in the assimilation of the external knowledge necessary to the combination with the existing knowledge). The construct was adopted after a scale developed by MacInerney-May (2012). Knowledge acquisition was measured through three items adapted from Jansen, Van den Bosch, and Volberda (2006), and Jaworski and Kohli (1993). Knowledge sharing was measured through three items adapted from Jaworski and Kohli (1993), and Tippins and Sohi (2003). Knowledge creation was measured through four items adapted from Pavlou and El Sawy (2006), Prieto, Revilla, and Rodríguez-Prado (2009), and Flatten, Brettel, Engelen, and Greve (2009).

Responsive market orientation and proactive market orientation scales used five and three items, adopted from Narver et al. (2004), and hereby used as in the study of Zhang and Duan (2010).

Innovation competence exploitation and innovation competence exploration scale used five items each, adapted from Atuahene-Gima (2005) and used in this study as in the work of Wang and Rafiq (2014), reflecting a period of five years. Business performance was measured through four items using the scale adapted from Gibson and Birkinshaw (2004), expressing stakeholder's satisfaction from a top management perspective, over a period of five years. Market and technological turbulence were measured through five items each, following the scale of MacInerney-May (2012). The final measurement model is presented in Appendix I (Table A.1.1), as well as the eliminated items and respective motives for elimination (Table A.2.1).

3.4. Results

3.4.1. Measurement Model

Scales Purification

During the purification phase two items were excluded from responsive market orientation as well as one from innovation competence exploitation and yet another from innovation competence exploration. One item was also excluded from business performance. Overall, out of the 32 initial items in the model, five have been dropped leaving 27 items in the measurement model. The two items dropped from responsive market orientation and the item dropped from business performance presented problems of excessive kurtosis (both well above 3.0). The cut offs considered in this study were | Kurtosis | > 2.2, and | Skewness | > 3.0 (Sposito, Hand, & Skarpness, 1983). The items taken out from innovation competence exploitation and innovation competence exploration were removed to ensure the discriminant validity between these constructs (Shaffer, DeGeest, & Li, 2016) while maintaining enough items in each to perform an adequate measure (four items per construct). The items of the measurement model obtained after the purification phase are presented in Appendix I (Table A.1.1).

Measures Assessment

The total variance extracted through the maximum likelihood method with free factor extraction from the measurement model was of 71.5%. A total of six factors was extracted with eigenvalues higher than 1.0. The Keiser-Meyer-Olkin (KMO) measure of sampling adequacy returned a value of 0.94. The goodness of fit test returned a value of 2.99, with a 0.00 *p*-value. All constructs present acceptable values of Cronbach alpha ranging from 0.78 (knowledge sharing) to 0.92 (innovation competence exploitation), above the recommended threshold of 0.70 (Hair, Black, Babin, Anderson, & Tatham, 2010). For all constructs, the composite reliability values were above the reference value of 0.70 (Nunally & Bernstein, 1978), suggesting internal consistency and reliability (see Table 3.2). The average variance extracted (AVE) is a strict measure of convergent validity, being more conservative than composite reliability (Malhotra & Dash, 2011): the AVE was above 0.50; AVE was greater than the maximum shared variance (MSV), and also greater than the average shared variance (ASV); the square root of AVE was greater than inter-construct correlations. Convergent and discriminant validity are supported (Hair et al., 2010; Malhotra & Dash, 2011). Table 3.1 presents the AVE, MSV and ASV of the constructs, while Table 3.2 presents the mean of the constructs, its standard deviation, composite reliability and AVE, as well as the inter-construct correlations.

Table 3.1 ***AVE, MSV and ASV***

	AVE	**MSV**	**ASV**
ACAP	0.75	0.52	0.42
REMKTOR	0.72	0.42	0.34
PROMKTOR	0.63	0.42	0.34
INXPLOIT	0.75	0.63	0.48
INXPLOR	0.61	0.58	0.39
BPERF	0.75	0.63	0.45

Table 3.2 ***Correlation Matrix***

	M	**SD**	**1**	**2**	**3**	**4**	**5**	**6**	**CR**	**AVE**
ACAP (1)	4.80	1.17	**0.86**						0.90	0.75
REMKTOR (2)	5.54	1.11	0.61	**0.85**					0.89	0.72
PROMKTOR (3)	5.20	1.18	0.58	0.65	**0.80**				0.84	0.63
INXPLOIT (4)	5.29	1.07	0.70	0.60	0.59	**0.87**			0.92	0.75
INXPLOR (5)	5.12	1.29	0.64	0.49	0.50	0.76	**0.78**		0.86	0.61
BPERF (6)	5.12	1.08	0.72	0.55	0.57	0.79	0.70	**0.87**	0.90	0.75

Note. Diagonal elements in bold are the square roots of AVE.

The maximum likelihood estimation analysis of moment structures (AMOS) procedure in IBM AMOS version 22 was used to assess the validity of the measurement model. The measurement model returned an acceptable fit: $\chi^2 = 664.9$, 306 degrees of freedom (df), significant, $\chi^2 / df = 2.17$, comparative fit index (CFI) = 0.94, Tucker-Lewis Index (TLI)

= 0.94, normed fit index (NFI) = 0.91, goodness of fit index (GFI) = 0.88, root mean square residual (RMR) = 0.08, adjusted goodness of fit (AGFI) = 0.85, root mean square error of approximation (RMSEA) = 0.056. No intra-construct error correlations were performed. Error correlations of mediators were allowed between responsive and proactive market orientation and between innovation competence exploitation and exploration (Preacher & Hayes, 2008).

3.4.2. Common Method Bias

Several methods were employed to assess common variance in the data. Combined, they reinforce the conclusion that while not inexistent, common method bias issues do not seem to be relevant in this study.

First, common method bias was assessed through the unmeasured latent factor test (Podsakoff et al., 2003). The common variance obtained by squaring the unstandardized common loadings of the common latent factor in the purified measurement model was of 31.4%, below the 50.0% in Hair et al. (2010). The introduction of such common latent factor only slightly affected the items standardized loadings: a maximum change of 0.14 was recorded (one item), far below the 0.20 threshold in Aiken, West, and Reno (1991). In fact, the median and the mean changes of the standardized loadings with and without the common latent factor were of 0.07. These small differences between the standardized loadings indicate a non-problematic level of common variance.

Second, the confirmatory factor analysis (CFA) of a single-factor model onto all the items were loaded shows a very poor fit ($\chi^2 = 2659.8, \chi^2 / df = 7.60$, CFI = 0.67, GFI = 0.59; TLI = 0.67, NFI = 0.64, RMR = 0.19, RMSEA = 0.134). If common method variance was responsible for most of the relations among the constructs, this one-factor model would fit the data well (Korsgaard & Roberson, 1995; Mossholder, Bennet, Kemery, & Wesolowski, 1998).

Lastly, the Harman single factor test was performed. The principal components analysis of all the items of the purified measurement model returned a 45.6% variance explained by the first factor, below the 50% cut off usually considered (Harman, 1967).

Although the first two methods are more frequently used in current literature than the Harman's single factor test, all three methods converge to indicate that common method variance is non-problematic.

3.4.3. Structural Model Fit and Main Hypotheses Tests

Statistical Power and Sample Adequacy

Using Soper's (2017) simulator, for a desired statistical power level of 0.80, finding a minimum absolute effect size of 0.10 with a 0.10 *p*-value in a structural equations model with eight latent variables and 27 items requires, ideally, a sample size with 1686 cases, and a minimum of 151 cases to establish the model structure. Bentler and Chou (1987) admit as low as five cases per item in SEM models if the data is normal, has no missing entries nor outliers. The data collected in this study is well behaved in that respect (Appendix I, section A.3): it is fairly normally distributed and has no incomplete responses. No outliers were considered or removed since the response space is closed and limited (Likert-type scale).

Other criteria asserting the sample's adequacy is that of Kline (2015), for whom sample sizes of at least 200 cases are adequate for most SEM models or, alternatively, collecting five to 10 cases per item. The current study has 370 cases for 27 items which makes for more than 13 cases *per* item. Kline's criterion (2015) for sample size-method (SEM) adequacy is met, as well as Bentler and Chou's (1987).

Structural Model Fit

The structural model presents an acceptable fit: $\chi^2 = 677.60$, significant, 308 df, $\chi^2 / df = 2.20$, CFI = 0.95, TLI = 0.94, NFI = 0.91, RMR = 0.09, AGFI = 0.85, RMSEA = 0.057. The χ^2 test is significant which is not surprising attending to the number of cases (approaching 400) and the relatively high correlations in the model's constructs; regarding the χ^2 / df it has been suggested with some consensus in the literature that a model with $\chi^2 / df < 3$ demonstrates reasonable fit (Iacobucci, 2010). A CFI fit index equal or larger than 0.95 is indicative of good model fit (Hu & Bentler, 1999). Ideally, the TLI and the NFI should both be above 0.95 (Hooper, Coughlan, & Mullen, 2008), while the RMSEA should be below 0.060 (Hu & Bentler, 1999). To expect TLI and CFI values above 0.95 (Hu & Bentler, 1999), however, is only reasonable for very large sample sizes (Byrne, 2001).

The hypothesized model was tested using SEM with IBM AMOS version 22. The model explains 69% of the variance of business performance, while statistical support for eight of the 11 main hypotheses is found (H_{1a}, H_{1b}, H_{1c}, H_{1d}, H_{1e}, H_{2a}, H_{3a}, and H_{3b}). No support was found for hypotheses H_{2b}, H_{4a} and H_{4b}. Table 3.3 presents the main hypotheses tests results.

Table 3.3 ***Hypotheses Tests of Model 1***

	Path	SC	SE	t-value	p-value
H_{1a}	ACAP → REMKTOR	0.619	0.061	9.249	***
H_{1b}	ACAP → PROMKTOR	0.618	0.076	8.817	***
H_{1c}	ACAP → INXPLOIT	0.577	0.076	8.370	***
H_{1d}	ACAP → INXPLOR	0.593	0.102	7.854	***
H_{2a}	REMKTOR → INXPLOIT	0.230	0.066	4.224	***
H_{2b}	PROMKTOR → INXPLOR	0.102	0.077	1.616	NS
H_{3a}	INXPLOIT → BPERF	0.438	0.086	5.739	***
H_{3b}	INXPLOR → BPERF	0.155	0.062	2.255	**
H_{4a}	REMKTOR → BPERF	-0.003	0.081	-0.004	NS
H_{4b}	PROMKTOR → BPERF	0.069	0.067	1.154	NS
H_{1e}	ACAP → BPERF	0.278	0.090	3.836	***

Note. NS: Not Significant. Tests of hypothesis are two tailed; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Results

The path coefficient from absorptive capacity to business performance is significant at a level lower than 0.01 ($\beta = 0.278$; $t = 3.836$), thus supporting hypothesis H_{1e}. The path coefficient from absorptive capacity to responsive market orientation is significant at a level lower than 0.01 ($\beta = 0.619$; $t = 9.249$), thus supporting hypothesis H_{1a}, while the path coefficient going from absorptive capacity to proactive market orientation is significant at a level lower than 0.01 ($\beta = 0.618$; $t = 8.817$), thus supporting hypothesis H_{1b}. The path coefficient going from absorptive capacity to innovation competence exploitation is significant at a level lower than 0.01 ($\beta = 0.577$; $t = 8.370$), thus supporting hypothesis H_{1c}, while the path coefficient going from absorptive capacity to innovation competence exploration is also significant at a level lower than 0.01 ($\beta = 0.593$; $t = 7.854$), thus supporting hypothesis H_{1d}. Hypothesis H_{2a} is also corroborated to a statistical significance level below 0.01 ($\beta = 0.230$; $t = 4.224$), thus confirming the significance of the path coefficient going from responsive market orientation to innovation competence exploitation, while the path coefficient going from proactive market orientation to innovation competence exploration, hypothesis H_{2b}, is not significant. As for the impacts of innovation competences orientation (exploitation-exploration) on business performance, the path coefficient going from innovation competence exploitation to business performance is significant at a level lower than 0.01 ($\beta = 0.438$; $t = 5.739$), statistically supporting H_{3a}, while the path coefficient going from innovation competence exploration to business performance is only significant at a level lower than 0.05 ($\beta = 0.155$; $t = 2.255$), statistically supporting H_{3b}. Finally, regarding the impacts of market orientation (responsive-proactive) on business performance, both the path coefficients from responsive market orientation to business performance and to proactive market orientation to business performance are non-significant, leaving H_{4a} and H_{4b} statistically unsupported.

To summarize, findings reveal empirical support for statistically significant positive impacts of absorptive capacity on responsive and proactive market orientation (H_{1a}, H_{1b}), of absorptive capacity on innovation competence exploitation and exploration (H_{1c}, H_{1d}), and of absorptive capacity on business performance (H_{1e}). Furthermore, there is empirical support for statistically significant positive impact of responsive market orientation on innovation competence exploitation (H_{2a}), but not of proactive market orientation on innovation competence exploration (H_{2b}). The impacts of innovation competence exploitation on business performance (H_{3a}) and innovation competence exploration on business performance (H_{3b}) are positive and significant. There is no statistical support for hypotheses concerning the impact of market orientation (responsive-proactive) on business performance (H_{4a}, H_{4b}).

3.4.4. Mediation

A construct can be explained by indirect effects as well as by direct effects (Little, Card, Bovaird, Preacher, & Crandall, 2007). The existence of a significant indirect effect in a chain of causation suggests that mediation is present (Zhao, Lynch, & Chen, 2010). In this sense, a hypothesized mediator is an additional link in a certain chain of causation. Mediation renders hypotheses testing more consistent and precise (Malhotra, Singhal, Shang, & Ployhart, 2014).

Using a 1000 bootstrap samples process with replacement and a 90% confidence level, estimates for the direct and indirect effects as well as their significance, were obtained. Bootstrapping is a powerful method for evaluating mediation effects since it does not require data to be normally distributed.

While the indirect effects of absorptive capacity can simultaneously flow through distinct types of market and innovation competence orientations before they reach business performance, AMOS output only informs about the total indirect effects and its significance of absorptive capacity on business performance. Computing the standardized indirect effects of absorptive capacity on business performance flowing through each innovation competence orientation type requires multiplying the standardized direct path coefficients in between absorptive capacity and business performance through innovation competence exploitation $(0.577 \times 0.438 = 0.253)$ and through innovation competence exploration $(0.593 \times 0.155 = 0.092)$, respectively (Hayes, 2013). The significance of these effects was calculated using the Sobel statistics (Sobel, 1982), which requires a normal data distribution. Overall, the results confirm only three mediation hypotheses: M_{2a}, M_{3a}, and M_{4a} (Table 3.4).

Table 3.4 ***Mediation Results of Model 1***

	Mediator	**Indirect Effect**	**Direct Effect**	**Total Effect**	**Mediation**
$\mathbf{M_{2a}}$	REMKTOR	0.142 (***)	0.577 (***)	0.719 (***)	Partial
$\mathbf{M_{2b}}$	PROMKTOR	0.062 (NS)	0.593 (***)	0.655 (***)	-
$\mathbf{M_{3a}}$	INXPLOIT	0.253 (***)	0.278 (***)	0.531 (ND)	Partial
$\mathbf{M_{3b}}$	INXPLOR	0.092 (NS)	0.278 (***)	0.370 (ND)	-
$\mathbf{M_{4a}}$	INXPLOIT	0.101 (***)	-0.003 (NS)	0.098 (NS)	Total
$\mathbf{M_{4b}}$	INXPLOR	0.016 (NS)	-0.069 (NS)	0.085 (NS)	-
-	ALL MED.	0.457 (***)	0.278 (***)	0.735 (***)	Partial

Note. ALL MED.: INXPLOIT, INXPLOR, REMKTOR, PROMKTOR. ND: not determined; NS: non-significant. Significance was calculated through the bias corrected percentile method (2-tailed); *p-values* in brackets; * p < 0.10, ** p < 0.05, *** p < 0.01.

3.4.5. Multi-Group Moderation: Turbulence, Size and Age

Technological and Market Turbulence

In this study, market turbulence refers to the rate of change in customer's preferences, while technological turbulence refers to the rate of change in technologies of interest to the firm (Jaworski & Kohli, 1993; Lavie, 2006). Both types of turbulence were observed to affect the firm's organizational outcomes (Drnevich & Kriauciunas, 2011), even if their effects on the firm's capabilities differ (MacInerney-May, 2012). While higher levels of market turbulence pressure firms to modify their services or products, higher levels of technological turbulence pressure the methods for producing outputs, the techniques involved and their components (Lavie, 2006). Frequent variations in customer's preferences may require modifications in market and innovation competences orientations, appealing to short-term changes in the degree of absorptive capacity, as specific knowledge adaptation may be sought for to cope with higher rates of market change. Frequent variations in technological requirements and dominant designs can be even more disruptive, putting in question some of the firm's competences entirely and effectively rendering them obsolete in extreme cases (Rosenbloom & Christensen, 1994; Tushman & Anderson, 1986). Such obsolescence may occur when knowledge, human or physical assets specific to an efficient production relationship become threatened by technologies rendering such relations inefficient (Afuah, 2001).

Method

Multi-group moderation, a special form of moderation analysis, was used to analyze the behavior of all the model's relations when the dataset is split into low-high values for a grouping variable.

Two groups divided by the means were created for each of the variables of interest: high and low technology turbulence (179 firms and 191 firms, respectively), and high and low market turbulence (183 firms and 187 firms, respectively). The joint model fit for the technological turbulence groups is good, meaning there is configural invariance in the model (χ^2/df = 1.66, CFI = 0.94, TLI = 0.93, NFI = 0.86, GFI = 0.84, RMR = 0.10, AGFI = 0.79, RMSEA = 0.045). The χ^2 test for the fully constrained and the unconstrained model has a significant *p-value* (0.00), which means there is no full metric invariance (Byrne, 2008). The stages for full metric invariance imply the groups to have non-significantly different factor means, loadings, intercepts, and residuals (Schmitt & Kuljanin, 2008). The joint model fit for the market turbulence groups is good, confirming configural invariance in the model (χ^2/df = 1.74, CFI = 0.93, TLI = 0.92, NFI = 0.85, GFI = 0.83, RMR = 0.10, AGFI = 0.80, RMSEA = 0.042). The χ^2 test for the fully constrained and the unconstrained model has however a significant *p-value* (0.00), which means there is no full metric invariance (Byrne, 2008). Partial metric invariance was assessed and confirmed (market and technological turbulence) by looking at the significance of the differences of items loadings between groups for each construct, verifying that at least one non-constrained path per factor was non-significantly different (Byrne, 2008). The significance of the differences in non-standardized path coefficients was tested between groups for each variable, through a z-score test (2-tailed). The results are presented in Table 3.5.

Table 3.5 ***Technological and Market Turbulence Effects***

	TTECH (L)	TTECH (H)	MTURB (L)	MTURB (H)	z-score
ACAP → BPERF	0.527 (***)	NS	-	-	***
ACAP → INXPLOIT	0.741 (***)	0.474 (***)	-	-	**
INXPLOIT → BPERF	0.369 (***)	0.684 (***)	-	-	**
ACAP → REMKTOR	-	-	0.647 (***)	0.397 (***)	***
ACAP → INXPLOR	-	-	0.946 (***)	0.543 (***)	***
ACAP → BPERF	-	-	0.574 (***)	0.133 (***)	***

Note. NS: Not Significant. L: Low; H: High. Z-score significances: * p < 0.10, ** p < 0.05, *** p < 0.01.

Age and Size Effects

Older and larger firms are believed to have higher absorptive capacity levels due to knowledge accumulation and more sophisticated routines facilitating assimilation and innovation (Rao & Drazin, 2002). While older firms tend to have a larger knowledge base they also tend to display some blindness due to the path dependencies of it (Danneels, 2008). More sizeable firms tend to become more inflexible, presenting higher core rigidities when it comes to capabilities change (Danneels, 2008).

Two more groups divided by the means were created for larger and smaller firm size (204 firms and 166 firms, respectively), older and newer firms (244 firms and 126 firms, respectively). The joint model fit for the firm size groups is good, which means there is configural invariance in the model (χ^2/df = 1.74, CFI = 0.94, TLI = 0.93, NFI = 0.86, GFI = 0.83, RMR = 0.10, AGFI = 0.79, RMSEA = 0.045). The χ^2 test for the fully constrained and the unconstrained model has a non-significant *p-value* (0.129), which means there is metric invariance (Byrne, 2008). The joint model fit for the firm age groups is good, which means there is configural invariance in the model (χ^2/df = 1.86, CFI = 0.93, TLI = 0.92, NFI = 0.86, GFI = 0.82, RMR = 0.11, AGFI = 0.78, RMSEA = 0.048). The χ^2 test for the fully constrained and the unconstrained model has a non-significant *p-value* (0.168), which means there is metric invariance (Byrne, 2008). The significance of the differences in non-standardized path coefficients was tested between groups for each construct, through a z-score test (2-tailed). The results are presented in Table 3.6.

Table 3.6 ***Firm Size and Age Effects on Model 1***

	Smaller	**Larger**	**Newer**	**Older**	**z-score**
ACAP → INXPLOR	0.548 (***)	1.034 (***)	-	-	**
PROMKTOR→ INXPLOR	0.340 (***)	NS	0.313 (***)	NS	***

Note. NS: Not Significant. Z-score significances: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

3.5. Discussion

The main purpose of this study was to clarify which of two competences is more important to the business performance of manufacturing firms: market orientation (responsive-proactive) or innovation competences orientation (exploitation-exploration). To our knowledge, this is the first study empirically addressing the question while separating the exploitation and exploration strategies for market orientations (responsive-proactive) and innovation competences orientation (exploitation-exploration), while considering the role of absorptive capacity. Thus far, this issue has been ill understood and constitutes a literature gap, with few studies on the matter (Ge & Ding, 2005; Langerak et al., 2007; Olavarrieta & Friedman, 2008) and more often model exploitation and exploration features in a single construct (ambidexterity).

Is innovation superseding marketing?

Innovation competences orientations (exploitation-exploration) are directly relevant to the positive enhancement of business performance whereas market orientations (responsive-proactive) are not. This suggests that in the firms' value chain, the marketing function is further away from producing an outcome impact on firm performance than the innovation function. Additionally, the finding could also suggest that at the time the data was collected firms were moving more on a 'seller's market' (a market driven by the firms' offer) than on a 'buyer's market' (a market driven by customer's demands). A seller's market may require less market oriented activities. However, if the findings suggest that relying on customers' needs is not enough for manufacturing firms to thrive if strong innovation competences are not in place, there is also a significant positive impact of responsive market orientation on innovation competence exploitation as well as a partial mediation role of responsive market orientation in the relation between absorptive capacity and innovation competence exploitation. Together, the two findings indicate that the marketing role is important as a knowledge source and as a knowledge-transformative node for innovation activities.

Are firms underexploring?

Proactive market orientation is not found to have a positive significant impact on innovation competence exploration. Not only the proactive market orientation mean value (5.19) is lower than that of reactive market orientation (5.52), its effect on innovation competence exploitation is non-significant. Furthermore, innovation competence exploration impact on business performance is much less intense than that of innovation competence exploitation. This means that at the time of the data collection firms were predominantly displaying an innovation reliability strategy (responsive market orientation and innovation competence exploitation). It also indicates that firms are being ineffective at transforming their customer's latent needs into knowledge with a meaningful impact on innovation competence exploration, possibly curtailing the latter's impact on business performance. Although it would be expectable to find that firms predominantly display the less costly and risky innovation reliability strategy (responsive market orientation and innovation competence exploitation), to find that proactive market orientation is ineffective signals a weakness in the marketing activities of manufacturing firms. The findings show that the weakness is more marketing related than innovation related because innovation competence exploration still displays a positive significant impact on business performance. This finding has managerial implications as it prompts manufacturing firms to accentuate and improve its proactive market orientation.

Can an open learning culture make a difference?

Innovation competences orientation (exploitation-exploration) are better enabled through absorptive capacity than through market orientation (responsive-proactive). Additionally, and unlike market orientation, absorptive capacity displays a positive significant direct impact on business performance. The relevance of this finding could be attributed to the complexity of modern competition among manufacturing firms. It suggests that globalization effects and the escalade of competition require firms to access, master, integrate and adapt knowledge relative to ever more competition dimensions, something that can be better achieved through the non-narrow scope of absorptive capacity and its consequent knowledge spillovers onto innovation competences orientation (exploitation-exploration). If absorptive capacity indicates the degree of openness of organizations in learning from the outside world, then the suggestion is that an open learning culture is key to the firm's core capabilities effectiveness and to firm performance. Martín-de Castro (2015) advocated that a collaborative/open innovation, absorptive capacity and market orientation are three constructs that reinforce each another, especially in knowledge-based and high-tech industrial markets. The author states that in such contexts organizational achievement strongly depends on technological innovation and that a single firm cannot innovate successfully in isolation. It is therefore important that firms are open to external relationships and networks to grow its own knowledge-bases and develop their innovation.

It seems therefore crucial that management effectively engages in efforts to expand the horizons of knowledge that their staff and teams can manage so that manufacturing firms can thrive. Fostering absorptive capacity leads to business performance directly and indirectly, through responsive market orientation and innovation competences exploitation.

Can absorptive capacity balance exploitation and exploration?

Absorptive capacity separately and significantly enhances exploitation and exploration innovation competences. Therefore, it is a pathway to develop ambidexterity in firms. As the standardized coefficients and their significance levels show, absorptive capacity is almost as important to the development of innovation reliability strategy (responsive market orientation and innovation competence exploitation) as it is to the development of innovation variability strategy (proactive market orientation and innovation competence exploration). This again suggests that the integration of non-narrow forms of knowledge is highly beneficial for firms to accommodate and embrace the exploitation-exploration paradox faced when developing innovation. It is somewhat surprising, but also demonstrative of absorptive capacity's power, that the finding holds truthful for an aggregate sample where SMEs firms predominate.

Do market and technological turbulence dampen absorptive capacity effects?

Absorptive capacity needs environmental stability for its effects to effectively cross the firm's value chain. This statement lies in the following observations: (i) the direct effect of absorptive capacity on business performance becomes non-significant for firms enduring above-average technological turbulence, and significant but much less intense for firms enduring above-average market turbulence; (ii) absorptive capacity's effect on innovation competence exploitation is almost halved for firms experiencing above-average technological turbulence, and; (iii) absorptive capacity's effects on innovation competence exploration is almost halved for firms experiencing above-average market turbulence.

When should firms prepare for rougher market and technological conditions?

Firms should use their absorptive capacity to develop their innovation flexibility ahead of turbulent times. At above-average technological turbulence conditions, innovation competence exploitation impact on business performance almost doubles, becoming the most important driver of business performance. On the contrary, at below-average market and technological turbulence conditions, absorptive capacity's direct impacts on business performance, innovation competence exploitation and innovation competence exploration are significant and more positive. When methods for producing outputs as well as the techniques involved and their components, see frequent changes (Lavie, 2006) - higher technological turbulence - firms seem to focus on the competences able to drive their performance in the short-term.

The less turbulent market and technological conditions are, the higher the impact of absorptive capacity on core capabilities and performance. This has a managerial implication:

manufacturing firms should anticipate and use absorptive capacity to change core capabilities ahead of higher turbulent times in order to preserve their business performance and better adapt to the environment once crossing 'rougher seas'.

How do firms respond to uncertainty?

Under higher turbulence (market or technological) firms preponderantly respond by taking the less risky path: they seem to compensate the increased external uncertainty associated with higher levels of turbulence by balancing competences to favor reliability, thus reducing total uncertainty. On the contrary, when turbulence (market or technological) is lower, firms seem to engage in more risk taking and foster their innovation variability strategy more intensely, increasing their chances of creating something more market disruptive. This suggests that under such conditions an innovation culture can make a positive difference. To this respect, Hurley and Hult (1998) findings already indicated that higher levels of innovativeness are closely related to cultures emphasizing learning, development and participative decision making.

Overall, these findings suggest that firms smooth out total uncertainty (external and internal to the firm) by adjusting the internal uncertainty associated with their competences to off-balance the uncertainty perceived in their environment. This interpretation carries a managerial implication: firms not possessing strong enough open learning and innovation cultures to engage in exploration at less turbulent times, could face substantially higher difficulties to succeed in fostering a variability innovation strategy. Organizational inertia and excessive innovation conservatism are likely to have limiting effects on business performance in the long-term and eventually reduce the survivability chances of manufacturing firms. Managerial ambition and vision are important to overcome inertia, as findings show that the assessment of real performance *vis-à-vis* aspirational levels influences short and long-term decisions while countering managerial myopia (Ben-Oz & Greve, 2015). Other recent research findings show that external openness, among other factors, is an important organizational antecedent of knowledge absorption activities while preventing inertia (De Araújo Burcharth, Lettl, & Ulhøi, 2015).

Are newer and smaller firms better at marketing?

Newer and smaller firms use latent customers' needs as a positive significant input for their innovation competence exploration, whereas larger and older firms do not. One could have expected older and larger firms to be better at this process, under the assumption they would tend to have more resources and experience, but the findings show that it is the other way around. Larger firms are better at using absorptive capacity to enhance innovation competence exploration, whereas newer and older firms are better at using proactive market orientation with the same purpose.

The simpler and immediate explanations are twofold. First, smaller and newer firms may have to struggle more for a piece of market share or entering a new market than larger and older firms. Therefore, having a larger incentive to use all the tools at their disposal, including engaging in the more risky and costly proactive market orientation, in order to come up with solutions and products warranting them a better future place in the market. Second, larger and older firms may be more affected by internal inertia, somewhat trapped at doing what they always did, or simply not having enough incentive to impel them to engage in costlier and riskier proactive market orientation. On the contrary, newer firms could have stronger "go get" cultures, or be more sensitive to the importance of understanding their customers' latent needs.

Do mediation effects reinforce the causality relations in the model?

Mediation findings do reinforce the conceptual model's causalities. Raisch's et al. (2009) question, seeking understanding if the external search for knowledge dominates innovation processes early on to be later followed by internal firm processes seems to have an affirmative answer in the partial mediation role of responsive market orientation and innovation competence exploitation in the relation between absorptive capacity and business performance.

3.6. Conclusions

3.6.1. Theoretical Implications

First, this study extends Baker and Sinkula (1999) by integrating innovation competences orientations in the conceptual model, and it builds on the works of Ge and Ding (2005), Langerak et al. (2007), and Olavarrieta and Friedman (2008), establishing the higher relevance of innovation competences orientation (exploitation-exploration) over market orientation (responsive-proactive) for manufacturing firms' business performance. The work of Fang et al. (2012), researching the relations of diverse sources of knowledge with the firm innovation is expanded, by considering not only market orientation but also absorptive capacity.

Second, it supports the view that fostering absorptive capacity, a higher-order knowledge-based capability (Wang & Ahmed, 2007; Winter, 2003), is very important to improve business performance directly, and especially indirectly, through innovation flexibility.

Third, it addresses the calls of Lane et al. (2006) for better examination of the link between absorptive capacity and radical forms of innovation, and the call of Kauppila (2007) for analysis of exploitation and exploration in separate. In doing so, it establishes that absorptive capacity is more important than market orientation (responsive-proactive) to the development of innovation competences (exploitation-exploration). Such finding extends the work of Tan and Liu (2014), who did not consider absorptive capacity in their model, and the work of Li et al. (2008), who did not evaluate the separate mediating role of innovation competences (exploitation-exploration).

Fourth, the study establishes that absorptive capacity is key for firms to achieve ambidexterity: it emerges as a capability that leads to an innovation reliability strategy as well as to an innovation variability strategy in similar intensity. Achieving balance between the exploitation and exploration activities through absorptive capacity offers a tangible ambidexterity development mechanism beyond that proposed by Chang, Hughes, and Hotho (2011), more vaguely stated in terms of the internalization of external environmental pressures. This finding converges with Lin et al. (2013) in their conclusion that learning practices have an important impact on innovation ambidexterity, which in turn have a direct relationship with firm performance (revenues, profits, and relative competitive growth, in their study). However, this study expands on their work by focusing on absorptive capacity as the main knowledge-based capability driver and, more importantly, by joining market orientation to the perspective. The balance found between exploitation and exploration activities is in line with the findings of He and Wong (2004), Gibson and Birkinshaw (2004), and Mom et al. (2007), reporting the positive effects of ambidexterity on firm performance. This is in line with paradox theory, defending that firms should simultaneously engage competing demands to ensure long-term sustainability (Lewis, 2000).

Fifth, the firms' higher preponderancy for exploitation can be interpreted through the lenses of cumulative prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992), explaining choices upon risky prospects. One of the tendencies explained is the certainty effect, a behavior in decision making that increases risk aversion in choices involving high probability gains, and risk seeking in choices involving high probability losses. Considering this theory, the preponderance of a risk aversion behavior under higher turbulence could mean that despite such circumstances firms still expect gains, and rely even more strongly on an innovation reliability strategy. This interpretation suggests that only before a prevailing prospect of high probability losses would firms be expected to engage more strongly in risk seeking and preponderantly foster an innovation variability strategy. Cumulative prospect theory sustains why exploitation activities are resilient to environmental turbulence and adverse economic conditions, perhaps only until survivability is at risk and an almost certain prospect of losses is faced.

Sixth, the preponderance of an innovation reliability strategy (exploitation) after the crisis does not counter the results of Laperche, Lefebvre, and Langlet (2011), who found that large French multinationals crossing an economic crisis (2009-2010) rationalized their R&D expenses while amplifying exploitation (a lower cost strategy). Additionally, Archibugi et al. (2013), showed that the European crisis caused firms to reduce investments in innovation with uncertain return (exploration). This latter study found that the observed pattern was for incumbent firms to expand their innovation before the crisis, with just a few and small new entrant firms doing the same after the crisis. As the current study shows, smaller and newer firms are more effective at using proactive market orientation to the benefit of innovation competence exploitation than larger and older firms are. This finding seems to be convergent with Archibugi et al. (2013), when it comes to small and new firm's post-crisis innovation behavior.

3.6.2. Managerial Implications

This study defends the development of absorptive capacity to balance and enhance exploitation and exploration orientations commanding innovation activities and the innovation flexibility of the firm, to improve business performance.

High levels of absorptive capacity help develop market and innovation competences orientations to adequately address market and technological turbulence, which is key in today's global competitive arena. Even if exploration activities are not predominant, they could be essential for the firm when survival is at stake. Such activities development can be greatly enhanced by absorptive capacity, especially during less turbulent conditions.

It is understandable that the variability innovation strategy is the least predominant due to its higher implicit uncertainty and longer-term orientation, but the results still highlight a worrying fact for the Portuguese firms represented by the sample: an ineffective use of proactive market orientation. The reasons for this could be either cultural or related to the prevalent industry sectors in the sample, many of which are traditional. Even so, non-high-tech SMEs fare batter when displaying higher proactive market orientation (Laforet, 2008). The finding suggests that a potential for better use of a variability innovation strategy exists, namely in seeking better understanding of the customers' latent needs while aligning proactive market orientation with innovation competence exploration.

The vision of O'Reilly and Tushman's (2008) becomes even more meaningful: the hardships of exploratory activities require senior management teams to foster learning, accept challenges to the *status quo*, and accept failure as a part of the process and care for the integration and transfers of knowledge. This suggestion articulates with other approaches, such as the meta-analysis of the relations between organizational culture and innovation of Büschgens, Bausch, and Balkin (2013). These authors concluded that managers of innovative organizations implement cultures emphasizing an external flexible orientation, while hierarchical cultures more focused on control and more internally oriented are less likely associated with innovative organizations. Furthermore, at the employee level, as Wei, O'Neill, Lee, and Zhou (2013) found, perceiving an innovation culture positively impacts job satisfaction and perceptions of organizational dynamism and firm performance, suggesting that setting an innovation culture is essential for the firm to obtain superior employee-level outcomes.

Finally, this study offers managers of manufacturing firms the insight that innovation competences are more important than market orientations when higher business performance is a goal to achieve.

3.6.3. Limitations and Further Work

Undoubtedly, this study contains limitations. While the findings show that the simultaneous use of reliability and variability innovation strategies is associated with higher business performance, it would be enriching to perform similar studies in longitudinal contexts, as different industries may conceal different results. Additionally, studies performed under survivability-threatening conditions would be worth pursuing to search for the limit conditions that could cause an innovation variability strategy to become temporarily predominant. The expansion of this research into different time moments and contrasting management cultures, namely gathering data from different countries, could also help clarify the circumstances under which firms would engage in riskier innovation activities of more exploratory nature. Furthermore, cross sectional studies have limitations in supporting the causality proposed in the hypotheses, while endogeneity issues could also affect the hypothesized relations in the model. Additionally, single informant studies are more prone to common variance issues, while the exclusive use of subjective measures is subject to respondent bias and social desirability issues. Future research on the topic would benefit from multiple informant data and secondary objective data (for example: investments in R&D and financial performance indicators) to limit common variance issues. The assumption that CEOs and CFOs respond basically in the same way to the questionnaire for each firm, their response assumed to be inter-changeable, is a simplification. TLI and NFI values for the structural model fit (TLI = 0.94, NFI = 0.91) suggest that the model could be optimized, as they should be ideally closer to 0.95. Finally, using other quantitative techniques in parallel to SEM could help discriminate different strategies within the sample leading to similarly higher levels of business performance (competing strategies). Fuzzy set qualitative comparative analysis (fsQCA) is one of the techniques allowing so. SEM is limited in this respect as it shows the significant aggregate relations in the entire sample - the prevailing strategies - while leaving eventual sub-sets of strategies with similar business performance outcomes hidden. This study does not include control variables, such as firm size and age, but it probes for its effects on the model.

Chapter 4 Fostering Knowledge Creation to Improve Performance: the Mediation Role of Manufacturing Flexibility

Abstract

While addressing increasing competition and highly dynamic changes in demand and customer preferences, firms need to boost their technological and management know-how to adequately develop manufacturing flexibility. Yet, the link between knowledge creation and manufacturing flexibility has not been sufficiently researched. While developing manufacturing flexibility is a complex and risky venture, firm-specific knowledge creation may mitigate such risks and make manufacturing flexibility more effective. The study examines the mediation effect of manufacturing flexibility in the relations between knowledge creation and technological turbulence with business and operations performance. Using a sample of 370 Portuguese manufacturing firms and a theoretical model tested through SEM, findings reveal that knowledge creation positively and significantly affects business and operations performance directly, and indirectly, through manufacturing flexibility. In addition, firms enduring above-average market turbulence display a smaller direct impact of knowledge creation and a higher impact of manufacturing flexibility on business performance. This study highlights the importance of the organizational ability to learn and create new ideas toward an effective development of manufacturing flexibility and business performance, contributing to explain why some firms get better outcomes of manufacturing flexibility than others, a disputed issue in the literature. Overall, results suggest that manufacturing firms need to support strong knowledge creation cultures.

Keywords: knowledge creation, manufacturing flexibility, business performance, operations performance, technological turbulence, market turbulence.

4.1. Introduction

The external pressures exerted by market and technological environmental conditions are strong drivers of change in firms (Sharifi & Zhang, 1999). Specific stress forces can be as diverse as environmental factors, price and cost pressures from competitors, the necessity to keep wide and dynamic product-mixes to satisfy an increasingly segmented and geographically dispersed demand, the need to address markets in proactive ways and the need to differentiate through constant innovation (D'Aveni, 2010). To cope with environmental pressures and competition, firms have to face hard paradoxes involving the present and the future, manage tensions between learning and performance, stability and change, alignment and adaptability (Smith, Binns, & Tushman, 2010). Competition increases the necessity for the development of internal firm capabilities (Foss & Eriksen, 1995) even when resistance is met, as managers are faced with the necessity to improve core capabilities but are often pinned down by such capabilities core rigidities (Leonard-Barton, 1992). One of the core capabilities that occasionally needs to undergo updates and changes is manufacturing flexibility. Manufacturing firms must cope with growing global competition on strategic dimensions as diverse as production costs, product quality and product innovation (Brettel et al., 2016). Firms use manufacturing flexibility as a strategic response to address high levels of competition, especially in high-wage countries, as backing up the costs of increased product quality is difficult and differentiation strategies become an alternative to address individual customer needs (Brettel et al., 2016). Because addressing multiple different customer needs requires higher levels of manufacturing flexibility, how to develop it in an effective firm-specific manner raises questions.

Does knowledge creation boosts manufacturing flexibility? Under which circumstances is manufacturing flexibility more performance-effective? Does manufacturing flexibility has a mediating role in the relationships between knowledge creation and business and operations performance? These are some of the questions addressed by this study.

Theoretical Background

The theoretical background of this study is that of the firm's KBV in combination with the dynamic capabilities perspective. Grant's (1996a) KBV, analyzing the processes of knowledge integration to create and develop capabilities, recognized the difficulty to develop dynamic and flexible-response capabilities critical for the firm's adaptation to hypercompetitive markets. He proposed the fundamental role of the firm to be the integration of individuals' specialist knowledge, and organizational capabilities to be the manifestation of such knowledge integration. Nonaka (1994) advanced the notion that knowledge is created at the organizational level through the interactions between tacit and explicit forms of knowledge. Nonaka and Konno (1998) introduced the concept of 'ba', or the shared space for emerging relationships (physical, virtual and mental), defending that knowledge cannot be separated from its context. Therefore, both individuals and their 'ba', or shared space, are crucial for the creation of knowledge. While knowledge creation concerns the continuous transfer, combination and conversion of forms of knowledge (Nonaka, 1990), knowing something emerges from education, practice, collaboration and interaction by and among knowledge users. Nonaka, Toyama, and Konno (2000) put forward the organizational perspective of firms as entities that dynamically create knowledge through a process with three main elements: first, knowledge created through the conversion of tacit and explicit knowledge; second, the shared context in which such conversion happens; third, knowledge inputs, outputs, and moderators of the process. The keys to such process leadership are, according to them, the role of top management in articulating the knowledge vision and the role of middle management in fostering the shared space where knowledge is created.

If the KBV of the firm (Grant, 1996b; Spender, 1996) highlights knowledge as the most strategically significant firm resource, the dynamic capabilities perspective (Teece et al., 1997) refers to the organization's ability to change its operations in an efficient and responsive manner to the environment, while striving for survival. The term 'dynamic capability' was first coined by Prahalad and Hamel (1990), in a work cited by Nonaka and Takeuchi (1995), and seminally defined by Teece et al. (1997) as the firm's ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments.

Manufacturing Flexibility

Manufacturing flexibility can be seen as a core capability. It is the firm's capability to address an increasing variety in demand without excessive costs, time, organizational disruptions, or performance losses (Zhang et al., 2003). While it is one of the most important capabilities for the firm's adaptability (Gerwin, 1987; Sethi & Sethi, 1990; Swamidass &

Newell, 1987), it is still unclear why some firms can obtain higher performance than others from increased manufacturing flexibility (Patel et al., 2012).

Developing flexibility involves the tension between change and preservation (Volberda, 1996). In the case of manufacturing flexibility, the tension between the need to change and the potentially quick obsolescence of equipment and technology, rendering the investments' pay-off uncertain in face of fast paced technologies. Kara and Kayis (2004) argued that manufacturing flexibility requires considerable investments, pushing firms to allocate resources to figure out the appropriate type of flexibility needed and how to achieve it.

While developing manufacturing flexibility can fail (Upton, 1995b), Lloréns, Molina, and Verdú (2005) found that environmental factors as well as internal resources are important to shape it. Patel et al. (2012) recommended future researchers to consider creativity as an antecedent of manufacturing flexibility. Research linking information-processing antecedents with manufacturing flexibility is still sparse, as well as the role and underpinnings of such antecedents (Ojha et al., 2015). Furthermore, the link between the need for flexibility and the design of manufacturing systems is weak (Terkaj, Tolio, & Valente, 2009). Koh and Gunasekaran (2006) defended that manufacturing firms should use a combination of tacit knowledge about uncertainties and explicit knowledge generated by an intelligent agent, to manage uncertainty.

In parallel, the technology acceptance model (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989) identified two factors influencing the decision to adopt new technologies: perceived usefulness and perceived ease-of-use. Autry, Grawe, Daugherty, and Richey (2010) extended the model by including the state of the technological environment in the form of technological turbulence and the extent of other technologies already adopted by the firm. They found that in technologically turbulent environments, the firm's perceived usefulness and ease-of-use of a new technology, as well as the firm's intention to use it, would be greater.

Mishra, Pundir, and Ganapathy (2014) identified some unaddressed issues in earlier research focusing on manufacturing flexibility, among which: (i) the need to deepen the research of the link between manufacturing flexibility and non-operational nor financial forms of firm performance, and (ii) the need to expand the studies using more dimensions of flexibility. The current study tackles both of issues by using subjective firm performance measures and a recent multi-dimensional conceptualization of manufacturing flexibility.

Effects on Firm Performance

Operations management literature has not reached a consensual conclusion about the effects of manufacturing flexibility on performance (Camisón & Villar Lopez, 2010). Research shows mixed results regarding the effects of manufacturing flexibility on performance in uncertain environments (Patel et al., 2012). Some studies support that such effects are greater under uncertainty (Anand & Ward, 2004; Chang, Yang, Cheng, & Sheu, 2003; Narasimhan & Das, 1999) while other studies support that manufacturing flexibility is higher in firms presenting higher business performance, regardless of the levels of environmental uncertainty (Pagell & Krause, 1999). Seeking further empirical consistency over the effects of manufacturing flexibility on firm performance seems to be still necessary (Anand & Ward, 2004; Pagell & Krause, 2004).

Approach

This study follows literature leads to consider knowledge creation, herein understood in terms of the organization ability to learn from sources and create new ideas, as an antecedent of manufacturing flexibility. This is relevant because firm-specific knowledge creation may potentially mitigate the risks associated with the development of manufacturing flexibility. Firm specific knowledge creation, if well used, can better align manufacturing flexibility with the firm's strategy in order that higher performance is achieved. Because manufacturing flexibility integrates technological dimensions, the present study considers technological turbulence as an additional antecedent of manufacturing flexibility, while keeping the perspective of market turbulence - with less direct technological consequents - as a systemic moderator. An additional rationale for this dichotomy concerns the need to better examine the relationship between manufacturing flexibility and firm performance contingent on market turbulence, as such relation outcome is not consensual in the literature.

An extensive online survey addressing top management (CEOs and CFOs) and covering an estimated 61.2% of the Portuguese manufacturing firms with 20 or more employees is the main data source used to statistically test the conceptual model's hypotheses. SEM is used to fit the model.

Contributions

This study unifies complementary literatures by probing if technological turbulence as well as knowledge creation can positively affect manufacturing flexibility. It contributes to explain why some companies can obtain higher performance than others through the mediation analysis of manufacturing flexibility in the relation between knowledge creation and business and operations performance. In addition, specific contributions of this study are as follows. First, the study responds to a literature gap, by including an organizational creativity form (Patel et al., 2012) – knowledge creation – to further the research on information-processing antecedents of manufacturing flexibility (Ojha, White, & Rogers, 2015) while adapting and empirically testing a theoretical approach inspired by Koh and Gunasekaran (2006). Second, it uses the theoretical insight of Autry et al. (2010) by joining technological turbulence to knowledge creation to theoretically fundament manufacturing flexibility's development. Third, it responds to the call of Anand and Ward (2004), Pagell and Krause (2004), and Mishra et al. (2014), for added empirical evidence on the relations between manufacturing flexibility and performance contingent on market turbulence, as well as the call to use a multi-dimensional concept of manufacturing flexibility in line with the latest operationalization's of the construct (Jain et al., 2013). Fourth, it contributes to consolidate manufacturing's flexibility mediating role in the relations between knowledge creation and firm performance, as studies focusing on such role are yet scarce in the literature (Patel et al., 2012; Wu, 2006). The managerial insights produced by this study highlight the need for manufacturing firms to foster knowledge creation cultures, better educate and train staff and employees, and develop other instruments of knowledge creation such as socialization.

In the following section the hypotheses are presented as well as its theoretical foundations. An explanation of the methods used in the study and a presentation of results follows. The chapter concludes with a discussion of the results, implications for both theory and practice, limitations and further research routes.

4.2. Hypotheses

4.2.1. Technological Turbulence and Manufacturing Flexibility

The more technology changes, the more the components, processes, techniques and methods required for producing organizational outputs will tend to change. The more intense the impacts of technological change, the higher the need for the firm's capabilities configuration to change, adapt, even entirely replace existing capabilities configuration (Lavie, 2006).

Technological Turbulence

Technological change addresses the rate of change and impact of technology, as described by Jaworski and Kohli (1993). Technological turbulence, on the other hand, concerns the volatility in technological change, raising threats and opportunities for manufacturing firms. Threats to manufacturing flexibility come in the form of rapid obsolesce of the firm's current technologies while opportunities emerge in the form of positive incentives - new technologies - for the firm to adapt faster and develop its manufacturing flexibility. Such incentives, taken positively, can be channeled to benefit the firm's needs and strategy.

Manufacturing Flexibility

Genchev and Willis (2014) bridged the gap connecting the uncertainty of the environment and the firm's manufacturing flexibility, referring to the latter as a firm-specific dynamic capability. Older definitions have viewed flexibility as a means to improve the firm's fast response to demand and achieve good performance through increases in the product-range (Upton 1994, 1995a). But more recently, a tendency exists for manufacturing flexibility to be viewed as a synergy of several dimensions (Jain et al., 2013; Zhang et al., 2003). For example, Dreyer and Grønhaug (2004) defended the multi-dimensionality of the flexibility construct (supply, production and product assortment flexibility) as a necessary condition for firms to face highly volatile environments, while other authors have equally contended for the complementary role of a wider scope of dimensions expressing manufacturing flexibility (Rogers, Ojha, & White, 2011).

Manufacturing flexibility, in this study, expresses the degree to which industrial processes throughout the supply chain are able to cope with variable requirements involving suppliers, volume of demand, product portfolio, machine specialization, routing processes, and cross training (Rogers et al., 2011).

The constant development of new technologies outside the firm can directly and positively impact manufacturing flexibility, by pushing the set-up of new know-how and technological roadmaps into further development. Kessler and Chakrabarti (1996) argued that technological turbulence enhances innovation speed, as new technologies enable new products and services. A convergent perspective has been sustained by Ahlström and Westbrook (1999), observing that advances in the manufacturing function could be crucial to achieve mass customization, which combines mass production with customization and requires manufacturing flexibility. Furthermore, Autry et al. (2010) found that higher technological turbulence causes the firm's perceived technological usefulness and intention to use a new technology to grow.

This study proposes that the higher the volatility in technological change is, the higher the levels of manufacturing flexibility should be, borrowing from the rationale that the firm's perceived usefulness, ease-of-use and intention to use new technology increase under higher technological turbulence conditions (Autry et al., 2010). The broader the scope and diversity of the available technological solutions – hinted by the degree of technological turbulence - the greater the incentives the firm has to develop manufacturing flexibility. The proposed impact of technological turbulence on manufacturing flexibility is direct, via this incentive mechanism (pressure) toward the adoption of new, readily-available, external know-how or technology. Therefore, the hypothesis is:

H_{1a}: Technological turbulence is positively associated with manufacturing flexibility.

4.2.2. Knowledge Creation and Manufacturing Flexibility

Capabilities involving knowledge are not static (Nonaka et al., 2000). They evolve in time along with knowledge itself, competition and environmental changes, and can therefore be seen as dynamic capabilities (Brockman, 2013). For example, Camuffo and Volpato (1996), in a case study focusing on Fiat's dynamic capabilities and operations, observed that the implementation and development of automation techniques was a path-dependent, non-linear, learning process. They argued that Fiat's technologies resulted from learning, internal developments, external acquisitions, imitation of competitors, and the replication and selection of capabilities. Spanos and Voudouris (2009) confirmed that the adaptation to new technologies is a path-dependent process that gradually accumulates technology going from the less complicated to the more articulated and complex.

In order to develop manufacturing flexibility, which tends to be a know-how and technology intensive capability, managers may either seek readily-available external technology and/or alternatively adapt and develop in-house firm-specific solutions.

Knowledge Creation

Nonaka (1994) stated that organizational knowledge is created through the exchanges happening between tacit and explicit forms of knowledge in organizations and the conversion of both into new forms of knowledge, a process happening at an individual level first (Brockman, 2013). Knowledge creation is defined in this study as the ability of employees to learn from sources and produce novel ideas internally (MacInerney-May, 2012). It is expectable that anticipating obsolescence in components of manufacturing flexibility requires capabilities that use knowledge. Without such capabilities, technological changes and its implications may not be timely detected nor fully understood, potentially limiting firms in the development of adequate levels of flexibility. There is a strong learning component in the adaptation to technological changes and the integration of new technologies in manufacturing.

Koh and Gunasekaran (2006) argued for the crucial role of knowledge in the integration of key manufacturing support processes and its importance to the adoption of advanced technology. Reinforcing this view is the finding that the assimilation of knowledge has effects on manufacturing capabilities (Tu, Vonderembse, Ragu-Nathan, & Sharkey, 2006), and the finding that it may be so at the organizational level, as indirectly supported by Urtasun-Alonso, Larraza-Kintana, García-Olaverri, and Huerta-Arribas (2014), who found a positive relationship between advanced human resources (HR) management and manufacturing flexibility. Mendes and Machado (2015), probing on the link between employees’ skills and manufacturing flexibility, showed that employees’ skills could foster manufacturing flexibility.

While these studies provide indirect evidence of a possible relationship between knowledge creation and manufacturing flexibility, the current study defends that knowledge creation is essential to the firm-specific process of adapting, developing and creating knowledge with a positive utility dimension for manufacturing flexibility. The higher the capability of the firm to learn and create new ideas, the more effective should be the internal generation of ideas applicable to a more effective development of manufacturing flexibility. Moreover, knowledge creation may theoretically explain how operational routines and sub-dimensions of manufacturing flexibility can be transformed and developed in more specific, consequent, and successful ways: if the internal ideation process of the firm is powerful, then decisions for transforming, adapting, and developing manufacturing flexibility should be made in a more informed manner, making its development more effective. The way through which firms interpret their environments affects their flexibility strategy and the performance of such strategy (De Treville, Bendahan, & Vanderhaeghe, 2007). Since knowledge creation should confer better ability to interpret information and use firm-specific knowledge, a positive relation between knowledge creation and manufacturing flexibility should be expected. The resulting hypothesis is:

H_{2a}: Knowledge creation is positively associated with manufacturing flexibility.

4.2.3. Knowledge Creation and Business Performance

Sharkie (2003) has defended that firms operate through people and that it is their contribution that leverages the emergence of competitive advantage. More specifically, he advocated that management needs to nurture a knowledge creation environment in order to develop resources to full potential and better compete with rivals. Carlucci, Marr, and Schiuma (2004) explored the mechanisms through which knowledge can impact business performance, designating such paths as the knowledge value chain. They discussed the strategic, managerial and operational dimensions of knowledge management, effectively linking it not only to competences and processes, but also to business performance and value creation.

Business Performance

Business performance is understood in this study as the level of stakeholder's satisfaction with the business, a measure used by Gibson and Birkinshaw (2004). Albeit a subjective measure, they showed it is highly correlated to financial performance indicators (Return on Equity (ROE), Return on Assets (ROA), and shareholder return).

The rationale is that firms with higher levels of knowledge creation and a better internal ideation process have more chances to be successful in firm-specific development processes leading to higher stakeholders' satisfaction. This study therefore hypothesizes that:

H_{2b}: Knowledge creation is positively associated with business performance.

4.2.4. Knowledge Creation and Operations Performance

The KBV views knowledge as the most strategically significant key resource of the firm and as a source of competitive advantage improving firm performance (Grant, 1996b; Spender, 1996). Knowledge management affects operational dimensions as noticed by Carlucci et al. (2004). Also, Fugate, Stank, and Mentzer (2009) found strong positive connection between the knowledge management process and operational performance.

Lloréns et al. (2005) found that environmental factors, as well as internal resources, affect flexibility, which in turn affects performance. Knowledge creation, the ability to learn from sources and produce novel ideas internally (MacInerney-May, 2012) is an organizational capability and also an internal resource with expectable effects beyond manufacturing flexibility.

Operations Performance

Operations performance, in the context of this study, is defined by the relative performance of lead time to market, manufacturing flow cost and production output quality level, when compared to the strongest competitors.

Firms better able to create knowledge internally more easily combine new knowledge with existing knowledge, with positive effects for the coordination of resources and management practices involved in operations performance (time, cost, quality). This is what Carlucci et al. (2004) defended, by stating that knowledge creation affects very diverse factors as it moves and transforms along the knowledge value chain of the firm. The resulting hypothesis is:

H_{2c}: Knowledge creation is positively associated with operations performance (time, cost, quality).

4.2.5. Manufacturing Flexibility and Business Performance

Anand and Ward (2004) provided empirical evidence in favor of the view of manufacturing flexibility as an antecedent of performance, especially under higher turbulence environments. Raymond and St.-Pierre (2005) found that advanced manufacturing systems positively affect business performance, indicating that the more technological dimensions of manufacturing flexibility should have positive effects on firm performance.

Overall, however, operations management literature has not reached a consensual conclusion over the effects of manufacturing flexibility on performance (Camisón & Villar Lopez, 2010). Research shows mixed results (Patel et al., 2012), with studies supporting that such effects are more powerful under uncertainty (Anand & Ward, 2004; Chang et al., 2003; Narasimhan & Das, 1999), and others defending that manufacturing flexibility is higher in firms with higher business performance, regardless of the levels of environmental uncertainty (Pagell & Krause, 1999).

It is expected that firms displaying higher levels of manufacturing flexibility adapt better to the environment, displaying higher business performance as a result. The rationale for this hypothesis implicitly assumes that manufacturing flexibility is adequate for the goals of the firms, leading to a positive stakeholder's satisfaction from a top management perspective (business performance), through a better alignment of the firm with its environment. Consequently, the hypothesis is:

H_{3a}: Manufacturing flexibility is positively associated with business performance.

4.2.6. Manufacturing Flexibility and Operations Performance

Raymond and St.-Pierre (2005) found that advanced manufacturing systems affect operational performance, not just business performance. Theoretically, manufacturing flexibility should allow for lower inventories, reduced warehousing areas, and simpler logistics, improving quality through faster feedback loops, better products and processes (Bolwijn & Kumpe, 1990). Swafford, Ghosh, and Murthy (2008) established supply chain process flexibilities as antecedents of supply chain agility, specifically concluding that a firm's supply chain agility is positively affected by the degree of flexibility in the processes of manufacturing, procurement and distribution. In turn, supply chain agility is required to produce innovative products and deliver to customers in a timely manner. Ojha et al. (2013), investigating the effect of manufacturing flexibility on workflow and operational performance with data collected from US manufacturing firms, found empirical and more direct evidence supporting manufacturing flexibility's positive effect on performance (lower inventories and costs). They also found manufacturing flexibility to increase the speed of materials flow (time).

It is expected that manufacturing flexibility is positively associated with operations performance (time, cost, and quality). The rationale for such hypothesis is that by developing manufacturing flexibility adequately, firms are expected to better adapt to a changing environment, with better outcomes in terms of throughput time, workflow cost and production quality. The hypothesis is:

H_{3b}: Manufacturing flexibility is positively associated with operations performance (time, cost, quality).

4.2.7. Mediation Role of Manufacturing Flexibility

Wu (2006) identified manufacturing flexibility as a mediating dynamic capability in the relations between resources and performance, while Patel et al. (2012) identified manufacturing flexibility to mediate the relation between contextual ambidexterity levels (simultaneous exploitation and exploration) and firm performance. These studies hint for a mediation role of manufacturing flexibility in the relations between knowledge-based capabilities and performance outcomes. Mendes and Machado (2015), found a mediating role of manufacturing flexibility in the relation between employees' skills and business performance, which is a possible indirect evidence in support of a mediation role of manufacturing flexibility in the relationship between knowledge creation and performance.

This study defends that manufacturing flexibility is a core capability able to assimilate firm-specific knowledge created within the firm and convert it into an additional indirect and positive impact on business performance. This means the improvement of manufacturing flexibility levels may help deliver better business results via reduced manufacturing costs or better production quality leading to higher sales and financial returns, satisfying stakeholders to a higher degree. The following mediation hypothesis is proposed:

M_{2a}: Manufacturing flexibility mediates the relationship between knowledge creation and business performance.

The knowledge-transformative process operated by manufacturing flexibility is also expected to improve operations performance (time, cost, quality) indirectly, through the improvement of manufacturing flexibility. The rationale is that if knowledge creation is adequately used in the development of the firm's manufacturing flexibility, it will align it better with the firm's needs and goals, increasing the firms' chances to achieve better operational outcomes, such as operations performance. Manufacturing flexibility will be expected to absorb part of the created know-how and apply it to increase its own impact on the firm's operations performance. This results in the following mediation hypothesis:

M_{2b}: Manufacturing flexibility mediates the relationship between knowledge creation and operations performance (time, cost, quality).

4.2.8. Technological Turbulence, Operations and Business Performance

Readily-available know-how and technological solutions from the marketplace can be adopted to improve manufacturing flexibility. The higher the turbulence, the wider the available scope of solutions as well as the combinations of possibilities resulting from it. The rationale is that the adoption of readily-available external technological solutions enables further developments in manufacturing flexibility. Such transformative effect is expected to produce positive impacts on operations performance as well as on business performance, in a similar way to that proposed for knowledge creation. Therefore, there are two additional mediation hypotheses to consider:

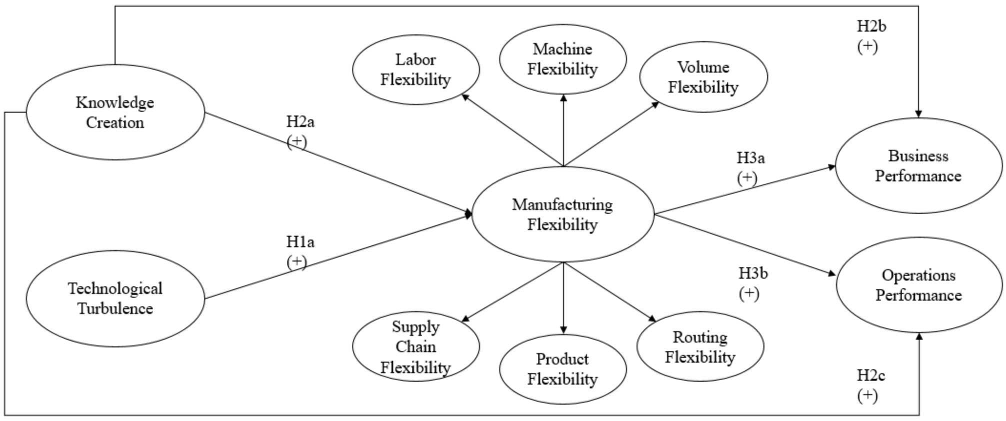
M_{2c}: Manufacturing flexibility mediates the relationship between technological turbulence and business performance.

And,

M_{2d}: Manufacturing flexibility mediates the relationship between technological turbulence and operations performance (time, cost, and quality).

Figure 4.1 presents the main hypotheses and expected signals in the conceptual model.

Figure 4.1 Conceptual Model 2



Source: own elaboration.

4.3. Methodology

4.3.1. Data Collection

An online survey aimed at CEOs and CFOs was sent by email to the 3728 registries of Portuguese manufacturing firms with 20 or more employees available in the Kompass Database (Kompass Diretório de Empresas para profissionais e solução de dados empresariais - Portugal, 2015). The online questionnaire guaranteed the anonymity of the respondents. Overall, 515 responses were obtained and 370 responses were validated. The survey was performed during early 2015. The response rate was of 10% of the sampling frame used, and of an estimated 6.1% of the targeted population of firms. The questions used scale items grounded in the literature, adapted to Portuguese. Of the valid responses and regarding firm size, 167 firms (45.1%) had 20 to 49 employees, 168 firms (45.4%) 50 to 249 employees, and 35 firms (9.5%) 250 or more employees. As to firm age, 22 of the firms (6%) were 10 years of activity or less, 104 firms (28%) were 11 to 25 years of activity, 200 firms (54%) were 26 to 65 years of activity, 22 firms (6%) were between 66 to 99 years of activity, and 22 firms (6%) were 100 or more years of activity. Regarding the split between CEOs and CFOs responses, 241 of the valid responses came from CEOs (65.1%) while 129 came from CFOs (34.9%). Of the valid respondent firms, sales (2014) ranged from 154.886 EUR a year to 10.866 million EUR a year, while exports ranged from zero to 4.178 million EUR a year. The median value of sales was 3.8 million EUR a year, while the median value of exports was of 1.0 million EUR a year. 339 firms reported non-zero export sales (91.6% of the respondents). 54.6%

of the valid respondent firms were located in northern Portugal, 39.7% in central Portugal, 3.2% in southern Portugal and 2.4% in the Portuguese archipelagos of Madeira and Azores. The valid respondent firms' sample comprised a total of 34 activity sectors, with the 10 more frequent sectors being printing, automotive, chemical, construction materials, machinery, furniture, ceramics, metallurgy and metallic products, food and food processing and textiles.

The sampling frame, data collection and data analysis methods are shared for the studies in chapters 3 to 5. A detailed presentation of the instrument of research, the sampling frame, the population coverage, the response rates and the sample characterization is offered in chapter 2, to avoid an integral repetition of large portions of text.

4.3.2. Measures

This study adopts scales grounded in the literature. A seven-point Likert-type scale was used for all non-demographic variables in the survey (from 1…*totally disagree* to 7…*totally agree*). The constructs were measured by multiple items adapted from the literature (Appendix I, Table A.1.2).

Knowledge creation was measured through four items, adopted from Pavlou and El Sawy (2006), Prieto et al. (2009), and Flatten et al. (2009), using the scale developed by MacInerney-May (2012).

Technological turbulence and market turbulence ware measured through five items each, following the scale of MacInerney-May (2012).

Manufacturing flexibility was measured using the scale of Rogers et al. (2011), operationalizing it as a second order construct with six factors, measured through three items each, namely product-mix flexibility, routing flexibility, equipment flexibility (herein machines flexibility), volume flexibility, labor flexibility and supply chain flexibility.

Operations performance (time, cost and quality) was measured through three new items proposed by this study, assessing joint operations performance of throughput time to market, manufacturing flow cost and production output quality, when compared to the strongest competitors of each firm over a five-year period. This measure was inspired by Ojha et al. (2013), who tested the effects of manufacturing flexibility on firm outcomes such as speed, system efficiency, cost and inventory.

Business performance was measured using five items from Gibson and Birkinshaw (2004), assessing stakeholder's satisfaction from a top management perspective, over a period of five years.

4.4. Results

4.4.1. Measurement Model

Scales Purification

During the purification phase, one item was excluded from machines flexibility (a sub-dimension of manufacturing flexibility), another item was excluded from business performance and another item was excluded from technological turbulence. Overall, out of the 34 initial items in the model, three have been dropped. The item dropped from business performance presented problems of excessive kurtosis (well above 3.0). The cut offs considered in this study were | Kurtosis | > 2.2, and | Skewness | > 3.0 (Sposito et al., 1983). The item taken out from machine flexibility was removed because it presented poor inter-item correlations resulting in below standard Cronbach alpha. Its removal resulted in a Cronbach's alpha change from 0.69, below the threshold in Hair et al. (2010), to 0.77. The item removed from technological turbulence was also dropped for poor loading. The items obtained after the purification phase are presented in Appendix I (Table A.1.2).

Measures Assessment

The total variance extracted by all the remaining items through the maximum likelihood method with free factor extraction was of 70.9%. A total of seven factors was extracted with eigenvalues higher than one. The KMO measure of sampling adequacy returned a value of 0.874. The goodness of fit test value was of 3.07 with a 0.00 *p*-value.

The purified measurement model revealed a composite reliability for all constructs above 0.70 - the threshold in Hair et al. (2010) - ranging from 0.79 for operations performance (time, cost, and quality) to 0.90 for business performance. The AVE was also above 0.50 for all constructs, ranging from 0.52 (manufacturing flexibility) to 0.75 (business performance). This is evidence supporting the convergent validity of the constructs. The AVE was greater than the MSV, and greater than the ASV - for all constructs. The square root of AVE was greater than the inter-construct correlations for all constructs. Thus, the measurement model constructs do not display discriminant convergence issues (Hair et al., 2010). These results are presented in Tables 4.1 and 4.2.

Table 4.1 ***AVE, MSV and ASV***

	AVE	MSV	ASV
TTURB	0.674	0.118	0.096
KCRE	0.681	0.432	0.241
OPERF	0.553	0.213	0.143
BPERF	0.757	0.432	0.253
MANFLEX	0.522	0.294	0.191

Table 4.2 ***Correlation Matrix***

	M	SD	1	2	3	4	5	CR	AVE
TTURB (1)	4.44	1.32	**0.82**					0.89	0.67
KCRE (2)	5.18	1.11	0.30	**0.83**				0.89	0.68
MANFLEX (3)	5.06	1.27	0.31	0.54	**0.72**			0.86	0.52
BPERF (4)	5.12	1.08	0.34	0.66	0.50	**0.87**		0.90	0.75
OPERF (5)	5.17	0.92	0.28	0.39	0.36	0.46	**0.74**	0.79	0.55

Note. Diagonal elements in bold are the square roots of AVE.

The maximum likelihood estimation AMOS procedure in IBM AMOS version 22 was used to assess the measurement's model fit. The refined measurement model, not resorting to any intra-construct error correlations, returned an acceptable fit: $\chi^2 = 813.8$, 419 df, significant, $\chi^2 / df = 1.94$, CFI = 0.94, TLI = 0.93, NFI = 0.88, RMR = 0.14, AGFI = 0.85, RMSEA = 0.051. No error correlations of same or different construct items were performed. The items obtained after the purification phase are presented in Appendix I (Table A.1.2).

4.4.2. Common Method Bias

Several methods were employed to assess common variance in the data. Combined, they reinforce the conclusion that while not inexistent, common method issues do not seem relevant in this study.

To assess the impact of common method bias the unmeasured latent factor test (Podsakoff et al., 2003) was performed. The common variance obtained by squaring the unstandardized common loadings of the common latent factor was under 27.0%, far from approaching the 50% threshold. The introduction of a common latent factor only slightly affected the items standardized loadings: a maximum change of 0.18 was recorded (one item) below the 0.20 threshold in Aiken et al. (1991). The average difference between the standardized loadings with and without the common latent factor was of 0.08 and the median was of 0.07. The small differences between the standardized loadings with and without the common latent factor indicate a tolerable level of common variance.

Moreover, the CFA of a single-factor model onto all the items were loaded shows a poor fit ($\chi^2 = 4429.7$, χ^2/df = 9.55, CFI = 0.40, GFI = 0.49, TLI = 0.40, NFI = 0.37, RMR = 0.29, RMSEA = 0.152). If common method variance was responsible for most of the relations among the constructs, this one-factor model would fit the data well (Korsgaard & Roberson, 1995; Mossholder et al., 1998).

In addition, the Harman single factor test was performed. A principal components analysis on all the items of the purified measurement model returned a 32.2% variance explained by the first factor, below the 50% cut off (Harman, 1967).

4.4.3. Structural Model Fit and Main Hypotheses Tests

Statistical Power and Sample Adequacy

For a desired statistical power level of 0.80, Soper's (2017) simulator indicates that finding a minimum absolute effect size of 0.10 with a 0.10 *p*-value, in a structural equations model with 10 latent variables and 31 items requires, ideally, a sample size with 1820 cases, and a minimum of 186 cases to establish the model structure. Bentler and Chou (1987) admit a minimum of five cases per item in SEM models if the data is normal, has no missing entries nor outliers. The data collected in this study is fairly normally distributed with no missing entries nor outliers (see Appendix I, section A.3). Kline (2015) informs that sample sizes of at least 200 cases are adequate for most models or, alternatively, collecting five to 10 cases per item. The current study has a sample size of 370 cases and more than 10 cases per item, therefore fitting Kline's criteria for sample size and method adequacy (SEM).

Structural Model Fit

The structural model presented an acceptable fit: $\chi^2 = 811.5$, 420 df, significant, $\chi^2 / df = 1.93$, CFI = 0.94, TLI = 0.93, NFI = 0.88, RMR = 0.12, AGFI = 0.85, RMSEA = 0.050. The χ^2 test is significant. However, it has been suggested with some consensus in the literature that a model with $\chi^2 / df < 3$ demonstrates reasonable fit (Iacobucci, 2010). A CFI fit index equal or larger than 0.95 is indicative of good model fit (Hu & Bentler, 1999). Ideally, the TLI and the NFI should both be above 0.95 (Hooper et al., 2008), while the RMSEA should be below 0.060 (Hu & Bentler, 1999). To expect TLI and CFI values above 0.95 (Hu & Bentler, 1999) is only reasonable for very large sample sizes (Byrne, 2001). The structural model explains 45% of the variance of business performance and 17% of the variance of operations performance (time, cost, and quality). Empirical support for all the six main hypotheses was found. Table 4.3 presents the main hypotheses tests results. The hypothesized model was tested using SEM with IBM AMOS version 22.

Table 4.3 ***Hypotheses Tests of Model 2***

	Path	SC	SE	t-value	p-value
H_{1a}	TTURB → MANFLEX	0.168	0.035	2.856	***
H_{2a}	KCRE → MANFLEX	0.455	0.049	6.663	***
H_{2b}	KCRE → BPERF	0.552	0.065	8.989	***
H_{2c}	KCRE → OPERF	0.276	0.057	3.808	***
H_{3a}	MANFLEX → BPERF	0.188	0.089	3.130	***
H_{3b}	MANFLEX → OPERF	0.197	0.057	2.603	***

Note. Tests of hypothesis are two tailed; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Results

The path coefficient from technological turbulence to manufacturing flexibility is significant at a level lower than 0.01 (β = 0.168; *t* = 2.856), thus supporting hypothesis H_{1a}. The path coefficient from knowledge creation to manufacturing flexibility is significant at a level lower than 0.01 (β = 0.455; *t* = 6.663), thus supporting hypothesis H_{2a}. The path coefficient going from knowledge creation to business performance is significant at a level lower than 0.01 (β = 0.552; *t* = 8.928), thus supporting hypothesis H_{1b}, and the path coefficient going from knowledge creation to operations performance is significant at a level lower than 0.01 (β = 0.276; *t* = 3.808), thus supporting hypothesis H_{2b}. Hypothesis H_{3a} is corroborated to a statistical significance level below 0.01 (β = 0.188; *t* = 3.130), thus confirming the statistical significance of the path coefficient going from manufacturing flexibility to business performance, while the path coefficient going from manufacturing flexibility to operations performance, hypothesis H_{3b}, is also significant to a level lower than 0.01 (β = 0.197; *t* = 2.603). To summarize, findings reveal empirical support for statistically significant positive impacts of technological turbulence, as well as knowledge creation, on manufacturing flexibility (H_{1a} and H_{2a}), knowledge creation on business and operations performance (H_{2b} and H_{2c}), and manufacturing flexibility on business and operations performance (H_{3a} and H_{3b}). No hypotheses in the model were left statistically unsupported.

4.4.4. Mediation

A construct can be explained by indirect effects as well as by direct effects (Little et al., 2007). The existence of a significant indirect effect in a chain of causation suggests that mediation is present (Zhao et al., 2010). In this sense, a hypothesized mediator is an additional link in a certain chain of causation. Mediation renders hypotheses testing more consistent and precise (Malhotra et al., 2014).

Using a 1000 bootstrap samples process with replacement at a 90% confidence level, estimates for the direct and indirect effects, as well as their significance, were obtained. Bootstrapping is a powerful method for evaluating mediation effects, as it does not assume nor require a normal data distribution. The results support all the four mediation hypotheses proposed in this study. The effects are significant, albeit relatively weak (Table 4.4).

Table 4.4 ***Mediation Results of Model 2***

	Mediator	Indirect Effect	Direct Effect	Total Effect	Mediation
$\mathbf{M_{2a}}$	MANFLEX	0.086 (**)	0.552 (***)	0.638 (***)	Partial
$\mathbf{M_{2b}}$	MANFLEX	0.090 (**)	0.276 (***)	0.365 (***)	Partial
$\mathbf{M_{2c}}$	MANFLEX	0.032 (**)	0 (-)	0.032 (**)	ND
$\mathbf{M_{2d}}$	MANFLEX	0.033 (**)	0 (-)	0.033 (**)	ND

Note. ND: Not-determined. Significance was obtained through the bias corrected percentile method (2-tailed); * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; a 1000 bootstrap samples with replacement method, at a 90% confidence level, was used to compute the effects.

4.4.5. Multi-Group Moderation: Market Turbulence

Multi-group moderation was used to analyze the behavior of all of the model's relations when the dataset is split into different values of a grouping variable. The group variable of choice was, in the case, market turbulence. Two groups divided by the means were created for high and low market turbulence (183 firms and 187 firms, respectively).

The joint model fit for the market turbulence groups was good, meaning that there is configural invariance in the model (χ^2/df = 1.75, CFI = 0.90, TLI = 0.89, NFI = 0.80, GFI = 0.80, RMR = 0.17, AGFI = 0.77, RMSEA = 0.045). The χ^2 test for the fully constrained and the unconstrained model has a significant *p-value* (0.001), which means there is no full metric invariance (Byrne, 2008). The stages for full metric invariance imply the groups to have non-significantly different factor means, loadings, intercepts, and residuals (Schmitt & Kuljanin, 2008). Partial metric invariance for market turbulence was assessed and confirmed, by looking at the significance of the differences of items loadings between groups for each construct: at least one non-constrained path per factor being non-significantly different is required for partial metric invariance to be confirmed (Byrne, 2008). The significance of the differences in non-standardized path coefficients was tested between groups for each variable, through a z-score test (2-tailed). The results (Table 4.5) highlight the model paths showing significant differences between the low and high market turbulence groups.

Table 4.5 ***Market Turbulence Effects on Model 2***

	MTURB (L)	MTURB (H)	z-score
MANFLEX → OPERF	0.060 (NS)	0.440 (**)	**
KCRE → BPERF	0.746 (***)	0.392 (***)	***

Note. NS: Not Significant; L: Low; H: High. Z-score significances: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

4.5. Discussion

The purpose of this study was to investigate knowledge creation as a key factor to explain why some firms can obtain higher performance from increased manufacturing flexibility than others, an issue identified in the literature. Overall findings suggest that firm-specific knowledge creation applicable to manufacturing flexibility is a candidate-capability to answer the question.

Is manufacturing flexibility a mediator?

Not only the impact of manufacturing flexibility on operations performance is positive and significant, the intensity of the effect increases for above-average market turbulence conditions, and the impact of knowledge creation on manufacturing flexibility is positive and significant in both circumstances (low and high market turbulence). This means that a better operations performance under higher market turbulence is explained by manufacturing flexibility, and also that a higher manufacturing flexibility is explained by higher knowledge creation, at the same time.

Manufacturing flexibility partially mediates the relations of knowledge creation with business and operations performance, which means part of the knowledge created in the firm gets transformed by manufacturing flexibility in additional positive effects on business and operations performance. Knowledge creation can thus explain how manufacturing flexibility can adapt, transform and develop in more consequent and impactful ways. If the internal ideation process of the firm is powerful, then decisions for adapting, transforming and developing manufacturing flexibility should be made in a more informed and context-wise manner, making its development and impacts on performance more effective through better alignment of manufacturing flexibility with competitive and environmental demands.

How important is knowledge creation?

Findings confirm knowledge creation's positive significant direct impact on manufacturing flexibility, and positive significant conversion of knowledge creation in indirect impacts on business and operations performance. Findings also show that the positive impacts of manufacturing flexibility on business and especially operations performance are significant and positive but not as intense as those of knowledge creation, for example, at average market turbulence levels. This suggests that other factors influenced by knowledge creation as it moves and transforms along the knowledge value chain of the firm (Carlucci et al., 2004) may have important impacts on business and operations performance. Additionally, it may also pinpoint a structural industry weakness at aligning manufacturing flexibility with environmental and demand requirements in the sample, or simply indicate that at average market turbulence conditions manufacturing flexibility requirements are not high.

The second finding is that knowledge creation is more important to the development of manufacturing flexibility than technological turbulence. Firms that do not possess adequate levels of knowledge creation will display lower business performance, as well as lower manufacturing flexibility and lower operations performance.

If a poor knowledge creation capability is in place, manufacturing flexibility may not be at an adequate level to contribute to higher operations performance under higher market turbulence. Firms relying less on internal knowledge creation to adapt available technologies and know-how or create new firm-specific knowledge will get behind on the development of manufacturing flexibility. This is relevant because for firms enduring above-average market turbulence, knowledge creation direct impact on business performance significantly drops in intensity, while the direct impact of manufacturing flexibility on operations performance rises quite significantly instead.

The result showing that the impact of knowledge creation on business performance is considerably reduced for firms perceiving above-average market turbulence suggests that higher-order dynamic capabilities (Wang & Ahmed, 2007; Winter, 2003) effects on firm performance are dampened by market turbulence. Although dynamic capabilities have been identified as a way to address turbulent environments (Pavlou & El Sawy, 2011), not all seem to be appropriate for such purpose at all times and in every condition. One possible explanation for this is that higher market turbulence could set a tougher internal environment in the firm, with different capabilities competing among each other for resources and investment allocations. In such conditions, it is understandable that core capabilities of more short-termed impact on firm outcomes get ahead (in the case, manufacturing flexibility *versus* knowledge creation).

Under which circumstances is manufacturing flexibility more important?

A possible explanation for the limited explanatory power of business and operations performance provided by the model (the amount of variance it explains is 45% and 17%, respectively), could be rooted in the fact that manufacturing flexibility may not guarantee, *per se*, improvements in firm performance if other mediating variables keep unaccounted for, such as innovation (Camisón & Villar López, 2010). Moreover, as multi-group moderation findings show, the case is different at above-average market turbulence levels: in such conditions, manufacturing flexibility has an intense and significant positive impact on operations performance.

Lastly, manufacturing flexibility's impact on operations performance is not significant for firms perceiving below-average market turbulence, but it positively and significantly affects operations performance for firms perceiving above-average market turbulence conditions. This confirms the key role of manufacturing flexibility in coping with demand and environmental fluctuations.

4.6. Conclusions

4.6.1. Theoretical Implications

This study responds to the necessity to further the research on information-processing antecedents of manufacturing flexibility (Ojha et al., 2015). It does so by adapting and empirically testing a theoretical approach in the line of Koh and Gunasekaran (2006), and offering a further probe into the links between strategic and operations perspectives, following the call of Ketchen and Guinipero's (2004). Furthermore, the study expands on the insight of Autry et al. (2010), joining knowledge creation and technological turbulence to theoretically fundament manufacturing flexibility's development.

While adding needed empirical evidence to the relationship between manufacturing flexibility and firm performance (Anand & Ward, 2004; Mishra et al., 2014; Pagell & Krause, 2004), the findings support the literature stream defending that manufacturing flexibility makes a positive difference in firm performance: in operations performance and under higher market turbulence conditions, in line with Narasimhan and Das (1999), Chang et al. (2003), and Anand and Ward (2004).

The fact that these results are from a sample where SMEs predominate, contributes to the scarce literature of manufacturing flexibility in such context, while suggesting that size is not that important when it comes to the need to foster a knowledge creation culture, as the benefits it brings to business and operations performance are clear.

Moreover, to our knowledge, this study is one of the few simultaneously using a multi-dimensional operationalization of manufacturing flexibility (six sub-dimensions), as called for by Mishra et al. (2014) in their review of manufacturing flexibility and suggestions for further research.

Also, this study adds to the few studies confirming manufacturing flexibility's mediating role in the relationships between knowledge resources, technological turbulence and firm performance (Patel et al., 2012; Wu, 2006).

In summary, this study highlights the potential of knowledge creation's theoretical explanatory power to clarify why the efforts of some firms to buildup and develop manufacturing flexibility produce better performance results than others. Knowledge creation direct positive impact on manufacturing flexibility and its indirect impacts on business and operations performance through manufacturing flexibility suggest that it is a capability able to explain how manufacturing flexibility can be adapted, transformed and developed to better respond to high market turbulence conditions and generate higher positive effects on operations performance.

4.6.2. Managerial Implications

There are several implications for managers to consider. First, they should foster knowledge creation capabilities to enable manufacturing flexibility to raise to levels adequate for coping with the firm's market environment at rough times, with less risk and through more informed decisions, based on the employee's specific know-how. This is indirectly in line with

Youndt, Snell, Dean, and Lepak (1996), and Bamberger, Biron, and Meshoulam (2014): an HR focused on human capital development is highly related to multiple dimensions of operational performance, such as employee productivity and machine efficiency.

Second, managers should foster knowledge creation irrespective of their firm size, which means supporting individual and group contributions of employees. This is a conclusion based on the fact that the majority of the firms in the sample are SMEs.

Third, the impact of manufacturing flexibility on operations performance being more intense for firms perceiving higher levels of market turbulence reinforces manufacturing flexibility's contingency-response role in the adaptability of firms. This means that managers cannot forgo to develop manufacturing flexibility. The threats to change are failure risks (Upton, 1995b) and internal inertia (Rosenbloom & Christensen, 1994), which can be mitigated through a culture supporting knowledge creation.

Fourth, this study reinforces the view that manufacturing flexibility should be seen as a multi-dimensional construct, extending from more machine and manufacturing-based sub-dimensions into the supply chain and the human factor (teams cross training). As Rogers et al. (2011) underlined, cross training employees for adequately engaging with different activities, different types of machines and diverse team's compositions, positively reinforces manufacturing flexibility.

4.6.3. Limitations and Further Work

It would be enriching to perform similar studies in longitudinal contexts, as different industries may conceal different results. Cross sectional studies such as this one have limitations in supporting the causality proposed in the hypotheses, while endogeneity issues could also affect the hypothesized relations in the model. Additionally, single informant studies are more prone to common variance issues, while the exclusive use of subjective measures is subject to respondent bias and social desirability issues. Future research on the topic would benefit from multiple informant data and secondary objective data (for example: investments in R&D, financial and operations performance indicators) to limit common variance issues. The assumption that CEOs and CFOs respond basically in the same way is a simplification. TLI and NFI values for the structural model fit (TLI = 0.93, NFI = 0.88) suggest that the model could be optimized, as they should be closer to 0.95. This study does not include control variables, such as firm size and age.

Chapter 5 Absorptive Capacity and Innovation Spillover Effects on Manufacturing Flexibility

Abstract

Shifting demand and ever shorter product cycles pressure manufacturing flexibility. Although the literature has established the positive impact of the firm's absorptive capacity on manufacturing flexibility, the separated role of exploitation and exploration innovation strategies in such relationship is still a literature gap. The question is: how do exploitation and exploration innovation strategies separately affect manufacturing flexibility? A survey's data addressing top management is analyzed through SEM. While using a sample of 370 manufacturing firms, findings reveal that although absorptive capacity effects on manufacturing flexibility are mainly direct, a significant positive indirect effect exists through responsive market orientation and innovation competence exploitation. Essentially, an innovation reliability strategy produces direct positive impact on manufacturing flexibility while simultaneously being a vehicle for absorptive capacity's indirect effects on manufacturing flexibility. Exploration innovation strategy is not found to significantly affect manufacturing flexibility, at least in the short and medium-term (less than five years). Findings also reveal that the direct absorptive capacity's impact on manufacturing flexibility is more intense in larger firms, which is indirect evidence of its path-dependent effects. This study contributes to combine key strategic firm features with manufacturing flexibility, while providing new empirical evidence of the mediation of innovation reliability strategy in the relationship between absorptive capacity and manufacturing flexibility.

Keywords: dynamic capabilities, absorptive capacity, market orientation, innovation competence orientation, manufacturing flexibility.

5.1. Introduction

Manufacturing flexibility has become relevant to achieve competitive advantages for firms, in a context of volatile demand and high levels of competition (Ojha et al., 2015; Patel et al., 2012; Tamayo-Torres et al., 2014). Among the capabilities important for the development of manufacturing flexibility are absorptive capacity and ambidexterity (Patel et al., 2012). While absorptive capacity allows for the recognition, assimilation and transformation of new knowledge, ambidexterity uses such knowledge for both exploitation and exploration (Patel et al., 2012). Patel et al. (2012) stated that each firm's absorptive capacity was context contingent and unique, enhancing the firm's returns through better alignment of manufacturing flexibility with the environment. Furthermore, they found that ambidexterity was also key to achieve increasing returns from manufacturing flexibility. The suggested mechanism explaining such result was that ambidexterity helped to channel the firm's learning efforts by harmonizing the optimization of existing routines and processes with the development of new routines and processes, thus ensuring continuity.

Building on Patel et al. (2012) work, the purpose of the current study is to evaluate to which extent the separate capabilities of organizational absorptive capacity, innovation reliability strategy and innovation variability strategy affect manufacturing flexibility and the discussion of the underlying mechanisms of such impacts. The central research question here is: how do innovation reliability and variability strategies separately affect manufacturing flexibility, when taking into account the role of absorptive capacity? While there are still very few studies focusing on the relationships between ambidexterity and manufacturing constructs, Tamayo-Torres, Roehrich, and Lewis (2017) showed significant connection between ambidexterity and manufacturing performance (quality, delivery, cost and flexibility), which makes the separate relationships between innovation competences (exploitation-exploration) and manufacturing flexibility expectable and worth analyzing in separate. To our knowledge, this is the first study to address the separate impacts of exploitation and exploration innovation strategies on manufacturing flexibility, which appears to be a literature gap, while also accounting for the firm's absorptive capacity. This study addresses Ketchen and Guinipero's (2004) request to link the strategic management to the operations management perspectives.

Theoretical Background

The main theories of reference in this study are the KBV of the firm (Grant, 1996b; Spender, 1996), which highlights knowledge as the most strategically important firm resource, and the dynamic capabilities perspective (Teece et al., 1997), which refers to an organization's ability to change its operations in an efficient and responsive manner to the environment. While a capability generally designates a certain functional area of the firm enabling it to engage in specific actions, a competence refers to the knowledge, skills and resources shaping the firm's ability to deliver superior customer value (Day, 1994). In simpler words, a competence designates the proficiency through which a capability is put into practice. A dynamic capability enables firms to change its core capabilities (Wang & Ahmed, 2007). The term 'dynamic capability' was seminally defined by Teece et al. (1997) as the firm's ability to integrate, build and reconfigure internal and external competences to rapidly address changing environments. Such capabilities have been more recently defined as the abilities to reconfigure the firm's resources and routines in a manner envisioned by management (Zahra et al., 2006). Most dynamic capabilities views involve knowledge and time, addressing the need to develop internal and external activities aiming at the change of core capabilities, to gain positive effects over the firm's competitive advantage and performance. Wu (2006) theoretically and empirically concluded that resources affect performance rather indirectly through dynamic capabilities such as innovation and market response speed but also through operational capabilities such as manufacturing efficiency and flexibility.

Manufacturing flexibility was recognized as a dynamic capability (Malik & Kotabe, 2009), as a result of its impact on firm performance in a dynamic world. Manufacturing flexibility has moreover been recognized as an important responsive and proactive type of strategic orientation (Brettel et al., 2016), thus a capability potentially enabling not only a response to the environment but also an attempt to shape it. This study regards manufacturing flexibility as a core capability of the firm, over which absorptive capacity, as well as innovation flexibility, have a higher power of influence.

Absorptive Capacity

The general perspective of learning as a capability building process closely relates to the more specific construct of absorptive capacity, the firm's ability to identify, assimilate and explore knowledge gained from external sources, as defined by Cohen and Levinthal (1989). Absorptive capacity represents a background structure enabling the firm to exploit and explore acquired, transformed and newly created knowledge (Cohen & Levinthal, 1994). In order to exploit externally acquired knowledge, firms need to translate it into usable forms oriented to the market, in their goal to build competitive advantage through innovation and strategic flexibility (Zahra & George, 2002). This study regards absorptive capacity as a higher-order dynamic capability common to all firms (Wang & Ahmed, 2007) and capable of enhancing other core capabilities, among which manufacturing flexibility, but also market and innovation related capabilities.

Manufacturing Flexibility

Manufacturing flexibility can be seen as a strategic capability that enables firms to achieve competitive advantage in the marketplace (Jain et al., 2013). It was defined as the firm's capability to address increasing variety in demand expectations without excessive costs, time, organizational disruptions or performance losses (Zhang et al., 2003). A more specific and recent definition deems it as "the ability of the manufacturing function to make adjustments needed for coping with environmental change with little penalty in time, effort, cost or performance" (Pérez Pérez et al., 2016, p. 3133). The strategic perspective of manufacturing flexibility as a response to certain forms of uncertainty (Pérez Pérez et al., 2016) has been founded by Slack (1983) and Gerwin (1993). More recently, manufacturing-based flexibilities have been linked to marketing-based flexibilities (D'Souza & Williams, 2000; Oke, 2005). Manufacturing flexibility is relevant for several firm outcomes such as acquiring resources and institutional support (Grewal & Tansuhaj, 2001), satisfying customers (Zhang et al., 2003), changing the supply chain configuration (Pagell & Krause, 2004) and meeting market demand (Anand & Ward, 2004).

While the initial definitions viewed manufacturing flexibility as a means to improve a firm's fast response to demand and achieve good performance through increases in the firm's product-range (Upton 1994, 1995a), more recent perspectives see manufacturing flexibility as a synergy of several dimensions (Jain et al., 2013; Zhang et al., 2003). For example, Dreyer and Grønhaug (2004) defended multi-dimensional flexibility (supply, production and product assortment flexibility) as a necessary condition for firms to face highly volatile environments, while other authors have equally argued for the complementary role of a wide scope of dimensions expressing manufacturing flexibility (Rogers et al., 2011). Rogers et al. (2011) illustrated the need for the complementarity of manufacturing flexibility's six dimensions (product mix flexibility, routing flexibility, equipment flexibility, volume flexibility, labor flexibility and supply management flexibility), giving the example of divergent practices by General Motors and Toyota in the eighties and nineties of the twentieth century. According to them, and in spite of heavy investments in advanced manufacturing technology, General Motors lines in the nineties were still much less flexible than Toyota's. While Toyota exploited the synergies across their supply management, HR management and operations (Milgrom & Roberts, 1995), General Motors did not reach the synergies extent of Toyota, remaining less flexible.

The challenge in developing manufacturing flexibility is expressed by the change-preservation paradox, the tension between the need to change manufacturing flexibility while preserving its purpose (Volberda, 1996). The tension emerges from the potentially quick obsolescence of equipment and technology the firm invested in with uncertain pay-off, in face of fast paced technologies that can quickly render investment targets obsolete. Kara and Kayis (2004) argued that manufacturing flexibility requires considerable investments, pushing firms to allocate time and resources just to figure out the appropriate type of flexibility needed and how to achieve it.

Exploitation and Exploration

Market orientation is, more generally, a capability that aims to align the firm with the market (Frishammar & Âke Hörte, 2007). It aims to recognize current market conditions, as well as predict future market conditions (Day, 1994; Kohli & Jaworski, 1990; Slater & Narver, 1994). It also reflects the characteristics of a dynamic capability, according to Zahra (2008). Market orientation requires the systematic use of generated knowledge to guide strategy recognition, understanding, creation, selection, implementation, and modification toward adaptation and response formulation to international markets (Hunt & Morgan, 1996). Baker and Sinkula (1999) gave empirical support to the notion that a firm's market orientation enhances organizational innovativeness and new product success. The ability to gather and use information about the present and the future is what enables market orientation to relate and enhance exploitative as well as explorative innovation (Fang et al., 2012). This study sees the market as a driving force of innovation processes. Lamore et al. (2013) provided evidence that responsive and proactive market orientations were positively related to R&D integration, suggesting that such conceptualization would contribute to approach the marketing function to the R&D function. The concept of responsive and proactive market orientation hereby used has originated from the criticisms raised against the more traditional perspective of the construct (customer-competitor view), being more convenient as an expression of the exploitation-exploration dichotomy focused on this study. Narver et al. (2004), argued that market orientation (responsive-proactive view) should be the basis of a firm's innovation. The authors stated that leadership is more effectively reached if firms focus on a superior understanding of their customers' needs (explicit and latent). Responsive market orientation is defined as the firm's activities to discover, understand and satisfy customers' explicit needs, while proactive market orientation is defined as the firm's activities to discover, understand and satisfy customer's implicit (herein latent) needs (Narver et al., 2004).

Furthermore, because innovation related ambidexterity has been proven important to the firm's outcomes (Gibson & Birkinshaw, 2004), innovation competences orientation (exploitation-exploration) is included in this study, given the interest to probe into its separated role to the firm's innovation processes and eventual spillover effects onto manufacturing flexibility. Innovation competences orientation (exploitation-exploration) expresses choices over the orientation of innovation activities and can be regarded as different strategies. Innovation competences orientation (exploitation-exploration) is a construct of Atuahene-Gima's (2005), who refers that while innovation competence exploitation expresses incremental refinements in the firm's existing innovation knowledge, skills and processes, innovation competence exploration expresses more radical developments of such knowledge, skills and processes.

Expanding on Adler et al. (2009), who first suggested that ambidexterity could facilitate the firm's simultaneous efficiency and adaptation in an operations context, Patel et al. (2012) found that firms pursuing exploitation and exploration were more likely to obtain higher returns from manufacturing flexibility. Even if firms relying on specific manufacturing technologies cannot immediately change their processes when a new technology becomes available, they must make the most of existing resources and processes (exploit) while planning for future changes (explore), as their current resources and processes depreciate (Ludwig & Pemberton, 2011).

Approach

A model including absorptive capacity, market orientation (responsive-proactive), innovation competences orientation (exploitation-exploration) and manufacturing flexibility is presented, discussed and tested, to research how paradoxical strategic orientations (responsiveness-proactivity and exploitation-exploration) depend on absorptive capacity and affect manufacturing flexibility. Additionally, the study of the mediation role of market and innovation competences orientations and the contingency effects of firm size on the model's relations is performed, in order not only to render hypotheses testing more consistent (Malhotra et al., 2014) but also to understand how firm size affects the model's relations. The advantage of a model aggregating several constructs simultaneously lies in the illustration of the tensions among them while providing further insight over their relative importance for manufacturing flexibility. The constructs of choice in this study are complementary: while absorptive capacity captures the organizational behavior toward acquiring, sharing and transforming knowledge from external sources, market orientation (responsive-proactive) relates to the firm's focus on costumers to create new services and product ideas, and innovation competences orientation (exploitation-exploration) expresses the strategic orientations of the innovation activities.

This study designates by innovation reliability strategy the set formed by responsive market orientation and innovation competence exploitation orientation, and by innovation variability strategy the set formed by proactive market orientation and innovation competence exploration orientation. The innovation reliability strategy is considered to be responsible for the alignment of the firm with its environment (adopting market characteristics), while the innovation variability strategy is considered to be responsible for the adaptability of the firm to its environment (creating market change). The innovation reliability and innovation variability strategies terminology is borrowed from Mom et al. (2007). The conceptual model presented in this study interlinks absorptive capacity, innovation flexibility and manufacturing flexibility.

An extensive online survey addressing top management (CEOs and CFOs) and covering an estimated 61.2% of the Portuguese manufacturing firms with 20 or more employees is the main data source used to statistically test the conceptual model's hypotheses. SEM is used to fit the model.

Contributions

This study contributes to the literature in several ways. First, to the operations literature by offering a further probe into the relations between the strategic and operations perspectives, following the call of Ketchen and Giunipero's (2004), and by advancing the research on information-processing antecedents of manufacturing flexibility (Ojha et al., 2015). A further contribution to the operations literature is the added empirical evidence involving a multi-dimensional operationalization of manufacturing flexibility, in line with its latest conceptualizations (Pérez Pérez et al., 2016; Rogers et al., 2011; Zhang et al., 2003). Second, this study contributes to the literature of ambidexterity by probing into the separated direct impacts of exploitation and exploration innovation strategies on manufacturing flexibility and their mediation role in the relationship between absorptive capacity and manufacturing flexibility. Finally it adds further rationale and evidence to the rarely examined link between absorptive capacity and exploratory orientations (Lane et al., 2006), and by responding to the calls of Adler et al. (2009) and Andriopoulos and Lewis (2009) for exploring ambidexterity in an operations context.

This study defends that the existence of an externally-oriented open learning culture in the form of absorptive capacity positively contributes not only to the exploitation and exploration innovation strategies, but also to the development of manufacturing flexibility. Furthermore, it defends that such contribution is direct and indirect, through both innovation strategies (exploitation-exploration), with the latter also directly affecting manufacturing flexibility.

In the section that follows, the study's hypotheses are presented as well as its theoretical foundations. It is followed by a presentation of the methods and results. The chapter concludes with a discussion of the results, implications for both theory and practice, limitations and further work routes.

5.2. Hypotheses

5.2.1. Absorptive Capacity and Manufacturing Flexibility

Breaking up internal inertia in firms involves anticipating the obsolescence of existing capabilities while creating new ones aligned with newer technological standards

(Rosenbloom & Christensen, 1994). Braglia and Petroni (2000), examining the relation between knowledge levels and manufacturing flexibility in SMEs found that firms behave in firm-specific and situation-specific manner when combining resources and capabilities required to address their environment. In such a combinatorial process, they have identified the maturity of managerial competence and organizational development as keys. Camuffo and Volpato (1996) argued that the technologies used by Fiat resulted from a wide diversity of sources such as learning, internal developments, external acquisitions, imitation of competitors, replication and selection of capabilities.

Technological adoption may not be adequately implemented without absorptive capacity. Firms with low levels of absorptive capacity can become limited in the development of adequate levels and types of manufacturing flexibility. Some direct and indirect empirical evidence linking absorptive capacity with manufacturing flexibility exists. Empirical evidence is available supporting the impact of absorptive capacity on the capability to implement new manufacturing practices and the identification of process innovations (Tu et al., 2006). Empirical support for the link between absorptive capacity and the firm's collaboration with supply chain partners also exists (Zacharia, Nix, & Lusch, 2011). Higher levels of absorptive capacity in firms are associated with higher employee and cross-functional interactions necessary for the exchanges leading to better organizational learning (Jansen, Van den Bosch, & Volberda, 2005; Todorova & Durisin, 2007).

According to Patel et al. (2012), absorptive capacity is a learning capability that can explain differential firm behavior. Specifically, and in relation to manufacturing flexibility, these authors defend that the role of absorptive capacity is to amplify the flexibility of the firm's response to demand, competitive and technological uncertainty, by enabling it to more effectively analyze and interpret information of changes concerning the operational environment and thus more effectively approach reconfiguration, realignment and renewal of operational capabilities. Firms with higher levels of absorptive capacity are expected to increase the scope and components mobility of manufacturing flexibility. They are also likely to rapidly address their product mix, being more effective in adapting to changes in demand to proactively respond to competitive landscape changes (Cohen & Levinthal, 1989) and respond to technological innovations (Cohen & Levinthal, 1994; Narasimhan, Rajiv, & Dutta, 2006). Firms with lower levels of absorptive capacity are expected to respond less effectively to environmental changes and less effectively use knowledge to manage manufacturing flexibility (Patel et al., 2012). Consequently, the hypothesis is:

H_{1a}: Absorptive capacity is positively associated with manufacturing flexibility.

5.2.2. Absorptive Capacity, Market and Innovation Competences Orientation

Absorptive Capacity

Learning develops from an individual or small group level up to a more advanced organizational learning, emerging in such a process as a dynamic capability according to some authors (Brockman, 2013). Absorptive capacity is one of the capabilities necessary for learning (Sun & Anderson, 2010). It represents the firm's ability to identify, assimilate and explore knowledge gained from external sources, as first defined by Cohen and Levinthal (1989), who implicitly presented it as a capability by using the term 'ability' (Lane et al., 2006). Subsequently, Cohen and Levinthal (1990) developed the definition of absorptive capacity as the firm's ability to value, assimilate and commercially use new external knowledge. In order to benefit from externally acquired knowledge firms need to translate it into market-oriented usable forms, building competitive advantage through innovation and strategic flexibility (Zahra & George, 2002). Absorptive capacity enables the firm to be proactive in building its internal competences, beyond just reacting to the environment (Daghfous, 2004). Learning via acquisition of knowledge is a central factor for both exploitation and exploration related internal activities (Mom et al., 2007). Other recent studies are convergent in the support of absorptive capacity's relevance. Ritala, Olander, Michailova, and Husted (2015) showed that sharing external knowledge (one of the dimensions of absorptive capacity in the current study) positively affects innovation performance, while Wu and Voss (2015) underlined that absorptive capacity levels make a positive difference for new entrant firms in foreign markets. Furthermore, for firms with constrained resources to invest on absorptive capacity, findings showed that managerial networking capability can complement absorptive capacity in the firm's innovation development (Kotabe, Jiang, & Murray, 2017).

Absorptive capacity's embedded purpose of sourcing external knowledge, sharing it and producing new knowledge with commercial applications establishes the interest to probe the relation of this capability with marketing related processes, and thus with market orientation (responsive-proactive) which is at the core of the marketing process of the firm.

Market Orientation

As for market orientation, which can also be regarded as a dynamic capability (Zahra, 2008), its purpose is to achieve an external alignment: that of the firm with its competitive landscape and environmental dynamism. It is defined by the firm's ability to follow and respond to changes in the marketplace while using intelligence generation and information dissemination (Zahra, 2008). It is about engaging with customers to deliver according to their perceived needs in the present and the future (He & Wei, 2011). It requires a systematic use of generated knowledge to guide strategy recognition, understanding, creation, selection, implementation and modification toward adaptation and response formulation (Hunt & Morgan, 1996).

Non-narrow knowledge acquisition, sharing and creation, obtained through absorptive capacity, should be able to enhance market related information useful for responsive and proactive market orientation processes, by amplifying the useful knowledge combinations possibilities for the firm. This study adopts the market orientation construct of Narver et al. (2004) as a dual set of strategies: responsive market orientation, the firm's process aiming to discover, understand and satisfy expressed customer's needs; and proactive market orientation, the firm's process to discover, understand, and satisfy latent customer's needs. Separating these components, which configure two different behaviors within the market orientation construct, is fundamental when also focusing on innovation (Narver et al., 2004), and thus useful for this study's conceptual model. The related hypotheses are:

H_{1b}: Absorptive capacity is positively associated with responsive market orientation.

And,

H_{1c}: Absorptive capacity is positively associated with proactive market orientation.

Innovation Competences Orientation

Innovation competence exploitation, in this study, expresses incremental refinements of the firm's existing innovation knowledge, skills and processes, while innovation competence exploration expresses more substantive overhauls of such knowledge, skills and processes, therefore adopting the same construct of innovation competence orientations as in Atuahene-Gima's (2005).

To Cohen and Levinthal (1994) higher absorptive capacity enables firms to forecast trends and take advantage of opportunities earlier than its competitors. This justifies its interest in the development of innovation activities. Absorptive capacity was shown to influence innovation before (Tsai, 2001). A meta-analysis by Lane et al. (2006), examining 289 papers between 1991 and 2002, noted that innovation is the main consequent of absorptive capacity. Anderson and Tushman (1990) as well as Helfat (1997) supported that absorptive capacity increases the speed and frequency of incremental innovation, based on the argument that incremental innovation develops primarily upon a base of existing knowledge. Van den Bosch et al. (1999) supported that absorptive capacity fosters incremental innovation through deeper understanding of a narrow range of closely related topics. On the other hand, Lane et al. (2006) observed that the relationship between absorptive capacity and radical innovation has received little attention, despite the argument that radical innovation should involve novel combinations of existing technologies and know-how (Van den Bosch et al., 1999). Absorptive capacity components focusing on non-narrow knowledge domains could help fuel radical innovation (Lane et al., 2006). Firms with higher levels of absorptive capacity should understand more easily how to innovate, product or process wise (Lane et al., 2006; Tu et al., 2006; Zahra & George, 2002). It is therefore expectable that absorptive capacity also affects the innovation competences underlying incremental and radical innovation in a positive way. This study hypothesizes that:

H_{1d}: *Absorptive capacity is positively associated with innovation competence exploitation. And,*

H_{1e}: *Absorptive capacity is positively associated with innovation competence exploration.*

5.2.3. Market and Innovation Competences Orientation

Defined by the firm's ability to follow and respond to changes in the marketplace, market orientation is a market-driven capability (Im, Hussain, & Sengupta, 2008; Jaworski & Kohli, 1993; Slater & Narver, 1999; Zahra, 2008), supposed to enable better market-oriented firms to develop and offer adapted solutions and products to the markets in a more efficient manner than less market-oriented firms. This is achieved through a process of engaging and listening to customers in order to deliver according to their perceived needs in the present and their latent needs in the future (He & Wei, 2011). It concerns not only learning about present day markets and customer's needs but also anticipating future markets' conditions and needs (Day, 1994; Kohli & Jaworski, 1990; Slater & Narver, 1994). This ability of gathering and using information about the present and the future is what makes market orientation interesting to exploitation and exploration (Fang et al., 2012). More precisely, market orientation contributes to innovation with market intelligence allowing the firm to make an appropriate use of it (Fang et al., 2012), such as to innovate in consistently differentiated and novel ways.

Additionally, significant empirical evidence of the impact of market orientation on innovation characteristics and performance exists in the literature, in studies focusing on services as well as on manufacturing firms (Atuahene-Gima, 1996). Specifically, Atuahene-Gima (1996) discovered a positive and significant association between market orientation (customer-competitor) and the innovation-marketing fit, product advantage and inter-functional teamwork. He suggested that effective management of innovation activities can be achieved through market orientation. There is wide empirical evidence of the positive impact of market orientation on new product success. Reporting on empirical studies published between 1990 and 2003 in 55 marketing journals, Baker and Sinkula (2005) concluded that empirical support for the positive impact of market orientation on new product success was transversal to the batch of papers under analysis. Market orientation (customer-competitor) was found to play a central role in enabling firms to be operationally and strategically efficient at the same time, by maintaining a dual exploitative and explorative role in the firm's competences (Atuahene-Gima, 2005). Using a sample of Chinese firms, Atuahene-Gima (2005) found that exploiting existing product innovation competences (operational efficiency) and exploring new product innovation competences (strategic efficiency) required a positive and strong market orientation, while exploitation and exploration capabilities were, in turn, associated with incremental and radical new product innovation outcomes.

Evidence is also mounting over the market orientation (responsive-proactive view) impacts on innovation-related constructs which suggests that both market orientation views (customer-competitor and responsive-proactive) are consistent. In a study based on a sample of United Kingdom SMEs, empirical findings showed the association of market orientation and innovation (Laforet, 2008). Results suggested, in the case, that non-high-tech firms fare better when displaying a proactive market orientation. Another study, involving a sample of Taiwanese high-tech firms, found that responsive and proactive market orientation are related to exploitative and explorative innovation, respectively (Li et al., 2008). These authors have reported a significant positive effect of responsive market orientation on incremental innovations and a significant positive effect of proactive market orientation on radical innovations. Such findings improved the understanding of how responsive and proactive modes of market orientation can affect incremental and radical innovation (to which exploitation and exploration innovation competences are required). Recent findings, based on a sample of Taiwanese manufacturing firms, corroborated the positive effect of market orientation (responsive-proactive) on exploitation and exploration innovation activities (Fang et al., 2012). Consequently, the hypotheses are:

H_{2a}: Responsive market orientation is positively associated with innovation competence exploitation.

And,

H_{2b}: Proactive market orientation is positively associated with innovation competence exploration.

5.2.4. Innovation Competences Orientation and Manufacturing Flexibility

While absorptive capacity essentially acquires, assimilates (shares) and creates knowledge, different innovation competences (exploitation-exploration) help the firm to find how to use such knowledge, collecting the information made available by different market orientation types (responsive-proactive) for exploitation and exploration purposes.

Manufacturing Flexibility

Relative competitive advantage requires firms to develop new capabilities and competences needed for the adaptation to the environment (Tamayo-Torres, Ruiz-Moreno, & Llórens-Montes, 2011). Growing competitiveness and dynamic environments, international markets globalization, and the development of new technologies also require managers to think of, implement, and develop dynamic production systems (Narasimhan & Das, 1999). Manufacturing flexibility enables the adaptation to and anticipation of environmental changes, offering manufacturing firms relative competitive advantages (Beach, Muhlemann, Price, Paterson, & Sharp, 2000).

Exploitation and Exploration

Lavie and Rosenkopf (2006) stated that firms must explore new possibilities for adapting to future environmental changes, as well as exploit existing capabilities, in order to compete in dynamic markets. Whereas exploitation is more associated with refinement and efficiency, exploration is more associated with variation, experimentation and higher risk (March, 1991); while exploitation is implemented through activities that aim to establish standardized processes and can be associated with a short-term perspective, exploration is about creating new knowledge and entirely new ways to solve problems, being associated with the longer term (March, 1996); exploitation is associated with experimental refinement and reuse of existing routines, while exploration is associated with changes to established processes (Baum et al., 2000).

Strategic behavior aims at keeping production costs under control and reducing throughput times while adequately responding to demand requisites variations. This means firms are expected to use the less costly exploitation of existing capabilities in the short-term, and the costlier exploration of new ideas in the longer term (Miller, Zhao, & Calantone, 2006). Exploitation and exploration configure different strategic options for the firm to respond to competitors (Li et al., 2008). One of the ways to implement exploitation is the elimination of deficient tasks and the search for new routes (Levinthal & March, 1993), while for the case of implementing exploration a longer-term perspective must be at play, in order to find alternatives to improve what exists (March, 1991).

Being a tool that responds to competitors, innovation competences are expected to be related to the specificities of their firm's production systems and develop in line with the viable, existing, technical possibilities within the firm. Even so, while innovation competence exploitation is expected to sustain incremental innovation more easily produced by the current firm's manufacturing technology, innovation exploration is expected to sustain more radical innovation, possibly not so straightforward to produce with the existing firm's manufacturing technology. In any case, manufacturing flexibility should be able to adapt to both in due course and develop in a way as to be able to timely and cost effectively produce the innovations coming out of both types of competences. Therefore, while innovation competences (exploitation-exploration) in manufacturing firms may be differently limited by what is possible to produce, how, how fast, at which cost and with what quality, some positive impact on manufacturing flexibility is to be expected even if in different frequency and intensity by each of the competences: the more innovative the firm, the greater the diversity of products it is expected to produce and the more its production processes must adapt and become flexible.

Some evidence already exists to support this expectation: Tamayo-Torres et al. (2011), focusing on Spanish manufacturing firms and investigating the relation between knowledge ambidexterity and manufacturing flexibility, found that higher levels of exploitative and explorative forms of knowledge are associated with higher levels of manufacturing flexibility, such a relation being amplified under higher environmental turbulence conditions and with higher organizational learning levels. This suggests that an association between innovation competences orientation (exploitation-exploration) and manufacturing flexibility should be expected. Ambidexterity promotes flexibility in the firm's response to environmental changes affecting demand, to changes in the competitive landscape and technological changes as well (Patel et al., 2012). While firms with higher ambidexterity levels are expected to frequently probe customer's needs and respond creatively (Lubatkin, Simsek, Ling, & Veiga, 2006), firms with lower levels of ambidexterity can lean toward incremental operational innovations, excessively focusing on exploitation and thus more often missing opportunities to enhance their manufacturing flexibility (Patel et al., 2012). Singh and Khamba (2014), investigating the connections between organizational competences and increased business performance in supply chain management, found that innovation competences are drivers for supply chain management capabilities improvements. A capability of exploitation and exploration can enable the development of manufacturing responses affecting flexibility, for example through a modified product mix (Patel et al., 2012). Firms with higher ambidexterity (balanced exploitation-exploration activities) are able to refine existing processes as well as develop new ones affecting manufacturing flexibility (Patel et al., 2012). Consequently, similar relations can be expected regarding the separate impacts of innovation competences exploitation and exploration on manufacturing flexibility. This study hypothesizes that:

H_{3a}: Innovation competence exploitation is positively related to manufacturing flexibility. And,

H_{3b}: Innovation competence exploration is positively related to manufacturing flexibility.

If market orientation (responsive-proactive) contributes to enhance innovation competences orientation (exploitation-exploration) and the latter positively impacts manufacturing flexibility, there could be indirect effects of market orientation on manufacturing flexibility going through innovation competences orientation. Such possibility makes an additional set of hypotheses necessary:

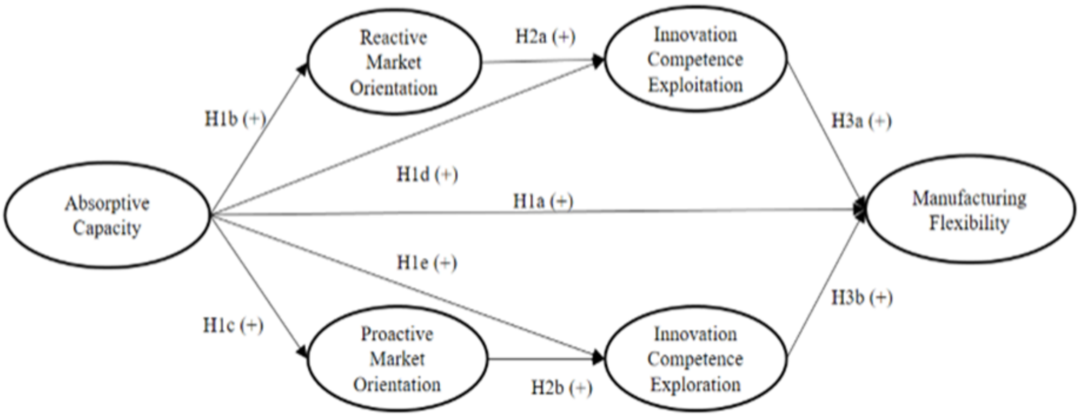
M_{1a}: Innovation competence exploitation mediates the positive relationship between responsive market orientation and manufacturing flexibility.

And,

M_{2b}: Innovation competence exploration mediates the positive relationship between proactive market orientation and manufacturing flexibility.

Figure 5.1 presents the main hypotheses configuration in the structural model.

Figure 5.1 Conceptual Model 3



Source: own elaboration.

5.3. Methodology

5.3.1. Data Collection

An online survey aimed at CEOs and CFOs was sent by email to the 3728 registries of Portuguese manufacturing firms with 20 or more employees available in the Kompass Database (Kompass Diretório de Empresas para profissionais e solução de dados empresariais - Portugal, 2015). The online questionnaire guaranteed the anonymity of the respondents. Overall, 515 responses were obtained and 370 responses were validated. The survey was performed during early 2015. The response rate was of 10% of the sampling frame used, and of an estimated 6.1% of the targeted population of firms. The questions used scale items grounded in the literature, adapted to Portuguese. Of the valid responses and regarding firm size, 167 firms (45.1%) had 20 to 49 employees, 168 firms (45.4%) 50 to 249 employees, and 35 firms (9.5%) 250 or more employees. As to firm age, 22 of the firms (6%) were 10 years of activity or less, 104 firms (28%) were 11 to 25 years of activity, 200 firms (54%) were 26 to 65 years of activity, 22 firms (6%) were between 66 to 99 years of activity, and 22 firms (6%) were 100 or more years of activity. Regarding the split between CEOs and CFOs responses, 241 of the valid responses came from CEOs (65.1%) while 129 came from CFOs (34.9%). Of the valid respondent firms, sales (2014) ranged from 154.886 EUR a year to 10.866 million EUR a year, while exports ranged from zero to 4.178 million EUR a year. The median value of sales was 3.8 million EUR a year, while the median value of exports was of 1.0 million EUR a year. 339 firms reported non-zero export sales (91.6% of the respondents). 54.6%

of the valid respondent firms were located in northern Portugal, 39.7% in central Portugal, 3.2% in southern Portugal and 2.4% in the Portuguese archipelagos of Madeira and Azores. The valid respondent firms' sample encompassed a total of 34 activity sectors, with the 10 more frequent sectors being printing, automotive, chemical, construction materials, machinery, furniture, ceramics, metallurgy and metallic products, food and food processing and textiles.

The sampling frame, data collection and data analysis methods are shared for the studies in chapters 3 to 5. A detailed presentation of the instrument of research, the sampling frame, the population coverage, the response rates and the sample characterization is offered in chapter 2, to avoid an integral repetition of large portions of text.

5.3.2. Measures

A seven-point Likert-type scale was used for all non-demographic variables in the survey (from 1…*totally disagree* to 7…*totally agree*). The constructs were measured by multiple items adapted from the literature (Appendix I, Table A.1.3).

This study's view of absorptive capacity combines and simplifies the definitions of Cohen and Levinthal (1990), Cohen and Levinthal (1994), and Zahra and George (2002), reducing its dimensionality. Absorptive capacity was measured hypothesizing a second-order construct with three components, adapted from a scale for organizational learning developed by MacInerney-May (2012). It conceptualizes absorptive capacity as a three factor dynamic capability: knowledge acquisition, the organizational practice of identifying, valuing and acquiring new knowledge about the market, technologies, trends and business models; knowledge sharing, the organizational practice of assimilating, adapting, codifying and disseminating such knowledge within the organization; and knowledge creation, the organizational practice of combining externally acquired knowledge with existing knowledge to create new knowledge. Knowledge acquisition was measured using three items adopted from Jansen et al. (2006) and Jaworski and Kohli (1993), reflecting the ability to acquire external knowledge. Knowledge sharing was measured through three items adopted from Jaworski and Kohli (1993) and Tippins and Sohi (2003), capturing the ability to share knowledge among employees and within the firm. Finally, knowledge creation was measured through four items taken from Pavlou and El Sawy (2006), Prieto et al. (2009), and Flatten et al. (2009), reflecting the ability of the firm's employees to learn from external and internal knowledge to produce new ideas. These items were adopted from the scale developed by MacInerney-May (2012).

Manufacturing flexibility was measured with the scale of Rogers et al. (2011), operationalizing manufacturing flexibility as a second order construct with six factors measured through three items each: product-mix flexibility, routing flexibility, equipment flexibility (herein machines flexibility), volume flexibility, labor flexibility and supply chain flexibility.

Responsive and proactive market orientations were measured through eight items originally developed by Narver et al. (2004), five of which were used to measure responsive market orientation and three other items to measure proactive market orientation. These items capture the ability of the firm to observe and retain customer's expressed, as well as latent, needs.

Innovation competence exploitation and exploration were measured through 10 items adopted from Atuahene-Gima's (2005), five of which to measure innovation competence exploitation and the other five to measure innovation competence exploration. These items express the exploitation and exploration of innovation competences over a period of five years, to assess consolidated practices.

5.4. Results

5.4.1. Measurement Model

Scales Purification

During the purification phase, two items were excluded from responsive market orientation, as well as one item from innovation competence exploitation and one item from innovation competence exploration. Additionally, one item was excluded from machines flexibility, a sub-dimension of manufacturing flexibility. Overall, out of the 46 initial items in the model, five have been dropped. The two items dropped from responsive market orientation presented problems of excessive kurtosis (both above 3.0). The cut offs considered in this study were | Kurtosis | > 2.2, and | Skewness | > 3.0 (Sposito et al., 1983). The items taken out from innovation competence exploitation and innovation competence exploration were removed to ensure the discriminant validity between these constructs (Shaffer et al., 2016) while maintaining enough items in each to perform an adequate measure (four items per construct). The item taken out of machine flexibility was removed because it presented poor inter-item correlations resulting in a below standard Cronbach alpha. Its removal resulted in a Cronbach's alpha change from 0.69, below the 0.70 threshold in Hair et al. (2010), to 0.77. The items obtained after the purification phase are presented in Appendix I (Table A.1.3).

The total variance extracted by all the remaining items through the maximum likelihood method with free factor extraction was of 69.6%. A total of nine factors was extracted with eigenvalues higher than one. The KMO measure of sampling adequacy returned a value of 0.914. The goodness of fit test returned a value of 2.55, with a 0.00 *p*-value.

Measures Assessment

The measurement model revealed composite reliabilities well above 0.70 for all constructs (Hair et al., 2010), ranging from 0.84 (proactive market orientation) to 0.93 (innovation competence exploitation). The AVE was above 0.50 for all constructs (Hair et al., 2010), ranging from 0.51 (manufacturing flexibility) to 0.76 (absorptive capacity and innovation competence exploitation). This indicates that all constructs have convergent validity. For all constructs, the AVE was greater than the MSV, and greater than the ASV. The square root of AVE was also greater than inter-construct correlations, for all constructs. Thus, the measurement model constructs do not display discriminant convergence issues (Hair et al., 2010). These results are shown in Tables 5.1 and 5.2.

Table 5.1 ***AVE, MSV and ASV***

	AVE	MSV	ASV
ACAP	0.763	0.513	0.402
REMKTOR	0.728	0.433	0.329
PROMKTOR	0.642	0.433	0.328
INXPLOIT	0.763	0.596	0.437
INXPLOR	0.620	0.596	0.351
MANFLEX	0.514	0.323	0.246

Table 5.2 *Correlation Matrix*

	M	SD	1	2	3	4	5	6	CR	AVE
ACAP (1)	4.80	1.17	**0.87**						0.91	0.76
MANFLEX (2)	5.60	1.27	0.57	**0.72**					0.86	0.51
REMKTOR (3)	5.54	1.11	0.62	0.43	**0.85**				0.89	0.73
PROMKTOR (4)	5.20	1.18	0.60	0.45	0.66	**0.80**			0.84	0.64
INXPLOIT (5)	5.29	1.07	0.72	0.57	0.62	0.61	**0.87**		0.93	0.76
INXPLOR (6)	5.12	1.29	0.65	0.45	0.51	0.52	0.77	**0.79**	0.87	0.62

Note. Diagonal elements in bold are the square roots of AVE.

The maximum likelihood estimation AMOS procedure in IBM AMOS version 22 was used to assess the validity of the measurement model. The measurement model evidenced an acceptable fit ($\chi^2 = 1529.3$, 757 df, significant, $\chi^2 / df = 2.02$, CFI = 0.92, GFI = 0.83, TLI = 0.91, NFI = 0.85, RMR = 0.15, AGFI = 0.81, RMSEA = 0.053). No intra-construct error correlations were introduced. Error correlations of mediators was allowed between responsive and proactive market orientation and between innovation competence exploitation and exploration (Preacher & Hayes, 2008).

5.4.2. Common Method Bias

The several methods employed to assess common variance in the data reinforce the conclusion that while not inexistent, common method issues do not seem to be relevant in this study.

To assess the impact of common method bias the unmeasured latent factor test (Podsakoff et al., 2003) was performed. The estimated common variance, obtained by squaring the unstandardized common loadings of the common latent factor, was of 34.8%, therefore not accounting for more than 50% of the total variance. Additionally, the introduction of the common latent factor did not greatly affect most of the items standardized loadings, with a top change of 0.19 (one item only), below the 0.20 threshold in Aiken et al. (1991). The average change of the standardized item loadings before and after the introduction of the common latent factor was of 0.08, and the median change of 0.08 as well.

Moreover, the CFA of a single-factor model onto all the items were loaded showed a poor fit ($\chi^2 = 5717.1, \chi^2 / df = 6.98$, CFI = 0.49, GFI = 0.47, TLI = 0.48, NFI = 0.45, RMR = 0.26, RMSEA = 0.127). If common method variance was responsible for the relationship among the constructs, this one-factor model would fit the data well (Korsgaard & Roberson, 1995; Mossholder et al., 1998).

Lastly, the Harman single factor test, performing a principal components analysis on all the items of the purified measurement model, returned a 32.8% variance explained by a first factor out of nine extracted, below the 50% cut off usually considered (Harman, 1967).

5.4.3. Structural Model Fit and Main Hypotheses Tests

Statistical Power

For a desired statistical power level of 0.80, finding a minimum absolute effect size of 0.10 with a 0.10 *p*-value, in a structural equations model with 13 latent variables and 41 items requires, ideally, a sample size with 1975 cases, and a minimum of 179 cases to establish the model structure (Soper, 2017). While Bentler and Chou (1987) admit as low as five cases per item in SEM models if the data is normally distributed, has no missing entries nor outliers (as it is the case of this study's data – Appendix I, section A.3), other criteria can be followed to judge of the adequacy of the sample for the study at hand. Kline (2015), for example, informs that sample sizes of at least 200 cases are adequate for most models, or, conversely, collecting five to 10 cases per item. The current study has a sample size of 370 cases and nine cases per item, therefore fitting Kline's criteria for sample size and method adequacy (SEM), while being better than Bentler and Chou's (1987) criteria.

Structural Model Fit

SEM was used to test the main hypotheses. The model fit was acceptable ($\chi^2 = 1531.7$, 759 df, significant; $\chi^2 / df = 2.02$, CFI = 0.92, TLI = 0.91, NFI = 0.85, RMR = 0.13, AGFI = 0.81, RMSEA = 0.053). A model with $\chi^2 / df < 3$ demonstrates reasonable fit (Iacobucci, 2010). A CFI fit index equal or larger than 0.95 is indicative of good model fit (Hu & Bentler, 1999). Ideally, the TLI and the NFI should both be above 0.95 (Hooper et al., 2008), while the RMSEA should be below 0.06 (Hu & Bentler, 1999). The model explains 33% of the variance of manufacturing flexibility. Findings reveal statistical support for seven of the nine main hypotheses of the model (Table 5.3), as well as statistical support for one of the two mediation hypotheses. To expect TLI and CFI values above 0.95 (Hu & Bentler, 1999) is only reasonable for very large sample sizes (Byrne, 2001). Table 5.3 presents the main hypotheses tests results. The hypothesized model was tested using SEM with IBM AMOS version 22.

Table 5.3 ***Hypotheses Tests of Model 3***

	Path	SC	SE	t-value	p-value
H_{1a}	ACAP → MANFLEX	0.334	0.282	3.496	***
H_{1b}	ACAP → REMKTOR	0.619	0.753	9.975	***
H_{1c}	ACAP → PROMKTOR	0.611	0.763	9.286	***
H_{1d}	ACAP → INXPLOIT	0.576	0.605	8.433	***
H_{1e}	ACAP → INXPLOR	0.594	0.783	7.776	***
H_{2a}	REMKTOR → INXPLOIT	0.230	0.198	4.267	***
H_{2b}	PROMKTOR → INXPLOR	0.098	0.103	1.567	NS
H_{3a}	INXPLOIT → MANFLEX	0.321	0.259	3.083	***
H_{3b}	INXPLOR → MANFLEX	-0.047	-0.030	-0.503	NS

Note. NS: Not Significant; Tests of hypothesis are two tailed; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Results

Specifically, the path coefficient from absorptive capacity to manufacturing flexibility is significant at a level lower than 0.01 ($\beta = 0.334$; $t = 3.496$), thus supporting hypothesis H_{1a}. The path coefficient going from absorptive capacity to responsive market orientation is significant at a level lower than 0.01 ($\beta = 0.619$; $t = 9.975$), thus supporting hypothesis H_{1b}, while the path coefficient going from absorptive capacity to proactive market orientation is significant at a level lower than 0.01 ($\beta = 0.611$; $t = 9.286$), thus supporting hypothesis H_{1c}. Hypothesis H_{1d} is also corroborated to a statistical significance level below 0.01 ($\beta = 0.576$; $t = 8.433$), thus confirming the significance of the path coefficient going from absorptive capacity to innovation competence exploitation, while the path coefficient going from absorptive capacity to innovation competence exploration, hypothesis H_{1e}, is also significant to a level lower than 0.01 ($\beta = 0.594$; $t = 7.776$). As to the impacts of market orientation (responsive-proactive) on innovation competences (exploitation-exploration), the path coefficient going from responsive market orientation to innovation competence exploitation is significant at a level lower than 0.01 ($\beta = 0.230$; $t = 4.267$), statistically supporting H_{2a}, while the path coefficient going from proactive market orientation to innovation competence exploration is not significant, leaving H_{2b} unsupported. Finally, regarding the impacts of innovation competences orientation (exploitation-exploration) on manufacturing flexibility, the path coefficient from innovation competence exploitation to manufacturing flexibility is significant at a level lower than 0.01 ($\beta = 0.321$; $t = 3.083$), thus supporting H_{3a}, while the path coefficient going from innovation competence exploration to manufacturing flexibility shows no statistical significance, leaving H_{3b} unsupported.

To summarize, findings reveal empirical support for statistically significant positive impacts of absorptive capacity on manufacturing flexibility (H_{1a}), market orientation (responsive and proactive; H_{1b} and H_{1c}), and innovation competences orientation (exploitation and exploration; H_{1d} and H_{1e}), as well as statistically significant positive impacts of responsive market orientation on innovation competence exploitation (H_{2a}). Empirical support of positive impacts of innovation competences orientation (exploitation and exploration) on manufacturing flexibility is only partial (H_{3a}).

No support is found of a positive impact of proactive market orientation on innovation competence exploration (H_{2b}) nor of a positive impact of innovation competence exploration on manufacturing flexibility (H_{3b}).

5.4.4. Mediation

A construct can be explained by indirect effects as well as by direct effects (Little et al., 2007). The existence of a significant indirect effect in a chain of causation suggests that mediation is present (Zhao et al., 2010). In this sense, a hypothesized mediator is an additional link in a certain chain of causation. Mediation renders hypotheses testing more consistent and precise (Malhotra et al., 2014).

Using a 1000 bootstrap samples with replacement process at a 90% confidence level, the direct, indirect, and total standardized effects involved in both mediation hypothesis ($M_{1a,\,b}$) are presented in Table 5.4.

Table 5.4 ***Mediation Results of Model 3***

	Mediators	Indirect Effect	Direct Effect	Total Effect	Mediation
$\mathbf{M_{1a}}$	INXPLOIT	0.074 (***)	-	0.074 (***)	ND
$\mathbf{M_{1b}}$	INXPLOR	-0.005 (NS)	-	-0.005 (NS)	ND
-	ALL MED.	0.200 (***)	0.334 (***)	0.533 (***)	Partial

Note. ALL MED.: INXPLOIT, INXPLOR, REMKTOR, PROMKTOR. ND: not determined; NS: non-significant. Significance was calculated through the bias corrected percentile method (2-tailed); * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Results show that only one of the two mediation hypotheses (M_{1a}) is supported with statistical significance. Findings also identify the joint partial mediation of responsive market orientation and innovation competence exploitation in the positive relationship between absorptive capacity and manufacturing flexibility, a direct result of the bootstrapping output from AMOS (not hypothesized *a priori*).

Composite paths significance through which the effects of absorptive capacity flow onto manufacturing flexibility were estimated through the Sobel statistic (Mackinnon & Dwyer, 1993). The Sobel statistic for the effects flowing from absorptive capacity to manufacturing flexibility through innovation competence exploitation is of 2.89 (> 1.96), with a *p*-value of 0.0037, a significant indirect effect. Multiplying the standardized coefficients of the paths (0.576 x 0.321) we get the intensity of the effect: 0.185. On the other hand, the Sobel statistics for the effects of absorptive capacity flowing through innovation competence exploration is of -0.420 (> -1.96), with a *p*-value of 0.00, a non-significant indirect effect.

This means that all the indirect effects of absorptive capacity on manufacturing flexibility are flowing through innovation competence exploitation (0.185) and through responsive market orientation (0.015), this latter value computed from the difference between the standardized coefficient of the totality of the indirect effects (0.200, see Table 5.4) and the standardized coefficient of the indirect effects flowing solely through innovation competence exploitation (0.185).

5.4.5. Multi-Group Moderation: Firm Size

Multi-group moderation, a special form of moderation analysis, was used to analyze the behavior of the model's relations when the dataset is split into low-high values for a grouping variable, firm size in this case. The z-score of the differences in the model paths for smaller and larger firm groups were observed. Two groups divided by the means were created for larger and smaller firm size (204 firms and 166 firms, respectively).

The joint model fit for the market turbulence groups is good, meaning there is configural invariance in the model ($\chi^2 / df = 1.77$, CFI = 0.88, TLI = 0.87, NFI = 0.77, GFI = 0.75, RMR = 0.18, AGFI = 0.71, RMSEA = 0.046). The χ^2 test for the fully constrained and the unconstrained model has a non-significant *p-value* (0.08), which means there is metric invariance (Byrne, 2008). The stages for full metric invariance imply the groups to have non-significantly different factor means, loadings, intercepts and residuals (Schmitt & Kuljanin, 2008).

Findings reveal that the impact of absorptive capacity on innovation competence exploration is more intense in larger firms. On the other hand, results also show that, conversely, the impact of proactive market orientation on innovation competence exploration is more important in smaller size firms (Table 5.5).

Table 5.5 ***Firm Size Effects on Model 3***

	Smaller	Larger	*z-score*
ACAP → INXPLOR	0.555 (***)	0.994 (***)	**
PROMKTOR → INXPLOR	0.317 (***)	NS	***

Note. NS: Not Significant. Z-score significances: * p < 0.10, ** p < 0.05, *** p < 0.01.

5.5. Discussion

The main purpose of this study was to evaluate how exploitation and exploration innovation strategies separately affect manufacturing flexibility and, in addition, to investigate the mediating role of such strategies in the relationship between absorptive capacity and manufacturing flexibility.

How important is an innovation reliability strategy to manufacturing flexibility?

Findings show that firms seem to enhance manufacturing flexibility through absorptive capacity and an innovation reliability strategy (responsive market orientation and innovation competence exploitation). It is therefore an innovation reliability strategy that is positively affecting manufacturing flexibility, while the innovation variability strategy shoes no significant effect on it whatsoever. Furthermore, the intensity of the impacts of absorptive capacity and innovation competence exploitation on manufacturing flexibility are at the same level of importance. This finding suggests that innovation competence exploitation impacts manufacturing flexibility in complementarity to absorptive capacity. Since innovation competence exploitation is strongly expressed by the optimization of firm-specific knowledge and competences related to familiar products and technologies, its significant positive impact on manufacturing flexibility means that it is the incremental optimization of innovation competence that affects manufacturing flexibility. This expresses a continuous optimization process, where a communication between the innovation reliability strategy and the operations of the firm is in place.

Why isn't innovation variability strategy significant to manufacturing flexibility?

The findings also show that the direct impact of innovation competence exploration on manufacturing flexibility is non-significant, meaning that one of the study's main hypothesis is not confirmed. A possible explanation for the lack of impact of innovation competence exploration on manufacturing flexibility can be rooted in the productivity dilemma (Abernathy, 1978), describing an incompatibility of short-term efficiency with long-term adaptability. Since some grounding exists in theory to support a positive impact of innovation competence exploration on manufacturing flexibility, the fact that such hypothesis remains unconfirmed may reflect a result relative to the time frame of the measure of innovation competence exploration (five years). Future research considering longer term effects should not be overlooked, given that the rationale and grounding are reasonably established. Organizational adaptation theory defends that long-term success requires a balance between continuity and change (Raisch & Birkinshaw, 2008). Organizational evolution can be conceived as a process defined by long periods of steady evolution marked by exploitation and alignment, and less frequent episodes of radical transformation marked by exploration (Tushman & O'Reilly, 1996). It has also been thought to integrate periods of discontinuous change (Tushman & Romanelli, 1985). An explanation for the non-significance of the impact of innovation competence exploration on manufacturing flexibility can therefore be that the moment of observation has not coincided with one of more radical change. Innovation competence exploration, requiring substantial changes, could be at odds with manufacturing flexibility, except perhaps on the more rare occasions that firms need to reinvent themselves and decide to overhaul the technological roadmaps of manufacturing flexibility. Such major overhauls are also unlikely to happen at the same time for the aggregate of the firms. Yet another consideration is that capital-intensive firms have capital assets that are not easily inter-changeable or renovated, such as plants and equipment (Miller & Cardinal, 1994). Some inertia is to be expected in manufacturing firms for which equipment and machines represent a financially burdensome requisite. Such assets are less permeable to innovation competence exploration spillovers because they will tend to be of more radical nature, possibly including the entire replacement of some technologies and equipment.

In any case, attention must be drawn to the risks that organizations more preponderantly engaged in exploitation face, namely, the increased risk of obsolescence (Levinthal & March, 1993). Narrow searches leading to rigid and limited cognitive maps and specialized competences can turn into core rigidities (Leonard-Barton, 1992). Preponderant engagement with exploitation, while improving short-term outcomes, may end up in competence traps and inadequate response to environmental changes (Ahuja & Lampert, 2001).

Are firms being effective at exploring their innovation competence?

Results show that a mediation role exists for innovation competence exploitation in the relationship between responsive market orientation and manufacturing flexibility. The total indirect effect between absorptive capacity and manufacturing flexibility through responsive market orientation and innovation competence exploitation is considerably larger than just the indirect effect of responsive market orientation on manufacturing flexibility. This finding, together with the non-significance of any indirect effects between absorptive capacity and manufacturing flexibility through proactive market orientation and innovation competence exploration, means that most of the indirect effects of absorptive capacity on manufacturing flexibility flow through innovation competence exploitation. This finding also means, however, that firms are not being proactive towards their customers nor seeking to effectively convert their latent needs into leads to explore their innovation competence. This offers an additional explanation for the lack of impact of innovation competence exploration on manufacturing flexibility while it suggests the existence of a serious managerial shortcoming: firms do not seem to be properly engaged nor effective at developing their innovation variability strategy.

Is absorptive capacity playing a key role?

The antecedent role of absorptive capacity to manufacturing flexibility is confirmed in this study, as well as its antecedence to innovation competences orientation (exploitation-exploration) and its priority in such antecedence *versus* market orientation (responsive-proactive).

Are smaller firms better at exploring their innovation competence?

Firms' above-average size display a significantly higher direct impact of absorptive capacity on manufacturing flexibility. In fact, absorptive capacity is highly path-dependent needing regular investments to be effective (Cohen & Levinthal, 1990). The development of organizational absorptive capacity builds on prior investments in the development of its components, which will tend to develop cumulatively (Cohen & Levinthal, 1990). Larger firms could have more resources regularly available to continuously invest in absorptive capacity, which is a possible explanation for this finding.

Interestingly, smaller-sized firms display a significant positive direct impact of proactive market orientation on innovation competence exploration, a relation that is non-significant when all the sample is considered. This could mean that either the innovation competence exploration of smaller firms is simpler and more easily affected by proactive market orientation or that smaller firms are better at looking for and using their customers' latent needs for exploring their innovation competence. Smaller firms may have to try harder to get and secure a market position than larger firms, leading them to be more proactively market oriented. A mix of the two explanations can also be at play.

Questions for the future

Overall, the findings suggest the firm's tendency to develop manufacturing flexibility more through the reliability associated with optimizing its innovation routines and processes than through the variability associated with riskier innovation strategies. These findings may have alternative explanations and raise more questions for future research. First, this study's findings partly diverge from previous studies that have confirmed the positive impact of ambidexterity on manufacturing flexibility, since only innovation competence exploitation seems to command such impact. The question is to better define the boundaries and circumstances explaining the different findings. Second, it should be noted that firms are enhancing business performance from higher innovation competence exploration (see chapter 3), despite the latter not having a significant impact on manufacturing flexibility. This raises a question if there could be a lag between the improvement of business performance and manufacturing flexibility. Could the enhancement of the first predict further developments on the latter? Fourth, the possibility that many of the firms in the sample have been affected by credit restrictions may justify the lack of meaningful impact of innovation competence exploration on manufacturing flexibility, since innovation competence exploration tends to require comparatively more intense financial resources. Could this be a central explanation or are the findings revealing a more pervasive pattern?

These findings contain important learnings expressed by the importance of firm-specific organizational absorptive capacity to the development of manufacturing flexibility, and the higher relative importance of absorptive capacity to the development of innovation competences orientation (exploitation-exploration), when compared to market orientation (responsive-proactive). This combination contains a surprising insight to managers as it elevates absorptive capacity to a priority status in relation to market orientation (responsive-proactive). It does not suggest that market orientation (responsive-proactive) is detrimental but, perhaps, that (i) manufacturing firms are not being as effective as they should in using market orientation to foster innovation competences orientation or (ii) that a state of competition has been achieved - stable market preferences - where the contributions coming from customers' needs may no longer be as important to differentiate the offer of manufacturing firms, something that is the primary role of innovation and seems less bounded than the explicit or implicit confines of the customers' mindsets. A remaining question lingers for the future: is this emerging priority structural or is it the result of a defective marketing and innovation culture in manufacturing firms, namely in what concerns their proactive market orientation and innovation competence exploration?

5.6. Conclusions

5.6.1. Theoretical Contribution

The study expands on Tu et al. (2006) and especially on Patel et al. (2012), by finding that absorptive capacity and an innovation reliability strategy can be seen as manufacturing flexibility antecedents. The study of Tu et al. (2006) used time-based manufacturing practices as the dependent variable, while the study of Patel et al. (2012) considered absorptive capacity and ambidexterity (without separating between exploitation and exploration) as moderators in the relationships between environmental uncertainty, manufacturing flexibility and firm performance.

The current study is, to our knowledge, the first to offer empirical evidence of the links between absorptive capacity, exploitation and exploration innovation strategies in separate, and manufacturing flexibility. This study contributes to the operations literature by offering a further probe into the links between the strategic and the operations perspectives, following the call of Ketchen and Giunipero's (2004) and advancing the research on information-processing antecedents of manufacturing flexibility (Ojha et al., 2015). Furthermore, and as an additional contribution to the operations literature, the study adds empirical evidence of a multi-dimensional concept of manufacturing flexibility, in line with its latest operationalization's (Pérez Pérez et al., 2016; Rogers et al., 2011; Zhang et al., 2003).

Lastly, the study contributes to the literature of ambidexterity by (i) studying the separated direct impacts of exploitation and exploration innovation strategies on manufacturing flexibility, (ii) probing such strategies mediating role in the relationship between absorptive capacity and manufacturing flexibility, (iii) adding further rationale and evidence on the less examined link between absorptive capacity and incremental innovation (Lane et al., 2006) and (iv) responding to the calls of Adler et al. (2009) and Andriopoulos and Lewis (2009) to explore ambidexterity in an operations context.

5.6.2. Managerial Implications

First, managers should foster their firm's absorptive capacity in order to also develop manufacturing flexibility. This requires setting a culture for open learning as well as providing incentives to qualified employees and teams to seek, acquire, share, and use external knowledge with a wide utility scope useful for innovation competences orientation (exploitation-exploration) and manufacturing flexibility developments.

Second, managers should develop and use innovation competence exploitation in close relation with incremental optimizations of manufacturing flexibility, while also fostering the later through absorptive capacity. Such a policy would easily amplify the development of manufacturing flexibility through innovation competence exploitation.

Third, managers of larger firms should continue reinforcing their firm's absorptive capacity to foster manufacturing flexibility, while those of smaller firms should consider allocating resources in a more effective manner between market orientation (responsive-proactive) and absorptive capacity.

Fourth, Portuguese firms represented by the sample seem to ineffectively use proactive market orientation. The reasons for this could be either cultural or related to the prevalent industry sectors in the sample, many of which are traditional. The finding suggests, however, that a potential for better use of innovation variability strategy exists, in seeking better understanding of the customers' latent needs while aligning proactive market orientation with innovation competence exploration. Managers should not overlook their overall innovation variability strategy and its expectable medium to long-term positive effects on manufacturing flexibility. Without such concern, innovation flexibility could remain hampered and stuck on an over-exploitation gear with future negative consequences for the development of manufacturing flexibility.

5.6.3. Limitations and Future Work

While the findings show that the simultaneous use of reliability and variability innovation strategies is associated with higher manufacturing flexibility, it would be enriching to perform similar studies in specific activity sectors, as different industries may conceal different results. Additionally, studies performed under survivability-threatening conditions would be worth pursuing to search for the limit conditions that could cause an innovation variability strategy to become temporarily predominant. The expansion of this research into different time moments and contrasting management cultures, namely gathering data from different countries, could also help clarify the circumstances under which firms would engage in riskier innovation activities of more exploratory nature. Furthermore, cross-sectional studies have limitations in supporting the causality proposed in the hypotheses, while endogeneity issues could also affect the hypothesized relations in the model. Additionally, single informant studies are more prone to common variance issues, while the exclusive use of subjective measures is subject to respondent bias and social desirability issues. Future research on the topic would benefit from multiple informant data and secondary objective data (for example: investments in R&D and operations performance indicators) to limit common variance issues. The assumption that CEOs and CFOs respond basically in the same way to the questionnaire for each firm is a simplification. TLI and NFI values for the structural model fit (TLI = 0.91, NFI = 0.85) suggest that the model could be optimized, as they should be ideally closer to 0.95. Finally, using other quantitative techniques in parallel to SEM could help discriminate different strategies within the sample leading to similarly higher levels of business performance (competing strategies). FsQCA is one of the techniques allowing so. SEM is limited in this respect as it shows the significant aggregate relations in the entire sample - the prevailing strategies - while leaving eventual sub-sets of strategies with similar business performance outcomes hidden. This study does not include control variables, such as firm size and age, although it tests for multi-group moderation on firm size.

Chapter 6 Conclusions

This thesis advocates for (i) open, externally oriented learning cultures in the form of high levels of absorptive capacity in manufacturing firms; (ii) the simultaneous pursuit of reliability and variability innovation strategies in manufacturing firms, and (iii) the importance of information-processing antecedents of manufacturing flexibility. It defends that absorptive capacity, innovation flexibility and manufacturing flexibility are key capabilities for the firms' alignment-flexibility-adaptability and that such capabilities are relevant to explain significant parts of the firm's business and operations performance.

This chapter contains a summary of main findings, key managerial implications, and main theoretical implications with some propositional considerations inducted from the studies' findings. The chapter ends with considerations on the limitations of the studies, followed by hints of future research prospects.

6.1. Summary of Main Findings

First, innovation competences orientation (exploitation and exploration) are more important to business performance than market orientation (responsive and proactive). While the former direct impacts are positive and significant, the latter are non-significant. This suggests that the innovation function is more important than the marketing function for the enhancement of business performance.

Second, absorptive capacity is more important for the development of innovation competences orientation (exploitation-exploration) than market orientation (responsive-proactive). This is especially so under below-average turbulence conditions: (i) the impact of absorptive capacity on innovation competence exploitation under below-average technological turbulence is higher and (ii) the impact of absorptive capacity on innovation competence exploration under below-average market turbulence is also higher. This suggests that the firm's innovation competences require more diverse knowledge inputs than just those coming from market orientation, even if the industry sectors are mainly traditional, as it is the case. It also suggests that such knowledge inputs require a relative stability to produce effects, meaning below-average turbulence conditions.

Third, absorptive capacity plays a crucial role as an enabler of the firm's innovation flexibility (innovation reliability and variability strategies), thus emerging as a possible antecedent of innovation ambidexterity. This suggests that, in order to be able to simultaneously develop innovation reliability and variability strategies firms need a source of non-narrow knowledge from which multiple combinations of existing and new knowledge can be used and formed.

Fourth, the impact of innovation competence exploitation on business performance is higher under higher technological turbulence conditions, while the direct impact of absorptive capacity on business performance gets dampened (under higher market turbulence) or even ceases to be significant (under higher technological turbulence). This makes innovation competence exploitation the more important competence within the firm, when different turbulence levels are considered.

Fifth, proactive market orientation comes up as non-significant to innovation competence exploration, suggesting a marketing handicap in properly addressing or using latent customer's needs for the firm's innovation competence exploration. This should have expectable negative consequences for the overall innovation flexibility of the firm and impacts on performance, especially in the medium and long-term.

Sixth, firms may be balancing total uncertainty (the environmental uncertainty associated with higher turbulence and the internal uncertainty associated with their innovation strategies) by responding with more reliable innovation strategies (exploitation), especially under higher turbulence. Although an expectable behavior, the overall innovation strategy of the firms seems to excessively lean toward exploitation, as signaled by the non-significant impact of proactive market orientation on innovation competence exploration.

Seventh, the best timing for firms to allocate more resources toward the reinforcement of absorptive capacity and/or an innovation variability strategy seems to be when they observe lower than average market and technological turbulence. This is because it is under such conditions that the direct effect of absorptive capacity is more positive on business performance. It is also under such conditions that the effects of absorptive capacity on innovation competences orientation (exploitation-exploration) is more powerful. By investing more in such capability at times of lower turbulence, firms will be enhancing business performance and innovation competences orientation (exploitation-exploration) quicker than rivals. This will also prepare firms to better withstand higher turbulent times, since having well developed innovation competence exploitation more strongly affects performance under such conditions.

Eighth, manufacturing flexibility can be enhanced by knowledge creation (a sub-dimension of absorptive capacity) in connection with the explicit positive incentive that technology turbulence represents. Firms not having enough resources or scale for fully developing a sophisticated absorptive capacity in all of its dimensions, can at least try to reinforce knowledge creation. Better firm-specific knowledge creation, possibly by creating incentives directed at the most knowledgeable firm employees, helps the understanding of the technological options available and positively contributes to more smoothly align the firm's manufacturing flexibility with its environment.

Ninth, manufacturing flexibility does impact performance in a stronger manner under above-average market turbulence. This is in line with the literature stream defending manufacturing flexibility's importance to align the firm with its environment under higher market turbulence.

Tenth, at least in the short and medium-term (less than five years) it is absorptive capacity and the innovation reliability strategy (exploitation) that more positively contribute to manufacturing flexibility. Innovation competence exploitation positively impacts manufacturing flexibility in complementarity to absorptive capacity. A question remains in knowing if the effect of absorptive capacity on manufacturing flexibility is dampened under above-average turbulence levels as it happens with its impact on business performance.

Eleventh, while larger firms display a higher absorptive capacity's impact on innovation competence exploration, smaller and newer firms display a higher proactive market orientation impact on innovation exploration orientation. This suggests that while larger firms may have more resources to invest in a costly capability as absorptive capacity and use it to better develop its innovation variability strategy (exploration), smaller firms make better use of proactive market orientation toward the same effect.

Twelfth, a relatively small intensity or even non-significance of market orientation (responsive-proactive) impacts on innovation competences orientation (exploitation-exploration) could be suggesting a structural marketing weakness in the Portuguese industry: firms could probably be better than they seem to be at using customer's explicit needs for their innovation competence exploitation, and are seemingly non-effective at using customer's latent needs for their innovation competence exploration. Although more research is needed, the finding can indicate an omnipresent pattern of defective market orientation in Portuguese manufacturing firms, with negative consequences for innovation competences orientation (exploitation-exploration) as well as for manufacturing flexibility and business performance.

6.2. Managerial Implications

This section elaborates a list of managerial implications of the main findings presented in the previous section. These implications may be specifically linked to the object of study (Portuguese firms with 20 or more employees) and therefore be hardly generalizable.

First, when the firm goal is business performance, the managerial resource allocation decision between marketing and innovation gets simplified: innovation competences orientation (exploitation-exploration) assume more importance to business performance than market orientation (responsive-proactive). When facing limited resources, managers should consider the pecking order between the two and invest first in improving innovation competence orientation (exploitation-exploration), since any positive change here will translate to more positive improvements on business performance.

Second, since absorptive capacity is more important to innovation competences orientation (exploitation-exploration) than market orientation (responsive-proactive), a second pecking order affecting the managerial resources allocation exists: it seems worthier for managers to invest in the firm's absorptive capacity to improve innovation competences orientation than to invest in market orientation for the same purpose.

Third, the fact that absorptive capacity can positively and significantly impact innovation competence exploitation and innovation competence exploration with positive results to business performance, establishes an additional reason for managers to reinforce the firm's absorptive capacity.

Fourth, firm's managers must be aware that the best they can rely on to face higher turbulent times are adequate core capabilities, such as the firm's innovation flexibility. Since the direct effects of absorptive capacity on business performance lose importance under higher turbulence, the firm must rely in well-developed innovation reliability and variability strategies instead. Because resources are limited, the capabilities underlying such strategies are best developed by absorptive capacity under lower turbulent regimes, as shown by the findings. This requires managers to foresight future turbulence conditions in order to timely and adequately invest in absorptive capacity, posssibly in a counter-cyclical manner to turbulence levels. Management should facilitate an ingrained open learning culture, to create the conditions for a better development of absorptive capacity and, consequently, of core capabilities such as market orientation and innovation competences orientation (exploitation-exploration). Such type of decisions is likely to require managerial maturity, quality and experience, something worth further research.

Fifth, the lack of significance of market orientation (responsive-proactive) to business performance and the lack of significance of proactive market orientation to innovation competence exploration can be signaling a structural handicap common to many firms in the sample. It may mean that Portuguese firms are inexperienced or ineffective at properly reading and transforming latent customer's needs in innovation competence exploration, thus limiting the impact of the latter on business performance and on manufacturing flexibility. The fact that the findings relegate market orientation (responsive-proactive) to the bottom of the pecking order of capabilities, with absorptive capacity and innovation competences orientation ahead, may be rooted in the same explanation: Portuguese manufacturing firms do not seem to be using customer's latent needs properly in their innovation activities. This could be revealing an excessively defensive attitude, with most of the firms in the sample preferring to align with the market than attempting to create market change. Such a finding, if proven relatively time-invariant (something requiring further research) could undermine the future of such firms or, at least, limit its growth potential. It shows a preponderant conservative and risk averse market approach: to follow, rather than to create change. An alternative explanation requiring further research could be that the activity sectors involved mainly display stable market preferences, rendering market orientation (responsive-proactive) secondary by nature and little worthy of development. Managers should, nevertheless, try to reinforce the follow up and understanding of customer's explicit and latent needs.

Sixth, the firm's reinforcement of innovation reliability strategy when facing higher turbulence could be a reflex of the previous point or, alternatively, a general attitude toward higher uncertainty. While the latter seems indeed to be a behavioral pattern which other studies have detected - the tendency to engage in less risky innovation activities under more difficult environmental conditions - the fact that firms assume a less exploratory attitude under higher turbulence raises a red flag. If manufacturing firms explore less under higher turbulence, it means they are relatively unable to create market change when it is most needed. Such limitation could become a handicap to their medium and long-term business performance (over five years), putting at risk their sustainability and survivability, especially if they do not invert the attitude once turbulence levels come down or, conversely, in case turbulence levels show a persistent tendency to grow. Not being able, not being effective, or not be willing to create market change means that firms could see their fate mainly dependent on external circumstances. To verify if this behavior is relatively time-invariant or not requires further research, as managers should periodically assess their firm's innovation reliability-variability strategic balances with an eye on its future sustainability.

Seventh, the finding that absorptive capacity is especially useful to develop core capabilities, such as innovation flexibility under lower turbulence, requires managerial foresight to look beyond the short-term when it comes to promoting an open learning culture in their firms. This is especially hard to do on a business world concerned with the short-term, the immediate actions of the competition and customer's decisions, and the addressment of daily problems. This suggests that proper handling of dynamic capabilities such as absorptive capacity, adaptive capability and innovation capability (Wang & Ahmed, 2007) requires firm managers to keep an eye on the future, while being mindful of the present.

Eighth, firms lacking the scale and the resources to develop sophisticated organizational absorptive capacity could focus on some of their sub-dimensions with similar purpose, such as knowledge creation. This recommendation is especially important for SMEs lacking the size, experience and resources to adopt very sophisticated absorptive capacity or invest in it continuously, as deemed ideal. Knowledge creation alone can, for example, amplify the positive effects of manufacturing flexibility on business and operations performance, as shown in chapter 4.

Ninth, managers should invest in manufacturing flexibility to achieve higher operations and business performance, especially under higher market turbulence. Although this result is disputed in the literature, the findings of this study seem to be clear in showing the positive significant effects of manufacturing flexibility on business and operations performance when market turbulence ramps up.

Tenth, as innovation competence exploitation comes out of the findings as the most important construct positively affecting business performance and manufacturing flexibility independently of turbulence levels, managers should have it as the absolute priority to generate results in those two areas, at least in the short term. However, as the findings also suggest, managers should also invest in improving the understanding and use of their customer's latent needs in order to amplify the importance of innovation competence exploration.

Eleventh, as the findings concerning smaller and younger firms suggest, it is possible that the proficiency in the use of latent customer's needs for innovation competence exploration is linked to cultural organizational traits, such as organizational inertia. Larger and older firms could profit from learning with smaller and newer firms on how to effectively use a proactive market orientation for the benefit of their innovation competence exploration. In particular, it seems relevant that managers of larger and older firms should evaluate their firm's proactive market orientation and try to improve it, something that their more effective absorptive capacity does not seem to achieve *per se*. This subject deserves more research to be better understood.

Twelfth, the non-significant impact of proactive market orientation on innovation competence exploration could be something specific to the object of study – Portuguese manufacturing firms with 20 or more employees – rather than a generalizable finding. Although more research is needed to establish the boundaries of this issue, other studies results suggest this finding to be context dependent (Laforet, 2008). The present study did not collect data from other countries for a meaningful comparison to be performed and tested. One way to try clarifying the matter would be to extend the geographical scope of the research to other countries.

Overall, the findings suggest that the transformative processes allowed by higher order dynamic capabilities (absorptive capacity) must be in place consistently. Such a conclusion directly summons the responsibility of management to support knowledge, creativity, open exchanges and learning in manufacturing firms, regardless of their size. The findings also implicitly underline the importance of qualified or creative employees to develop the knowledge-base of the firms more effectively, in order to enable transformational processes in core capabilities leading to higher performance.

6.3. Theoretical Implications for Discussion

The findings in the thesis have theoretical implications at several levels. This section presents the most relevant. It is possible to induce from findings a few theoretical propositions, containing insights for future research.

Dynamic Capabilities

The dynamic capabilities framework has emerged as a complement of the RBV of the firm to address market dynamism and the evolutionary nature of resources and capabilities (Wang & Ahmed, 2007). There is some consensus in the statement that dynamic capabilities, by and large, should be more useful to the firm moving in dynamic business environments (Eisenhardt & Martin, 2000). Its seminal definition already contains the purpose “to rapidly address changing environments” (Teece et al., 1997, p. 516). However, some of this thesis findings show that the higher the order of a dynamic capability (absorptive capacity) the less direct and intense are its effects on business performance under higher market and technological turbulence. Although turbulence and dynamism are different concepts, their similitude is sufficient for further reflection on the finding suggesting that absorptive capacity is useful for firms in advance of highly turbulent or more dynamic market situations, and not necessarily during such situations. At the same time, this study findings suggest that innovation flexibility and manufacturing flexibility impacts on performance are higher under higher turbulence.

Although both innovation flexibility and manufacturing flexibility can be regarded as dynamic capabilities or as core capabilities, this study’s regards them as core capabilities due to the presence of a higher order dynamic capability (absorptive capacity). A possible proposition emerging with respect to the order of dynamic capabilities could be related to the nature of its effects on firm outcomes such as firm performance under conditions of higher turbulence and/or dynamism:

Proposition 1: A capability should be considered dynamic if its impact on firm performance is mainly indirect, especially under above-average market and technological turbulence conditions.

Proposition 2: A capability should be considered a core capability if displaying a significant positive direct impact on firm performance under above-average market and technological conditions.

These propositions should be tested by further research. If anything, they would put in question the classification of adaptive capability and innovation capability as dynamic capabilities' commonalities (Wang & Ahmed, 2007), since the former have some equivalence to this study's innovation flexibility (innovation reliability and variability strategies).

A broader theoretical suggestion potentially clarifying the field would be the introduction of the concept of relative dynamic capability:

Proposition 3: A capability should be considered dynamic if displaying a utility scope broad enough to influence the change of other subordinate core capabilities, while displaying small or insignificant direct effects on firm performance under above-average market and technological turbulence conditions.

Proposition 4: A capability is to be considered dynamic in relation to any other capability if its utility scope is wider, or more general, than the capability it is being compared with, and if it can be used as a change instrument over that capability.

Proposition 5: A capability that depends on factors or other capabilities external to its daily practice and purpose in order to change, can only be designated as dynamic in relative terms and when in connection to other subordinate, non-superseding, capabilities.

The concept of relative dynamic capability would identify only the most important organizational and managerial capabilities leading to medium and long-term performance as 'dynamic', while introducing a rank order between different capabilities recognized in some studies as 'dynamic'. This is a proposition for a complementary criterion to classify dynamic capabilities and mitigate the confusion surrounding its many definitions and unclear boundaries. This thesis proposes that dynamic capabilities are classified as such based on their tested effect on core capabilities and firm performance, as well as based on the range of core capabilities and other capabilities that they can be used to change.

As Easterby-Smith and Prieto (2008) have acknowledged, learning activities are at the very core of dynamic capabilities, since knowledge and tacit knowledge in particular can be regarded as the most strategically important assets of firms (Gupta & Govindarajan, 2000; Grant, 1996a).

Paradox Theory and Ambidexterity

As the findings illustrate, absorptive capacity is shown to simultaneously enhance the innovation reliability (or innovation exploitation) and variability (or innovation exploration) strategies. This suggests absorptive capacity as an antecedent of ambidexterity, but also as part of it. Instead of the more usual but abstract interaction between innovation exploitation and exploration typically used in the conceptualization of ambidexterity, this thesis looks at absorptive capacity as the mechanism that interrelates the complementary learning that exploitation and exploration involve.

Paradox theory and part of the ambidexterity literature converge when defending that organizations should simultaneously embrace paradoxical tensions, namely the simultaneous pursuit of exploitation and exploration resulting in mutual reinforcement of both through the interrelations of complementary learning that each in separate involves (Gibson & Birkinshaw, 2004; Lewis, 2000; O'Reilly & Tushman, 2008; Raisch & Birkinshaw, 2008). Such processes can occur simultaneously and at the same level even within small firms, with manager's exploitation activities being fueled by top-down knowledge inflows and manager's exploration activities being fueled by bottom-up and horizontal knowledge inflows (Mom et al., 2007). This thesis proposes that absorptive capacity is one of the main components of such complementary learning, and thus a crucial part of the interrelation mechanism supporting ambidexterity, the very embodiment of the interaction between exploitation and exploration.

Proposition 6: Organizational learning and organizational absorptive capacity are mechanisms through which the complementarities and interaction between exploitation and exploration innovation activities occur and become significant for the firm performance.

Uncertainty, Prospects and Survivability

Higher turbulence *per se*, as the findings show, is not a sufficient incentive for the firms to prefer the preponderance of an innovation variability strategy instead of an innovation reliability strategy. Cumulative prospects theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992) and the finding that innovation reliability strategies predominate, together with a deficient understanding or use of latent customer's needs for innovation competence exploration, suggest that only before a prevailing prospect of high probability losses are firms expected to more strongly leverage a riskier innovation variability strategy. Due to the path dependency of absorptive capacity, but also of manufacturing flexibility and innovation flexibility, firms below a certain threshold of resources and capacities will arguably be able to put in motion an effective innovation variability strategy right before the prospect of high probability losses. This rationale, together with the findings, leads to the proposition that firms more at risk of unsustainability will be older than average, larger than average, and possessing a culture leaning toward conservativism, excessively change and risk averse even during less turbulent times and excessively focused on the short-term.

Proposition 7: Manufacturing firms larger and older than average and additionally displaying excessively conservative or inertial organizational traits, namely as expressed by persistently ineffective proactive market orientation, will be less sustainable in the medium and long- term.

Proposition 8: Manufacturing firms smaller and younger than average and additionally displaying excessively conservative or inertial traits, namely as expressed by ineffective proactive market orientation, are at risk of short-term disappearance.

Marketing *versus* Innovation

As the findings show, market orientation (responsive-proactive) does not have any significant impact on business performance. Moreover, proactive market orientation does not have a significant impact on innovation competence exploration in older and larger firms. These findings come as somewhat unexpected. Kohli and Jaworski (1990) have identified some circumstances under which market orientation could lose impact on performance, such as limited competition, stable market preferences, technologically turbulent sectors and booming economies. The circumstances above do not seem to offer proper explanation for the lack of market orientation (responsive-proactive) impact on performance in the current study, except perhaps a prevalence of stable market preferences in the markets addressed by the firms in the sample. That could also explain the lack of impact of proactive market orientation on innovation competence exploitation through the admission of a real scarcity of latent needs to work with. Kohli and Jaworski (1990) have furthermore stated that the quality of market intelligence, its dissemination, the organizational response and the quality of execution of marketing programs can be determinant to the impact of market orientation on performance. These causes seem more suitable an explanation for the findings, basically indicating a possible lack of marketing proficiency in Portuguese marketing firms. On the other hand, Kirca et al. (2005) pointed out that the market orientation relationship with firm performance should be stronger in manufacturing firms, low hierarchical power distances, uncertainty-avoidance cultures and studies using subjective measures of performance. The studies in the thesis concern a study object that may share some of the above characteristics. Could the lack of impact of market orientation (responsive-proactive) on business performance be due to high hierarchical power distance, the poor quality of market intelligence, the lack of organizational response or poor execution of marketing programs? Further research is required to answer these questions.

The rationale of the allocation decision of resources between marketing and innovation must thus be questioned, for if the findings suggest that an immediate reinforcement of innovation competences orientation (exploitation-exploration) will have a direct and significant positive effect on business performance, they also raise the question if market orientation (responsive-proactive) is being properly used to guide innovation activities. It is theoretically, empirically supported and hardly disputable that having an edge at understanding the explicit and latent needs in a market can lead to better innovation, and yet many firms in the sample seem to disregard the importance of using a proactive market orientation to that effect. While responsive market orientation fosters exploitation, refinement and efficiency within the available knowledge-base of the firm (Baker & Sinkula, 2007; Corso & Pellegrini, 2007; Narver et al., 2004), proactive market orientation pushes knowledge beyond the experience of the firm, fostering exploration through discovery, variation and higher risk taking (Atuahene-Gima et al., 2005; Narver et al., 2004; Tan & Liu, 2014).

As Laforet (2008) results indicate, non-high-tech United Kingdom SMEs innovate better when displaying a proactive market orientation. Although the findings in this thesis indicate that newer and smaller firms use proactive market orientation to enhance innovation competence exploration, there still seems that many of the SMEs in the sample, even if they are non-high-tech, do not adequately use proactive market innovation to foster their innovation competence exploration. This matter deserves more research as it could be signaling a structural deficiency in the marketing activities of many Portuguese SMEs, leading them to under-explore their innovation competence, with possible negative results in medium and long-term business performance and sustainability, as an exploration innovation strategy leads to business performance due to the benefits originating in less marginally differentiated products (Rosenkopf & Nerkar, 2001).

The higher importance of innovation competences orientation (exploitation-exploration) to business performance (in a period of five years or less) must thus be regarded with caution, since not investing in market orientation, especially of the proactive kind, could hamper innovation competence exploration and become, in time, hazardous for the sustainability of a balanced innovation. Therefore, if it is correct that these findings shed some light over a pecking order between market and innovation competences, they cannot be considered a definitive answer, as disregarding proper use of market insights (latent market needs) to an innovation variability strategy could prove foolish in the medium and long-term. Firms excessively responsive in their market orientation could become too inertial to anticipate important market change opportunities (Tan & Liu, 2014). If responsive and proactive market orientations are not entirely aligned with innovation competence exploitation and exploration, respectively, such a fact could mean that the marketing and the R&D functions are further apart than they should (Lamore et al., 2013).

Proposition 9: Older and larger than average firms display a tendency for conservatism and inertial organization expressed by a relatively ineffective use of proactive market orientation for innovation competence exploration purposes.

Proposition 10: Firms displaying an effective use of market orientation (responsive-proactive) in the guidance of innovation competences orientation (exploitation-exploration) will tend to lead business performance in their activity sector.

Open Learning Cultures

Absorptive capacity amplifies the flexibility of the firm's response to demand, competitive and technological uncertainty, through a more effective analysis and interpretation of environmental changes and a more consequent acquisition, sharing and use of knowledge to approach the realignment and renewal of operational capabilities (Patel et al., 2012). This capability scope is large, potentially encompassing knowledge about new technologies as much as about market trends and business models and even about organizational trends. The large scope of absorptive capacity is what makes it a useful tool in shaping other core capabilities, such as innovation flexibility (innovation reliability and variability strategies) as well as manufacturing flexibility. Absorptive capacity is not only based on a more effective analysis and interpretation of environmental changes, but also on a non-narrow knowledge seeking focus, a characteristic providing depth and complexity to the knowledge combination possibilities that it allows. Such combinatorial wealth is what makes absorptive capacity useful as a feeder and change tool of core capabilities, such as those related to marketing and innovation, and possibly other core capabilities, such as HR and other key internal organizational capabilities of firms.

A way to foster absorptive capacity within firms is to develop diverse teams able to work together and expose themselves to new perspectives (Cohen & Levinthal, 1990). Absorptive capacity requires qualified people, but also proper incentives for them to be alert and seek proper knowledge outside their firm's knowledge-base, so they can properly contribute to the firm's ideation process (Salter et al., 2015). For absorptive capacity to be in place consistently, management must understand the value of knowledge, creativity, open exchanges and learning in manufacturing firms. Furthermore, exploration activities require bold attitudes from management, such as accepting the *status quo* to be challenged, accepting and coping with failure as part of progress and caring for the integration and transfers of knowledge (O'Reilly & Tushman, 2008). Setting up an innovative culture in firms requires less focus on control and more focus on flexibility and openness to new perspectives and ideas (Büschgens et al., 2013). Such a culture, beyond the expectable positive effects on learning, exploitation, exploration and performance, also positively contributes to job satisfaction and superior employee-level outcomes. Although it seems something straightforward it is probably the exception in manufacturing firms rather than the rule, something worthy of deeper research.

Proposition 11: Without an adequate open learning culture, valuing internal free knowledge exchanges and supporting qualified employees toward a more consequent ideation process, knowledge-based capabilities will not function to full potential, undermining the potential of market oriented, innovation oriented and flexibility oriented capabilities, with possible performance shortcomings.

Proposition 12: A measure of future sustainability of a firm should include its degree of openness to learning from external sources, and its willingness to use it to improve its market, innovation and operational core capabilities toward better alignment and adaptability with its environment.

Decisions and Causality

One of the principles followed in the development of the conceptual models hereby tested, besides the grounding in theory, was that antecedents should have a wider utility scope and purpose than consequents. Although reverse causality is always a possibility and certainly plays a role, broader scope constructs should antecede narrower scope constructs due to time-path dependency and history. For example, while it is admissible that the observation of what positively influences business performance affects the way to conduct strategic and manufacturing flexibility, the firm's environment is dynamic which means that past performance observation has a limited value in shaping back core capabilities such as innovation flexibility. Also, innovation flexibility and manufacturing flexibility are pre-existent realities in the value chain to business performance or operations performance, and therefore should antecede these constructs. In the same way, there are no strategic or manufacturing flexibilities without a minimum pre-existing knowledge-base to assist the development of even the elementary components of innovation flexibility and manufacturing flexibility, which suggests a concept of causality reinforcing the theoretical arguments and empirical evidence available in literature.

The philosophical position adopted was that causality between management constructs should be established in the direction of the dissipation of possibilities. Starting from the constructs allowing wider combination of possibilities and decisions (larger number of decision options available) toward the ones narrowing such possibilities (fewer number of decision options available) through the implicit sequence of managerial decisions involved in the firm's value chain as it evolves in time. For example, while absorptive capacity allows for multiple combinations of knowledge possibilities concerning technology choices, market trends and business models, market orientation (responsive-proactive) involves a narrower decision-focus to decide which explicit and latent customer's needs seem more suitable to feed into innovation competences. In this sense, the absence of a significant impact of proactive market orientation on innovation competence exploration could also be interpreted as a failure to align the perception of customer's latent needs with the strategy of the firm or even an unclear firm strategy. Innovation competences orientation (exploitation-exploration) involve further decisions in the process concerning which market orientations and other general knowledge coming from absorptive capacity to develop, trimming even more the possibilities for knowledge combinations and available choices, a process that ends with the decisions of which new products to develop. Similarly, the adoption of technology or other changes in any of the dimensions reflecting manufacturing flexibility follow a similar rationale. Both processes - the development of innovation flexibility and of manufacturing flexibility - have certain rigidities and irreversibility aspects when considerable investments and decisions are made regarding technologies, people, and know-how under uncertain environmental circumstances. These ideas on causality can be summed up in the following propositions:

Proposition 13: Causality between capabilities, resources, or competences should be established from the ones offering more diversity of choice and decisions to the ones narrowing down the options of choice and decisions, down to final outcomes.

Proposition 14: Dynamic capabilities, understood as the most important organizational capabilities leading to medium and long-term performance, should be reflected by constructs allowing for a wide diversity of options and decisions with impact on the shaping of subordinate capabilities.

6.4. Limitations

The studies in this thesis are cross-sectional. This generates a limitation in the transposition of the findings and conclusions to specific industry sectors, as organizational and manufacturing characteristics may substantially differ between different activity sectors. The data used in the studies has been single-sourced and may be contaminated by common method variance and self-reporting issues, such as social desirability. The representativeness of the sample should be taken with caution as there is an over representation bias of larger firms in relation to the target population. A telephone follow-up – not performed – would likely have helped achieve higher response rates. Such procedure was not adopted due to time and budgetary constraints. Some methodological assumptions are to be re-examined with greater care, namely the assumption that CEOs and CFOs share identical knowledge levels about their firms' capabilities. The fact that the data gathered comes from both functions (CEOs and CFOs) may result in accuracy limitations. Also, the assumption that firm sizes of 20 or more employees provide an acceptable threshold for properly evaluating the constructs under focus could be overly simplistic, since smaller firms could lack sufficient internal specialization of capabilities, for example. Correlations of self-reported levels of performance and absorptive capacity with secondary source information on performance and R&D expenditures were not performed, which leaves a confirmation gap. Secondary source information would provide independent information capable to better validate, or refute, the primary source data used in the studies. The data analysis method (SEM) has limitations in finding subsets of strategies leading to similar levels of performance or manufacturing flexibility, for example. The use of complementary data analysis techniques is recommended for furthering this research. The expansion of the research to specific industry sectors, other countries and different moments in time could contribute to a better assessment of the findings and to explore other topics such as how different management cultures and different competition intensity levels between activity sectors could affect the results. The conceptual structural equations models could be further developed as the TLI and NFI reveal (Hooper et al., 2008), especially in the models of chapters 3 and 5. Comparison with rival models could be a process to follow, something that was not considered in this research. Some disagreement between the classifications of primary and secondary data in the sampling frame and respondents sample characterization should be harmonized on follow up research on the issue. The studies presented in this thesis have not considered control variables, although firm size and firm age have been used as multi-group moderators to determine how they affect the models. Since the object of study focuses on Portuguese firms, the results present context specific features hard to generalize. Lastly, none of the studies in this thesis probed the relationships between innovation flexibility (innovation reliability and variability strategies) and operations performance, a link left to future research.

6.5. Future Avenues for Research

First, expanding on the limitations, further studies based on similar models could narrow down the choice of activity sectors in order to obtain more consistency in the conclusions. This could be done by selecting contrasting industry sectors when it comes to the level of technological intensity, for example, or other sectorial traits of interest, such as competitive intensity.

Second, these studies could be extended in time, in order to take measures at different periods to probe for differences in the capabilities configurations leading to higher business and operations performance, and higher manufacturing flexibility.

Third, it would be interesting to expand the studies to an international context to check for national differences. This was attempted during the survey phase but not enough data has been gathered to allow proper comparison. The studies reflect only the Portuguese context, for which enough data has been gathered.

Fourth, secondary data should be obtained to cross check latent construct measures and fine tune the models. A second informant in firms, when and where possible, would also help the accuracy of the measures. Both procedures should limit data biases.

Fifth, further studies would benefit in considering the role of the firm's strategy orientation in the process of alignment and adaptability to the environment. Although the models capture behaviors based on implicit choices (strategies), no cross assessment with the firm's strategic orientation was developed to measure if intended and realized strategic orientations are aligned.

Sixth, it would be interesting to measure the management qualifications and experience to evaluate its relations with firm performance. These studies do not integrate such characteristics.

Seventh, further studies could include tests to the propositions presented in this chapter and inducted from some of the findings, to validate or disproof its theoretical value.

Eighth, the relationships between innovation flexibility and operations performance were not focused in this thesis, which leaves room for further research.

Lastly, other techniques could be employed in complementarity with SEM to probe for more details on the capabilities configurations leading to high value outcomes. For example, fsQCA could help find clusters of competing strategies resulting in similar business performance, or similar manufacturing flexibility levels.

Overall, a background challenge remains: finding the key capabilities and mechanisms critical to sustain competitive advantage and to the explanation of differential firm performance. This thesis is but a limited conceptual and empirical exercise having as one of the goals testing knowledge-based dynamic and core capabilities relevant for the enhancement of manufacturing flexibility, business and operations performance. To this respect, the conceptual models presented and tested in this thesis explain 69% of business performance variance (chapter 3), 45% of business performance and 17% of operations performance (chapter 4), and 33% of manufacturing flexibility variance (chapter 5), which can be considered a satisfactory global result.

References

Abernathy, W. J. (1978). *The Productivity Dilemma: Roadblock to Innovation in the Industry*. Baltimore, MD: Johns Hopkins University Press.

Adler, P. S., Benner, M., Brunner, D. J., MacDuffie, J. P., Osono, E., Staats, B. R., Takeuchi, H., Tushman, M. L., & Winter, S. G., (2009). Perspectives on the productivity dilemma. *Journal of Operations Management*, *27*(2), 99-113.

Afuah, A. (2001). Dynamic boundaries of the firm: Are firms better off being vertically integrated in the face of a technological change? *Academy of Management Journal*, *44*(6), 1211-1228.

Ahlström, P., & Westbrook, R. (1999). Implications of mass customization for operations management: an exploratory survey. *International Journal of Operations & Production Management*, *19*(3), 262-275.

Ahuja, G., & Lampert, C. M. (2001). Entrepreneurship in the large corporation: A longitudinal study of how established firms create breakthrough inventions. *Strategic Management Journal*, *22*(6-7), 521-543.

Aiken, L. S., West, S. G., & Reno, R. R. (1991). *Multiple regression: Testing and interpreting interactions.* Thousand Oaks, CA: Sage Publications.

Ambrosini, V., & Bowman, C. (2009). What are dynamic capabilities and are they a useful construct in strategic management? *International Journal of Management Reviews*, *11*(1), 29-49.

Amit, R., & Schoemaker, P. J. H. (1993). Strategic assets and organizational rent. *Strategic Management Journal*, *14*(1), 33-46.

Anand, G., & Ward, P. T. (2004). Fit, flexibility and performance in manufacturing: coping with dynamic environments. *Production and Operations Management*, *13*(4), 369-385.

Anderson, P., & Tushman, M. L. (1990). Technological discontinuities and dominant designs: A cyclical model of technological change. *Administrative Science Quarterly*, *35*(4), 604-633.

Andriopoulos, C., & Lewis, M. W. (2009). Exploitation-exploration tensions and organizational ambidexterity: Managing paradoxes of innovation. *Organization Science*, *20*(4), 696-717.

Arbuckle, J., & Wothke, W. (2012). Structural Equation Modeling Using AMOS: An Introduction. Retrieved from https://stat.utexas.edu/images/SSC/Site/AMOS_Tutorial.pdf

Archibugi, D., Filippetti, A., & Frenz, M. (2013). The impact of the economic crisis on innovation: Evidence from Europe. *Technological Forecasting and Social Change*, *80*(7), 1247-1260.

Armstrong, C. E., & Shimizo K. (2007). A review of approaches to empirical research on the resource-based view of the firm. *Journal of Management*, *33*(6), 959-986.

Atuahene-Gima, K. (1995). An exploratory analysis of the impact of market orientation on new product performance a contingency approach. *Journal of Product Innovation Management*, *12*(4), 275-293.

Atuahene-Gima, K. (1996). Market orientation and innovation. *Journal of Business Research*, *35*(2), 93-103.

Atuahene-Gima, K. (2005). Resolving the capability-rigidity paradox in new product innovation. *Journal of Marketing*, *69*(4), 61-83.

Atuahene-Gima, K., Slater, S. F., & Olson, E. M. (2005). The contingent value of responsive and proactive market orientations for new product program performance. *Journal of Product Innovation Management*, *22*(6), 464-482.

Autry, C. W., Grawe, S. J., Daugherty, P. J., & Richey, R. G. (2010). The effects of technological turbulence and breadth on supply chain technology acceptance and adoption. *Journal of Operations Management*, *28*(6), 522-536.

Bain, J. S. (1968). *Industrial Organization*. New York, NY: John Wiley & Sons.

Baker, W. E., & Sinkula, J. M. (1999). The synergistic effect of market orientation and learning orientation on organizational performance. *Journal of the Academy of Marketing Science*, *27*(4), 411-427.

Baker, W. E., & Sinkula, J. M. (2005). Market orientation and the new product paradox. *Journal of Product Innovation Management*, *22*(6), 483-502.

Baker, W. E., & Sinkula, J. M. (2007). Does market orientation facilitate balanced innovation programs? An organizational learning perspective. *Journal of Product Innovation Management*, *24*(4), 316-334.

Bamberger, P. A., Biron, M., & Meshoulam, I. (2014). *Human resource strategy: Formulation, implementation, and impact.* London, UK: Routledge.

Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99-120.

Barney, J. B. (1997). *Gaining and sustaining competitive advantage*. Reading, MA: Addison-Wesley Publishing Company.

Baum, J. A., Li, S. X., & Usher, J. M. (2000). Making the next move: How experiential and vicarious learning shape the locations of chains' acquisitions. *Administrative Science Quarterly*, *45*(4), 766-801.

Beach, R., Muhlemann, A. P., Price, D. H. R., Paterson, A., & Sharp, J. A. (2000). A review of manufacturing flexibility. *European Journal of Operational Research*, *122*(1), 41-57.

Ben-Oz, C., & Greve, H. R. (2015). Short-and long-term performance feedback and absorptive capacity. *Journal of Management*, *41*(7), 1827-1853.

Bentler, P. M., & Chou, C. P. (1987). Practical issues in structural modeling. *Sociological Methods & Research*, *16*(1), 78-117.

Bolwijn, P. T., & Kumpe, T. (1990). Manufacturing in the 1990s-productivity, flexibility and innovation. *Long Range Planning*, *23*(4), 44-57.

Braglia, M., & Petroni, A. (2000). Towards a taxonomy of search patterns of manufacturing flexibility in small and medium-sized firms. *Omega*, *28*(2), 195-213.

Brettel, M., Klein, M., & Friederichsen, N. (2016). The Relevance of Manufacturing Flexibility in the Context of Industrie 4.0. *Procedia CIRP*, *41*, 105-110.

Brockman, B. (2013). The evolution of organizational learning in new venture development. *Journal of Small Business and Entrepreneurship*, *26*(3), 261-275.

Büschgens, T., Bausch, A., & Balkin, D. B. (2013). Organizational culture and innovation: A meta-analytic review. *Journal of Product Innovation Management*, *30*(4), 763-781.

Byrne, B. M. (2001). *Structural equation modeling with AMOS: Basic concepts, applications, and programming*. Mahwah, New Jersey: Lawrence Erlbaum.

Byrne, B. M. (2008). Testing for multigroup equivalence of a measuring instrument: A walk through the process. *Psicothema*, *20*(4), 872-882.

Camisón, C., & Villar López, A. (2010). An examination of the relationship between manufacturing flexibility and firm performance: the mediating role of innovation. *International Journal of Operations & Production Management*, *30*(8), 853-878.

Camuffo, A., & Volpato, G. (1996). Dynamic capabilities and manufacturing automation: organizational learning in the Italian automobile industry. *Industrial and Corporate Change*, *5*(3), 813-838.

Carlucci, D., Marr, B., & Schiuma, G. (2004). The knowledge value chain: how intellectual capital impacts on business performance. *International Journal of Technology Management*, *27*(6-7), 575-590.

Cepeda, G., & Vera, D. (2007). Dynamic capabilities and operational capabilities: A knowledge management perspective. *Journal of Business Research*, *60*(5), 426-437.

Chakravarthy, B. S. (1982). Adaptation: a promising metaphor for strategic management. *Academy of Management Review*, *7*(1), 35–44.

Chakravarthy, B., & Lorange, P. (2008). *Profit or growth? Why you don't have to choose*. Upper Saddle River, NJ: Wharton School Publishing.

Chang, S. C., Yang, C. L., Cheng, H. C., & Sheu, C. (2003). Manufacturing flexibility and business strategy: an empirical study of small and medium sized firms. *International Journal of Production Economics*, *83*(1), 13-26.

Chang, Y., Hughes, M., & Hotho, S. (2011). Internal and external antecedents of SMEs' innovation ambidexterity outcomes. *Management Decision*, *49*(10), 1658-1676.

Cohen, W. M., & Levinthal, D. A. (1989). Innovation and learning: the two faces of R&D. *The Economic Journal*, *99*(397), 569-596.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*, *35*(1), 128–152.

Cohen, W. M., & Levinthal, D. A. (1994). Fortune favors the prepared firm. *Management Science*, *40*(2), 227-251.

Corso, M., & Pellegrini, L. (2007). Continuous and discontinuous innovation: Overcoming the innovator dilemma. *Creativity and Innovation Management*, *16*(4), 333-347.

Crossan, M. M., Lane, H. W., & White, R. E., (1999). An organizational learning framework: from intuition to institution. *Academy of Management Review*, *24*(3), 522-537.

D'Aveni, R. A. (2010). *Hypercompetition*. New York, NY: The Free Press.

D'Souza, D. E., & Williams, F. P. (2000). Toward a taxonomy of manufacturing flexibility dimensions. *Journal of Operations Management*, *18*(5), 577-593.

Daghfous, A. (2004). Absorptive capacity and the implementation of knowledge-intensive best practices. *SAM Advanced Management Journal*, *69*(2), 21-27.

Danneels, E. (2008). Organizational antecedents of second-order competences. *Strategic Management Journal*, *29*(5), 519-543.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319-340.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science*, *35*(8), 982-1003.

Day, G. S. (1994). The capabilities of market-driven organizations. *The Journal of Marketing*, *58*(4), 37-52.

De Araújo Burcharth, A. L. L., Lettl, C., & Ulhøi, J. P. (2015). Extending organizational antecedents of absorptive capacity: Organizational characteristics that encourage experimentation. *Technological Forecasting and Social Change*, *90*(Part A), 269-284.

De Treville, S., Bendahan, S., & Vanderhaeghe, A. (2007). Manufacturing flexibility and performance: bridging the gap between theory and practice. *International Journal of Flexible Manufacturing Systems*, *19*(4), 334-357.

Decarolis, D. M., & Deeds D. L. (1999). The Impact of Stocks and Flows of Organizational Knowledge on Firm Performance: An Empirical Investigation of the Biotechnology Industry. *Strategic Management Journal*, *20*(10), 953-968.

Dierickx, I., & Cool, K. (1989). Asset Stock Accumulation and the Sustainability of Competitive Advantage: Reply. *Management Science*, *35*(12), 1514-1514.

Dreyer, B., & Grønhaug, K. (2004). Uncertainty, flexibility, and sustained competitive advantage. *Journal of Business Research*, *57*(5), 484-494.

Drnevich, P. L., & Kriauciunas, A. P. (2011). Clarifying the conditions and limits of the contributions of ordinary and dynamic capabilities to relative firm performance. *Strategic Management Journal*, *32*(3), 254-279.

Easterby-Smith, M., & Prieto, I. M. (2008). Dynamic capabilities and knowledge management: an integrative role for learning? *British Journal of Management*, *19*(3), 235-249.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they? *Strategic Management Journal*, *21*(10/11), 1105-1121.

Eisenhardt, K. M., & Westcott, B. J. (1988). Paradoxical demands and the creation of excellence: the case of just-in-time manufacturing. In R. E. Quinn, & K. S. Cameron (Eds.), *Paradox and Transformation: Toward a Theory of Change in Organization and Management* (pp. 169-194). Cambridge, MA: Ballinger.

Fang, S. R., Chou, C. H., Yang, S. M., & Ou, C. C. (2012). Enhancing innovation through learning: the roles of market orientation and inter organizational knowledge stores. *Technology Analysis and Strategic Management*, *24*(3), 285-298.

Ferreras-Méndez, J. L., Newell, S., Fernández-Mesa, A., & Alegre, J. (2015). Depth and breadth of external knowledge search and performance: The mediating role of absorptive capacity. *Industrial Marketing Management*, *47*, 86-97.

FFMS (2015). Empresas das Indústrias Transformadoras: total e por escalão de pessoal ao serviço (2009-2012). PORDATA - Estatísticas, gráficos e indicadores de Municípios, Portugal e Europa. Retrieved November 4, 2015, from https://www.pordata.pt/Municipios/Empresas+das+Ind%C3%BAstrias+Transformadoras+total+e+por+escal%C3%A3o+de+pessoal+ao+servi%C3%A7o+(2009+2012)-330.

FFMS (2017). Empresas no sector da indústria transformadora: total e por tipo. (2017). PORDATA - Estatísticas, gráficos e indicadores de Municípios, Portugal e Europa. Retrieved November 4, 2017, from https://www.pordata.pt/Portugal/Empresas+no+sector+da+ind%C3%BAstria+transformadora+total+e+por+tipo-2955-247994.

Figueiredo, P. N. (2002). Does technological learning pay off? Inter-firm differences in technological capability-accumulation paths and operational performance improvement. *Research Policy*, *31*(1), 73-94.

Flatten, T., Brettel, M., Engelen, A., & Greve, G. (2009). A measure of absorptive capacity development and validation. *Academy of Management Proceedings*, *1*, 1-6.

Foss, N. J., & Eriksen, B. (1995). Competitive advantage and industry capabilities. In C. A. Montgomery (Ed.), *Resource-based and evolutionary theories of the firm: Towards a synthesis* (pp. 43-69). Norwell, MA: Kluwer Academic Publishers.

Frishammar, J., & Åke Hörte, S. (2007). The role of market orientation and entrepreneurial orientation for new product development performance in manufacturing firms. *Technology Analysis and Strategic Management*, *19*(6), 765-788.

Fugate, B. S., Stank, T. P., & Mentzer, J. T. (2009). Linking improved knowledge management to operational and organizational performance. *Journal of Operations Management*, *27*(3), 247-264.

Ge, G. L., & Ding, D. Z. (2005). Market orientation, competitive strategy and firm performance: an empirical study of Chinese firms. *Journal of Global Marketing*, *18*(3-4), 115-142.

Gefen, D., Straub, D. W., & Boudreau, M. C. (2000). Structural equation modeling and regression: Guidelines for research practice. *Communications of the Association for Information Systems*, *4*(7), 1-77.

Genchev, S., & Willis, G. (2014). A note on manufacturing flexibility as a firm-specific dynamic capability. *Manufacturing Letters*, *2*(4), 100-103.

Gerwin, D. (1987). An agenda for research on the flexibility of manufacturing processes. *International Journal of Operations & Production Management*, *7*(1), 38-49.

Gerwin, D. (1993). Manufacturing flexibility: a strategic perspective. *Management Science*, *39*(4), 395-410.

Gibson, C., & Birkinshaw, J. (2004). The antecedents, consequences, and mediating role of organizational ambidexterity. *Academy of Management Journal*, *47*(2), 209-226.

Grant, R. M. (1996a). Prospering in a dynamically-competitive environments: organizational capability as knowledge integration. *Organization Science*, *7*(4), 375-387.

Grant, R. M. (1996b). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, *17*(S2), 109-122.

Greve, H. R. (2007). Exploration and exploitation in product innovation. *Industrial and Corporate Change*, *16*(5), 945-975.

Grewal, R., & Tansuhaj, P. (2001). Building organizational capabilities for managing economic crisis: The role of market orientation and strategic flexibility. *Journal of Marketing*, *65*(2), 67-80.

Gupta, A. K., & Govindarajan, V. (2000). Knowledge flows within multinational corporations. *Strategic Management Journal*, *21*(4), 473-496.

Gupta, A. K., Smith, K. G., & Shalley, C. E. (2006). The interplay between exploration and exploitation. *Academy of Management Journal*, *49*(4), 693-706.

Gurd, B., & Thomas, J. (2012). Familly business management: Contribution of the CFO. *International Journal of Entrepreneurial Behavior & Research*, *18*(3), 286-304.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2010). *Multivariate Data Analysis* (7th Ed.). New York, NY: Pearson.

Han, J. K., Kim, N., & Srivastava, R. K. (1998). Market orientation and organizational performance: is innovation a missing link? *The Journal of Marketing*, *62*(4), 30-45.

Harman, D. (1967). A single factor test of common method variance. *Journal of Psychology*, *35*, 359-378.

Hatch, M. J., & Erhlich, S. B. (1993). Spontaneous humour as an indicator of paradox and ambiguity in organizations. *Organization Studies*, *14*(4), 505-526.

Hatch, N. W., & Dyer, J. H. (2004). Human capital and learning as a source of sustainable competitive advantage. *Strategic Management Journal*, *25*(12), 1155-1178.

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guilford Press.

He, X., & Wei, Y. (2011). Linking market orientation to international market selection and international performance. *International Business Review*, *20*(5), 535-546.

He, Z., & Wong, P. (2004). Exploration vs. exploitation: an empirical test of the ambidexterity hypothesis. *Organization Science*, *15*(4), 481-494.

Helfat, C. E. (1997). Know-how and asset complementarity and dynamic capability accumulation: The case of R&D. *Strategic Management Journal*, *18*(5), 339-360.

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M. A., Singh, H., Teece, D. J., & Winter, S. G. (2007). *Dynamic Capabilities: Understanding Strategic Change in Organizations*. Malden, MA: Blackwell Publishing.

Henderson, R., & Clark, K. (1990). Architectural innovation: the reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly*, *35*(1), 9–30.

Henderson, R., & Cockburn, I. (1994). Measuring competence? Exploring firm effects in pharmaceutical research. *Strategic Management Journal*, 15(Winter Special Issue), 63-84.

Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural Equation Modelling: Guidelines for Determining Model Fit. *Electronic Journal of Business Research Methods*, *6*(1), 53-60.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: a multidisciplinary journal*, *6*(1), 1-55.

Huang, K. F., Lin, K. H., Wu, L. Y., & Yu, P. H. (2015). Absorptive capacity and autonomous R&D climate roles in firm innovation. *Journal of Business Research*, *68*(1), 87-94.

Hunt, S. D., & Morgan, R. M. (1996). The resource-advantage theory of competition: dynamics, path dependencies, and evolutionary dimensions. *The Journal of Marketing*, *60*(4), 107-114.

Hurley, R. F., & Hult, G. T. M. (1998). Innovation, market orientation, and organizational learning: an integration and empirical examination. *The Journal of Marketing*, 62(3), 42-54.

Iacobucci, D. (2010). Structural equations modeling: Fit Indices, sample size, and advanced topics. *Journal of Consumer Psychology*, *20*, 90-98.

Im, S., Hussain, M., & Sengupta, S. (2008). Testing interaction effects of the dimensions of market orientation on marketing program creativity. *Journal of Business Research*, *61*(8), 859-867.

Jain, A., Jain, P. K., Chan, F. T., & Singh, S. (2013). A review on manufacturing flexibility. *International Journal of Production Research*, *51*(19), 5946-5970.

Jansen, J. J., Van den Bosch, F. A., & Volberda, H. W. (2005). Managing potential and realized absorptive capacity: how do organizational antecedents matter? *Academy of Management Journal*, *48*(6), 999-1015.

Jansen, J. J., Van den Bosch, F. A., & Volberda, H. W. (2006). Exploratory innovation, exploitative innovation, and performance: Effects of organizational antecedents and environmental moderators. *Management Science*, *52*(11), 1661-1674.

Jaworski, B. J., & Kohli, A. K. (1993). Market orientation: antecedents and consequences. *The Journal of Marketing*, *57*(3), 53-70.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, *47*(2), 263-291.

Kara, S., & Kayis, B. (2004). Manufacturing flexibility and variability: an overview. *Journal of Manufacturing Technology Management*, *15*(6), 466-478.

Kauppila, O. (2007). *Towards a Network Model of Ambidexterity* (Report No. W-429). Helsinki School of Economics, Working Papers.

Kessler, E., & Chakrabarti, A. (1996). Innovation speed: A conceptual model of context, antecedents, and outcomes. *Academy of Management Review*, *21*(4), 1143-1191.

Ketchen, D. J., & Giunipero, L. C. (2004). The intersection of strategic management and supply chain management. *Industrial Marketing Management*, *33*(1), 51-56.

Kirca, A. H., Jayachandran, S., & Bearden, W. O. (2005). Market orientation: A meta-analytic review and assessment of its antecedents and impact on performance. *Journal of Marketing*, *69*(2), 24-41.

Kline, R. B. (2015). *Principles and practice of structural equation modeling*. New York, NY: The Guilford Press.

Kline, S. J., & Rosenberg, N. (1986): An overview of innovation. In: R. Landau & N. Rosenberg (Eds.): *The Positive Sum Strategy: Harnessing Technology for Economic growth* (pp. 275-306). Washington (D.C.): National Academy Press.

Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. O*rganization Science*, *3*(3), 383–397.

Koh, S., & Gunasekaran, A. (2006). A knowledge management approach for managing uncertainty in manufacturing. *Industrial Management & Data Systems*, *106*(4), 439-459.

Kohli, A. K., & Jaworski, B. J. (1990). Market orientation: the construct, research propositions, and managerial implications. *The Journal of Marketing*, 5*4*(2), 1-18.

Kompass Diretório de Empresas para profissionais e solução de dados empresariais - Portugal. (2015). Pt.kompass.com. Retrieved January, 1 2015, from https://pt.kompass.com/

Korsgaard, M. A., & Roberson, L. (1995). Procedural justice in performance evaluation: The role of instrumental and non-instrumental voice in performance appraisal discussions. *Journal of Management*, *21*(4), 657-669.

Kotabe, M., Jiang, C. X., & Murray, J. Y. (2017). Examining the complementary effect of political networking capability with absorptive capacity on the innovative performance of emerging-market firms. *Journal of Management*, *43*(4), 1131-1156.

Laforet, S. (2008). Size, strategic, and market orientation effects on innovation. *Journal of Business Research*, *61*(7), 753-764.

Lamore, P. R., Berkowitz, D., & Farrington, P. A. (2013). Proactive/responsive market orientation and marketing-research and development integration. *Journal of Product Innovation Management*, *30*(4), 695-711.

Lane, P. J., Koka, B. R., & Pathak, S. (2006). The reification of ACAP: A critical review and rejuvenation of the construct. *Academy of Management Review, 31*(4), 833-863.

Langerak, F., Hultink, E. J., & Robben, H. S. (2007). The mediating role of new product development in the link between market orientation and organizational performance. *Journal of Strategic Marketing*, *15*(4), 281-305.

Laperche, B., Lefebvre, G., & Langlet, D. (2011). Innovation strategies of industrial groups in the global crisis: Rationalization and new paths. *Technological Forecasting and Social Change*, *78*(8), 1319-1331.

Laursen, K., & Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal*, *27*(2), 131-150.

Lavie, D. (2006). Capability reconfiguration: An analysis of incumbent responses to technological change. *Academy of Management Review*, *31*(1), 153-174.

Lavie, D., & Rosenkopf, L. (2006). Balancing exploration and exploitation in alliance formation. *Academy of Management Journal*, *49*(4), 797-818.

Lawrence, P., & Lorsch, J. (1967). *Organizations and environment: Managing differentiation and integration.* Cambridge, MA: Harvard University Press.

Leonard-Barton, D. (1992). Core capabilities and core rigidities: a paradox in managing new product development. *Strategic Management Journal*, 13(Summer Special Issue), 111-125.

Levinthal, D. A., & March, J. G. (1993). The myopia of learning. *Strategic Management Journal*, *14*(S2), 95-112.

Lewis, M. W. (2000). Exploring paradox: Toward a more comprehensive guide. *Academy of Management Review*, *25*(4), 760-776.

Li, C. R., Lin, C. J., & Chu, C. P. (2008). The nature of market orientation and the ambidexterity of innovations. *Management Decision*, *46*(7), 1002-1026.

Lin, H. E., & McDonough, E. F. (2014). Cognitive frames, learning mechanisms, and innovation ambidexterity. *Journal of Product Innovation Management*, *31*(S1), 170-188.

Lin, H., McDonough, E., Lin, S., & Lin, C. (2013). Managing the exploitation/exploration paradox: the role of a learning capability and innovation ambidexterity. *Journal of Product Innovation Management*, *30*(2), 262-278.

Little, T. D., Card, N. A., Bovaird, J. A., Preacher, K. J., & Crandall, C. S. (2007). Structural equation modeling of mediation and moderation with contextual factors. In T. D., Little, J. A., Bovaird, & N. A., Card (Eds.), *Modeling Contextual Effects in Longitudinal Studies* (pp. 207-230). New York: Routledge.

Lloréns, F., Molina, L., & Verdú, A. (2005). Flexibility of manufacturing systems, strategic change and performance. *International Journal of Production Economics*, *98*(3), 273-289.

Lubatkin, M. H., Simsek, Z., Ling, Y., & Veiga, J. F. (2006). Ambidexterity and performance in small-to medium-sized firms: The pivotal role of top management team behavioral integration. *Journal of Management*, *32*(5), 646-672.

Ludwig, G., & Pemberton, J. (2011). A managerial perspective of dynamic capabilities in emerging markets: The case of the Russian steel industry. *Journal for East European Management Studies*, *16*(3), 215-236.

MacInerney-May, K. (2012). *The Value of Dynamic Capabilities for Strategic Management* (PhD thesis, Universität zu Köln). Retrieved from, Kölner UniversitätsPublikationsServer http://kups.ub.uni-koeln.de/4526/.

MacKinnon, D. P., & Dwyer, J. H. (1993). Estimating mediated effects in prevention studies. *Evaluation Review, 17*(2), 144-158.

Mahoney, J. T., & Pandian, J. R. (1992). The resource-based view within the conversation of strategic management. *Strategic Management Journal*, *13*(5), 363-380.

Malhotra N. K., & Dash S. (2011). *Marketing Research an Applied Orientation.* London: Pearson Publishing.

Malhotra, M. K., Singhal, C., Shang, G., & Ployhart, R. E. (2014). A critical evaluation of alternative methods and paradigms for conducting mediation analysis in operations management research. *Journal of Operations Management*, *32*(4), 127-137.

Malik, O. R., & Kotabe, M. (2009). Dynamic capabilities, government policies, and performance in firms from emerging economies: Evidence from India and Pakistan. *Journal of Management Studies*, *46*(3), 421-450.

Mansfield, E. (1986). Patents and innovation: an empirical study. *Management Science*, *32*(2), 173-181.

March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, *2*(1), 71-87.

March, J. G. (1996). Continuity and change in theories of organizational action. *Administrative Science Quarterly*, *41*(2), 278-287.

Marconi, M., & Lakatos, E. M. (2007). *Técnicas de Pesquisa.* São Paulo: Editoras Atlas SA.

Martín-de Castro, G. (2015). Knowledge management and innovation in knowledge-based and high-tech industrial markets: The role of openness and absorptive capacity. *Industrial Marketing Management*, *47*, 143-146.

Mendes, L., & Machado, J. (2015). Employees' skills, manufacturing flexibility and performance: a structural equation modelling applied to the automotive industry. *International Journal of Production Research*, *53*(13), 4087-4101.

Milgrom, P., & Roberts, J. (1995). Complementarities and fit strategy, structure, and organizational change in manufacturing. *Journal of Accounting and Economics*, *19*(2), 179-208.

Miller, C. C., & Cardinal, L. B. (1994). Strategic planning and firm performance: A synthesis of more than two decades of research. *Academy of Management Journal*, *37*(6), 1649-1665.

Miller, K. D., Zhao, M., & Calantone, R. J. (2006). Adding interpersonal learning and tacit knowledge to March's exploration-exploitation model. *Academy of Management Journal*, *49*(4), 709-722.

Mishra, R., Pundir, A. K., & Ganapathy, L. (2014). Manufacturing flexibility research: A review of literature and agenda for future research. *Global Journal of Flexible Systems Management*, *15*(2), 101-112.

Mom, T. J., Van den Bosch, F. A., & Volberda, H. W. (2007). Investigating managers' exploration and exploitation activities: The influence of top-down, bottom-up, and horizontal knowledge inflows. *Journal of Management Studies*, *44*(6), 910-931.

Morgan, R. E., & Berthon, P. (2008). Market orientation, generative learning, innovation strategy and business performance inter-relationships in bioscience firms. *Journal of Management Studies*, *45*(8), 1329-1353.

Mossholder, K. W., Bennett, N., Kemery, E. R., & Wesolowski, M. A. (1998). Relationships between bases of power and work reactions: The mediational role of procedural justice. *Journal of Management*, *24*(4), 533-552.

Narasimhan, O., Rajiv, S., & Dutta, S. (2006). Absorptive capacity in high-technology markets: The competitive advantage of the haves. *Marketing Science*, *25*(5), 510-524.

Narasimhan, R., & Das, A. (1999). An empirical investigation of the contribution of strategic sourcing to manufacturing flexibilities and performance. *Decision Sciences, 30*(3), 683-718.

Narver, J. C., & Slater, S. F. (1990). The effect of a market orientation on business profitability. *The Journal of Marketing*, *54*(4), 20-35.

Narver, J. C., Slater, S. F., & MacLachlan, D. L. (2004). Responsive and Proactive Market Orientation and New-Product Success. *Journal of Product Innovation Management*, *21*(5), 334-347.

Nelson, R. R., & Winter, S. G. (1982). *An Evolutionary Theory of Economic Change*. Cambridge, MA: Harvard University Press.

Newbert, S. L. (2007). Empirical research on the resource-based view of the firm: an assessment and suggestions for future research. *Strategic Management Journal*, *28*(2), 121-146.

Nicholson, N., & Cannon, D. (2000). Two views from the bridge: how CFOs and SME leaders perceive top team dynamics. *European Management Journal*, *18*(4), 367-376.

Noble, C. H., Sinha, R. K., & Kumar, A. (2002). Market orientation and alternative strategic orientations: a longitudinal assessment of performance implications. *Journal of Marketing*, *66*(4), 25-39.

Nonaka, I. (1990). *Management of Knowledge Creation: A Theory of Organizational Knowledge Creation*. New York, NY: Oxford University Press.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science, 5*(1), 14-37.

Nonaka, I., & Konno, N. (1998). The concept of "ba": Building a foundation for knowledge creation. *California Management Review*, *40*(3), 40-54.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. New York, NY: Oxford University Press.

Nonaka, I., Toyama, R., & Konno, N. (2000). SECI, Ba and leadership: a unified model of dynamic knowledge creation. *Long Range Planning*, *33*(1), 5-34.

Nunally, J., & Bernstein, I. (1978). *Psychometric Theory*. New York, NY: McGraw-Hill.

O'Reilly, C. A., & Tushman, M. L. (2008). Ambidexterity as a dynamic capability: resolving the innovator's dilemma. *Research in Organizational Behavior*, *28*, 185-206.

Ojha, D., White, R. E., & Rogers, P. P. (2013). Managing demand variability using requisite variety for improved workflow and operational performance: the role of manufacturing flexibility. *International Journal of Production*, *51*(10), 2915-1934.

Ojha, D., White, R. E., Rogers, P. P., & Kuo, C. C. (2015). Information processing-related infrastructural antecedents of manufacturing flexibility–a real options perspective. *International Journal of Production Research*, *53*(17), 5174-5192.

Oke, A. (2005). A framework for analyzing manufacturing flexibility. *International Journal of Operations & Production Management*, *25*(10), 973-996.

Olavarrieta, S., & Friedmann, R. (2008). Market orientation, knowledge-related resources and firm performance. *Journal of Business Research*, *61*(6), 623-630.

Pagell, M., & Krause, D. R. (1999). A multiple-method study of environmental uncertainty and manufacturing flexibility. *Journal of Operations Management*, *17*(3), 307-325.

Pagell, M., & Krause, D. R. (2004). Re-exploring the relationship between flexibility and the external environment. *Journal of Operations Management*, *21*(6), 629-649.

Patel, P. C., Messersmith, J. G., & Lepak, D. P. (2013). Walking the tightrope: An assessment of the relationship between high-performance work systems and organizational ambidexterity. *Academy of Management Journal*, *56*(5), 1420-1442.

Patel, P. C., Terjesen, S., & Li, D. (2012). Enhancing effects of manufacturing flexibility through operational absorptive capacity and operational ambidexterity. *Journal of Operations Management*, *30*(3), 201-220.

Pavlou, P. A., & El Sawy, O. A. (2006). From IT leveraging competence to competitive advantage in turbulent environments: The case of new product development. *Information Systems Research*, *17*(3), 198-227.

Pavlou, P. A., & El Sawy, O. A. (2011). Understanding the elusive black box of dynamic capabilities. *Decision Sciences*, *42*(1), 239-273.

Pelham, A. M. (2000). Market orientation and other potential influences on performance in small and medium-sized manufacturing firms. *Journal of Small Business Management*, *38*(1), 48-67.

Penrose, E. T. (1959). *The theory of the growth of the firm.* New York, NY: Sharpe.

Pérez Pérez, M., Serrano Bedia, A. M., & López Fernández, M. C. (2016). A review of manufacturing flexibility: systematizing the concept. *International Journal of Production Research*, *54*(10), 3133-3148.

Peteraf, M. A., & Barney, J. B. (2003). Unraveling the resource-based tangle. *Managerial and Decision Economics*, *24*(4), 309-323.

Piening, E. P., & Salge, T. O. (2015). Understanding the antecedents, contingencies, and performance implications of process innovation: A dynamic capabilities perspective. *Journal of Product Innovation Management*, *32*(1), 80-97.

Pisano, G. P. (2015). *A Normative Theory of Dynamic Capabilities: Connecting Strategy, Know-How, and Competition.* (No. W-16-036). Harvard Business School Technology and Operations Management Unit.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88*(5), 879-903.

Porter, M. E. (1979). How Competitive Forces Shape Strategy. *Harvard Business Review* *57*(2), 137-145.

Porter, M. E. (1980). *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York, NY: The Free Press.

Porter, M. E. (1985). *Competitive Advantage*. New York, NY: The Free Press.

Prahalad, C. K., & Hamel, G. (1990). The core competencies of the corporation. *The Harvard Business Review*, *68*(3), 79-91.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*(3), 879-891.

Priem, R. L., & Butler, J. E. (2001). Is the resource-based “view” a useful perspective for strategic management research? *Academy of Management Review*, *26*(1), 22-40.

Prieto, I. M., Revilla, E., & Rodríguez-Prado, B. (2009). Building dynamic capabilities in product development: how do contextual antecedents matter? *Scandinavian Journal of Management*, *25*(3), 313-326.

Proença, P., Laureano, R. M., & Laureano, L. M. (2014). Determinants of capital structure and the 2008 financial crisis: Evidence from Portuguese SMEs. *Procedia - Social and Behavioral Sciences*, *150*, 182-191.

Raisch, S., & Birkinshaw, J. (2008). Organizational ambidexterity: Antecedents, outcomes, and moderators. *Journal of Management*, *34*(3), 375-409.

Raisch, S., Birkinshaw, J., Probst, G., & Tushman, M. L. (2009). Organizational ambidexterity: Balancing exploitation and exploration for sustained performance. *Organization Science*, *20*(4), 685-695.

Rakthin, S., Calantone, R. J., & Wang, J. F. (2016). Managing market intelligence: The comparative role of absorptive capacity and market orientation. *Journal of Business Research*, *69*(12), 5569-5577.

Rao, H., & Drazin, R. (2002). Overcoming resource constraints on product innovation by recruiting talent from rivals: A study of the mutual fund industry, 1986–1994. *Academy of Management Journal, 45*(3), 491-507.

Raymond, L. & St-Pierre, J. (2005). Antecedents and performance outcomes of advanced manufacturing systems sophistication in SMEs. *International Journal of Operations & Production Management*, *25*(6), 514-533.

Reis, R. (2013). *The Portuguese slump and crash and the euro crisis.* (No. W-19288). National Bureau of Economic Research.

Rindova, V. P., & Kotha, S. (2001).Continuous 'morphing': competing through dynamic capabilities, form, and function. *Academy of Management, 44*(6), 1263-1280.

Ritala, P., Olander, H., Michailova, S., & Husted, K. (2015). Knowledge sharing, knowledge leaking and relative innovation performance: An empirical study. *Technovation*, *35*, 22-31.

Roberts, P. W., & Amit, R. (2003). The dynamics of innovative activity and competitive advantage: The case of Australian retail banking, 1981 to 1995. *Organization Science*, *14*(2), 107-122.

Rogers, P. P., Ojha, D., & White, R. E. (2011). Conceptualizing complementarities in manufacturing flexibility: a comprehensive view. *International Journal of Production Research*, *49*(12), 3767-3793.

Rosenbloom, R. S., & Christensen, C. M. (1994). Technological discontinuities, organizational capabilities, and strategic commitments. *Industrial and Corporate Change*, *3*(3), 655-685.

Rosenkopf, L., & Nerkar, A. (2001). Beyond local search: boundary-spanning, exploration, and impact in the optical disk industry. *Strategic Management Journal*, *22*(4), 287-306.

Rubin, P. H. (1973). The expansion of firms. *Journal of Political Economy*, *81*(4), 936-949.

Rumelt, R. (1984). Towards a strategic theory of the firm. In R. Lamb (Ed.), *Competitive Strategic Management* (pp. 556-570). Englewood Cliffs, NJ: Prentice-Hall.

Salter, A., Wal, A. L., Criscuolo, P., & Alexy, O. (2015). Open for Ideation: Individual-Level Openness and Idea Generation in R&D. *Journal of Product Innovation Management*, *32*(4), 488-504.

Schmitt, N., & Kuljanin, G. (2008). Measurement invariance: Review of practice and implications. *Human Resource Management Review*, *18*(4), 210-222.

Schneider, K. (1990). *The Paradoxical Self: Toward an Understanding of Our Contradictory Nature*. New York: InSight Books.

Schulze, P., Heinemann, F., & Abedin, A. (2008). Balancing Exploitation and Exploration. In *Academy of Management Proceedings*, 1-6. Anaheim, CA.

Selznick, P. (1957). *Leadership in Administration: A Sociological Interpretation.* New Orleans, LO: Quid Pro Books.

Seo, Y. W., Chae, S. W., & Lee, K. C. (2015). The impact of absorptive capacity, exploration, and exploitation on individual creativity: Moderating effect of subjective well-being. *Computers in Human Behavior*, *42*, 68-82.

Sethi, A. K., & Sethi, S. P. (1990). Flexibility in manufacturing: a survey. *International Journal of Flexible Manufacturing Systems*, *2*(4), 289-328.

Shaffer, J. A., DeGeest, D., & Li, A. (2016). Tackling the problem of construct proliferation: A guide to assessing the discriminant validity of conceptually related constructs. *Organizational Research Methods*, *19*(1), 80-110.

Sharifi, H., & Zhang, Z. (1999). A methodology for achieving agility in manufacturing organizations: An introduction. *International Journal of Production Economics*, *62*(1), 7-22.

Sharkie, R. (2003). Knowledge creation and its place in the development of sustainable competitive advantage. *Journal of Knowledge Management*, *7*(1), 20-31.

Simsek, Z. (2009). Organizational ambidexterity: Towards a multilevel understanding. *Journal of Management Studies*, *46*(4), 597-624.

Singh, C. D., & Khamba, J. S. (2014). Evaluation of manufacturing competency factors on performance of an automobile manufacturing unit. *International Journal for Multi-Disciplinary Engineering and Business Management*, *2*(2), 4-16.

Slack, N. (1983). Flexibility as a manufacturing objective. *International Journal of Operations & Production Management*, *3*(3), 4-13.

Slater, S. F., & Narver, J. C. (1994). Market orientation, customer value, and superior performance. *Business Horizons*, *37*(2), 22-28.

Slater, S. F., & Narver, J. C. (1999). Research notes and communications: Market-oriented is more than being customer-led. *Strategic Management Journal*, *20*(12), 1165-1168.

Slater, S. F., & Narver, J. C. (2000). The positive effect of a market orientation on business profitability: a balanced replication. *Journal of Business Research*, *48*(1), 69-73.

Smith, K. K., & Berg, D. N. (1987). *Paradoxes of group life: Understanding conflict, paralysis, and movement in group dynamics.* San Francisco, CA: Jossey-Bass.

Smith, W. K., & Lewis, M. W. (2011). Toward a theory of paradox: A dynamic equilibrium model of organizing. *Academy of Management Review*, *36*(2), 381-403.

Smith, W. K., Binns, A., & Tushman, M. L. (2010). Complex business models: Managing strategic paradoxes simultaneously. *Long Range Planning*, *43*(2), 448-461.

Sobel, M. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. *Sociological Methodology*, *13*, 290-312.

Soper, D. S. (2017). *A-priori Sample Size Calculator for Structural Equation Models - Free Statistics Calculators [Software]*. Retrieved November 4, 2017, from https://www.danielsoper.com/statcalc/calculator.aspx?id=89.

Spanos, Y., & Voudouris, I. (2009). Antecedents and trajectories of AMT adoption: the case of Greek manufacturing SMEs. *Research Policy*, *38*(1), 144-155.

Spender, J. C. (1996). Making knowledge the basis of a dynamic theory of the firm. *Strategic Management Journal*, *17*(S2), 45-62.

Sposito, V. A., Hand, M. L., & Skarpness, B. (1983). On the efficiency of using the sample kurtosis in selecting optimal lp-estimators. *Communications in Statistics-simulation and Computation*, *12*(3), 265-272.

Staber, U., & Sydow, J. (2002). Organizational adaptive capacity: a structuration perspective. *Journal of Management Inquiry*, *11*(4), 408–424.

Sun, P. Y., & Anderson, M. H. (2010). An examination of the relationship between ACAP and organizational learning, and a proposed integration. *International Journal of Management Reviews*, *12*(2), 130-150.

Sveiby, K. E. (2001). A knowledge-based theory of the firm to guide in strategy formulation. *Journal of Intellectual Capital*, *2*(4), 344-358.

Swafford, P., Ghosh, S., & Murthy, N. (2008). Achieving supply chain agility through IT integration and flexibility. *International Journal of Production Economics*, *116*(2), 288-297.

Swamidass, P., & Newell, W. (1987). Manufacturing strategy, environmental uncertainty and performance: a path analytic model. *Management Science*, *33*(4), 509-524.

Tamayo-Torres, J., Gutierrez-Gutierrez, L., & Ruiz-Moreno, A. (2014). The relationship between exploration and exploitation strategies, manufacturing flexibility and organizational learning: An empirical comparison between Non-ISO and ISO certified firms. *European Journal of Operational Research*, *232*(1), 72-86.

Tamayo-Torres, J., Roehrich, J. K., & Lewis, M. A. (2017). Organizational ambidexterity, manufacturing performance and environmental dynamism. *International Journal of Operations & Production Management*, *37*(3), 282-299.

Tamayo-Torres, J., Ruiz-Moreno, A., & Lloréns-Montes, F. J. (2011). The influence of manufacturing flexibility on the interplay between exploration and exploitation: the effects of organizational learning and the environment. *International Journal of Production Research*, *49*(20), 6175-6198.

Tan, M., & Liu, Z. (2014). Paths to success: an ambidexterity perspective on how responsive and proactive market orientations affect SMEs' business performance. *Journal of Strategic Marketing*, *22*(5), 420-441.

Teece, D. J. (2000). Strategies for managing knowledge assets: the role of firm structure and industrial context. *Long Range Planning*, *33*(1), 35-54.

Teece, D. J. (2007). Explicating dynamic capabilities: the nature and micro foundations of (sustainable) enterprise performance. *Strategic Management Journal*, *28*(13), 1319-1350.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509-533.

Teng, B.-S., & Cummings, J. L. (2002). Trade-offs in managing resources and capabilities. *Academy of Management Executive*, *16*(2), 81–91.

Terkaj, W., Tolio, T., & Valente, A. (2009). A review on manufacturing flexibility. In T. Tolio (Ed.) *Design of flexible production systems* (pp. 41-61). Berlin Heidelberg: Springer.

Thomas, H., & Pollock, T. (1999). From I-O economics' S-C-P paradigm through strategic groups to competence-based competition: reflections on the puzzle of competitive strategy. *British Journal of Management*, *10*(2), 127-140.

Tippins, M. J., & Sohi, R. S. (2003). IT competency and firm performance: is organizational learning a missing link? *Strategic Management Journal*, *24*(8), 745-761.

Todorova, G., & Durisin, B. (2007). Absorptive capacity: Valuing a reconceptualization. *Academy of Management Review*, *32*(3), 774-786.

Tortoriello, M. (2015). The social underpinnings of absorptive capacity: The moderating effects of structural holes on innovation generation based on external knowledge. *Strategic Management Journal*, *36*(4), 586-597.

Tsai, K. H., Chou, C., & Kuo, J. H. (2008). The curvilinear relationships between responsive and proactive market orientations and new product performance: A contingent link. *Industrial Marketing Management*, *37*(8), 884-894.

Tsai, W. (2001). Knowledge transfer in inter-organizational networks: effects of network position and ACAP on business unit innovation and performance. *Academy of Management Journal*, *44*(5), 996-1004.

Tsai, W. (2002). Social structure of "coopetition" within a multiunit organization: Coordination, competition, and intra-organizational knowledge sharing. *Organization science*, *13*(2), 179-190.

Tu, Q., Vonderembse, M. A., Ragu-Nathan, T. S., & Sharkey, T. W. (2006). Absorptive capacity: Enhancing the assimilation of time-based manufacturing practices. *Journal of Operations Management*, *24*(5), 692-710.

Tushman, M. L., & Anderson, P. (1986). Technological discontinuities and organizational environments. *Administrative Science Quarterly*, *31*(3), 439-465.

Tushman, M. L., & O'Reilly, C. A. (1996). The ambidextrous organizations: managing evolutionary and revolutionary change. *California Management Review*, *38*(4), 8-30.

Tushman, M. L., & Romanelli, E. (1985). Organizational Evolution: A Metamorphosis Model of Convergence and Reorientation. In L. L. Cummings & B. Staw (Eds.), *Research in Organizational Behavior* (Vol. 7, pp. 171-222). Greenwich, CT: JAI Press.

Tversky, A., & Kahneman, D. (1992). Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and Uncertainty*, *5*(4), 297-323.

Tzokas, N., Kim, Y. A., Akbar, H., & Al-Dajani, H. (2015). Absorptive capacity and performance: The role of customer relationship and technological capabilities in high-tech SMEs. *Industrial Marketing Management*, *47*, 134-142.

Upton, D. M. (1994). The management of manufacturing flexibility. *California Management Review*, *36*(2), 72-89.

Upton, D. M. (1995a). Flexibility as process mobility: the management of plant capabilities for quick response manufacturing. *Journal of Operations Management*, *12*(3), 205-224.

Upton, D. M. (1995b). What really makes factories flexible? *Harvard Business Review*, *73*(4), 74-84.

Urtasun-Alonso, A., Larraza-Kintana, M., García-Olaverri, C., & Huerta-Arribas, E. (2014). Manufacturing flexibility and advanced human resource management practices. *Production Planning & Control*, *25*(4), 303-317.

Van den Bosch, F. A., Volberda, H. W., & De Boer, M. (1999). Coevolution of firm ACAP and knowledge environment: Organizational forms and combinative capabilities. *Organization Science*, *10*(5), 551-568.

Vince, R., & Broussine, M. (1996). Paradox, defense and attachment: Accessing and working with emotions and relations underlying organizational change. *Organization Studies*, *17*(1), 1-21.

Volberda, H. (1996). Toward the flexible form: how to remain vital in hypercompetitive environments. *Organization Science*, *7*(4), 359-374.

Wang, C. L., & Ahmed, P. K. (2004). The development and validation of the organizational innovativeness construct using confirmatory factor analysis. *European Journal of Innovation Management*, *7*(4), 303–313.

Wang, C. L., & Ahmed, P. K. (2007). Dynamic capabilities: A review and research agenda. *International Journal of Management Reviews*, *9*(1), 31-51.

Wang, C. L., & Rafiq, M. (2014). Ambidextrous Organizational Culture, Contextual Ambidexterity and New Product Innovation: A Comparative Study of UK and Chinese High-tech Firms. *British Journal of Management*, *25*(1), 58-76.

Wang, C. L., Senaratne, C., & Rafiq, M. (2015). Success traps, dynamic capabilities and firm performance. *British Journal of Management*, *26*(1), 26-44.

Wei, Y. S., O'Neill, H., Lee, R. P., & Zhou, N. (2013). The impact of innovative culture on individual employees: The moderating role of market information sharing. *Journal of Product Innovation Management, 30*(5), 1027-1041.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*(2), 171-180.

Wiggins, R. T., & Ruefli, T.W. (2005). Schumpeter’s ghost: Is hyper competition making the best of times shorter? *Strategic Management Journal*, *26*(10), 887-911.

Winkelbach, A., & Walter, A. (2015). Complex technological knowledge and value creation in science-to-industry technology transfer projects: The moderating effect of absorptive capacity. *Industrial Marketing Management*, *47*, 98-108.

Winter, S. G. (2003). Understanding dynamic capabilities. *Strategic Management Journal*, *24*(10), 991-995.

Wu, A., & Voss, H. (2015). When does absorptive capacity matter for international performance of firms? Evidence from China. *International Business Review*, *24*(2), 344-351.

Wu, L.-Y. (2006). Resources, dynamic capabilities and performance in a dynamic environment: perceptions in Taiwanese IT enterprises. *Information & Management*, *43*(4), 447-454.

Yaniv, E. (2011). Construct clarity in theories of management and organization. *Academy of Management Review*, *36*(3), 590-592.

Yannopoulos, P., Auh, S., & Menguc, B. (2012). Achieving fit between learning and market orientation: Implications for new product performance. *Journal of Product Innovation Management*, *29*(4), 531-545.

Youndt, M. A., Snell, S. A., Dean, J. W., & Lepak, D. P. (1996). Human resource management, manufacturing strategy, and firm performance. *Academy of Management Journal*, *39*(4), 836-866.

Zacharia, Z. G., Nix, N. W., & Lusch, R. F. (2011). Capabilities that enhance outcomes of an episodic supply chain collaboration. *Journal of Operations Management*, *29*(6), 591-603.

Zahra, S. A. (2008). Being entrepreneurial and market driven: implications for company performance. *Journal of Strategy and Management*, *1*(2), 125-142.

Zahra, S. A., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review*, *27*(2), 185-203.

Zahra, S. A., Sapienza, H. J., & Davidsson, P. (2006). Entrepreneurship and dynamic capabilities: A review, model and research agenda. *Journal of Management Studies*, *43*(4), 917-955.

Zhang, J., & Duan, Y. (2010). The impact of different types of market orientation on product innovation performance: evidence from Chinese manufacturers. *Management Decision*, *48*(6), 849-867.

Zhang, Q., Vonderembse, M. A., & Lim, J. S. (2003). Manufacturing flexibility: defining and analyzing relationships among competence, capability, and customer satisfaction. *Journal of Operations Management*, *21*(2), 173-191.

Zhao, X., Lynch Jr., J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and Truths about Mediation Analysis. *Journal of Consumer Research*, *37*(4), 197-206.

Zollo, M., & Winter, S. G. (2002). Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, *13*(3), 339-351.

Zott, C. (2003). Dynamic capabilities and the emergence of intra-industry differential firm performance: Insights from a simulation study. S*trategic Management Journal*, *24*(2), 97-125.

Appendix I

A.1. Item Loadings of Measurement Models

Measurement Model 1

Table A.1.1 ***Measurement Model 1***

Items	Std. Loadings	t-value
Knowledge Acquisition		
We frequently acquire knowledge about technologies and market trends from external sources	0.84	1.00
We are able to identify and acquire external knowledge (e.g. market, technology) very quickly	0.83	16.99
Employees of our unit regularly visit other branches to learn about new technologies, trends, or business models	0.63	12.27
Knowledge Sharing		
Existing knowledge (e.g. market or technology) is readily available to each department	0.73	1.00
Our company periodically circulates codified knowledge in the form of documents to update its departments	0.71	12.21
When something important happens (market or technology development), the whole company knows about it in a short period	0.74	12.61
Knowledge Creation		
Our employees have the capabilities to produce many novel and useful ideas	0.78	1.00
Within this company, we have the capabilities to successfully learn new things	0.90	19.02
We have the capabilities to effectively develop new knowledge or insights that have the potential to influence product development	0.87	18.36
When solving problems, we can rely on good cross-departmental support	0.74	14.97
Responsive Market Orientation		
Our business objectives are driven primarily by customer satisfaction	Dropped	-
We constantly monitor our level of commitment and orientation to serving customer needs	0.78	17.37
Our strategy for competitive advantage is based on our understanding of customer's needs	Dropped	-
We measure customer satisfaction systematically and frequently	0.89	20.98
We have routine or regular measures of customer service	0.87	20.26
Proactive Market Orientation		
We help customers to anticipate developments in the markets	0.79	17.11
We incorporate solutions to unarticulated customer needs in our products and services	0.82	17.80
We search for opportunities in areas where customers have difficulty in expressing their needs	0.77	16.50
Innovation Competence Exploitation		

Over the last 5 years, my company...		
…upgraded current knowledge and skills for familiar products and technologies	0.85	19.88
…enhanced skills in exploiting well-established technologies that improve productivity of current innovation operations	Dropped	-
…enhanced competences in searching for solutions to customer problems that are closed to established solutions rather than completely new solutions	0.83	19.17
…upgraded skills in product development processes in which the company already possessed significant experience	0.90	22.16
…strengthened our knowledge and skills for projects that improve efficiency of existing innovation activities	0.89	21.61
Innovation Competence Exploration		
Over the last 5 years, my company...		
…acquired entirely new technologies and skills	0.79	17.55
…learned product development skills and processes entirely new to the industry (e.g. product design, prototyping new products, timing new product introductions, customizing products for local markets, etc.)	0.83	18.75
…acquired entirely new managerial and organizational skills that are important for innovation (e.g. forecasting technological and customer trends, identifying emerging markets and technologies, integrating R&D activities, marketing, manufacturing and other functions, managing the product development process)	0.82	18.46
…learned new skills for the first time (e.g. funding new technology, staffing R&D function, training and development of R&D and engineering personnel)	0.67	13.99
…strengthened innovation skills in areas where it had no prior experience	Dropped	-
Business Performance		
Over the last 5 years, my company...		
…has given me the opportunity and encouragement to do the best work I am capable of	0.90	21.71
…people at all levels have been satisfied with the level of business performance	0.89	21.17
…has come much closer to achieve its full potential	0.82	18.61
…has done a good job in satisfying our customers	Dropped	-

Measurement Model 2

Table A.1.2 ***Measurement Model 2***

Items	Std. Loadings	t-value
Knowledge Creation		
Our employees have the capabilities to produce many novel and useful ideas	0.79	17.9
Within this company, we have the capabilities to successfully learn new things	0.91	22.1
We have the capabilities to effectively develop new knowledge or insights that have the potential to influence product development	0.85	20.1
When solving problems, we can rely on good cross-departmental support	0.74	16.1
Labor Flexibility		
Employees are cross trained to perform a variety of activities	0.90	-
Workers operate various types of machines	0.78	18.9
Workers are cross trained in multiple cells/teams	0.87	22.9
Volume Flexibility		
We quickly change the quantities of our products produced	0.78	-
We vary the total output from one period to the next	0.81	16.6
We easily change the output volume of a manufacturing process	0.92	18.6
Routing Flexibility		
A typical part can be routed to alternate machines	0.81	-
A typical part can use many different routes	0.72	13.4
The system has alternative routes in case machines break down	0.79	14.4
Supply Chain Flexibility		
Suppliers adjust quantities without significantly increasing unit cost	0.83	-
Suppliers adjust quantities without significantly increasing lead time	0.91	19.4
Our suppliers adjust delivery times to changing requirements	0.80	17.3
Product-Mix Flexibility		
We produce different product types without major changeovers	0.75	
We build different products in the same plant at the same time	0.74	13.6
We easily change from one product to another	0.89	15.7
Machines Flexibility		
A typical part can be routed to alternate machines	0.85	12.9
A typical part can use many different routes	Dropped	-
The system has alternative routes in case machines break down	0.75	-
Operations Performance		
Manufacturing cost	0.73	14.4
Manufacturing quality	0.81	16.1
Lead time to market	0.69	13.6
Business Performance		
Over the last 5 years, my company...		
…has given me the opportunity and encouragement to do the best work I am capable of	0.89	21.2
…people at all levels have been satisfied with the level of business performance	0.90	21.6
…has come much closer to achieve its full potential	0.82	18.6
…has done a good job in satisfying our customers	Dropped	-

Items	Std. Loadings	t-value
Technology Turbulence		
Technology in our industry is changing rapidly	0.82	18.6
Technological changes provide big opportunities in our industry	0.88	20.7
A large number of new product ideas have been made possible through technological breakthroughs in our industry	0.86	20.0
In our industry, major technological innovations are developed quite regularly	0.71	15.2

Measurement Model 3

Table A.1.3 ***Measurement Model 3***

Items	Std. Loadings	t-value
Knowledge Acquisition		
We frequently acquire knowledge about technologies and market trends from external sources	0.86	1.00
We are able to identify and acquire external knowledge (e.g. market, technology) very quickly	0.84	19.95
Employees of our unit regularly visit other branches to learn about new technologies, trends, or business models	0.64	13.46
Knowledge Sharing		
Existing knowledge (e.g. market or technology) is readily available to each department	0.74	1.00
Our company periodically circulates codified knowledge in the form of documents to update its departments	0.73	12.71
When something important happens (market or technology development), the whole company knows about it in a short period	0.75	13.09
Knowledge Creation		
Our employees have the capabilities to produce many novel and useful ideas	0.79	1.00
Within this company, we have the capabilities to successfully learn new things	0.90	19.64
We have the capabilities to effectively develop new knowledge or insights that have the potential to influence product development	0.88	18.99
When solving problems, we can rely on good cross-departmental support	0.75	15.54
Labor Flexibility		
Employees are cross trained to perform a variety of activities	0.90	1.00
Workers operate various types of machines	0.75	17.63
Workers are cross trained in multiple cells/teams	0.88	23.09
Volume Flexibility		
We quickly change the quantities of our products produced	0.76	17.67
We vary the total output from one period to the next	0.81	19.57
We easily change the output volume of a manufacturing process	0.93	1.00
Routing Flexibility		
A typical part can be routed to alternate machines	0.80	14.27
A typical part can use many different routes	0.72	13.15
The system has alternative routes in case machines break down	0.79	1.00
Supply Chain Flexibility		
Suppliers adjust quantities without significantly increasing unit cost	0.80	1.00
Suppliers adjust quantities without significantly increasing lead time	0.92	18.10
Our suppliers adjust delivery times to changing requirements	0.80	16.55
Machine Flexibility		
Machines/tooling can be set up quickly	0.86	1.00
A typical part can use many different routes	Dropped	-
Machine set-ups are easy	0.75	12.31
Product Flexibility		
We produce different product types without major changeovers	0.74	15.54
We build different products in the same plant at the same time	0.74	15.63
We easily change from one product to another	0.89	1.00

Responsive Market Orientation		
Our business objectives are driven primarily by customer satisfaction	Dropped	-
We constantly monitor our level of commitment and orientation to serving customer needs	0.79	17.81
Our strategy for competitive advantage is based on our understanding of customer's needs	Dropped	-
We measure customer satisfaction systematically and frequently	0.89	21.59
We have routine or regular measures of customer service	0.87	20.79
Proactive Market Orientation		
We help customers to anticipate developments in the markets	0.80	17.51
We incorporate solutions to unarticulated customer needs in our products and services	0.82	18.32
We search for opportunities in areas where customers have difficulty in expressing their needs	0.78	16.93
Innovation Competence Exploitation		
Over the last 5 years, my company...		
…upgraded current knowledge and skills for familiar products and technologies	0.85	20.70
…enhanced skills in exploiting well-established technologies that improve productivity of current innovation operations	Dropped	-
…enhanced competences in searching for solutions to customer problems that are closed to established solutions rather than completely new solutions	0.84	20.17
…upgraded skills in product development processes in which the company already possessed significant experience	0.91	23.52
…strengthened our knowledge and skills for projects that improve efficiency of existing innovation activities	0.89	22.43
Innovation Competence Exploration		
Over the last 5 years, my company...		
…acquired entirely new technologies and skills	0.80	18.20
…learned product development skills and processes entirely new to the industry (e.g. product design, prototyping new products, timing new product introductions, customizing products for local markets, etc)	0.84	19.47
…acquired entirely new managerial and organizational skills that are important for innovation (e.g. forecasting technological and customer trends, identifying emerging markets and technologies, integrating R&D activities, marketing, manufacturing and other functions, managing the product development process)	0.82	18.79
…learned new skills for the first time (e.g. funding new technology, staffing R&D function, training and development of R&D and engineering personnel)	0.68	14.29
…strengthened innovation skills in areas where it had no prior experience	Dropped	-

A.2. Descriptive Statistics of the Constructs

Table A.2.1 Cronbach Alphas and Eliminated Items

Construct	Cronbach Alpha	Items Removed	Reason for Removal
Knowledge Acquisition	0.79	0	-
Knowledge Sharing	0.77	0	-
Knowledge Creation	0.88	0	-
Innovation Competence Exploitation	0.86	1	Discriminant validity
Innovation Competence Exploration	0.92	1	Discriminant validity
Responsive Market Orientation	0.84	2	Excessive kurtosis
Proactive Market Orientation	0.88	0	-
Business Performance	0.90	1	Excessive kurtosis
Product Flexibility	0.81	0	-
Routing Flexibility	0.81	0	-
Machines Flexibility	0.77	1	Poor loading
Volume Flexibility	0.86	0	-
Labor Flexibility	0.86	0	-
Supply Chain Flexibility	0.88	0	-
Technological Turbulence	0.89	1	Poor loading
Market Turbulence	0.81	1	Poor loading

Technological and Market Turbulence

One item was removed from the technological turbulence scale and one item was removed from the market turbulence scale, leaving each of the measures with four items. Both items were removed for presenting poor standard loadings, below the commonly accepted 0.70 (Hair et al., 2010).

The 4 items used to measure technological turbulence were: 1. Technology in our industry is changing rapidly; 2. Technological changes provide big opportunities in our industry; 3. A large number of new product ideas have been made possible through technological breakthroughs in our industry; 4. Technological developments in our industry are rather minor; 5. In our industry, major technological innovations are developed quite regularly. Item number 4 was removed for poor loading.

The 4 items used to measure market turbulence were: 1. In our kind of business, customers' product preferences change quite a bit overtime; 2. Our customers tend to look for new products all the time; 3. We are witnessing demand for our products and services from customers who never bought them before; 4. New customers tend to have product-related needs that are different from those of our existing customers. 5. We cater to the same customers that we served in the past. Item number 5 was removed for poor loading.

Table A.2.2 ***Descriptive Statistics of the Constructs***

Construct	Mean	SD
Knowledge Acquisition	4.70	1.18
Knowledge Sharing	4.52	1.21
Knowledge Creation	5.18	1.11
Innovation Competence Exploitation	5.29	1.07
Innovation Competence Exploration	5.12	1.29
Responsive Market Orientation	5.54	1.11
Proactive Market Orientation	5.20	1.18
Business Performance	5.12	1.08
Operations Performance	5.17	0.92
Product Flexibility	5.54	1.26
Routing Flexibility	4.82	1.39
Machines Flexibility	5.01	1.19
Volume Flexibility	5.10	1.35
Labor Flexibility	5.13	1.15
Supply Chain Flexibility	4.73	1.29
Technological Turbulence	4.44	1.32
Market Turbulence	4.51	1.25

A.3. Structural Equations Models Assumptions

The concept behind SEM consists of a multivariate extension of the multiple linear regression model, combining factor analysis with multiple regression analysis while allowing for tests such as mediation and moderation analysis, for example. SEM models are not statistically accepted. They can only fail to be statistically rejected (Arbuckle & Wothke, 2012). They are used to evaluate the relations between latent constructs, having as base a measurement model of such latent variables and a set of theoretically established relations among them that form the structural model. SEM tests the hypothesized causal relationships.

SEM assumes data follows a multivariate normal distribution, the relationships between the endogenous and the exogenous variables are linear, data is free of outliers, the observed variance is non-spurious, the models are over or exactly identified, and error terms are uncorrelated with other variable error terms.

The data used in this thesis displays fairly good univariate normality, as can be seen in the next section. The study has not used any case with missing data. No error correlations of same or different construct items were performed. Most of the relations are linear and the residual variance of the constructs is fairly homoscedastic. The next section illustrates these points.

A.3.1. Univariate Data Normality

The figures below show the Q-Q plots for the responses distribution of each construct used throughout chapters 3 to 5. The average of the measurement items was used for every construct. It is notorious that no serious violations to univariate normality are present in most of the constructs. Given the fairly good normality graphically observed for all constructs, it is plausible to assume that multivariate normality should not be a problem.

Figure A.3.1.1 Knowledge Acquisition normal Q-Q Plot

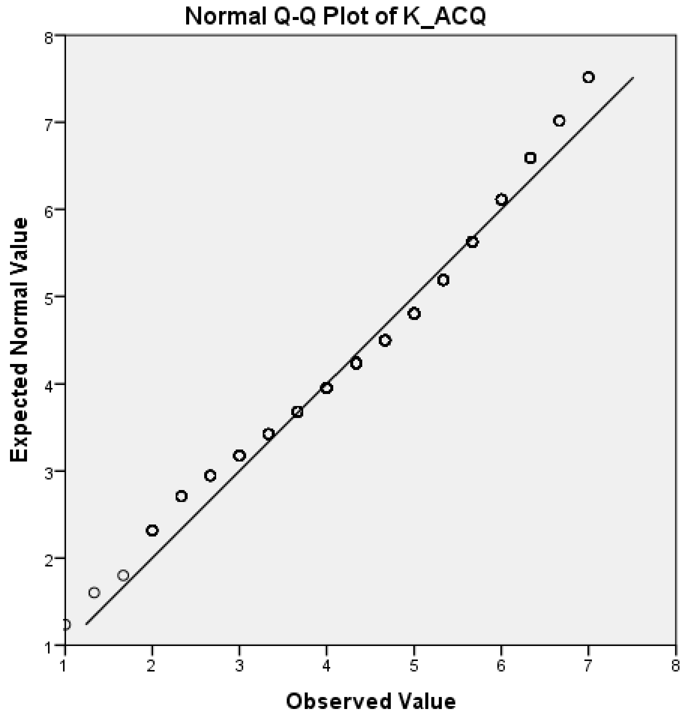


Figure A.3.1.2 Knowledge Sharing normal Q-Q Plot

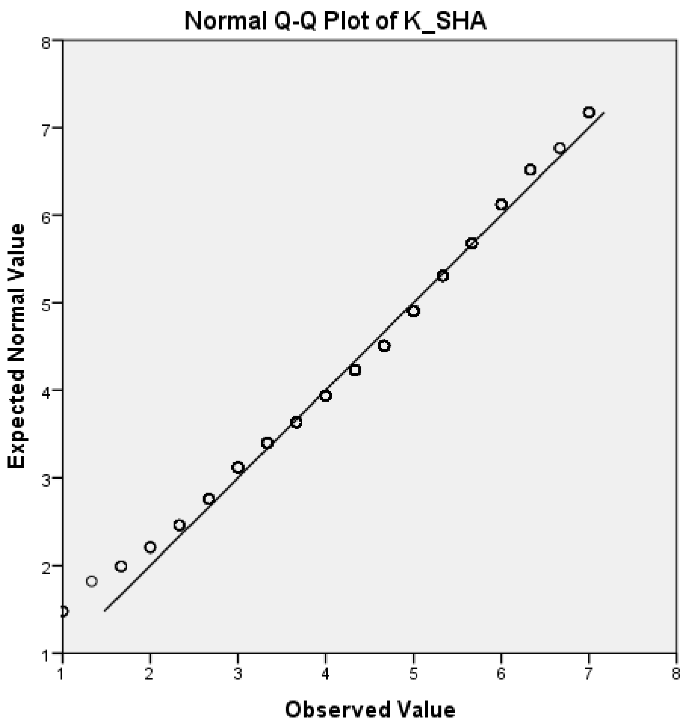


Figure A.3.1.3 Knowledge Creation normal Q-Q Plot

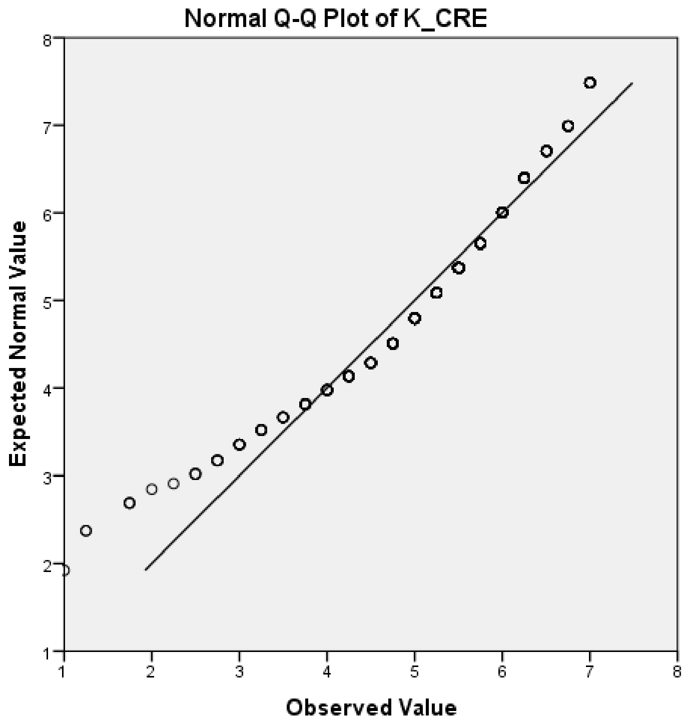


Figure A.3.1.4 Responsive Market Orientation normal Q-Q Plot

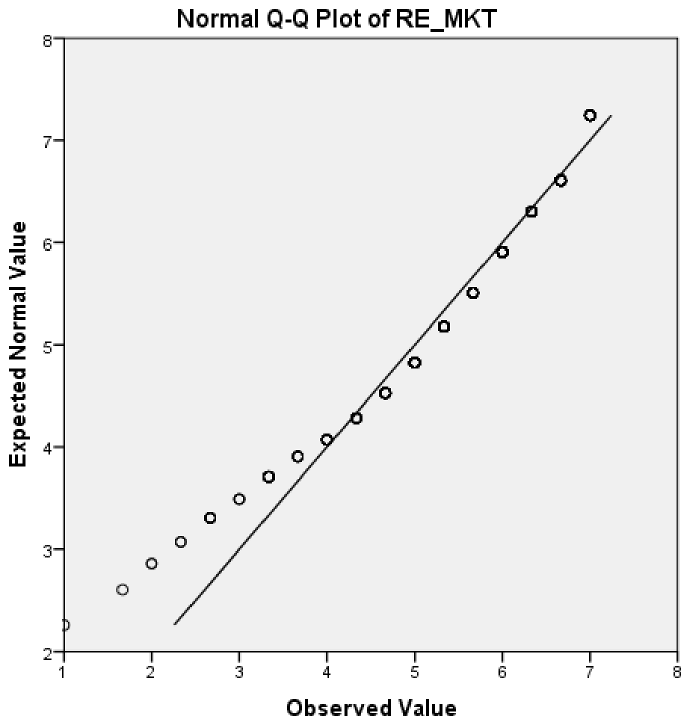


Figure A.3.1.5 Proactive Market Orientation normal Q-Q Plot

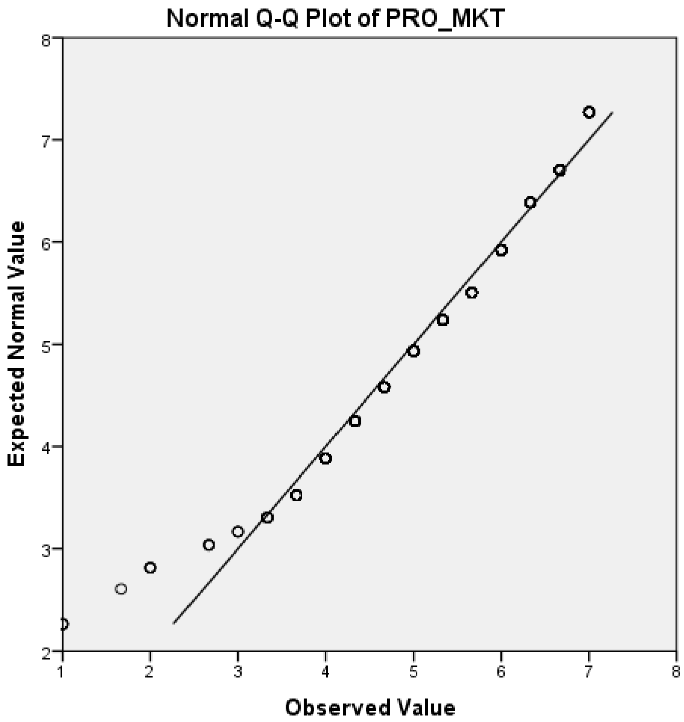


Figure A.3.1.6 Innovation Competence Exploration normal Q-Q Plot

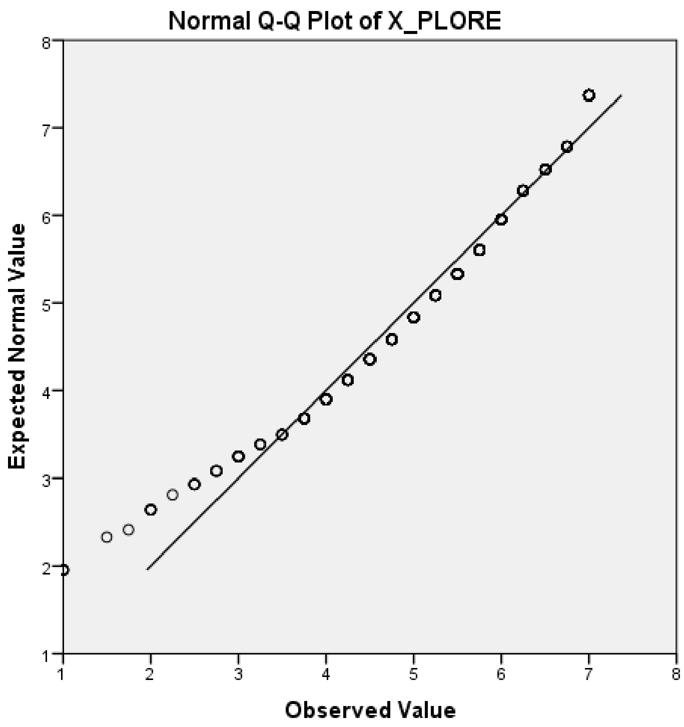


Figure A.3.1.7 Innovation Competence Exploitation normal Q-Q Plot

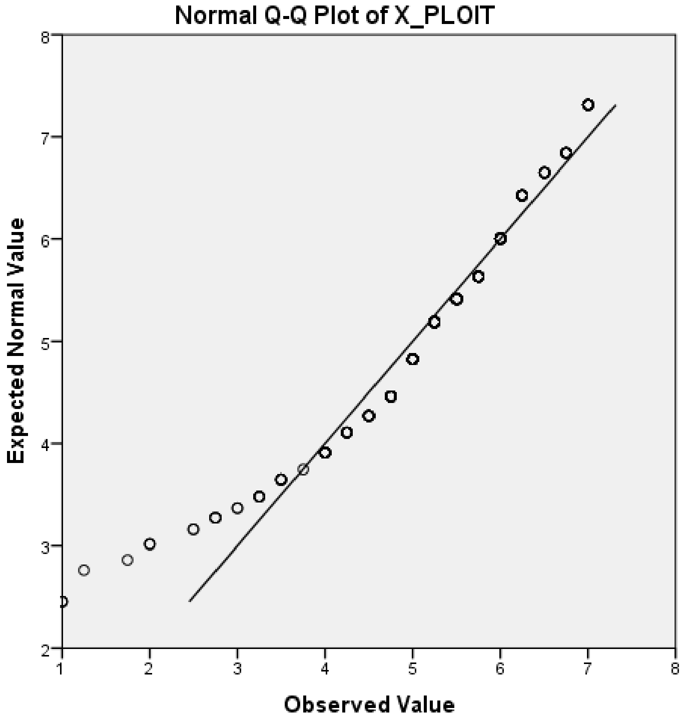


Figure A.3.1.8 Business Performance normal Q-Q Plot

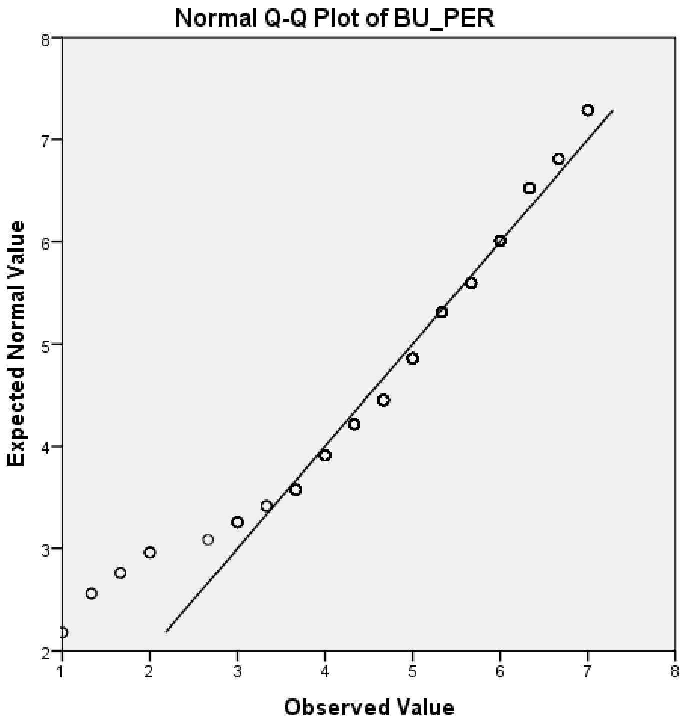


Figure A.3.1.9 Operations Performance normal Q-Q Plot

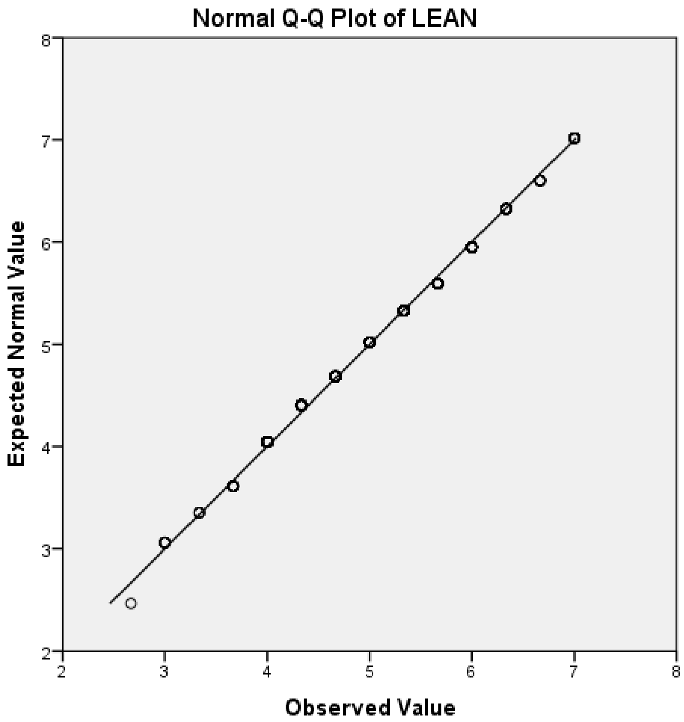


Figure A.3.1.10 Product Flexibility normal Q-Q Plot

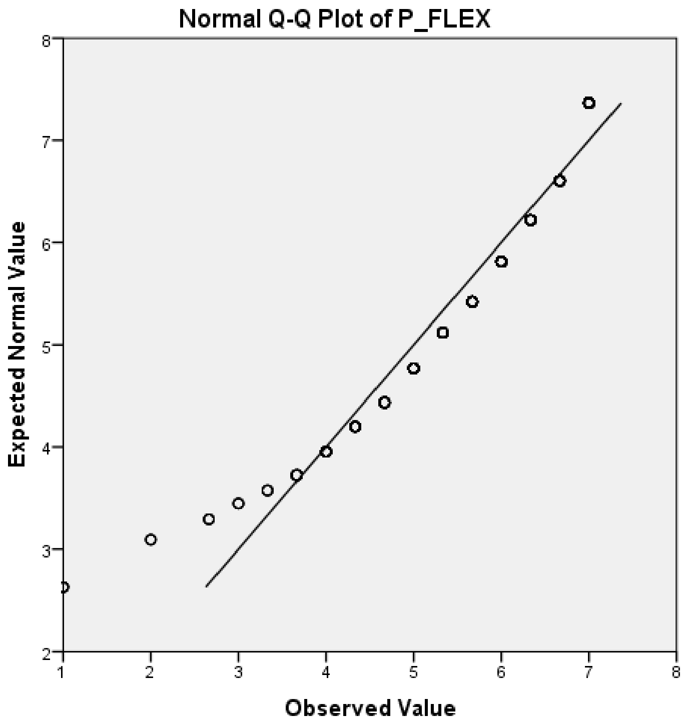


Figure A.3.1.11 Routing Flexibility normal Q-Q Plot

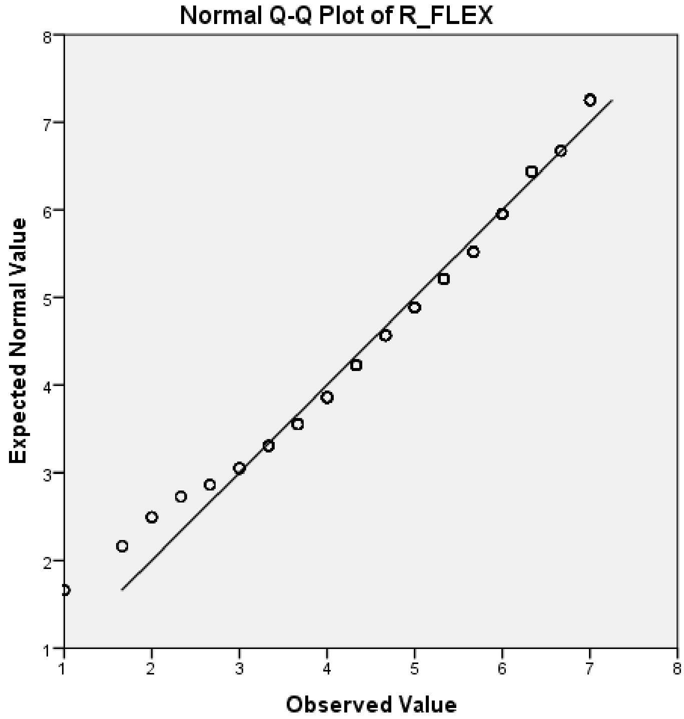


Figure A.3.1.12 Machines Flexibility normal Q-Q Plot

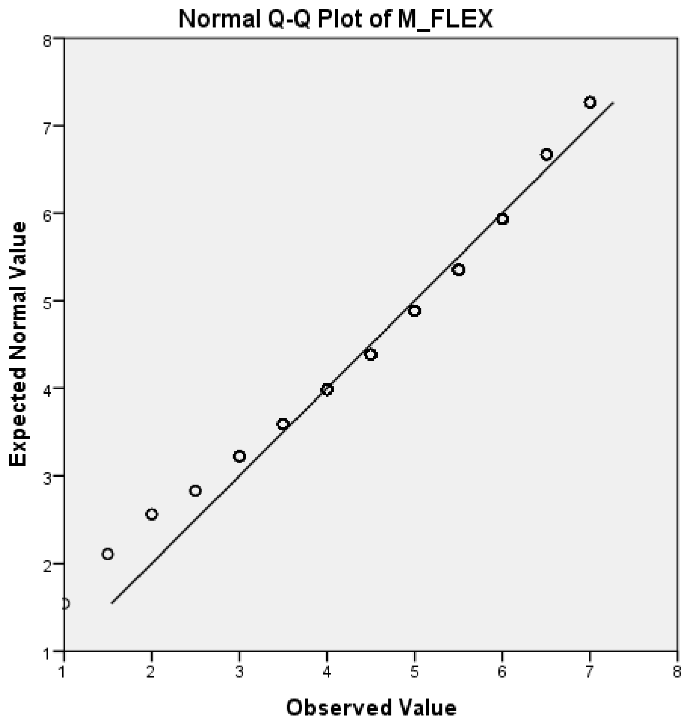


Figure A.3.1.13 Volume Flexibility normal Q-Q Plot

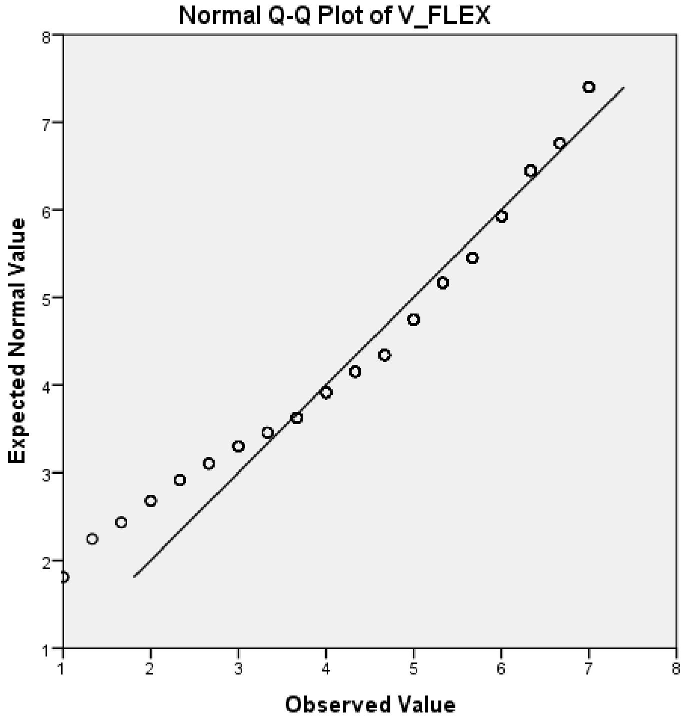


Figure A.3.1.14 Labor Flexibility normal Q-Q Plot

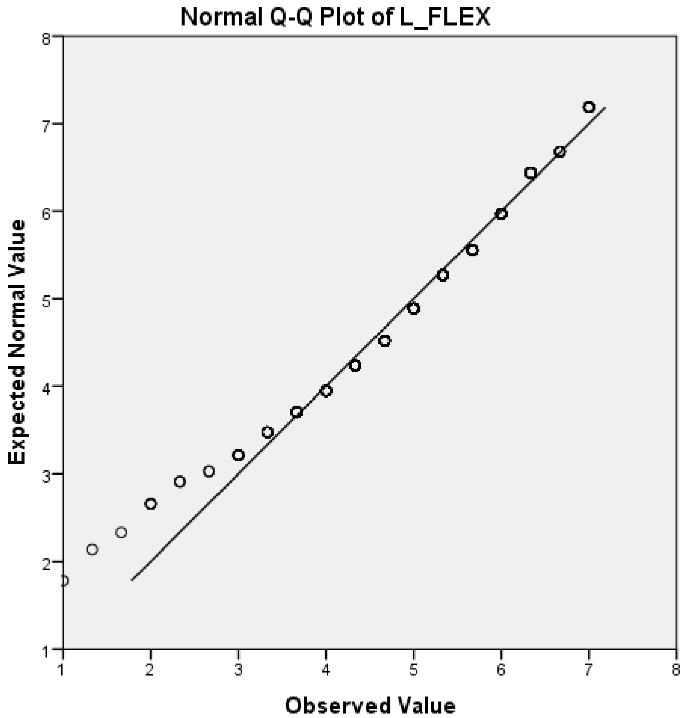
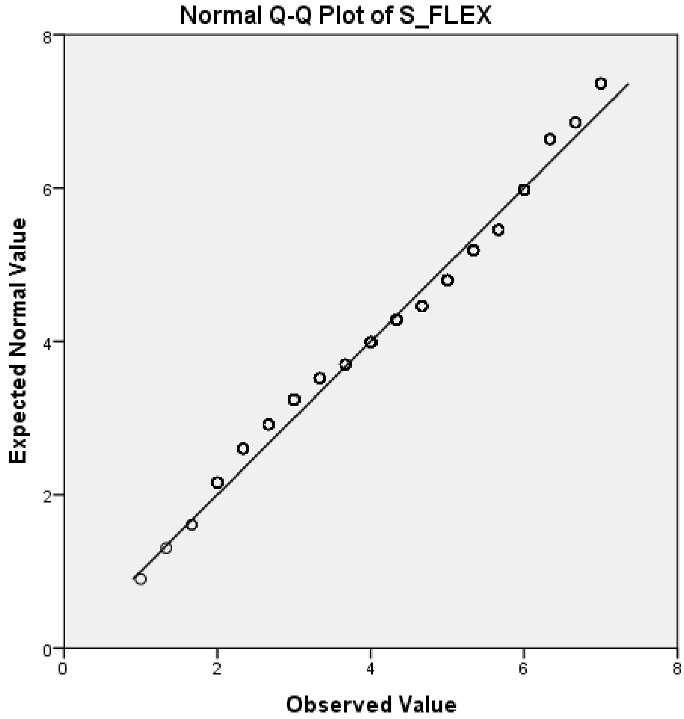


Figure A.3.1.15 Supply Chain Flexibility normal Q-Q Plot



A.3.2. Multivariate Normality, Skewness and Kurtosis

The tables that follow show the skewness and kurtosis of each validated measurement item for all measurement models. All values presented are within the values considered acceptable in the current research: | Skewness | ≤ 3.0 and | Kurtosis | ≤ 2.2 (Sposito et al., 1983). The criteria followed is stricter than more recent criteria such as that of Kline (2011), accepting absolute equal or below to 3.0 for skewness and equal or below 10.0 for kurtosis.

A normal distribution has skewness and kurtosis values of 0.0. If the skewness and kurtosis deviations from normality for each measurement item are under acceptable parameters, it is plausible to assume that the deviations from multivariate normality are accepted. This is the case for all items in all of the models used.

Table A.3.2.1 Items of the Measurement Model 1

Item	Minimum	Maximum	Skewness	CR	Kurtosis	CR
buper3	1.000	7.000	-0.898	-7.051	1.343	5.272
buper2	1.000	7.000	-0.876	-6.878	1.545	6.065
buper1	1.000	7.000	-1.008	-7.918	1.502	5.897
remkt5	1.000	7.000	-0.885	-6.949	0.732	2.872
remkt4	1.000	7.000	-1.025	-8.049	0.973	3.820
remkt2	1.000	7.000	-1.117	-8.772	1.823	7.158
promkt3	1.000	7.000	-0.876	-6.876	0.799	3.138
promkt2	1.000	7.000	-0.899	-7.063	0.706	2.771
promkt1	1.000	7.000	-0.861	-6.759	0.898	3.526
xploit5	1.000	7.000	-0.921	-7.230	1.198	4.704
xploit4	1.000	7.000	-1.074	-8.433	1.729	6.790
xploit3	1.000	7.000	-0.909	-7.136	1.560	6.126
xploit1	1.000	7.000	-1.041	-8.175	1.617	6.348
xplore4	1.000	7.000	-0.586	-4.598	-0.429	-1.683
xplore3	1.000	7.000	-0.774	-6.080	0.202	0.794
xplore2	1.000	7.000	-0.862	-6.772	0.228	0.897
xplore1	1.000	7.000	-1.041	-8.175	0.625	2.454
kncre4	1.000	7.000	-1.051	-8.253	1.059	4.158
kncre3	1.000	7.000	-0.960	-7.539	1.174	4.609
kncre2	1.000	7.000	-0.988	-7.762	1.029	4.040
kncre1	1.000	7.000	-0.615	-4.827	-0.034	-0.133
knsha3	1.000	7.000	-0.449	-3.527	-0.295	-1.157
knsha2	1.000	7.000	-0.284	-2.229	-0.509	-1.997
knsha1	1.000	7.000	-0.619	-4.862	0.032	0.124
knacq3	1.000	7.000	-0.200	-1.571	-0.636	-2.498
knacq2	1.000	7.000	-0.822	-6.458	0.288	1.131
knacq1	1.000	7.000	-0.703	-5.524	0.022	0.085
Multivariate					273.377	66.441

Table A.3.2.2 Items of the Measurement Model 2

Item	Minimum	Maximum	Skewness	CR	Kurtosis	CR
techd5	1.000	7.000	-0.209	-1.641	-0.587	-2.304
techd3	1.000	7.000	-0.453	-3.555	-0.447	-1.753
techd2	1.000	7.000	-0.596	-4.684	-0.145	-0.569
techd1	1.000	7.000	-0.489	-3.836	-0.310	-1.216
buper3	1.000	7.000	-0.896	-7.035	1.305	5.123
buper2	1.000	7.000	-0.816	-6.404	1.378	5.411
buper1	1.000	7.000	-0.977	-7.676	1.467	5.760
maflex3	1.000	7.000	-0.563	-4.421	-0.088	-0.344
maflex1	1.000	7.000	-0.902	-7.082	0.762	2.990
prflex1	1.000	7.000	-0.939	-7.375	0.564	2.213
prflex2	1.000	7.000	-1.639	-12.874	2.369	9.300
prflex3	1.000	7.000	-1.314	-10.315	1.708	6.708
lean3	1.000	7.000	-0.364	-2.858	0.082	0.322
lean2	2.000	7.000	-0.456	-3.582	0.132	0.517
lean1	1.000	7.000	-0.195	-1.530	0.075	0.293
roflex3	1.000	7.000	-0.797	-6.261	-0.002	-0.008
roflex2	1.000	7.000	-0.537	-4.215	-0.368	-1.447
roflex1	1.000	7.000	-0.775	-6.088	-0.076	-0.299
laflex3	1.000	7.000	-0.673	-5.287	0.573	2.249
laflex2	1.000	7.000	-0.810	-6.361	0.449	1.762
laflex1	1.000	7.000	-0.840	-6.596	0.821	3.223
voflex3	1.000	7.000	-0.858	-6.736	0.455	1.785
voflex2	1.000	7.000	-1.027	-8.067	0.744	2.922
voflex1	1.000	7.000	-0.914	-7.180	0.271	1.066
scflex3	1.000	7.000	-0.571	-4.487	-0.341	-1.338
scflex2	1.000	7.000	-0.456	-3.581	-0.436	-1.711
scflex1	1.000	7.000	-0.496	-3.892	-0.372	-1.460
kncre4	1.000	7.000	-1.051	-8.253	1.059	4.158
kncre3	1.000	7.000	-0.973	-7.637	1.204	4.727
kncre2	1.000	7.000	-1.039	-8.161	1.175	4.615
kncre1	1.000	7.000	-0.592	-4.646	-0.099	-0.389
Multivariate					326.323	69.385

Table A.3.2.3 Items of the Measurement Model 3

Item	Maximum	Maximum	Skewness	CR	Kurtosis	CR
knsha3	1.000	7.000	-0.449	-3.527	-0.295	-1.157
knsha2	1.000	7.000	-0.284	-2.229	-0.509	-1.997
knsha1	1.000	7.000	-0.619	-4.862	0.032	0.124
knacq3	1.000	7.000	-0.200	-1.571	-0.636	-2.498
knacq2	1.000	7.000	-0.822	-6.458	0.288	1.131
knacq1	1.000	7.000	-0.703	-5.524	0.022	0.085
xplore4	1.000	7.000	-0.586	-4.598	-0.429	-1.683
xploit5	1.000	7.000	-0.921	-7.230	1.198	4.704
xplore1	1.000	7.000	-1.041	-8.175	0.625	2.454
xplore2	1.000	7.000	-0.862	-6.772	0.228	0.897
xplore3	1.000	7.000	-0.774	-6.080	0.202	0.794
xploit1	1.000	7.000	-1.041	-8.175	1.617	6.348
xploit3	1.000	7.000	-0.909	-7.136	1.560	6.126
xploit4	1.000	7.000	-1.074	-8.433	1.729	6.790
promkt3	1.000	7.000	-0.876	-6.876	0.799	3.138
promkt2	1.000	7.000	-0.899	-7.063	0.706	2.771
promkt1	1.000	7.000	-0.861	-6.759	0.898	3.526
remkt5	1.000	7.000	-0.885	-6.949	0.732	2.872
remkt4	1.000	7.000	-1.025	-8.049	0.973	3.820
remkt2	1.000	7.000	-1.117	-8.772	1.823	7.158
maflex3	1.000	7.000	-0.555	-4.362	-0.096	-0.378
maflex1	1.000	7.000	-0.895	-7.029	0.748	2.935
prflex1	1.000	7.000	-0.932	-7.317	0.554	2.174
prflex2	1.000	7.000	-1.631	-12.805	2.291	8.997
prflex3	1.000	7.000	-1.329	-10.438	1.730	6.794
roflex3	1.000	7.000	-0.798	-6.268	-0.015	-0.057
roflex2	1.000	7.000	-0.530	-4.161	-0.369	-1.447
roflex1	1.000	7.000	-0.767	-6.025	-0.084	-0.329
laflex3	1.000	7.000	-0.700	-5.494	0.597	2.345
laflex2	1.000	7.000	-0.810	-6.361	0.449	1.762
laflex1	1.000	7.000	-0.874	-6.865	0.898	3.525

Item	Maximum	Maximum	Skewness	CR	Kurtosis	CR
voflex3	1.000	7.000	-0.864	-6.785	0.445	1.746
voflex2	1.000	7.000	-1.030	-8.091	0.725	2.848
voflex1	1.000	7.000	-0.914	-7.180	0.271	1.066
scflex3	1.000	7.000	-0.571	-4.487	-0.341	-1.338
scflex2	1.000	7.000	-0.456	-3.581	-0.436	-1.711
scflex1	1.000	7.000	-0.482	-3.785	-0.390	-1.533
kncre4	1.000	7.000	-1.051	-8.253	1.059	4.158
kncre3	1.000	7.000	-0.960	-7.539	1.174	4.609
kncre2	1.000	7.000	-0.988	-7.762	1.029	4.040
kncre1	1.000	7.000	-0.615	-4.827	-0.034	-0.133
Multivariate					521.166	84.412

A.3.3. Linearity

Linearity was evaluated by performing an analysis of variance (ANOVA) between the independent and dependent variables for each model. The significance value of the deviations of linearity (an output of the ANOVA test on SPSS) were then observed. Relations presenting a significant deviation from linearity ($p < 0.05$) could present limitations for SEM.

Model 1

The relation between business performance and absorptive capacity presents a non-significant deviation from linearity (0.092). The relations between business performance and innovation competences orientation (exploitation-exploration) present a non-significant deviation from linearity for the case of innovation competence exploitation (0.298) but a significant deviation from linearity for the case of innovation competence exploration (0.001). The relations between business performance and market orientation (responsive-proactive) present a significant deviation from linearity for the case of responsive market orientation (0.039) and a non-significant deviation from linearity for the case of proactive market orientation (0.101).

In view of the potentially problematic relations (non-linear) between business performance and innovation competence exploration and business performance and responsive market orientation, ordinary least squares regression was used to evaluate the linearity of each pair. The ordinary least squares regression of business performance on innovation competence exploration has presented a significant level for the latter as an explanatory variable of the former (0.000) thus the relationship between the two can be considered sufficiently linear. The ordinary least squares regression of business performance on responsive market orientation has presented a significant level as well (0.000), leading to a similar conclusion.

Moving to the intermediate level of model 1, the relation between innovation competence exploration and proactive market orientation has revealed a significant deviation from linearity (0.000), whereas the relationship between innovation competence exploration and absorptive capacity has not (0.199). The relations between innovation competence exploitation and responsive market orientation and between innovation competence exploitation and absorptive capacity have both shown significant deviations from linearity.

Ordinary least square regressions for the potentially problematic relationships have all returned significant levels of explanatory power of each of the independent variables under consideration, meaning that the relations can be considered sufficiently linear.

Finally, the relation between responsive market orientation and absorptive capacity and between proactive market orientation and absorptive capacity have not shown any significant deviations from linearity.

Model 2

The relation between business performance and manufacturing flexibility presented a non-significant deviation from linearity (0.068), while the relation between operations performance and manufacturing flexibility presented a non-significant deviation from linearity (0.105). The relations between business performance and knowledge creation as well as between operations performance and knowledge creation, however, presented significant deviations from linearity (0.000). Ordinary least squares regression of business performance on knowledge creation revealed the latter as a significant explanatory variable of the former, while ordinary least squares regression of operations performance on knowledge creation also revealed the latter as a significant explanatory variable of the former. The relations were thus considered sufficiently linear.

Furthermore, the relationships between manufacturing flexibility and technological turbulence and between manufacturing flexibility and knowledge creation have not shown significant deviations from linearity (0.425 and 0.520, respectively).

Model 3

The relation between manufacturing flexibility and absorptive capacity presented a non-significant deviation from linearity (0.451). The relation between manufacturing flexibility and innovation competences orientation (exploitation-exploration) revealed a non-significant deviation from linearity for the case of innovation competence exploitation (0.663), and a significant deviation from linearity for the case of innovation competence exploration (0.001). An ordinary least squares regression of manufacturing flexibility on innovation competence exploration has revealed the significance of the latter in the explanation of the former. The relation between manufacturing flexibility and innovation competence exploration can thus be considered sufficiently linear.

A.3.4. Multicollinearity

When the variance of the dependent variable is explained by the overlap of the variances of the independent variables multicollinearity occurs. This means that the independent variables variance are not explaining unique variance in the dependent variable, which is not ideal.

Model 1

A multivariate regression of business performance on innovation competences exploitation (exploitation-exploration), market orientation (responsive-proactive) and absorptive capacity has been performed. The variable inflation factor (VIF) of each independent variable in the regression presented values below 3.0 on all cases (minimum VIF of 1.663, for proactive market orientation and maximum VIF of 2.559, for innovation competence exploitation). The usual threshold for VIF being of 3.0 (Hair et al., 2010), the model does not seem to display any problems to this respect.

Model 2

Multivariate regressions of business performance on manufacturing flexibility and knowledge creation and another of operations performance on manufacturing flexibility and knowledge creation were performed. No VIF factors above 2.0 have been recorded (1.262 was the maximum level recorded). The model does not present multicollinearity concerns.

Model 3

A multivariate regression of manufacturing flexibility on innovation competences exploitation (exploitation-exploration), market orientation (responsive-proactive) and absorptive capacity has been performed. A VIF has been calculated for each independent variable on the regression, presenting values below 3.0 on all cases (minimum VIF of 1.663, for proactive market orientation and maximum VIF of 2.559, for innovation competence exploitation). The usual threshold for VIF being of 3.0 (Hair et al., 2010), the model does not seem to display any problems to this respect.

A.3.5. Homoscedasticity

Part of the SEM requirements is that the variables exhibit homoscedasticity, meaning a homogeneity of variance across different levels of the variable. The variance of each non-independent variable across its different levels is presented for all models. No serious heteroscedasticity patterns are visible on any variable residual variance plot.

Figure A.3.5.1 Business Performance residual variance

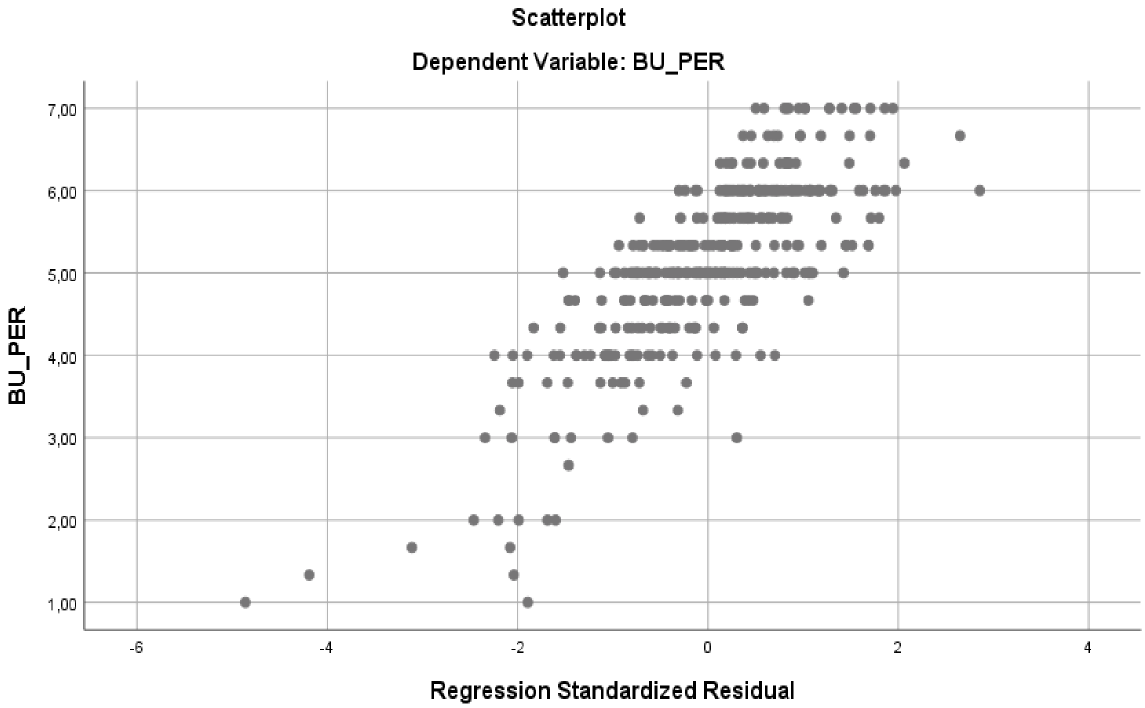


Figure A.3.5.2 Innovation Competence Exploitation residual variance

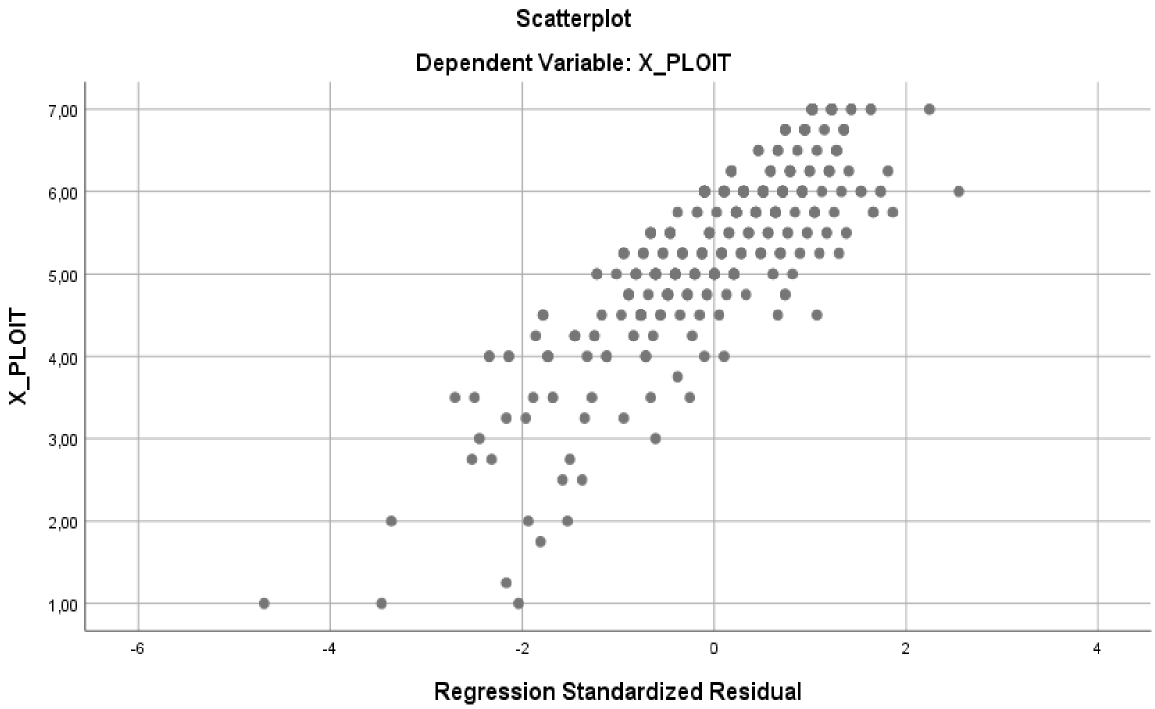


Figure A.3.5.3 Innovation Competence Exploration residual variance

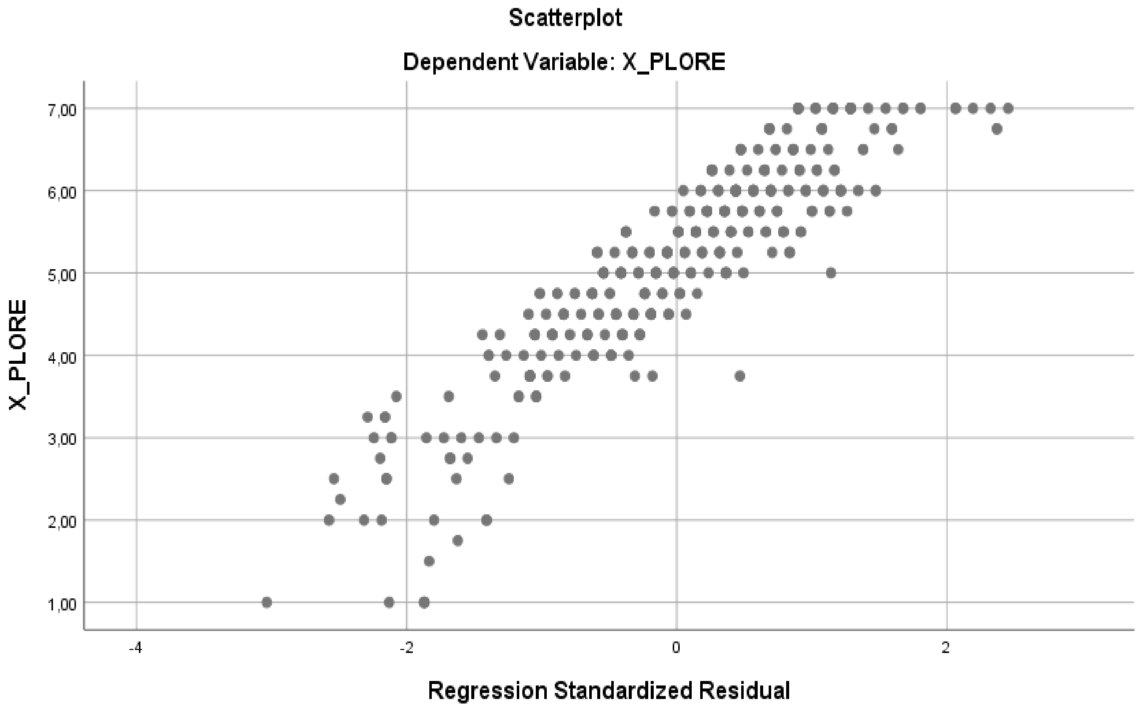


Figure A.3.5.4 Responsive Market Orientation residual variance

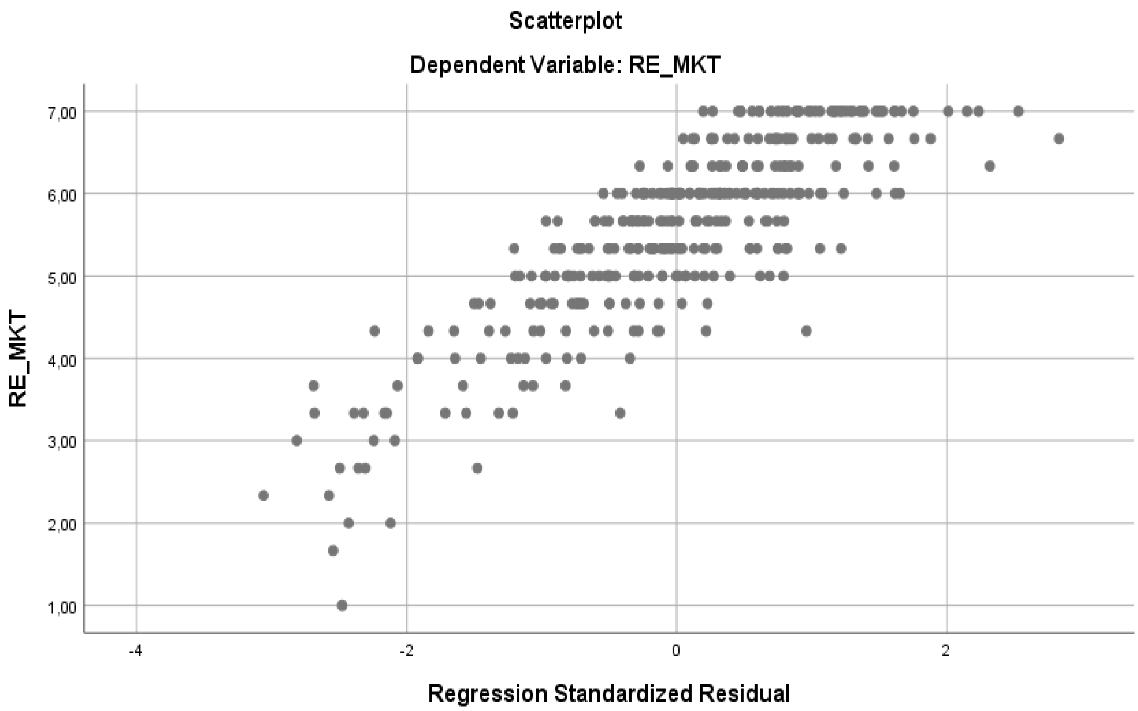


Figure A.3.5.5 Proactive Market Orientation residual variance

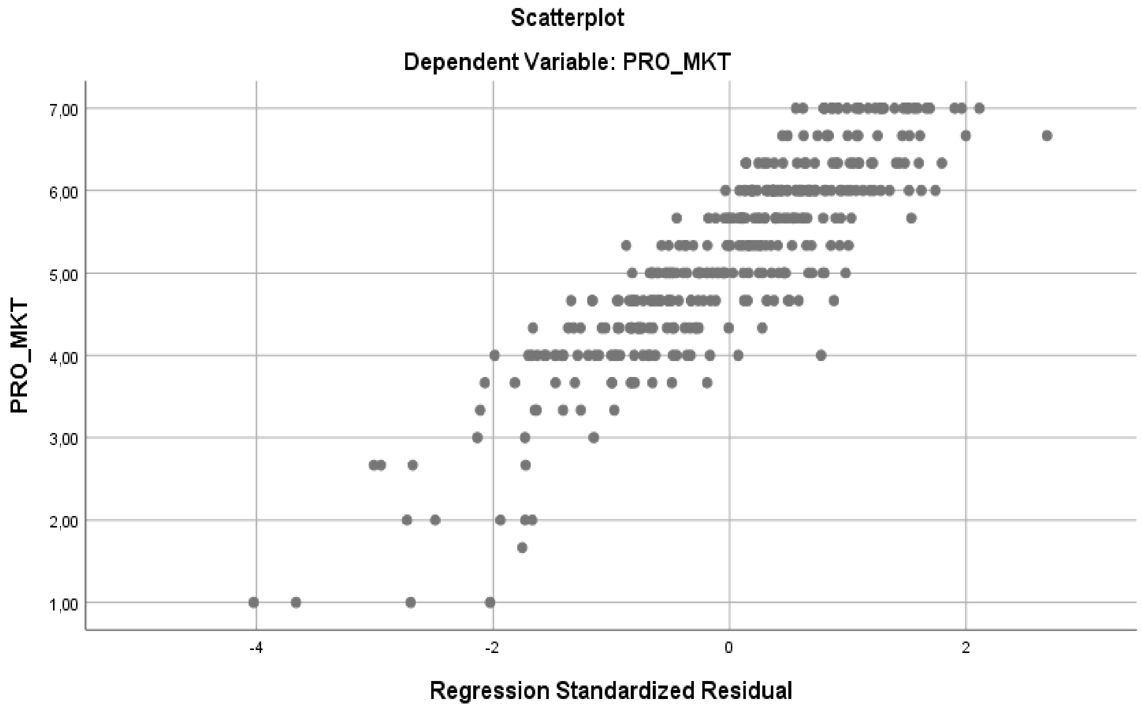


Figure A.3.5.6 Operations Performance residual variance

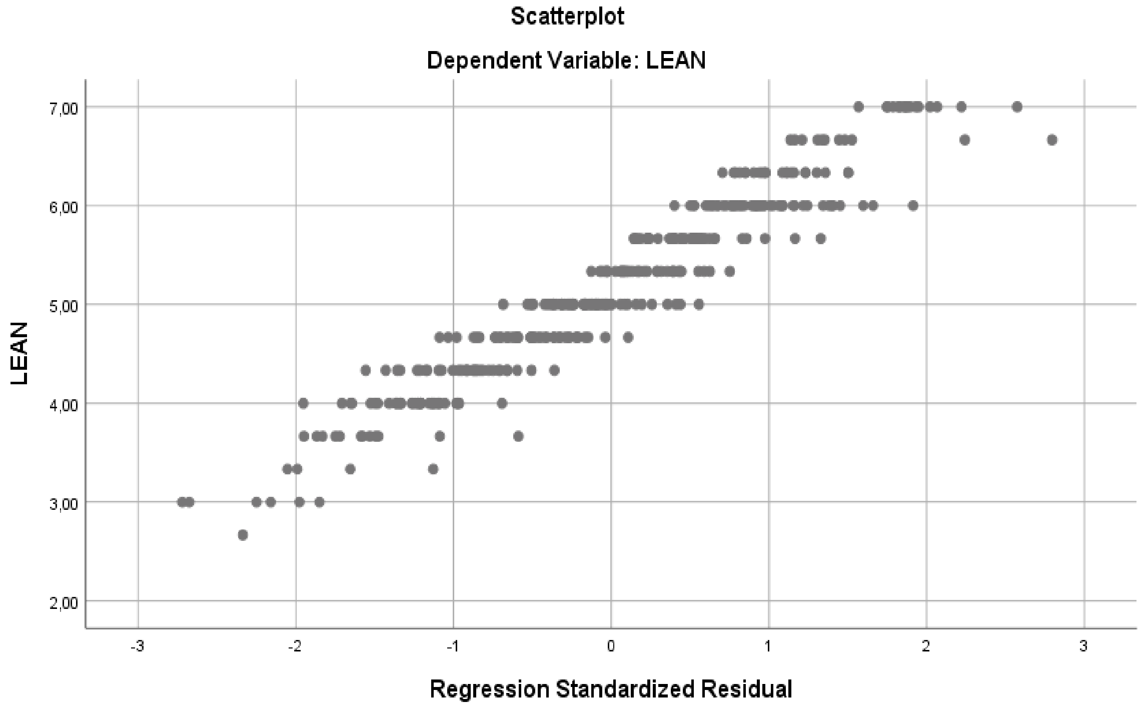


Figure A.3.5.7 Manufacturing Flexibility residual variance

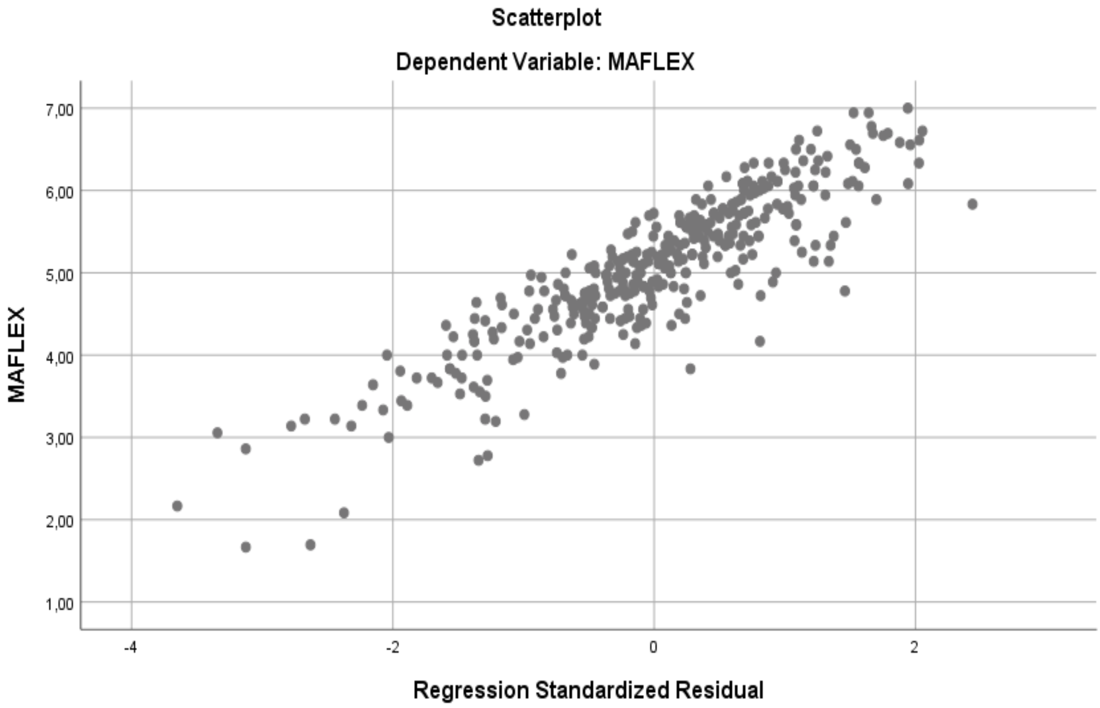
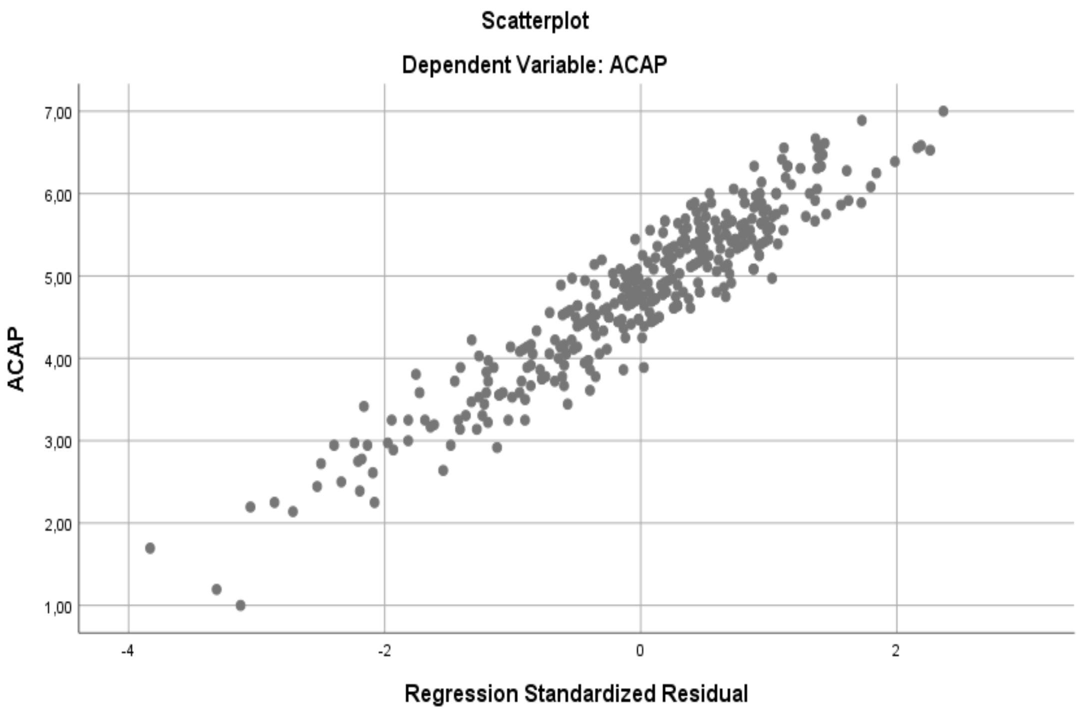


Figure A.3.5.8 Absorptive Capacity residual variance



A.4. Configural and Metric Invariance

Configural invariance and metric invariance tests were performed to validate the factor structure and loadings across different data groups. When these invariances are not confirmed, then the models are measuring different latent constructs for each data group. Configural invariance was assessed by looking at model fit for different data groups in AMOS, while metric invariance was assessed performing a χ^2 differences test. If there is not a significant *p-value* for the χ^2 differences between groups then the model is invariant, as desired. Both types of invariance are tested during the CFA in AMOS.

A.5. Questionnaire

This section presents the original questionnaire (in Portuguese) as delivered by email to the manufacturing firms in the sample.

Portugal - Inquérito sobre capacidades dinâmicas (88 itens)

Muito importante:

Este questionário dirige-se ao Diretor Geral (CEO) ou ao Diretor Financeiro (CFO), devendo ser respondido por um dos dois.

- A identidade do(a) inquirido(a) será mantida anónima.
- Assim que o(a) inquirido(a) começar o questionário, deverá evitar interrupções.
- A opção de gravar para posteriormente continuar a responder pode ser usada.
- Por favor responda a todos os itens.

Agradecemos antecipadamente a sua colaboração!

Indique de 1 (discordo totalmente) até 7 (concordo totalmente) o seu grau de concordância relativamente ao que caracteriza a sua empresa:

1. Adquirimos frequentemente conhecimento acerca de tendências tecnológicas e de mercado.

2. Somos capazes de identificar e adquirir conhecimento externo muito rapidamente (ex.: mercado, tecnologia).

3. Os nossos colaboradores visitam regularmente outros departamentos ou filiais para adquirirem conhecimento acerca de novas tecnologias, tendências ou modelos de negócio.

4. Os conhecimentos já existentes (ex.: de mercado, tecnologia) são postos à disposição de todos os departamentos.

5. A nossa empresa faz circular periodicamente, através de documentos, conhecimento codificado com o objetivo de atualizar os departamentos.

6. Na eventualidade de surgir uma situação importante (desenvolvimento no mercado ou tecnologia), toda a empresa toma conhecimento num curto espaço de tempo.

7. Os nossos colaboradores têm as capacidades necessárias para conceber ideias úteis e inovadoras.

8. Na nossa empresa, temos as capacidades necessárias para aprender com êxito algo de novo.

9. Temos as capacidades necessárias para desenvolver de forma eficaz novos conhecimentos ou visões capazes de influenciar o desenvolvimento de produtos.

10. Na resolução de um problema, podemos contar com um bom apoio interdepartamental.

11. Produzimos diferentes tipos de produtos com períodos mínimos de transição entre uns e outros.

12. Produzimos produtos diferentes, ao mesmo tempo, nas mesmas instalações.

13. Mudamos facilmente o fabrico de um produto para outro.

14. Um componente típico pode ser encaminhado para máquinas alternativas.

15. Um componente típico pode ser encaminhado de muitas formas diferentes.

16. O sistema de produção tem rotas alternativas para o caso de avaria nalguma máquina.

17. O arranque e configuração das máquinas/ferramentas é rápido.

18. A nossa máquina típica realiza numerosos tipos de operações.

19. Os arranques e configurações das máquinas são fáceis.

20. Conseguimos alterar rapidamente as quantidades dos produtos fabricados.

21. Variamos o volume total de produção de um período para outro.

22. Mudamos facilmente o volume de produção de um processo de fabrico.

23. Os colaboradores fabris recebem uma formação polivalente que lhes permite realizar várias atividades.

24. Os colaboradores fabris operam com diversos tipos de máquinas.

25. Os colaboradores fabris recebem uma formação polivalente em múltiplas células ou equipas.

26. Os fornecedores adaptam as quantidades fornecidas sem aumentarem significativamente os custos unitários.

27. Os fornecedores adaptam as quantidades fornecidas sem aumentarem significativamente os prazos de entrega.

28. Os nossos fornecedores adaptam os prazos de entrega à evolução dos nossos requisitos.

29. Os nossos objetivos empresariais dirigem-se principalmente para a satisfação dos clientes.

30. Fazemos uma constante monitorização do nosso nível de empenho e da orientação para satisfazer as necessidades dos clientes.

31. A nossa vantagem competitiva baseia-se na compreensão das necessidades dos clientes.

32. Fazemos uma avaliação sistemática e frequente da satisfação dos clientes.

33. Fazemos avaliações rotineiras ou regulares ao sistema de apoio ao cliente.

34. Ajudamos os nossos clientes a antecipar desenvolvimentos nos mercados.

35. Nos nossos produtos e serviços incorporamos soluções para necessidades não expressas pelos clientes.

36. Procuramos oportunidades em áreas onde os clientes têm dificuldade em expressar as suas necessidades.

Nos últimos 5 anos, a minha empresa... (items 37 a 50)

37. ...adquiriu tecnologias e competências completamente novas.

38. ...aprendeu técnicas e processos de desenvolvimento de produto completamente novas no sector (por exemplo, design de produto, protótipos de novos produtos, calendarização do lançamento de novos produtos, personalização de produtos para mercados locais).

39. ...adquiriu competências de gestão e organização completamente novas que são importantes para a inovação (por exemplo, previsão de tendências tecnológicas e do consumo, identificação de tecnologias e mercados emergentes, integração de atividades de investigação e desenvolvimento, de comercialização, de fabrico e de outras funções, gestão do processo de desenvolvimento de produto).

40. ...aprendeu novas competências pela primeira vez (por exemplo, financiamento de novas tecnologias, dotação de pessoal de I&D, formação e desenvolvimento de I&D e de pessoal técnico).

41. ...reforçou competências de inovação em áreas onde não tinha experiência prévia.

42. ...melhorou os conhecimentos e competências atuais sobre produtos e tecnologia já familiares.

43. ...aumentou a capacidade de exploração de tecnologias bem-estabelecidas para melhorar a produtividade das operações de inovação atuais.

44. ...melhorou competências de busca de soluções para os problemas dos clientes que estão mais próximo de soluções já provadas que de soluções totalmente novas.

45. ...melhorou competências nos processos de desenvolvimento de produto para os quais a empresa já possuía experiência significativa.

46. ...reforçou o nível de conhecimento e competências para projetos que melhorem a eficiência de atividades de inovação já existentes.

47. ...deu-me a oportunidade e incentivos para fazer o melhor de que sou capaz.

48. ...soube satisfazer todas as partes implicadas com o nível de desempenho da empresa.

49. ...conseguiu chegar mais próximo de alcançar o seu máximo potencial.

50. ...tem feito um bom trabalho na satisfação dos nossos clientes.

51. No nosso sector, a tecnologia está a mudar rapidamente.

52. As mudanças tecnológicas criam grandes oportunidades para o nosso sector.

53. Grandes descobertas tecnológicas no nosso sector tornaram possível um grande número de novas ideias de produto.

54. Os desenvolvimentos tecnológicos no nosso sector são pouco significativos.

55. No nosso sector, grandes inovações tecnológicas surgem com alguma regularidade.

56. Na nossa linha de negócio as preferências dos clientes pelos produtos variam muito ao longo do tempo.

57. Os nossos clientes tendem constantemente a procurar novos produtos.

58. Estamos a assistir a uma procura dos nossos produtos e serviços por clientes que nunca os tinham comprado.

59. Os novos clientes tendem a apresentar necessidades relativas a produtos diferentes daquelas dos nossos clientes habituais.

60. Servimos os interesses dos mesmos clientes a quem servimos no passado.

Classifique o desempenho da sua empresa, de 1 (muito pior) até 7 (muito melhor), relativamente ao desempenho do seu concorrente mais forte, nos últimos 5 anos.

61. Eficiência de fabrico (exemplo: uma alta eficiência de fabrico pode estar associada a ciclos de produção contínua, baixa taxa de incidência de avarias, baixa taxa de desperdício, baixa taxa de interrupção do fornecimento de componentes, baixa taxa de atrasos nos serviços a clientes).

62. Qualidade de fabrico (exemplo: uma alta qualidade de fabrico pode estar associada a uma baixa taxa de reclamações, a uma elevada adequação aos padrões de qualidade do mercado).

63. Tempo de serviço médio ao mercado (prazo médio de serviço aos clientes, desde a confirmação de encomenda até à entrega).

Agradecemos a sua colaboração!

Obrigado por ter concluído este inquérito.