Antecedents of a Firm´s Supply Chain Agility:

The Roles of a Transactive Memory System and Supply Network Flexibility

Marisel Fernandez-Giordano[a,c], Mark Stevenson[b], Leopoldo Gutierrez[a], and Javier Llorens-Montes[a]

[a] Department of Management, Faculty of Economics and Business Management, University of Granada, Granada, Spain

[b] Department of Management Science, Lancaster University Management School, Lancaster University, Lancaster, UK

[c] Department of Accounting and Financial Economics, Faculty of Law and Social Sciences, University of Rey Juan Carlos, Madrid, Spain

Antecedents of a Firm´s Supply Chain Agility:

The Roles of a Transactive Memory System and Supply Network Flexibility

Abstract

Purpose: The purpose of this paper is twofold. First, to evaluate the roles of a transactive memory system and the supply network flexibility of the firm as antecedents of a firm's supply chain agility (FSCA), also incorporating the moderating role of the transactive memory system. Second, to evaluate the relationship between FSCA and operations performance (OP).

Design/methodology/approach: Four hypothesized relationships are tested with survey data from 190 high-tech firms using structural equation models.

Findings: FSCA can be enhanced through the transactive memory system and supply network flexibility, although a higher degree of transactive memory system weakens the positive relationship between supply network flexibility and FSCA. A positive relationship is identified between FSCA and OP, while FSCA mediates the relationship between SNF and OP.

Practical implications: Managers can increase FSCA and improve OP by developing both the transactive memory system and supply network flexibility. Given that firms have limited resources, investment in internal capabilities should be prioritized as this appears to be more effective at developing FSCA.

Originality/value: The findings expand the literature by exploring two antecedents of FSCA and by analyzing the impact of FSCA on different measures of OP. Few prior studies have highlighted the importance of the transactive memory system to the operations function.

Keywords: Firm's supply chain agility; transactive memory system; supply network flexibility; operations performance.

Type: Research paper.

Acknowledgements: This research was supported by the European Regional Development Fund (European Union, Research Project A-SEJ-154-UGR18) and the Government of Spain (Research Project ECO2017-84138-P, and Research Grant FPI/2014 - BES-2014-069489).

1. Introduction

Today's hypercompetitive environment has pushed firms towards finding new ways to compete (Gligor *et al.*, 2019). More specifically, research suggests that developing agility is an important means of improving competitiveness in the current environment (Gligor *et al.*, 2015; Fayezzi *et al.*, 2017; Kim and Chai, 2017). Agile firms *"have a 70 percent chance of being in the top quartile of organizational health, the best indicator of long-term performance"* (McKinsey & Company, 2018). Indeed, agility is a capability related to a firm's ability to successfully detect and respond to market opportunities and threats (Fayezzi *et al.*, 2017). It covers multiple areas of a firm, with the supply chain of a firm being one of the most important aspects for the development of agility. The supply chain function involves critical business processes for successfully meeting widely variable and unpredictable customer expectations (Swafford *et al.*, 2006; Gligor *et al.*, 2019). Therefore, this paper focuses on the supply chain agility of a firm (FSCA), defined as the capability to adapt or respond in a speedy manner to a changing marketplace environment (Swafford *et al.*, 2006).

Although the literature has identified various antecedents or enablers of FSCA and some of the outcomes associated with FSCA, there have been recent calls to explore other antecedents of FSCA and further examine its effects on performance (Gligor *et al.*, 2015; Tse *et al*., 2016; Chan *et al.*, 2017; Fayezi *et al.*, 2017). In this regard, the literature on agility underlines that it can be achieved through two broad groups of factors, related to change expectancy and change response. *Change expectancy* refers to an organization's ability to sense changes in the external environment and how these changes affect the internal dynamics of the firm (Fayezi *et al.*, 2017; p. 382). Knowledge management is one of the necessary factors for managing change expectancy and developing a dynamic capability such as agility. One way to improve knowledge management is through the transactive memory system (TMS). The TMS is related to the management capability of the operations function of a firm, which includes managing internal aspects of the firm. This capability allows for the creation, maintenance, transfer, and coordination of knowledge in work teams (Huang and Cheng, 2018). Although the literature has recognized the importance of knowledge management in agile processes, its study in the context of supply chains is very scarce (Cerchione and Esposito, 2016). In particular, in the field of operations management, TMS has been studied fundamentally in temporary and cross-functional teams created to develop a specific task (Akgün *et al.*, 2005; Lewis and Herndon, 2011; Cotta and Salvador, 2020). However, the TMS of the operations department could contribute greatly to the development of FSCA. For example, firms like Zara or Amazon have all succeeded in developing FSCA because they have teams that quickly generate and coordinate new knowledge in the face of unexpected problems (Choi *et al*., 2002; Lee, 2004; Gravier, 2016).

Change response is based on the way in which a firm reacts to external changes in the marketplace (Fayezi *et al*., 2017; p. 389), where flexibility is a key factor. Flexibility allows a firm to change business processes and customize operational responses to the demands of the environment. One key aspect of flexibility is the flexibility of the supply network (SNF). The SNF is related to the management capability of the operations function of a firm, which includes managing external aspects of the firm. This is based on the collaborative capability of the firm to effectively and efficiently reconfigure the supply base (Liao *et al*., 2010). Regarding this variable, it is important to note the following two points. First, although the existing literature has recognized the importance of different types and dimensions of flexibility (Chan *et al*., 2017; Manders *et al*., 2017), we specifically focus on SNF as it is a determining concept in agility that requires further empirical exploration (Purvis *et al*., 2014; Liao and Marsillac, 2015). Second, although a large body of literature suggests that flexibility can have a significant impact on FSCA (Swafford *et al*., 2006; Swafford *et al*., 2008; Braunscheidel and Suresh, 2009; Chiang *et al*., 2012; Chan *et al*., 2017), the circumstances under which flexibility is positively related to business success remain unexplored (e.g. moderating variables that could increase or decrease this relationship) (Manders *et al*., 2017). Thus, we explore how TMS moderates the SNF-FSCA relationship to provide a more complete view of flexibility, i.e. the internal *vs*. external business aspects for achieving agility.

Building on this, and from a dynamic capabilities perspective, our study uses a survey in the high technology sector to evaluate a variable related to knowledge – a transactive memory system (TMS) – and a variable related to flexibility – a firm's supply network flexibility (SNF) – as potential antecedents of FSCA. The study also evaluates the effect of FSCA on a firm's operations performance (OP). Operations managers must know what results to expect from the implementation of FSCA-focused strategies, yet prior studies have evaluated only some measures of OP (e.g. Gligor and Holcomb, 2012; Blome *et al.*, 2013; Eckstein *et al.*, 2015; Gligor *et al.*, 2015., Tse *et al.*, 2016). Our study expands the literature by exploring the relationship between FSCA and four specific measures of OP

– delivery, production cost, product quality, and production flexibility. Jointly considering these four measures provides a more complete and comprehensive understanding of the multiple criteria that affect operations performance (Wong *et al.*, 2011).

Based on the above, our study has two main goals. First, to analyze the roles of TMS and SNF as potential antecedents of FSCA, incorporating the moderating role of TMS in the relationship between SNF and FSCA. Second, to evaluate the relationship between FSCA and OP. Thus, we ask:

RQ1. Are TMS and SNF antecedents of FSCA, and does TMS have a moderating effect on the relationship between SNF and FSCA?

RQ2. How does FSCA affect OP?

The study contributes to the existing literature on agility in two key ways. First, it evaluates two antecedents of FSCA – TMS and SNF – providing evidence of the positive influence of these variables. In doing so, it becomes one of the first studies to evaluate the role of TMS both in developing FSCA and as a moderator. Second, it analyzes the relationship between FSCA and OP with an expanded set of measures compared to previous studies.

The remainder of the paper is organized as follows. Section 2 provides the theoretical background and develops five hypotheses. Section 3 outlines the survey method adopted, the construction of the measurement instruments, and the validation of scales. Section 4 presents the results before they are discussed in Section 5, where concluding remarks, implications for research and practice, limitations, and future research directions are also provided.

2. Theoretical Background: Research Model and Hypothesis Development

This study is underpinned by the theory of dynamic capabilities, an extension of the resourced-based view (RBV) (Barney, 1991). Dynamic capabilities can be defined as a firm´s ability to integrate, build, and reconfigure its internal and external resources and capabilities in response to the changing environment (Teece *et al.*, 1997; Wang and Ahmed, 2007). "The term '*dynamic*' refers to the capacity to renew competences so as to achieve congruence with the changing business environment… The term '*capabilities*' emphasizes the key role of strategic management in appropriately adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competences to match the requirements of a changing environment" (Teece *et al*., 1997; p. 515).

In line with a wide variety of recognized authors in the operations management and supply chain management fields, we consider the FSCA as a dynamic capability (Gligor and Holcomb, 2012; Whitten *et al.*, 2012; Blome *et al*., 2013; Eckstein *et al*., 2015; Gligor *et al*., 2015; Aslam *et al*., 2018; Irfan *et al*., 2019). Gligor and Holcomb (2012) pointed out that FSCA is a dynamic capability because it meets the criteria of being a higher-level capability. It allows for responding to continual and unpredictable changes and is, therefore, particularly necessary and effective in a constantly changing, volatile, and unpredictable business environment; its approach is based on speed and responsiveness; and its main objective is to increase competitiveness (Oliva *et al.*, 2019). All these characteristics facilitate the integration and organization of resources and knowledge as well as their rapid application. In addition, FSCA is developed and renewed in response to changes in customer demand and in the economic and market structure, favoring a temporary competitive advantage (Gligor and Holcomb, 2012; Blome *et al*., 2013).

2.1 FSCA

FSCA is a particular type of organizational agility, defined as the supply chain capability of a firm to adapt or respond in a speedy manner to a changing marketplace environment (Swafford *et al.*, 2006). Organizational agility is traditionally characterized by a lack of consensus around its definition, which requires achieving agility in multiple areas of a firm, incorporating people, business processes, strategies, information systems, facilities and the supply chain of the firm (Walter, 2020). We focus on the FSCA because this type of agility provides a better and more transparent platform for assessing and understanding agility since it highlights the complexity and dependence of intra-organizational capabilities to maintain and develop inter-organizational agility (Fayezi *et al*., 2017). As economies have changed and business dependencies have increased, the idea of an agile supply chain is a key ingredient for overall agility, especially in highly volatile environments (Kisperska-Moron and Swierczek, 2009).

There are numerous definitions and interpretations of FSCA (Chan *et al.*, 2016). However, Swafford *et al.* (2006), in their seminal paper on FSCA, defined FSCA as the capability of the firm to adapt or respond quickly to the dynamic and unpredictable business environment. This capability focuses on speed at the firm level; for example, market responsiveness, reduced product development cycle time, reduced delivery and manufacturing lead time, high levels of customization and service, and frequent new product introductions (Swafford *et al.* 2008). FSCA represents how speedily these outcomes can be achieved (2006), which allows market uncertainty to be transformed into opportunities, especially in highly customized environments (Tse *et al.*, 2016; Um, 2017). The literature on agility underlines that it can be achieved through two broad groups of factors: factors related to "*change expectancy*" and factors related to "*change response*". Change expectancy refers to an organization's ability to sense changes in the external environment and how these changes affect the internal dynamics of the firm (Fayezi *et al.*, 2017; p. 382). In this sense, knowledge management (or the identification and leverage of collective knowledge in a firm) would be one of the necessary factors to manage "*change expectancy*" and develop a dynamic capability such as agility. In fact, the development of dynamic capabilities depends to a large extent on the management of knowledge and learning of the firm (Oliva *et al*., 2019). Knowledge enables the development of an accurate and timely awareness of what changes are necessary and when they should be made (Alavi and Leidner, 2001; Dove, 2006).

Among the various forms of knowledge management in the firm, knowledge management in work groups has aroused growing interest (Huang and Chen, 2018). Academics have investigated ways of managing group knowledge, such as generating, capturing, storing, sharing and implementing knowledge (Akgün *et al*., 2005). One way to manage group knowledge is through the TMS. Although the literature has recognized the importance of knowledge management in agile processes (Swaffor *et al*., 2006; Vázquez-Bustelo and Avella, 2006; Cerchione and Esposito, 2016; Fayezzi *et al*., 2017), its study at the FSCA level has been practically non-existent. Based on an extensive review of the literature on knowledge management in a supply chain context, Cerchione and Esposito (2016) pointed out that although knowledge is a key strategic factor in today's business environment, knowledge management is still a neglected topic in the SC literature, even by specialized supply chain management journals and knowledge management journals.

Change response is based on the way in which a firm responds to external changes in the marketplace (Fayezi *et al*., 2017; p. 389). An important factor for this "change response" would be flexibility. Flexibility allows a firm to change business processes and customize operational responses to the demands of the environment. Firms that take a proactive stance on these dimensions may be able to reconfigure their resources, improve their work, and develop new products and services in response to changes in their environment (Lee, 2004). Although flexibility has been recognized as an antecedent of FSCA, specific dimensions of flexibility need to be studied in greater depth (Chan *et al.*, 2017). Moreover, although a large body of literature suggests that flexibility can have a significant impact on FSCA (Swafford *et al*., 2006; Swafford *et al.*, 2008; Braunscheidel and Suresh, 2009; Chiang *et al*., 2012; Chan *et al*., 2017), the circumstances under which flexibility is positively related to business success remain unexplored (e.g. moderating variables that could increase or decrease this relationship) (Manders *et al.*, 2017). In this sense, we intend to fill this gap in the literature, evaluating how the knowledge generated in the firm's operations department can contribute to the SNF and FSCA relationship.

Meanwhile, it is known that agility is related to the management of internal and external processes and mechanisms of the firm (Braunscheidel and Suresh, 2009). At the internal level, a firm requires fluid and agile relationships in its departments or functions and, externally, it requires fluid and agile relationships with its suppliers and customers (Jackson and Johansson, 2003). Our study thus aims to evaluate TMS and SNF antecedents of FSCA and to incorporate organizational capabilities relating to the internal and external management abilities of the firm, i.e. the TMS of a firm’s operations department and a firm’s SNF, in the measurement of FSCA. Taken together, the two variables provide a better understanding of how different operations capabilities influence the development of FSCA.

2.1.1 TMS

TMSs have been widely used by organizational psychologists and teamwork researchers to explore how groups of individual specialists can share information and integrate knowledge effectively to tackle a common task (Cotta and Salvador, 2020). A TMS is a team-level cognitive structure that influences how team members encode, store, retrieve, and communicate information and knowledge (Wegner, 1987; Lewis, 2003). “It is a property of a group” (Wegner 1987, p. 191), not necessarily formal, which includes two components: the structural component consists of individual knowledge, and the process component is a set of communication processes among individuals that coordinate learning, retrieval, and application of knowledge (Mell *et al*., 2014). That is, TMSs have an organised store of knowledge that is contained entirely in the individual memory systems of the group members and a set of knowledge-relevant transactive processes that occur among group members. In this sense, a TMS supposes the existence of differentiated knowledge between the members of the group and knowledge shared by the group (Wegner 1987). This differentiated knowledge is useful because it provides the group with diverse and specialized knowledge that can be applied to the task of the group. Shared knowledge is useful because it helps all members to quickly locate the specialized expertise that different members of the group possess (Lewis and Herndon, 2011). Thus, the TMSs allow a group to relate tasks to the most qualified members and know exactly whom to consult to receive advice in different domains of knowledge (Argote and Guo, 2016). Therefore, a TMS is not only a shared understanding of 'who knows what' or a knowledge directory; it also involves the dynamic integration of all members' expertise and an element of collective knowledge creation (Lewis and Herndon, 2011), which may favor the development of knowledge management processes (i.e. knowledge creation, storage, transfer, sharing, application) (Argote and Guo, 2016; Cerchione and Esposito, 2016).

The TMS concept was first used by Wegner (1987) when studying coordination between couples to resolve information processing problems (Huang and Cheng, 2018). Over time, it has been extended and applied to other contexts and units of analysis, including various other types of dyadic relationships (Hammedi *et al*., 2013; Argote and Guo, 2016), work groups (Liang *et al*., 1995; Argote and Guo, 2016), organizations (Huang and Cheng, 2018), and to contexts that transcend organizational boundaries, such as a TMS between supply chain partners (Obayi *et al*., 2017). In particular, in the operations management field, TMS has been studied fundamentally in the context of teamwork in knowledge-intensive tasks, such as software development; consulting projects, the development of new products, especially in temporary and inter-functional teamwork created to develop a specific task (Akgün *et al*., 2005; Lewis and Herndon, 2011; Cotta and Salvador, 2020). This study evaluates the TMS in the operations department of the firm (hereafter referred to as operations TMS). That is, how the members of the operations department of the firm develop, apply and integrate the knowledge of the department.

Traditionally, the literature has suggested a TMS has three basic characteristics: specialization, credibility, and coordination (Lewis and Herndon, 2011; Hammedi *et al*., 2013; Huang and Cheng, 2018). Specialization refers to the existence of differentiated and unique knowledge amongst group members. Differentiated knowledge is created from a division of knowledge responsibilities, by virtue of which each member is responsible for unique knowledge (Lewis and Herndon, 2011). Specialization can reduce the cognitive load of team members since they only need to concentrate on their own area of expertise, yet they can simultaneously leverage other team members' knowledge in jointly performing a given task (Zhong *et al.*, 2012). Credibility establishes that the group can trust the knowledge of each individual member. This can save much time as they do not need to make explicit claims to justify their own knowledge (Zhong *et al.*, 2012). Moreover, perceptions of credibility enhance the willingness of members to exchange and absorb each other's knowledge, thereby leading to greater team learning (Li and Huang, 2013). Finally, coordination involves sharing individual knowledge to perform a specific task efficiently (Hammedi *et al.*, 2013). Coordination facilitates collaboration among team members to exchange knowledge and work together effectively while performing a task (Li and Huang, 2013; Heavey and Simsek, 2015). In fact, smooth and efficient coordination creates information channels that reduce the time and investment required to seek necessary information from teammates (Li and Huang, 2013).

The above three characteristics allow working groups to obtain a series of benefits (Argote and Guo, 2016; Huang and Cheng, 2018). They enable the creation, maintenance, and transfer of knowledge; and they improve alignment between team members (Heavey and Simsek, 2017; Huang and Cheng, 2018). Thus, TMSs recognize and make use of the specific knowledge and experience of each team member and combine it through transactional processes or personal interactions that link team members and are necessary for processing and coordinating information cooperatively (Argote and Guo, 2016; Heavey and Simsek, 2017).

2.1.2 SNF

The literature recognizes the importance of different types and dimensions of flexibility in order to achieve agility (Christopher, 2000; Manders *et al.*, 2017; Huo *et al.*, 2018). SNF is a specific dimension of flexibility that is recognized as a key aspect of agility but one that has been rarely tested empirically (Purvis *et al.*, 2014). Only a few recent studies have used this concept to evaluate, for example, sources of SNF (Purvis *et al.*, 2014), the mediating role of SNF in acquiring external knowledge and production innovation flexibility (Liao and Marsillac, 2015), and the relationship between SNF and supply chain performance (Liao *et al.*, 2010). Although there are various definitions of SNF (e.g.

Lummus *et al*., 2003; Stevenson and Spring, 2007; Purvis *et al*., 2014; Liao and Marsillac, 2015), as summarized in Appendix A, they all agree that SNF implies the ability of the firm to manage, reconfigure, re-align or reinvent relationships with suppliers. This study follows the definition suggested by Liao *et al*. (2010), which encapsulates the main aspects of key definitions (see Appendix A). SNF is defined as *"the extent of responsive ability of the firm through the use of collaborative capabilities to reconfigure the supply base effectively and efficiently"* (Liao *et al*., 2010). A firm's supply base is the visible part of its supply network, specifically the *"portion of the supply network that is actively managed by the focal company through contracts and purchasing of parts, materials, and services"* (Choi and Krause, 2006, p. 638). Accordingly, SNF does not depend on a supplier's capabilities (Purvis *et al*., 2014) but rather on the focal firm's ability in a future situation to redesign and reconfigure its supply base (Swafford *et al.*, 2006). Thus, it is important that firms are able to reorganize rapidly and find alternative suppliers (Purvis *et al*., 2014) to maintain a sufficient set of options and responses to potential changes in the environment (Liao and Marsillac, 2015).

Flexibility has traditionally been measured (e.g. in a manufacturing flexibility context) in terms of range, mobility, and uniformity (Swafford *et al.*, 2006; Stevenson and Spring, 2007; Liao and Marsillac, 2015; Huo *et al.*, 2018), and these terms can be applied to SNF. Firms may consider having multiple alternative sources of supply (range), the ability to change from one supplier to another without penalties in time or cost (mobility), and the ability to change suppliers whilst maintaining similar levels of performance (uniformity) (Liao and Marsillac, 2015).

2.2 The Relationship between TMS and FSCA

Although the literature on TMSs in the context of supply chains is still under development, it recognizes that the management and sharing of knowledge can shape supply chain management practices (Wong and Wong, 2011). For example, Ofek and Sarvary (2001) demonstrated that early implementation or participation in knowledge management leads to significant improvements in cost, quality, and cycle time throughout the supply chain when knowledge is used and applied in the job. Likewise, the benefits associated with the existence of a TMS are especially important to the development of agility (Argote and Guo, 2016; Fayezzi *et al.*, 2017), which involves anticipating and rapidly responding to environmental uncertainty (Fayezi *et al.*, 2017). However, these premises have not been specifically tested on a particular type of organizational agility such as the FSCA.

Some authors have advocated the importance of TMSs when faced with high levels of uncertainty (Argote and Guo, 2016) for two main reasons. First, survival in dynamic and turbulent markets requires firms to foster learning and knowledge creation processes. Unstable environments require new knowledge to be generated rapidly to face unpredictable events (Gligor *et al.*, 2015). Learning facilitates the creation and use of knowledge, and thus enables adaptation to new situations (Braunscheidel and Suresh, 2009). TMSs can therefore foster and accelerate group learning (Lin and Lin, 2001). Based on an analysis of 218 Taiwanese firms, Li and Huang (2013) found that specialization, credibility, and coordination influence exploitative and explorative learning. Research has also demonstrated that learning impacts an organization's internal (or departmental) learning, which is itself an antecedent of FSCA (Braunscheidel and Suresh, 2009). Agile organizations trust their employees, who possess the technical experience and know-how to be alert to opportunities and challenges presented by the changing environment (Shin *et al.*, 2015).

Second, the coordination of this learning and knowledge is key to managing uncertainty. High uncertainty requires non-programmed or relational coordination, which further requires high levels of communication and adjustment between team members (Argote and Guo, 2016). Such coordination is facilitated by the characteristics of a TMS, e.g. specialization and credibility, which in uncertain situations facilitates consultation with subject experts. A TMS will allow knowledge to be coordinated in the operations department, and this improves an organization's reaction and/or adaptation capabilities. Moreover, organizations can improve collective improvisation (Zheng and Mai, 2013) and/or response capacity by making better use and application of their integrated knowledge (Heavey and Simsek, 2017). They can also develop capabilities for communication and problem-solving between members of the department. Sharing individual mental models enables the base of shared meaning to expand, increasing a department's capability for effective coordinated action (Lin and Lin, 2001).

Teams that use their knowledge are versatile and excellent at solving problems (Shin *et al.*, 2015) due to the creative friction that develops within the team. Further, non-redundant knowledge transactions facilitate the search for and discovery of new knowledge and ideas (Heavey and Simsek, 2017). For example, Ren *et al.* (2006)

indicated that TMSs reduce response times by facilitating knowledge recovery and improving the quality of decision making through the coordination and evaluation of tasks. TMSs can also reduce the time needed to complete tasks (Argote and Guo, 2016) and increase innovation potential (Peltokorpi, 2014; Argote and Guo, 2016).

Based on the above, it is argued that an operation's TMS could increase FSCA due to the benefits derived from the creation, use, and coordination of knowledge. The TMS implies the strategic use of resources and the tactical management of manufacturing operations (Chan *et al.*, 2017). We thus propose the following:

H1. The level of the operations TMS positively influences FSCA.

2.3 The Relationship between SNF and FSCA

SNF is characterized by the availability of different strategic options for product supply. This enables the focal firm to quickly and easily structure, coordinate, and manage its supply network based on environment uncertainties (Lummus *et al.*, 2003; Liao *et al.*, 2010; Liao and Marsillac, 2015). Firms with multiple suppliers have contingency plans that provide them with greater reaction capabilities (Masson *et al.*, 2007). In other words, SNF enables the focal firm to develop the ability for *"surprise management"* (Chan *et al.*, 2017, p. 488).

Agile supply chains have the ability to rapidly reconfigure a temporary network of organizations (Purvis *et al.*, 2014). Choi and Krause (2006) indicated that many firms, in their eagerness to optimize the supply base, reduce their number of suppliers; but this increases dependence on a more limited set of remaining suppliers, which ultimately constrains flexibility. SNF eliminates supplier dependence and enables the focal firm to rapidly adjust to supply and demand (Liao and Marsillac, 2015). The capability to add and eliminate suppliers, to choose suppliers that can cope with volume changes or rapidly introduce new products, and the ability to vary relationships with providers (Lummus *et al.*, 2003), are key to fulfilling new demands with sufficient speed and precision (Choi and Krause, 2006). As Lummus *et al.* (2003) argued, the supply chain must be designed whilst taking change into account. But when the market changes, competitive priorities can also change, which can then make it necessary to find new supply chain partners with the capabilities required. For example, firms can use suppliers with new and better knowledge, technologies, or other capabilities needed to fulfill changing supply requirements (Liao *et al.*, 2010). Such capabilities facilitate responsiveness to customers

(Chiang *et al.*, 2012), more reliable product supply, positive changes to product volumes and mix (Liao *et al.*, 2010), and the development of more effective and profitable innovations (Liao and Marsillac, 2015). In their study of a sample of 201 manufacturing firm leaders, Liao and Marsillac (2015) found that SNF enables firms to acquire external knowledge and improve their product innovation capabilities.

It therefore follows that the availability of different strategic options for product supply (without penalties of cost, time, or quality) enables the focal firm to make better use of the resources in its supply base (Lummus *et al.*, 2003; Liao *et al.*, 2010), enhancing adaptation to changing market requirements (Purvis *et al.*, 2014). This could facilitate the development of FSCA and the contribution to key supply chain outcome measures. We thus propose the following:

H2. The level of SNF positively influences FSCA.

2.4 The Moderating Effect of TMS on the Relationship between SNF and FSCA

The SNF-FSCA relationship requires a firm to find appropriate suppliers that can face up to the changing environment as quickly as possible. It is therefore necessary to be able to know and detect changes in the environment so that the best strategic combination for supplying products and managing network complexity can be identified. The presence of an operations TMS could contribute greatly to this relationship given that one of the most striking benefits of a TMS concerns the creation, maintenance, transfer, and coordination of knowledge (Heavey and Simsek, 2017; Huang and Cheng, 2018). Thus, the TMS could make it easier for the firm to detect and respond to environmental change.

On the one hand, it is important that a firm is able to determine the heterogeneous resources and capabilities of its current and potential supply base and to understand the potential for reengineering its systems and processes throughout the supply chain (Liao and Marsillac, 2015). That is, operations managers must evaluate each supplier's capabilities and any risks to order fulfillment (Kull *et al.*, 2014). The internal knowledge base is needed to recognize the value of external knowledge, to assimilate it, and then apply it (Liao and Marsillac, 2015). It has been recognized in the literature that knowledge management can lead to detecting changes in the external environment and to understanding how these changes can affect the internal dynamics of a firm (Fayezi *et al.*, 2017). For example, knowledge management systems supported by information systems are useful mechanisms for this purpose (Overby *et al*. 2005; Sambamurthy *et al.* 2003).

Moreover, knowledge allows for accurate and timely awareness of when a change must be made, which is facilitated by a firm's knowledge management processes (Dove, 2006). An operations TMS is thus expected to contribute the knowledge needed to establish the best combination for the supply network promptly, thereby strengthening the relationship between SNF and FSCA.

On the other hand, a TMS could also facilitate management of the complexities associated with the chosen strategic combination. Complexity of the supply base depends on three factors: (1) the number of suppliers; (2) the degree of differentiation between suppliers; and, (3) the level of interrelationships between suppliers (Choi and Krause, 2006). We can thus expect a flexible supply network to have greater complexity since a firm's SNF is known to involve at least two of these characteristics. The focal firm should have multiple and different suppliers available to supply products (Liao and Marsillac, 2015), but having a large number of suppliers increases the coordination required (Handfield and Nichols, 1999). These complexities represent a challenge for management due to the difficulty of understanding the problems in question, poorly defined relationships between causes and effects, the interrelationship of factors, and the appearance of uncertainty (Hartono *et al.*, 2019). The characteristics of a TMS could be key to management in such contexts as they facilitate both the generation of knowledge on different suppliers and coordination abilities.

It is thus concluded that the knowledge generation and coordination capabilities of an operations TMS can make it easier for the focal firm to find the best strategic combination for supplying its products quickly and for managing the complexities associated with the network effectively. Such activities are key in a changing market as they strengthen the relationship between SNF and FSCA. We thus propose the following:

H3. Operations TMS positively moderates the relationship between SNF and FSCA.

2.5 The Relationship between FSCA and OP

Although the literature suggests FSCA can influence an organization's success and prosperity (Fayezi *et al.*, 2017), little empirical research has been undertaken to assess its true performance impact (Gligor *et al.*, 2015). Some recent studies have begun to examine this relationship, but the focus has been on measures related to financial performance or on a narrow range of operations measures (Swafford *et al.*, 2008; Gligor and Holcomb, 2012; Blome *et al.*, 2013; Eckstein *et al.*, 2015; Gligor *et al.*, 2015; Al-Shboul, 2017;

Chan *et al.*, 2017; Um, 2017). This study therefore provides a more in-depth analysis of the relationship between FSCA and OP, expanding on prior studies as summarized in Appendix B. We examine four key areas of OP – delivery, production cost, product quality, and production flexibility – that reflect the four key capabilities required of a focal firm when responding to competition (Wong *et al.*, 2011).

2.5.1 The Relationship between FSCA and OP

Although some studies have evaluated the relationship between FSCA and OP (e.g. Gligor and Holcomb, 2012; Blome *et al*., 2013; Eckstein *et al*., 2015; Gligor *et al*., 2015), the performance measures adopted have provided only partial coverage of the relationship. Our research aims to go deeper than prior studies by evaluating the relationship between FSCA and four specific measures of OP – delivery, production cost, product quality, and production flexibility – which have an important influence on business competitiveness. Jointly considering these four key measures provides a more complete and comprehensive understanding of the multiple criteria that affect operations performance (Wong *et al*., 2011).

The theory of dynamic capabilities explains sources of competitive advantage (Teece *et al.*, 1997). Therefore, performance is a key component of the theory and is usually seen as the ultimate aim of dynamic capabilities. However, the possession of dynamic capabilities does not necessarily lead to higher performance, rather the performance outcomes are dependent on (1) the quality of the capabilities that the dynamic capabilities alter, and (2) the evolutionary fitness of such capabilities (Laaksonen and Peltoniemi, 2018). Some authors have pointed out that FSCA can maintain or develop a sustainable competitive advantage (Blome *et al.*, 2013; Gligor *et al.*, 2015; Chan *et al.*, 2017; Um, 2017) by improving the internal functioning of the organization and by enabling more effective responses to external parties (Blome *et al.*, 2013). Three characteristics enable FSCA to generate a sustainable competitive advantage (Blome *et al.*, 2013): (1) it is a unique capability generated from specific internal and external capabilities; (2) it requires a temporary evolution over a prolonged time period; and, (3) it relies on the development of complex relationships internally and externally with customers and suppliers based on history. From a resource-based view (RBV) perspective, these characteristics enable the firm to sustain a competitive advantage, which may in turn lead to higher levels of operating performance (Barney, 1991; Blome *et al.*, 2013).

Some studies have indicated that FSCA contributes to the success of particular operations objectives (Gligor *et al.*, 2015; Chan *et al.*, 2017). First, regarding *delivery*, the ability of agile supply chains to recover rapidly from external disturbances encourages an adherence to delivery deadlines and increases the likelihood of a reliable and precise service (Gligor and Holcomb, 2012; Eckstein *et al*., 2015; Chan *et al*., 2017). A short replacement time for materials and services, quick and flexible adjustments to production processes, and the flexible relocation of inventories improve lead times and the handling of customer deliveries (Swafford *et al.*, 2006). Further, greater responsiveness to changes in product mix or volume also contributes to quality and delivery performance (Christopher 2000; Eckstein *et al*., 2015). Second, regarding *production costs*, supply chain interruptions have been shown to represent an important cost factor for firms (Blome *et al.*, 2013). FSCA enables firms to manage interruptions, preventing stoppages in production and optimizing supply chain costs (Blome *et al*., 2013; Eckstein *et al*., 2015; Chan *et al*., 2017). Further, FSCA reduces the time required to replace materials and services, to reconfigure machinery, and to adjust production processes, enabling the more profitable personalization of products with greater efficiency (Eckstein *et al*., 2015). Through FSCA, firms improve synchronization between supply and demand, reducing the cost of inventories and transportation (Christopher 2000; Eckstein *et al.*, 2015). Moreover, postponement can result in reduced costs of inventory, production, and transportation through less stock-keeping items and volume-oriented economies of scale (Christopher 2000; Lee 2004). Shortened replacement times for materials and services, improved throughput and set-up times, and the quick adjustment of production processes enable firms to customise products cost-efficiently while avoiding product markdowns caused by excess inventories (Lee 2004). Based on a sample of 283 firms, Gligor *et al.* (2015) examined two performance dimensions: customer effectiveness and cost efficiency. The authors showed that the development of FSCA allows firms to meet ever-changing customer expectations in a cost-efficient manner.

Third, regarding *product quality*, to develop FSCA a firm not only needs a fast and effective internal management system for its processes but also a fast and effective external management system for its suppliers and customers. Joint planning in purchasing, logistics and production with other members of the supply chain allows volume changes or design modifications to be more effectively accomplished (Blome *et al*., 2013). In fact, a firm's capability to perform incremental changes to design and to rapidly modify engineering specifications enables waste reduction and more effective responses to incidents, improving product quality (Eckstein *et al*., 2015). Finally, regarding *production flexibility*, because FSCA extends beyond a single firm and involves relationships with key suppliers (Braunscheidel and Suresh 2009), this capability allows for the quick and flexible alignment of production processes and the relocation of inventories (Blome *et al*., 2013).

Thus, overall, it can be argued that FSCA permits a firm to rapidly change key measures of its operations performance, i.e. delivery, production cost, product quality, and production flexibility. It follows that FSCA enables the development of a sustainable competitive advantage by strengthening a series of key abilities underpinning the success of firms in environments characterized by strong competition and high uncertainty (Chan *et al*., 2017). Such abilities in turn lead to better operations performance. We thus propose the following:

H4a. FSCA positively influences delivery.

H4b. FSCA positively influences production cost.

H4c. FSCA positively influences product quality.

H4d. FSCA positively influences production flexibility.

The four relationships to be empirically investigated are illustrated in the theoretical model depicted in Figure 1.

[Take in Figure 1]

3. Research Method

3.1 Target Population and Survey Procedure

Spanish companies in the high-tech sector were selected from the Iberian Balance Sheet Analysis System (SABI) database to investigate the hypotheses. The database includes information on company size, age, industry sector, financial ratios, operations measures, and other miscellaneous data. Relevant firms were identified according to the codes attributed by The North American Industry Classification System (NAICS), as used in Kile and Phillips (2009). Most authors have argued that agility is an important determinant of firm success, particularly in turbulent environments (Overby *et al.*, 2006; Gligor *et al.*, 2015; Kim and Chai, 2017). Typically, a high-tech context introduces novelty and new eventualities related to R&D while, at the same time, these firms face high levels of uncertainty (Mthanti and Urban, 2014). The sector is characterized by the rapid renewal of knowledge and by its high degree of complexity, which requires constant investment in research and continuous adaptation to the environment (Wang *et al.*, 2013) meaning the development of knowledge, flexibility and agility are crucial to survival.

We followed Dillman's (2000) prescriptions to collect survey data. After a comprehensive literature review, we developed a pilot survey, which was validated using four academics and six supply chain managers. The experts recommended some modifications and minor changes in wording to facilitate comprehension of the questions, and these were incorporated. Following Braunscheidel and Suresh (2009) and Krause *et al.* (2018) the unit of analysis was the focal firm, and the preferred respondents were senior managers with knowledge of the processes and activities of the firm´s operations department and who had the capacity to make decisions in that department. Data were collected via the computer-assisted telephone interview (CATI) system. Interviewers were trained to know the measures in detail meaning they could answer any questions posed by the respondents.

From a total population of 1,525 firms, 495 were contacted by telephone and we received 226 responses. Responses with a high number of missing values were deleted. Hair *et al.* (2010) suggested that *"the researcher should consider the simple remedy of deleting offending case(s) and/or variable(s) with excessive levels of missing data… variables or cases with 50 percent or more missing data should be deleted"* (Hair *et al.*, 2010; p.46). We decided to remove all non-complete responses, obtaining a final sample composed of 190 responses. We also evaluated non-response bias according to Fawcett *et al.* (2014) by comparing the mean values between respondents (190 firms) and non-respondents (305 firms, i.e. 495 minus 190) according to the number of employees (firm size), sales, and operating profit variables. The values were similar, suggesting non-respondent firms did not introduce significant bias into the study (number of employees df=2; F=0.16; Sig.=0.84; sales df=2; F=1.85; Sig.=0.16, and, operating profit df=2; F=1.36; Sig.=0.26). In addition, non-respondents were asked why they were unable to take part. The main reasons were the lack of a qualified person to answer the survey and a firm policy that did not permit the sharing of confidential information.

3.2 Instruments and Measures

The main constructs used were: TMS, SNF, FSCA, and OP. All four are reflective constructs. The measurement scales for these variables, as shown in Appendix C, were adapted from prior studies: TMS (Lewis, 2003), SNF (Liao *et al.*, 2010), FSCA (Swafford *et al.*, 2006), and OP (Wong *et al.*, 2011). A seven-point Likert scale was adopted to capture managers' perceived levels of these variables (from 1=maximum disagreement to 7=maximum agreement).

Two firm-level control variables that might influence operations performance were also investigated: firm age and firm size. Firm age, i.e. the number of years since a firm was founded, can affect the implementation of supply chain management practices and therefore OP (Gligor *et al.*, 2015). Firm size, based on the number of employees, can also influence OP as large firms may derive greater synergistic effects from supply chain agility than smaller firms (Chan *et al.*, 2017). Moreover, large firms have more resources to implement supply chain management practices (Gligor *et al.*, 2015; Chan *et al.*, 2017). Consistent with research conventions, both control variables were measured by logarithmic transformations (Gligor *et al.*, 2015). More specifically, the Neperian logarithm was used.

3.3 Validity and Reliability of Scales

We first established the content validity of the scales by performing an extensive literature review. Second, we assessed the reliability of each scale, calculating Cronbach's alpha (α) coefficient, with all coefficients exceeding the generally accepted cut-off value of 0.07 (Kaynak and Hartley, 2006). Third, we examined construct validity (convergent and discriminant validity) using confirmatory factor analysis (CFA). Convergent validity requires standardized item loadings and > 0.6 and significant, i.e. a t-value >1.96 (Hair *et al.*, 2010). Some items were removed that did not meet these criteria (see Appendix C). Moreover, a good fit of the measurement model can ensure convergent validity (Schumacker and Lomax, 1996). A model is considered satisfactory if the incremental fit index (IFI) is > 0.90, the comparative fit index (CFI) is > 0.90, and the root mean square error of approximation (RMSEA) is < 0.08 (Byrne, 2013). The results of the CFA indicate good fit for the measurement model with a Chi-square (X^2) of 797 and 546 degrees of freedom (df) (X^2/df=1.46; IFI=0.90; CFI=0.90; and RMSEA=0.05). In summary, all standardized item loadings indicated that the constructs exhibit convergent validity. Table I shows the purified scales, which in all cases are within the accepted limits.

[Take in Table I]

Following Fornell and Larcker (1981), we used AVE to evaluate discriminant validity. The square root of the AVE for each pair of constructs was greater than their correlation (see Table II). The square root of the AVE appears on the main diagonal of Table II and is greater than the correlations between constructs. This demonstrates the presence of discriminant validity between the constructs used in the model. In addition, following Henseler *et al.* (2015), the heterotrait-monotrait ratio of correlations (HTMT) was calculated for each pair of constructs. As Table III shows, the HTMT ratio is < 0.85 for each pair of constructs, also indicating the presence of discriminant validity.

[Take in Table II and Table III]

3.4 Common Method Variance

This study is based on a single respondent per firm. In order to avoid the problems associated with the use of a single respondent, we followed the requirements outlined by Malhotra and Grover (1998) and Krause *et al.* (2018). Specifically, Krause *et al.* (2018) explained when single-respondent research with a key informant may be considered valid in operations and supply chain management surveys, e.g. based on the cognitive perspective, key informant's role, and target concept. In addition, it should be noted that much recent research has employed a single respondent approach without affecting methodological rigor (e.g. Gligor *et al.*, 2015; Dubey *et al.*, 2018; Rojo *et al.*, 2018; Roldan Bravo *et al.*, 2018). Nonetheless, it remains important to consider whether common method bias is a concern. Therefore, we followed the steps proposed by Podsakoff *et al.* (2003). Respondents were assured that there were no correct or incorrect answers and that they were free to answer the questions in the most honest way possible. In this sense, although the respondents were answering questions related to TMS, SNF, FSCA, and OP, it was unlikely that they could have intuited the specific research model. If the research question is unknown, respondents are less able to manipulate their answers to meet expectations about the assumed relationships. In addition, the response range was broad (seven point scales) and the questions were not grouped by construct. The pretest of the questionnaire also eliminated potential ambiguities, improving the scale items.

Harman's single-factor test was also used, whereby if common method bias is a serious threat to the results then a single factor will account for most of the variance. We employed an exploratory factor analysis of all survey items, with the first factor accounting for only 26.54% of the explained variance. Since no general factor emerged that accounted for the majority of the covariance, we can conclude that common method bias is not a serious issue among our data. Alternatively, Chang *et al.* (2010) suggested using confirmatory factor analysis (CFA). Following the authors' suggestions, all survey items were charged to a single factor in the CFA and the fit statistics did not show good fit (X^2/df 4.52; IFI 0.23; CFI 0.22; RMSEA 0.14). Further, to add robustness to the single-respondent data, we correlated the OP results with secondary data from the SABI database, reaching a high and significant correlation (OP correlation based on operating profit =0.77**; OP correlation based on sales =0.56**). This verifies that the respondents were knowledgeable about the content of the survey.

4. Results

After validating the measurement model, structural equation modeling (SEM) was used to estimate all hypotheses. The SEM approach refers to a series of statistical techniques used to analyze data. SEM consists of two components, a measurement model (*see Section 3.3 Validity and Reliability of Scales*) and a structural model. The structural model shows the direction and strengths of the relationships between the variables (Hussey and Eagan, 2007*)*. SEM models have two types of variables: observed variables (also called manifest or measured), and unobserved variables (also called underlying or latent) that can be independent (exogenous) or dependent (endogenous) in nature. Latent variables are hypothetical constructs that cannot be directly measured, and in SEM are typically represented by multiple manifest variables that serve as indicators of the underlying constructs. The SEM model is an *a priori* hypothesis about a pattern of linear relationships among a set of observed and unobserved variables. The objective in using SEM is to determine whether the *a priori* model is valid, rather than to find a suitable model (Shah and Goldstein, 2006). *"The SEM method is most appropriate when theory or a priori guidelines allow the researcher to posit the relationships among the variables in the model"* (Hussey and Eagan, 2007; p.304). Our model is made up of a set of unobserved or latent variables (FSCA, TMS, SNF and OP) that were measured by multiple observed or manifest variables. Once the hypotheses proposed were theoretically justified, we used SEM to test whether the relationships between latent variables were valid.

We utilized SEM with bootstrapping (Nevitt and Hancock, 2001). As a nonparametric resampling procedure, bootstrapping uses the available data to generate an empirical approximation of the sampling distribution of a statistic. Each parameter is associated with a confidence interval (CI). The effects are significant if zero is not contained in the 95% confidence interval (Zhao *et al.*, 2010). If the confidence interval includes zero, then the hypothesis is rejected. Bootstrapping was preferred to test the hypotheses because it requires far fewer assumptions and has greater statistical power (Preacher and Hayes, 2008). It allows effect sizes to be calculated and hypothesis tests to be conducted for an estimate, even when the underlying distribution is unknown; it can test significance in small samples (Preacher and Hayes, 2008; Hayes, *et al.*, 2013); and, it is widely accepted across a variety of literatures (Huertas-Valdivia *et al.*, 2018).

To test the proposed research model, we first calculated the direct effects (*H1*, *H2* and *H4*) before following the methodology used by Gligor *et al.* (2015) to calculate the moderating effect (*H3*).

4.1 Direct Effect Results

Figure 2 depicts the results of the direct effects (*H1*, *H2* and *H4*). Results indicate a good fit for the model with a Chi-square of 1,209 and 616 degrees of freedom, IFI=0.90, CFI=0.90 and RMSEA=0.07 (Byrne, 2013).

[Take in Figure 2]

H1 was supported by the data (CR = 0.69; β_1=0.32; $p < 0.01$; IC 0.22, 1.6), indicating a direct and positive relationship between TMS and FSCA. Results also support *H2* (CR=3.21; β_2=0.25; $p < 0.01$; IC 0.08, 0.43), suggesting a direct and positive relationship between SNF and FSCA. This demonstrates that both TMS and SNF impact positively and significantly on FSCA. *H4* was also supported (CR=3.97; β_4=0.64; $p < 0.01$; IC 0.03, 0.40); hence, results provide support for the hypothesized direct and positive relationship between FSCA and OP.

4.2 Moderating Effect Results

To test the moderating effect (*H3*), we examined the interaction between SNF and TMS. The two variables were first centered to reduce the risk of multi-collinearity (Aiken and

West, 1991). Next, FSCA was regressed on SNF, TMS, and SNF×TMS. The results are depicted in Figure 3. The interaction term was significant (CR=-2.034; β_3= -0.14; $p < 0.05$; IC -0.28, -0.01) and multi-collinearity was not a problem (VIF=1.00). Results show that TMS moderates the relationship between SNF and FSCA. The interaction term was however negative meaning *H3* is not supported. This suggests that TMS has a negative moderating effect on the relationship between SNF and FSCA. We will return to this result in the forthcoming discussion.

[Take in Figure 3]

4.3 Robustness Tests

Four different methods were used to test the proposed theoretical model. First, a test of robustness was performed to ensure the proposed model does not suffer from endogeneity problems. Two alternative models were estimated and their global fit compared (Rojo *et al.*, 2016). The first model assumed that FSCA influences TMS, TMS influences SNF, which in turn influences OP. The results indicate a Chi-square of 1,258 with 617 degrees of freedom, IFI=0.87, CFI=0.87 and RMSEA=0.07. The second model assumed that TMS influences SNF, SNF influences FSCA, and finally FSCA influences OP. The results indicate a Chi-square of 1,566 with 618 degrees of freedom, IFI=0.81, CFI=0.80 and RMSEA=0.09. The estimations result for the two alternative models are included in Appendix D (figures 1 and 2). As the fit indices and appendix show, the alternative models present a worse fit than the proposed model. Therefore, the proposed model gives a better explanation of the data (Rojo *et al.*, 2016 and 2018).

Second, we tested the proposed theoretical model using moderate mediation analysis, as developed by Hayes (2013). This approach uses PROCESS, a computational procedure for SPSS and SAS, which enables statistical inferences based on the bootstrapping technique and covers the estimation of several classes of models. The moderate mediation analysis allows the main, mediation and moderation effects to be evaluated jointly. The results confirm the previously obtained findings for all hypotheses. The estimations result for the moderate mediation analysis is included in Table I, Appendix D.

Third, the theoretical model was again tested using moderate mediation analysis but with a different operational performance variable. Instead of using the operational performance extracted from the survey and measured using a seven-point Likert scale, we used an objective measure of operational performance extracted from the SABI database whereby operational performance was measured using the operating profit of the firm. Operating profit is the profitability of the business from core operations, excluding any financing or tax-related aspects, and was determined from the SABI database by subtracting operating expenses from the gross profit. This measure is particularly valuable for seeing how a business performs over a long period of time, and it is a key metric for managers to monitor because it reflects the revenue and expenses they can control. The results of the analysis (see Table II, Appendix D) indicate that the proposed theoretical relationships were maintained.

Fourth, in order to be consistent with previous studies that developed and validated the measurement scales used in this study, all scales were treated as reflective latent constructs. For reflective measurement, any changes in observed indicators are assumed to have been caused by changes in the latent construct (Churchill 1979). However, although the vast majority of studies in the field of management and OM are based on these types of measures (Xu *et al.*, 2019), it is important to note that some authors have pointed out the need to correctly distinguish between reflective and formative measurements (Lee and Cadogan, 2013; Xu *et al.*, 2019). The error in the type of measurement used can produce an inadequate specification of the models and have adverse consequences for the validity of the conclusions obtained, in addition to causing differences in the values of the routes established in structural models (Jarvis *et al.*, 2003; Podsakoff *et al.*, 2006; Diamantopoulos, 2008; Cadogan and Lee, 2013; Lee and Cadogan, 2013). Therefore, to avoid these problems, we have also tested the model whilst assuming the scales that could generate any controversy around this debate (i.e. TMS and OP) were formative measurements. All of the results maintained the previously tested hypotheses ($\beta1 = 0.37$; $p < 0.01$; $\beta2 = 0.25$; $p < 0.01$; $\beta3 = -0.24$; $p < 0.05$; $\beta4 = 0.53$; $p < 0.01$), including the mediating effect of FSCA in the SNF-OP relationship ($\beta = 0.02$; $p > 0.05$).

5. Discussion and Conclusions

As economies have changed and business dependencies have increased, the idea of having an agile supply chain has become a key ingredient for overall agility, especially in highly volatile environments (Kisperska-Moron and Swierczek, 2009). This is because firms with FSCA perform better in terms of responding to unforeseen events. However, although the literature has identified various antecedents or enablers of FSCA, and has also identified some of the outcomes associated with FSCA, there have been calls to explore other antecedents of FSCA and to further scrutinize its performance effects (Gligor *et al*., 2015; Tse *et al.,* 2016; Chan *et al*., 2017; Fayezi *et al*., 2017). From the dynamic capabilities view, this study has pursued two main goals: (i) to analyze the role of TMS and SNF as potential antecedents of FSCA, evaluating the moderating role of TMS in the SNF-FSCA relationship; and, (ii) to evaluate the relationship between FSCA and OP. This final section discusses the study's main implications for research and practice, along with its limitations and future research potential. It closes with the study's overall conclusions.

5.1 Discussion of Research Implications

The paper makes two important contributions to the operations and supply chain management literature from the perspective of dynamic capabilities. First, it extends our understanding of how a dynamic capability like FSCA can be built, evidencing the relationship between the capabilities of the firm that imply managing internal aspects of the firm (e.g. operations TMS) and managing external aspects of the firm (e.g. SNF). The identified positive relationship between TMS and FSCA (*H1*) supports the argument that high levels of TMS in the operations department encourage a dynamic capability such as FSCA. This finding is compatible with earlier studies that have shown a connection between knowledge management and dynamic capabilities (Nielsen, 2006; Fayezzi *et al.*, 2017; Gutiérrez *et al.*, 2018); Oliva *et al.*, 2019). Specifically, the development, combination and use of knowledge in the firm's operations department strengthens the firm's capability to feel and respond regularly to environmental changes, contributing to the development of FSCA. Although the benefits of TMS and the use of knowledge have been recognized in several fields (Zheng and Mai, 2013; Peltokorpi, 2014; Argote and Guo, 2016; Fayezzi *et al.*, 2017; Heavey and Simsek, 2017), TMSs in the context of supply chains have received limited attention (Cerchione, R. and Esposito, 2016). Therefore, our work validates the importance of human resources and knowledge management practices in the development of FSCA, as noted by Vázquez-Bustelo and Avella (2006). The study extends knowledge by considering the operations TMS and exploring the benefits that this can have for FSCA.

In addition, the positive relationship between SNF and FSCA (*H2*) reinforces the need to develop SNF capability to reconfigure the supply base when confronted by environmental change. This is consistent with operations and supply chain management literature that recognizes the importance of different types of flexibility for achieving FSCA (Swafford *et al.*, 2006; Swafford *et al.*, 2008; Braunscheidel and Suresh, 2009; Chan *et al.* al., 2017) whilst expanding knowledge on the flexibility-agility relationship by exploring a specific type of flexibility, i.e. SNF. Taken together, these antecedents – TMS and SNF – highlight the need to develop the firm's management capabilities, both internally and externally to achieve FSCA. The importance of these capabilities was suggested in prior studies (e.g. Vázquez-Bustelo and Avella, 2006; Braunscheidel and Suresh, 2009; Gligor *et al.*, 2015; Fayezi *et al.*, 2017; Gligor *et al.*, 2019) and is now empirically confirmed by our paper.

An important finding of this research is related to the way in which different capabilities connected to the operations of the firm interact. The negative moderation effect of TMS on the SNF-FSCA relationship (*H3*) is also important as it demonstrates how one capability could replace another. The relationship between SNF and FSCA has been shown to be weakened when a firm has high levels of operations TMS. This may be because TMS provides the firm with greater internal management capabilities, which facilitate its own adaptation to market changes. Similarly, Zheng and Mai (2013) demonstrated that a well-developed TMS reduces the need to search for external resources in responding to unexpected events. Environments with significant commercial opportunities and high uncertainty are characterized by unexpected events that require a business response, and one way of responding is to improvise. The teams with a well-developed TMS have the cognitive resources necessary to generate the required knowledge internally. Indeed, real-time integration and the application of new and pre-existing knowledge favors rapid and improvised responses to changes in the environment without needing to look externally for solutions (Zheng and Mai, 2013).

As the operations department develops its TMS, it relies less on the supply base to improve FSCA as solutions can be forged internally. Indeed, the ability to create, maintain, transfer and coordinate knowledge enables the firm to draw on its own abilities instead of consulting external parties to solve problems (Carney *et al.*, 2008). Further, improving FSCA through a firm’s internal processes encourages quick response and eliminates the costs associated with seeking out new suppliers and generating commercial transactions (Williamson, 1975). SNF involves finding the best strategic combination for product supply. This requires not only the presence of available suppliers but also the time, cost and knowledge necessary to perform a search and to select suppliers effectively and efficiently. Firms with a high level of operations TMS will thus be incentivized to invest in themselves to respond to uncertainty instead of delegating this to external agents.

Second, the study contributes to the dynamic capabilities literature by examining the relationship between FSCA and OP. The identified positive relationship between FSCA and OP (*H4*) confirms the importance of developing FSCA to improve a firm's operating measures. Prior studies have explored the relationship between FSCA and OP but considered only some dimensions of performance (Blome *et al.*, 2013; Eckstein *et al.*, 2015; Gligor *et al.*, 2015; Chan *et al.*, 2017). By considering four specific dimensions – delivery, production cost, product quality and production flexibility – our study provides a more complete understanding of the operating measures improved by FSCA. As such, this paper has added to our understanding of dynamic capabilities because performance is a key component of the theory and usually seen as the ultimate aim of dynamic capabilities (Laaksonen and Peltoniemi, 2018). It is found that FSCA is a dynamic capability capable of leading to higher operational performance due to the quality of the capabilities it alters (i.e. TMS and SNF) and the evolutionary ability of such capabilities.

These results generate solid empirical support for the dynamic capabilities literature that faces the challenge of explaining the nature of those capabilities. A dynamic capability like FSCA allows the firm to manage other capabilities that can ultimately lead to performance improvements. As mentioned above, our study responds to some recent calls to explore new antecedents of FSCA and their effects on performance (Chiang *et al.*, 2012; Blome *et al.*, 2013; Gligor *et al.*, 2015; Chan *et al.*, 2017; Fayezi *et al.*, 2017). The study allows us to understand how different firm capabilities can lead to the development of a dynamic capacity as important for business success as FSCA. The findings highlight the need to pay more attention to the connection between capabilities that the firms can manage exclusively internally and capabilities that require external management with agents that are often outside of their control. Furthermore, these findings highlight the existence of capabilities that the firm can develop to replace other capabilities. Strengthening capabilities based on the management of internal knowledge of firm operations allows replacing capabilities based on external management with suppliers.

5.2 Discussion of Managerial Implications

This study enables managers to understand how FSCA can be strengthened, including in the high-technology sector, which is characterized by the rapid renewal of knowledge and by its high degree of complexity requiring constant investment in research and continuous adaptation to the environment to survive. FSCA depends not only on a firm's internal management capability (e.g. developing a TMS in the operations department) but also on its external management with other agents in the supply chain (e.g. suppliers). Thus, managers can enhance FSCA by developing both intra- and inter-organizational resources. In terms of intra-organizational resources, this research provides evidence of how firms can improve FSCA by managing often overlooked aspects of the operations department. Managers can develop a solid TMS in the operations department by building collaborative work teams, fostering trust amongst group members, and by recruiting personnel that both specialize in a specific area and are willing to share and coordinate their individual knowledge. Such teams exhibit a greater responsive capability and can develop creative solutions to unexpected problems (Akgün *et al.,* 2006), thereby increasing FSCA. Meanwhile, in terms of inter-organizational resources, managers can develop SNF by building a network of suppliers flexible enough to adapt to changes in the environment and thus able to quickly respond to new demands. Maintaining flexible networks in uncertain environments reduces a firm's dependence on its suppliers and increases its capability to adjust supply to meet demand.

The most significant finding of this study however is related to the challenge of coordinating the two variables. That is, although SNF and TMS have a positive effect on the development of the FSCA, it is important to be aware that the existence of a solid TMS can detract from the benefits that SNF has on the FSCA. Under this premise, and given that firms have limited resources, it may be necessary to prioritize one antecedent over another. Achieving the right balance between the two will depend on multiple factors, such as the characteristics of the industrial sector in which the company operates, the type of product it develops, or the different processes that are used. In principle, generating the FSCA through the TMS in the operations department involves using its internal knowledge, improvising when there are changes and ambiguities in the environment, without facing the costs associated with searching for new suppliers and generating new commercial transactions.

In addition, the empirical evidence presented in this paper reveals the results that managers can expect from the successful implementation of FSCA-focused strategies. Developing the FSCA enables the firm to compete in an increasingly dynamic and changing environment by simultaneously improving operations dimensions such as regarding product quality, production costs, product delivery, and production flexibility. In light of these findings, there does not appear to be a trade-off between these four performance dimensions.

5.3 Research Limitations and Future Research Directions

Despite the theoretical contributions and managerial implications, the present study has certain limitations. The method for collecting information was survey research. This method requires standardized information in order to define or describe variables, or to study relationships between variables. Although we follow the recommendations developed by Malhotra and Grover (1998) and Krause *et al.* (2018) to increase the methodological rigor of the study, the approach used could suffer from some subjectivity. Like most previous studies, it is based on self-reported and single-respondent data. Thus, although we have tried to resolve this issue with appropriate analysis, the data may be less objective than in studies that use multiple respondents or that analyze objective databases. This research is conducted from the viewpoint of a single firm. Some variables however could benefit from a dyadic or triadic perspective. For example, SNF is related to the capability of the focal firm to develop collaborative relationships with its suppliers. The cross-sectional research design also limits the extent to which we can infer cause-effect relationships. This can be overcome in future research through multiple respondent and longitudinal data collection. Further, this study was conducted exclusively in the high-tech sector in Spain. High-tech firms often operate globally, i.e. their clients are markets, countries, firms and organizations around the world. Therefore, we would expect similar results in other countries of a comparable level of development and industrialization, although this needs to be verified. Beyond the high-tech sector, questions might be raised about the generality of the results; hence, caution should be exercised when extrapolating the findings to other industries. Thus, future research could evaluate whether these relationships are transferrable to other industries, e.g. with lower volatility or uncertainty.

In addition, we have focused on the TMS of the operations function whereas future research could evaluate the development of a joint TMS between buyers and suppliers and its impact on other operations performance measures. Furthermore, to measure the presence of TMS operations, we use the perspective of the operations professional. This study focused on the operations department as the unit of analysis and on operations professionals, who are likely to assess the TMS due to their “bird's-eye view” of the department in general and of the operations, behaviors, and actions of the department members in particular. Although some studies on TMS consider that using a single key informant is sufficient to measure TMS (Cabeza-Pulles *et al.*; 2017; Obayi *et al.*, 2017), the study could be enriched by the contribution of different members of the department. At the same time, it is necessary to consider that different factors can influence the development of a TMS. For example, team member familiarity and task interdependence (Chiang *et al.*, 2014) are factors that can influence the development of a TMS. Future research could incorporate these variables for a more specific understanding of the studied phenomenon. Moreover, an important aspect of agility is related to the ability to sense changes in the environment and respond to them. Our study assesses how firms can respond to these changes whereas future research could focus more on how the changes are felt or impact firms. Finally, agility is a capability that improves through repetition. Therefore, research could be conducted that considers, as a control variable, the number of times that a firm has deployed agility as this may represent a learning curve that influences future performance.

References

Aiken, L. S. and West, S. G. (1991), *Multiple regression: Testing and interpreting interactions*, Newbury Park, CA: Sage.

Akgün, A. E., Byrne, J., Keskin, H., Lynn, G. S. and Imamoglu, S. Z. (2005), “Knowledge networks in new product development projects: A transactive memory perspective”. *Information & Management*, Vol 42 No. 8, pp. 1105-1120.

Akgun, A. E., Byrne, J. C., Keskin, H. and Lynn, G. S. (2006), Transactive memory system in new product development teams. *IEEE Transactions on Engineering Management*, Vol. 53 No. 1, pp. 95-111.

Al-Shboul, M. A. (2017), “Infrastructure framework and manufacturing supply chain agility: The role of delivery dependability and time to market”, *Supply Chain Management: An International Journal*, Vol. 22 No. 2, pp. 172-185.

Anderson, J.C. and Gerbing, D.W. (1988), “Structural equation modeling in practice: a review and recommended two-step approach”, *Psychological Bulletin*, Vol. 103 No. 3, pp. 411-423.

Argote, L. and Guo, J. M. (2016), “Routines and transactive memory systems: Creating, coordinating, retaining, and transferring knowledge in organizations”, *Research in Organizational Behavior: An Annual Series of Analytical Essays and Critical Reviews,* Vol 36, pp. 65-84.

Barney, J. (1991), “Firm resources and sustained competitive advantage”. *Journal of Management,* Vol. 17 No. 1, pp. 99-120.

Baron, R. M. and Kenny, D. A. (1986), “The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations”, *Journal of Personality and Social Psychology,* Vol. 51 No. 6, p. 1173.

Blome, C., Schoenherr, T. and Rexhausen, D. (2013), “Antecedents and enablers of supply chain agility and its effect on performance: A dynamic capabilities perspective”. *International Journal of Production Research,* Vol. 51 No. 4, pp. 1295-1318.

Braunscheidel, M. J. and Suresh, N. C. (2009), “The organizational antecedents of a firm's supply chain agility for risk mitigation and response”, *Journal of Operations Management,* Vol. 27 No. 2, pp. 119-140.

Byrne, B. M. (2013), *Structural equation modeling with LISREL, PRELIS, and SIMPLIS: Basic concepts, applications, and programming,* Psychology Press.

Cadogan, J. W. and Lee, N. (2013), "Improper use of endogenous formative variables", *Journal of Business Research,* Vol. 66 No. 2, pp. 233-241.

Carney, M., Dieleman, M. and Sachs, W. (2008), “The value of social capital to family enterprises in Indonesia”, *Entrepreneurship in Emerging Regions Around the World: Theory, Evidence and Implications,* p. 297.

Cerchione, R. and Esposito, E. (2016). “A systematic review of supply chain knowledge management research: State of the art and research opportunities”. *International Journal of Production Economics*, Vol. 182, pp. 276-292.

Chang, S.J., Witteloostuijn, V. and Eden, L. (2010), “From the editors: common method variance in international business research”, *Journal of International Business Studies,* Vol. 41 No. 2, pp. 178-184.

Chan, A. T. L., Ngai, E. W. T. and Moon, K. K. L. (2017), “The effects of strategic and manufacturing flexibilities and supply chain agility on firm performance in the fashion industry”. *European Journal of Operational Research,* Vol. 259 No. 2, pp. 486-499.

Chiang, C., Kocabasoglu-Hillmer, C. and Suresh, N. (2012), “An empirical investigation of the impact of strategic sourcing and flexibility on firm's supply chain agility”, *International Journal of Operations & Production Management,* Vol. 32 No. 1, pp. 49-78.

Choi, T. Y. and Hong, Y. (2002). Unveiling the structure of supply networks: Case studies in Honda, Acura, and Daimler Chrysler. *Journal of Operations Management,* Vol. 20 No. 5, pp. 469-493.

Choi, T. Y. and Krause, D. R. (2006), “The supply base and its complexity: Implications for transaction costs, risks, responsiveness, and innovation”, *Journal of Operations Management,* Vol. 24 No. 5, p. 637.

Christopher, M. (2000). The agile supply chain: competing in volatile markets. *Industrial marketing management*, Vol. 29 No. 1, pp. 37-44.

Churchill Jr, G. A. (1979). A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research*, Vol. 16 No. 1, pp. 64-73.

Cotta, D. and Salvador, F. (2020), “Exploring the antecedents of organizational resilience practices–A transactive memory systems approach”. *International Journal of Operations & Production Management*, Vol. 40 No. 9, pp. 1531-1559.

Diamantopoulos, A. (2008). Formative indicators: Introduction to the special issue.

Dillman, D. A. (2000), “Procedures for conducting government-sponsored establishment surveys: Comparisons of the total design method (TDM), a traditional cost-compensation model, and tailored design”, *Proceedings of American Statistical Association, Second International Conference on Establishment Surveys,* pp. 343-352.

Dubey, R., Altay, N., Gunasekaran, A., Blome, C., Papadopoulos, T. and Childe, S. J. (2018). Supply chain agility, adaptability and alignment: empirical evidence from the Indian auto components industry. *International Journal of Operations & Production Management*, Vol. 38 No. 1, pp. 129-148.

Eckstein, D., Goellner, M., Blome, C. and Henke, M. (2015), “The performance impact of supply chain agility and supply chain adaptability: The moderating effect of product complexity”, *International Journal of Production Research*, Vol. 53 No. 10, pp. 3028-3046.

Fayezi, S., Zutshi, A. and O'Loughlin, A. (2017), “Understanding and development of supply chain agility and flexibility: A structured literature review”, *International Journal of Management Reviews,* Vol. 19 No. 4, pp. 379-407.

Fawcett, S.E., Waller, M.A., Miller, J.W., Schwieterman, M.A., Hazen, B.T. and Overstreet, R.E. (2014), “A trail guide to publishing success: tips on writing influential conceptual, qualitative, and survey research”, *Journal of Business Logistics*, Vol. 35 No. 1, pp. 1-16.

Fornell, C. and Larcker, D.F. (1981), “Evaluating structural equation models with unobservable variables and measurement error”, *Journal of Marketing Research,* Vol. 43 No. 1, pp. 39-50.

Gligor, D., Gligor, N., Holcomb, M. and Bozkurt, S. (2019). Distinguishing between the concepts of supply chain agility and resilience. *The International Journal of Logistics Management*.

Gligor, D. M., Esmark, C. L. and Holcomb, M. C. (2015), “Performance outcomes of supply chain agility: When should you be agile?”, *Journal of Operations Management,* Vol. 33, pp. 71-82.

Gligor, D. M. and Holcomb, M. C. (2012), “Antecedents and consequences of supply chain agility: Establishing the link to firm performance”, *Journal of Business Logistics,* Vol. 33 No. 4, pp. 295-308.

Gravier, M. (2016), *The secret to supply chain success: Agility,* Supply Chain Management Review.

Gutierrez-Gutierrez, L. J., Barrales-Molina, V. and Kaynak, H. (2018). The role of human resource-related quality management practices in new product development. *International Journal of Operations & Production Management,* Vol. 38 No. 1, pp. 43-66.

Hair, J., Black, W., Babin, J. and Anderson, R. (2010), *Multivariate Data Analysis. A Global Perspective*, Prentice Hall, Upper Saddle River NJ.

Hammedi, W., van Riel, A. C. and Sasovova, Z. (2013), "Improving screening decision making through transactive memory systems: A field study", *Journal of Product Innovation Management,* Vol. 30 No. 2, pp. 316-330.

Handfield, R. B., Ragatz, G. L., Petersen, K. J. and Monczka, R. M. (1999), "Involving suppliers in new product development", *California Management Review,* Vol. 42 No. 1, pp. 59-82.

Hartono, B., Sulistyo, S. R., Chai, K. H. and Indarti, N. (2019), "Knowledge management maturity and performance in a project environment: Moderating roles of firm size and project complexity". *Journal of Management in Engineering,* 35(6), 04019023.

Hayes, A.F. (2013), *Introduction to Mediation, Moderation, and Conditional Process Analysis. A Regression-Based Approach*, The Guilford Press, New York, NY.

Heavey, C. and Simsek, Z. (2017), "Distributed cognition in top management teams and organizational ambidexterity: The influence of transactive memory systems", *Journal of Management,* Vol. 43 No. 3, pp. 919-945.

Henseler, J., Ringle, C.M. and Sarstedt, M. (2015), "A new criterion for assessing discriminant validity in variance-based structural equation modeling, *Journal of the Academy of Marketing Science*, Vol. 43 No. 1, pp. 115-135.

Huang, C. and Chen, P. (2018), "Exploring the antecedents and consequences of the transactive memory system: An empirical analysis", *Journal of Knowledge Management,* Vol. 22 No. 1, pp. 92-118.

Huertas-Valdivia, I., Llorens-Montes, F. J. and Ruiz-Moreno, A. (2018), "Achieving engagement among hospitality employees: A serial mediation model", *International Journal of Contemporary Hospitality Management,* Vol. 30 No. 1, pp. 217-241.

Huo, B., Gu, M. and Wang, Z. (2018). Supply chain flexibility concepts, dimensions and outcomes: an organisational capability perspective. *International Journal of Production Research*, Vol. 56 No. 17, pp. 5883-5903.

Hussey, D. M. and Eagan, P. D. (2007). Using structural equation modeling to test environmental performance in small and medium-sized manufacturers: can SEM help SMEs? *Journal of Cleaner Production*, Vol. 15 No. 4, pp. 303-312.

Jackson, M., and Johansson, C. (2003), "An agility analysis from a production system perspective". *Integrated Manufacturing Systems,* Vol. 14 No. 6, pp. 482–488.

Jarvis, C. B., Mackenzie, S. B. and Podsakoff, P. M. (2003), "A critical review of construct indicators and measurement model misspecification in marketing and consumer research", *Journal of Consumer Research*, Vol. 30 No. 2, pp. 199-218.

Kaynak, H. and Hartley, J. L. (2006), “Using replication research for just-in-time purchasing construct development”, *Journal of Operations Management,* Vol. 24 No. 6, p. 868.

Kile, C. O. and Phillips, M. E. (2009), “Using industry classification codes to sample high-technology firms: Analysis and recommendations”, *Journal of Accounting, Auditing & Finance,* Vol. 24 No.1, pp. 35-58.

Kim, M. and Chai, S. (2017), “The impact of supplier innovativeness, information sharing and strategic sourcing on improving supply chain agility: Global supply chain perspective”, *International Journal of Production Economics,* Vol. 187, pp. 42-52.

Kisperska-Moron, D. and Swierczek, A. (2009), “The agile capabilities of Polish companies in the supply chain: an empirical study”. *International Journal of Production Economics*, Vol. 118, pp. 217–224.

Krause, D., Luzzini, D. and Lawson, B. (2018). Building the case for a single key informant in supply chain management survey research. *Journal of Supply Chain Management,* Vol. 54 No. 1, pp. 42-50.

Kull, T. J., Oke, A. and Dooley, K. J. (2014), “Supplier selection behavior under uncertainty: Contextual and cognitive effects on risk perception and choice”, *Decision Sciences,* Vol. 45 No. 3, pp. 467-505.

Lee, H. (2004), The triple-A supply chain. *Harvard Business Review*, Vol. 82 No. 10, pp. 102-113.

Lee, N. and Cadogan, J. W. (2013), "Problems with formative and higher-order reflective variables", *Journal of Business Research,* Vol. 66 No. 2, pp. 242-247.

Lewis, K. (2003), “Measuring transactive memory systems in the field: Scale development and validation”, *Journal of Applied Psychology,* Vol. 88 No.4, p. 587.

Lewis, K. and Herndon, B. (2011), “Transactive memory systems: Current issues and future research directions”, *Organization Science, Vol. 22 No.*5, pp. 1254-1265.

Li, Y. and Huang, J. (2013), “Exploitative and exploratory learning in transactive memory systems and project performance”, *Information & Management,* Vol. 50 No. 6, pp. 304-313.

Liang, D. W., Moreland, R. and Argote, L. (1995), “Group versus individual training and group performance: The mediating role of transactive memory”, *Personality and Social Psychology Bulletin,* Vol. 21 No. 4, pp. 384-393.

Liao, Y., Hong, P. and Rao, S. S. (2010), “Supply management, supply flexibility and performance outcomes: An empirical investigation of manufacturing firms”, *Journal of Supply Chain Management,* Vol. 46 No. 3, pp. 6-22.

Liao, Y. and Marsillac, E. (2015), “External knowledge acquisition and innovation: The role of supply chain network-oriented flexibility and organisational awareness”, *International Journal of Production Research,* Vol. 53 No. 18, pp. 5437-5455.

Lin, F. and Lin, S. (2001), “A conceptual model for virtual organizational learning”, *Journal of Organizational Computing and Electronic Commerce,* Vol. 11 No. 3, pp. 155-178.

Lummus, R. R., Duclos, L. K. and Vokurka, R. J. (2003), “Supply chain flexibility: Building a new model”, *Global Journal of Flexible Systems Management,* Vol. 4 No. 4, pp. 1-13.

Malhotra, M. K. and Grover, V. (1998). An assessment of survey research in POM: from constructs to theory. *Journal of Operations Management,* Vol. 16 No. 4, pp. 407-425.

Manders, J. H., Caniëls, M. C. and Ghijsen, P. W. T. (2017). Supply chain flexibility: A systematic literature review and identification of directions for future research. *The International Journal of Logistics Management*, Vol. 28 No. 4, pp. 964-1026.

Masson, R., Iosif, L., MacKerron, G. and Fernie, J. (2007), “Managing complexity in agile global fashion industry supply chains”, The International Journal of Logistics Management, Vol. 18 No. 2, pp. 238-254.

McKinsey & Company. (2018). How to select and develop individuals for successful agile teams: A practical guide. Retrieved from https://www.mckinsey.com/business-functions/organization/our-insights/how-to-select-and-develop-individuals-for-successful-agile-teams-a-practical-guide

McKinsey & Company. (2018). The five trademarks of agile organizations. Retrieved from https://www.mckinsey.com/business-functions/organization/our-insights/the-five-trademarks-of-agile-organizations

Mthanti, T. S. and Urban, B. (2014). Effectuation and entrepreneurial orientation in high-technology firms. *Technology Analysis & Strategic Management*, Vol. 26 No. 2, pp. 121-133.

Nevitt, J. and Hancock, G. R. (2001). Performance of bootstrapping approaches to model test statistics and parameter standard error estimation in structural equation modeling. *Structural Equation Modeling*, Vol. 8 No. 3, pp. 353-377.

Nielsen, A. P. (2006). Understanding dynamic capabilities through knowledge management. *Journal of Knowledge Management.*

Obayi, R., Koh, S. C., Oglethorpe, D. and Ebrahimi, S. M. (2017), “Improving retail supply flexibility using buyer-supplier relational capabilities”. *International Journal of Operations & Production Management,* Vol. 37 No. 3, pp. 343-362.

Ofek, E. and Sarvary, M. (2001), “Leveraging the customer base: creating competitive advantage through knowledge management”. *Management Science*, Vol. 47 No. 11, pp. 1141-456.

Oliva, F. L., Couto, M. H. G., Santos, R. F. and Bresciani, S. (2019), “The integration between knowledge management and dynamic capabilities in agile organizations”. *Management Decision*, Vol. 57 No. 8, pp. 1960-1979.

Overby, E., Bharadwaj, A. and Sambamurthy, V. (2006). Enterprise agility and the enabling role of information technology. *European Journal of Information Systems*, Vol. 15 No. 2, pp. 120-131.

Peltokorpi, V. (2014), “Transactive memory system coordination mechanisms in organizations: An exploratory case study”, *Group & Organization Management,* Vol. 39 No. 4, pp. 444-471.

Podsakoff, N. P., Shen, W. and Podsakoff, P. M. (2006). The role of formative measurement models in strategic management research: review, critique, and implications for future research. *Research Methodology in Strategy and Management*, Vol. 3 No. 1, pp. 197-252.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. and Podsakoff, N. P. (2003), “Common method biases in behavioral research: A critical review of the literature and recommended remedies”, *Journal of Applied Psychology,* Vol. 88 No. 5, p. 879.

Preacher, K. J. and Hayes, A. F. (2008), “Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models”, *Behavior Research Methods,* Vol. 40 No. 3, pp. 879-891.

Purvis, L., Gosling, J. and Naim, M. M. (2014), “The development of a lean, agile and leagile supply network taxonomy based on differing types of flexibility”, *International Journal of Production Economics,* Vol. 151, pp. 100-111.

Ren, Y. Q., Carley, K. M. and Argote, L. (2006), “The contingent effects of transactive memory: When is it more beneficial to know what others know?”, *Management Science,* Vol. 52 No. 5, pp. 671-682.

Rojo, A., Llorens-Montes, J. and Perez-Arostegui, M. N. (2016). The impact of ambidexterity on supply chain flexibility fit. Supply Chain Management: An International Journal, Vol. 21 No. 4, pp. 433-452.

Rojo, A., Stevenson, M., Lloréns Montes, F. J. and Perez-Arostegui, M. N. (2018), ”Supply chain flexibility in dynamic environments: The enabling role of operational absorptive capacity and organisational learning”, *International Journal of Operations & Production Management*, Vol. 38 No. 3, pp. 636-666.

Roldán Bravo, M. I., Ruiz-Moreno, A. and Lloréns Montes, F. J. (2018). Examining desorptive capacity in supply chains: the role of organizational ambidexterity. *International Journal of Operations & Production Management*, Vol. 38 No. 2, pp. 534-553.

Shah, R. and Goldstein, S. M. (2006). Use of structural equation modeling in operations management research: Looking back and forward. *Journal of Operations Management*, Vol. 24 No. 2, pp. 148-169.

Shekarian, M., Nooraie, S. V. R. and Parast, M. M. (2020). An examination of the impact of flexibility and agility on mitigating supply chain disruptions. *International Journal of Production Economics,* Vol. 220, p. 107438.

Shin, H., Lee, J., Kim, D. and Rhim, H. (2015), “Strategic agility of Korean small and medium enterprises and its influence on operational and firm performance”, *International Journal of Production Economics,* Vol. 168, pp. 181-196.

Stevenson, M. and Spring, M. (2007), “Flexibility from a supply chain perspective: Definition and review”, *International Journal of Operations & Production Management,* Vol. 27 No. 7, pp. 685-713.

Swafford, P. M., Ghosh, S. and Murthy, N. (2008), “Achieving supply chain agility through IT integration and flexibility”, *International Journal of Production Economics,* Vol. 116 No. 2, pp. 288-297.

Swafford, P., Ghosh, S. and Murthy, N. (2006), “The antecedents of supply chain agility of a firm: Scale development and model testing”, *Journal of Operations Management*, Vol. 24 No. 2, pp. 170-188.

Tse, Y.K., Zhang, M., Akhtar, P. and MacBryde, J. (2016), "Embracing supply chain agility: an investigation in the electronics industry", *Supply Chain Management*, Vol. 21 No. 1, pp. 140-156.

Um, J. (2017), “The impact of supply chain agility on business performance in a high level customization environment”, *Operations Management Research,* Vol. 10 Nos. 1/2, pp. 10-19.

Vázquez-Bustelo, D. and Avella, L. (2006). Agile manufacturing: Industrial case studies in Spain. *Technovation,* Vol. 26 No. 10, pp. 1147-1161.

Wang, C. L. and Ahmed, P. K. (2007). Dynamic capabilities: A review and research agenda. *International Journal of Management Reviews,* Vol. 9 No. 1, pp. 31-51.

Wang, C. H., Lu, Y. H., Huang, C. W. and Lee, J. Y. (2013), “R&D, productivity, and market value: An empirical study from high-technology firms”, *Omega,* Vol. 41 No. 1, pp. 143-155.

Wegner, D. M. (1987), “Transactive memory: A contemporary analysis of the group mind”, *Theories of Group Behavior* (pp. 185-208) Springer.

Whitten, G. D., Green, K. W. and Zelbst, P. J. (2012), “Triple-A supply chain performance”. *International Journal of Operations & Production Management*, Vol. 32 No. 1, pp. 28-48.

Williamson, O. E. (1975), “Markets and hierarchies”, *New York, 2630*

Wong, W. P. and Wong, K. Y. (2011). “Supply chain management, knowledge management capability, and their linkages towards firm performance”. *Business Process Management Journal,* Vol. 17 No. 6, pp. 940-964.

Wong, C. Y., Boon-itt, S. and Wong, C. W. Y. (2011), “The contingency effects of environmental uncertainty on the relationship between supply chain integration and operational performance”, *Journal of Operations Management,* Vol. 29 No. 6, pp. 604-615.

Xu, L., Peng, X. and Prybutok, V. (2019). Formative measurements in operations management research: Using partial least squares. *Quality Management Journal*, Vol. 26 No. 1, pp. 18-31.

Zhao, X., Lynch, J.G. and Chen, Q. (2010), “Reconsidering Baron and Kenny: myths and truths about mediation analysis”, *Journal of Consumer Research,* Vol. 37 No. 2, pp. 197-206.

Zheng, Y. and Mai, Y. (2013), “A contextualized transactive memory system view on how founding teams respond to surprises: Evidence from china”, *Strategic Entrepreneurship Journal,* Vol. 7 No. 3, pp. 197-213.

Appendices, Figures and Tables

Appendix A. Definitions of Supply Network Flexibility (SNF) of the Firm from the Literature

AUTHOR	*YEAR*	*JOURNAL*	*CONCEPT*
Liao and Marsillac	2015	*International Journal of Production Research*	Supply chain network-oriented flexibility. ➢ Supply chain network flexibility (SNF) ➢ The extent of responsive ability through the use of collaborative capabilities to reconfigure the supply base effectively and efficiently. ➢ Information-spanning flexibility (ISF) ➢ The ability of a firm to efficiently and effectively disseminate change-provoking information along the supply chain.
Purvis et al.	2014	*International Journal of Production Economics*	Supply Network Flexibility (SNF) ➢ Vendor flexibility. Refers to the flexibility related to individual vendors within the supply system. The flexibility of individual nodes. ➢ Sourcing flexibility. Refers to the ability of the system's coordinator to reconfigure a supply chain network through the selection and deselection of vendors. The ability of the focal firm to re-design (re-configure) and manage (coordinate) the supply chain (sourcing flexibility).
Liao et al.	2010	*Journal of Supply Chain Management*	Supply flexibility The extent of responsive ability through the use of supplier-specific capabilities and of inter-organizational collaborative capabilities. ➢ Supplier flexibility (SF) The extent of responsive abilities through the use of supplier-specific capabilities. ➢ Supply network flexibility (SNF)

			The extent of responsive abilities through the use of collaborative capabilities to reconfigure the supply base effectively and efficiently.
Stevenson and Spring	2007	*International Journal of Operations & Production Management*	Four-tiered hierarchy of flexibilities: floor level, plant level, firm level, network level. Supply chain flexibilities (network level) ➢ Robustness: range of market change with which the existing supply chain configuration is able to cope. ➢ Re-configuration: potential to re-align or reinvent the supply chain in response to (or in anticipation of) market change. ➢ Relationship: ability to build collaborative relationships both up- and downstream, including for new product development. ➢ Logistics potential to rapidly send and receive products cost effectively as customers and sources of supply change. ➢ Organizational ability to align (or re-distribute) skills to meet the current needs of the whole supply chain. ➢ Inter-organizational IS: ability to align information systems with existing supply chain entities to meet changing information needs.
Lummus et al.	2003	*Global Journal of Flexible Systems Management*	Supply network flexibility (SNF) Ability to add and remove suppliers and select suppliers, to select suppliers that can add new products quickly, to vary supplier relationships, and to have suppliers make volume changes.

Appendix B. Prior Literature on the Relationship between FSCA and Performance

AUTHOR	*YEAR*	*JOURNAL AND SUMMARY*	*PERFORMANCE DIMENSIONS*
Al-Shboul, M.A.	2017	*Supply Chain Management: An International Journal* *The study examines the role of delivery dependability and time-to-market on the relationship between the infrastructure framework and supply chain agility. In addition, it evaluates the impact of supply chain agility on firm performance.*	Manufacturing firm performance ➢ Market share ➢ Return on investment ➢ The growth of market share ➢ The growth of sales ➢ Growth in return on investment ➢ Profit margin on sales ➢ Overall competitive position
Chan et al.	2017	*European Journal of Operational Research* The authors study two organizational flexibility factors – strategic flexibility and manufacturing flexibility – that are critical antecedents to supply chain agility. They also evaluate the relationship between strategic flexibility, manufacturing flexibility and supply chain agility and the effect on firm performance.	FIRM PERFORMANCE Firm performance – operational excellence ➢ Product delivery cycle time ➢ Timeliness of after-sales service ➢ Productivity improvements Firm performance – customer relationship ➢ Bond with customers ➢ Knowledge of customer buying patterns Firm performance – revenue growth ➢ Increased sales of existing products ➢ Finding new revenue streams Firm performance – financial achievement ➢ Return on investment after tax ➢ Growth in return on investment

			➢ Sales growth ➢ Return on sales ➢ Growth in return on sales
Um	2017	*Operations Management Research* The paper examines the effect of supply chain agility on customer service, differentiation, and business performance.	Business performance ➢ Return on sales (ROS) ➢ Return on Assets (ROA) ➢ Market share growth ➢ Sales growth
Tse et al.	2016	*Supply Chain Management: An International Journal* The paper evaluates the antecedents of firm's supply chain agility and how this variable impacts on firm's performance.	Firm performance ➢ Return on sales ➢ Sales growth ➢ Return on asset ➢ Overall profitability ➢ Return on investment
Eckstein et al.	2015	*International Journal of Production Research* The authors investigate the effects of supply chain agility and supply chain adaptability on cost performance and operational performance.	Cost performance ➢ Manufacturing cost ➢ Inventory carrying costs ➢ Cost of transportation and handling ➢ Cost of purchased goods and services Operational performance (+) ➢ Product quality ➢ Service level ➢ On-time delivery

Gligor et al.	2015	*Journal of Operations Management* The authors examine the association between firm's supply chain agility (FSCA), cost efficiency and customer effectiveness and financial performance.	Customer effectiveness ➢ Ability to handle customer emergencies ➢ Ability to handle non-standard orders to meet ➢ special needs ➢ Ability to provide customers with real-time ➢ information about their order ➢ Stock availability ➢ Order fulfillment ➢ Order-to-delivery cycle time ➢ Order-to-delivery cycle time consistency ➢ On-time deliveries Cost efficiency ➢ Distribution costs ➢ Manufacturing costs ➢ Inventory costs Financial performance ➢ Return on Assets (ROA)
Blome et al.	2013	*International Journal of Production Research* The paper investigates the fundamental building blocks of supply chain agility, which are conceptualized as supply- and demand-side competence. The model further assesses the influence of supply chain agility on operational performance.	Operational performance ➢ Customer service ➢ Cost performance ➢ Service level performance ➢ Flexibility

Gligor and Holcomb	2012	*Journal of Business Logistics* The authors study different antecedents of supply chain agility and their relationship with operational performance and relational performance.	Operational performance A firm's ability to: ➢ Deliver undamaged orders each time ➢ Provide accurate orders at all times ➢ Meet deadlines as promised to supply chain partners
Swafford et al.	2008	*International Journal Production Economics* The paper evaluates the relationship between supply chain flexibility, information technology integration and supply chain agility. Further, it examines the effect of information technology integration and supply chain agility on performance.	Competitive business performance ➢ Return on global assets ➢ Global market share ➢ Profit margins ➢ Sales/number of employees

Appendix C. The Items Used in This Study

Transactive Memory System (TMS): Lewis (2003). With respect to the operations department of the firm:

Specialization

1. Each member has specialized knowledge of some aspect of operations.
2. I have knowledge about one aspect of the operations that no other member has.*
3. Different members are responsible for expertise in different areas of operations.
4. The specialized knowledge of several different members was needed to complete the operations projects.
5. I know which members have expertise in specific operational areas.*

Credibility

1. I was comfortable accepting procedural suggestions from other members.
2. I trusted that other members' knowledge about the project of operations was credible.
3. I was confident relying on the information that other members brought to the discussion.
4. When other members gave information, I wanted to double-check it for myself.*
5. I did not have much faith in other members' expertise.

Coordination

1. Our department worked together in a well-coordinated fashion.
2. Our department had very few misunderstandings about what to do.
3. Our department needed to backtrack and start over a lot.
4. We accomplished the task smoothly and efficiently.
5. There was much confusion about how we would accomplish the operations task.*

Supply Network Flexibility (SNF): Liao et al. (2010).

1. We have multiple supply sources for most purchased items.*
2. We are able to replace one supply source for another with low cost.
3. We are able to replace one supply source for another in a short time.
4. We can switch supply source with little negative effect on component quality and design.

Firm's supply chain agility (FSCA): Swafford et al. (2006). Please indicate the speed or quickness with which your operation's department, in conjunction with suppliers and customers, can engage in the following activities:

1. Reduce manufacturing lead times.
2. Reduce product development cycle time.
3. Increase frequency of new product introductions.
4. Increase level of customization.*
5. Adjust worldwide delivery capacity/capability.*
6. Improve level of customer service.*
7. Improve delivery reliability.
8. Improve responsiveness to changing market needs.
9. Reduce setup/changeover time.

10. Increase production capacity.
11. Decrease ramp-up time for new products.
12. Reduce delivery lead time.

Operations Performance (OP): Wong et al. (2011).

<u>Delivery</u>

1. Correct quantity with the right kind of products.*
2. Delivery products quickly or short lead-time.
3. Provide on-time delivery to our customers.
4. Provide reliable delivery to our customers.
5. Reduce customer order taking time. *

<u>Production cost</u>

1. Produce products with low costs.
2. Produce products with low inventory costs.
3. Produce products with low overhead costs.
4. Offer price as low or lower than our competitors. *

<u>Product quality</u>

1. High performance products that meet customer.*
2. Produce consistent quality products with low defects.
3. Offer high reliable products that meet customer needs.
4. High quality products that meet our customer needs.

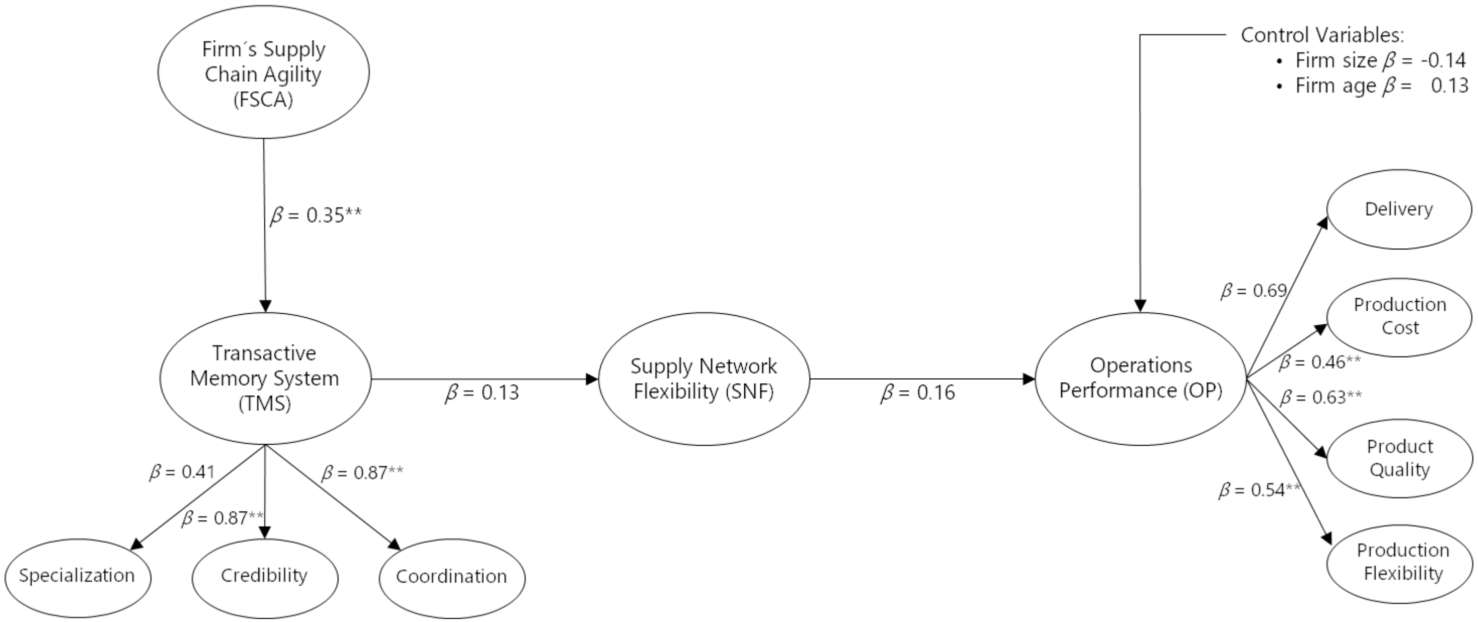
<u>Production flexibility</u>

1. Able to rapidly change production volume.
2. Produce customized product features.*
3. Produce broad product specifications within same facility.*
4. The capability to make rapid product mix changes.

Note. * items were removed to meet the reliability and validity criteria.

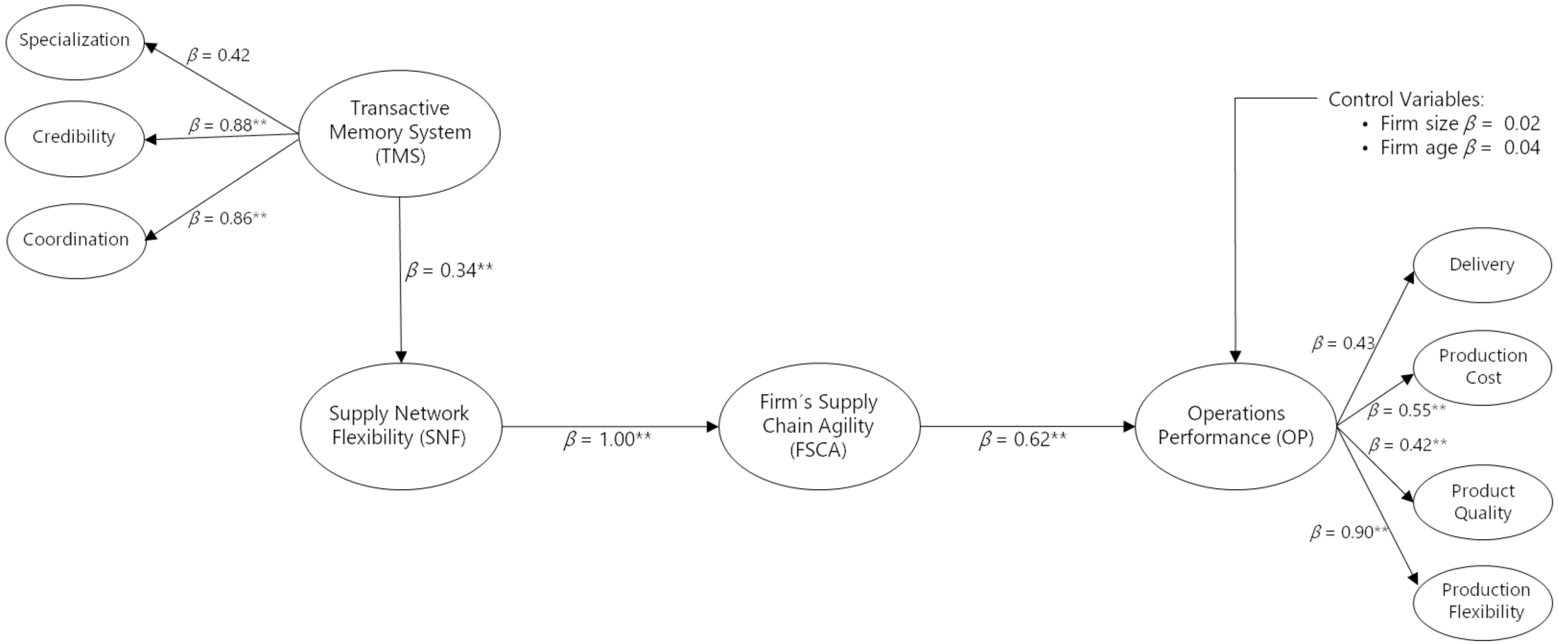
Appendix D. Tests of Robustness (Figures 1-2 and Tables I-II)

Figure 1. Alternative Model 1



Note. Significant at *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Figure 2. Alternative Model 2



Note. Significant at *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table I. Moderated Mediation Results I

	Firm´s supply chain agility			Operational performance		
	Coefficient βª (*p*)	SE	95 percent CI	Coefficient βª (*p*)	SE	95 percent CI
Constant	-1.354 (-0.280)	1.249	-3.817 ; 1.110	3.755 (0.000)	0.277	3.208 ; 4.301
Control variables						
Firm age	-0.012 (0.005)	0.004	-0.020 ; -0.004	0.007 (0.025)	0.003	0.001 ; 0.013
Firm size	-0.000 (0.004)	0.000	-0.000 ; 0.000	0.000 (0.205)	0.000	0.000 ; 0.000
Independent variable						
SNF	0.860 (0.003)	0.284	0.300 ; 1.421	0.001 (0.987)	0.047	-0.091 ; 0.093
Moderator						
TMS	1.025 (0.000)	0.233	0.566 ; 1.485			
Interaction						
SNF × TMS	-0.124 (0.019)	0.052	-0.227 ; -0.020			
Mediation						
FSCA				0.308 (0.000)	0.047	0.215 ; 0.400
R	0.531			0.452		
R^2	0.282			0.204		
F	14.442			11.885		
p	0.000			0.000		

Note. Supply network flexibility (SNF); transactive memory system (TMS); firm´s supply chain agility (FSCA); standard errors (SE); confidence intervals (CI). Significant at **p* < 0.05; ***p* < 0.01; ****p* < 0.001.

Table II. Moderated Mediation Results II (using Operating Profit as the Independent Variable)

	Firm´s supply chain agility			Operational performance		
	Coefficient βª (*p*)	SE	95 percent CI	Coefficient βª (*p*)	SE	95 percent CI
Constant	-1.354 (0.280)	1.249	-3.817 ; 1.110	-3265.681 (0.134)	2169.055	-7544.947 ; 1013.584
Control variables						
Firm age	-0.012 (0.005)	0.004	-0.020 ; -0.004	30.148 (0.199)	23.379	-15.975 ; 76.274
Firm size	-0.000 (0.004)	0.000	-0.000 ; 0.000	1.120 (0.000)	0.235	0.656 ; 1.584
Independent variable						
SNF	0.860 (0.003)	0.284	0.300 ; 1.421	-55.343 (0.880)	364.653	-774.755 ; 664.070
Moderator						
TMS	1.025 (0.000)	0.233	0.566 ; 1.485			
Interaction						
SNF × TMS	-0.124 (0.019)	0.052	-0.227 ; -0.020			
Mediation						
FSCA				730.763 (0.048)	366.781	7.151 ; 1454.374
R	0.531			0.344		
R^2	0.282			0.119		
F	14.442			6.220		
p	0.000			0.000		

Note. Supply network flexibility (SNF); transactive memory system (TMS); firm´s supply chain agility (FSCA); standard errors (SE); confidence intervals (CI). Significant at $*p < 0.05$; $**p < 0.01$; $***p < 0.001$.

Appendix E. Profile firms

Metrics	*No. of firms*	Percentage
Job function		
Operations Manager	150	79%
Quality Manager	11	6%
Project Manager	15	8%
Purchasing Manager	14	7%
Size (number of employees)		
50 or below	82	43%
51-100	44	23%
101-500	56	30%
501 or more	8	4%
Age (years in existence)		
10 or below	27	14%
11-50	155	82%
51 or more	8	4%
Industry type		
High-tech manufacturing	190	100%

Figures and Tables

Figure 1: Theoretical Framework of the Study

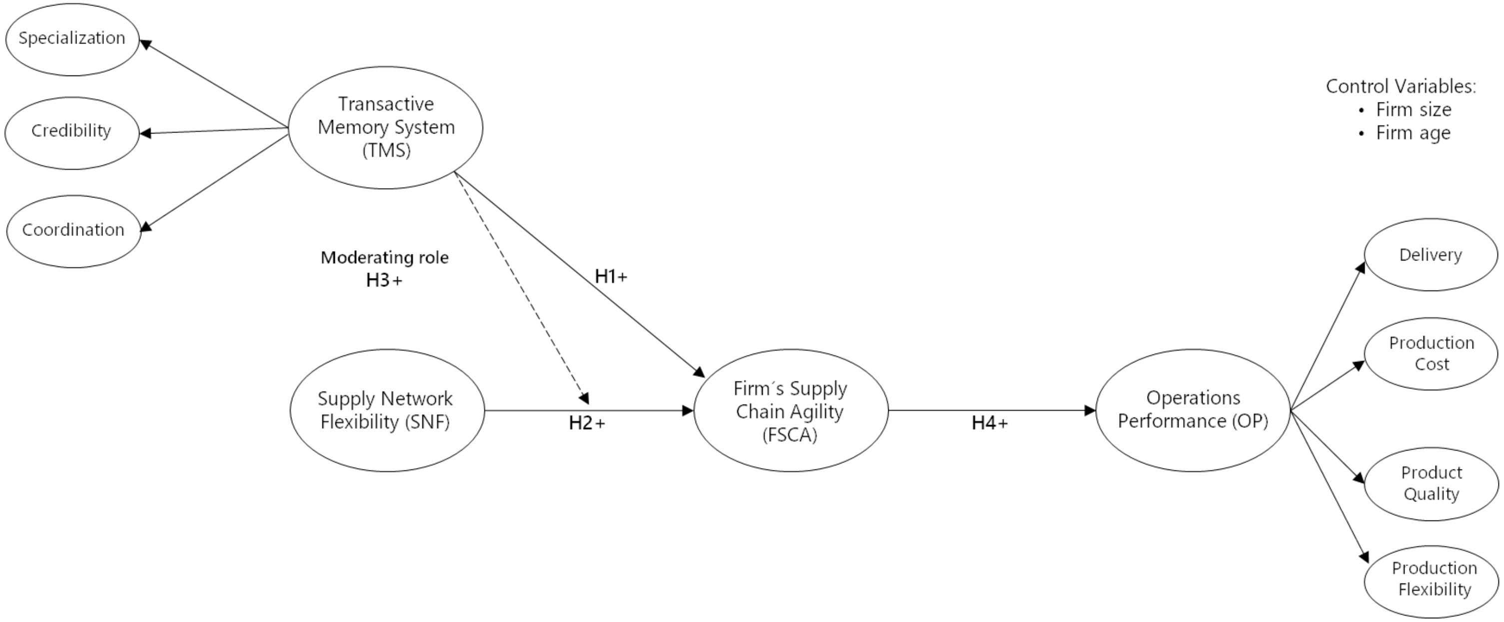
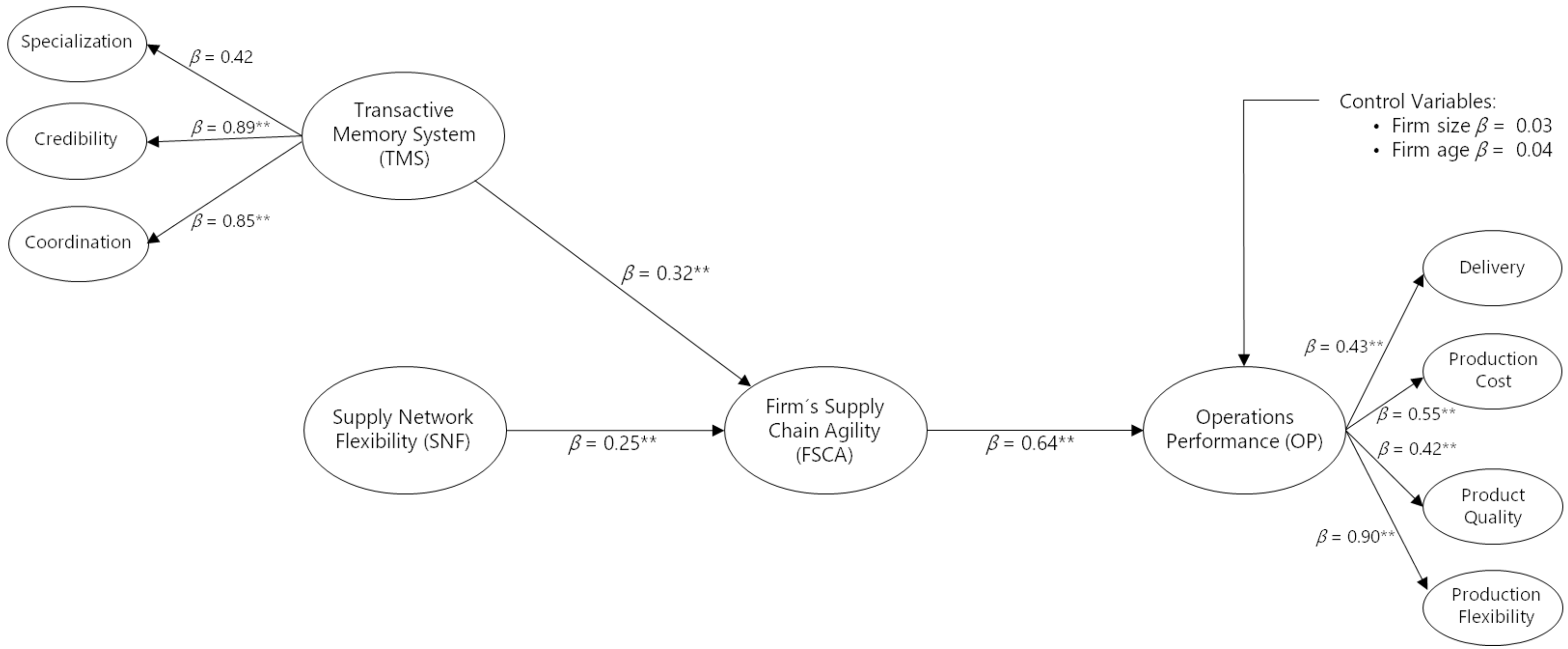
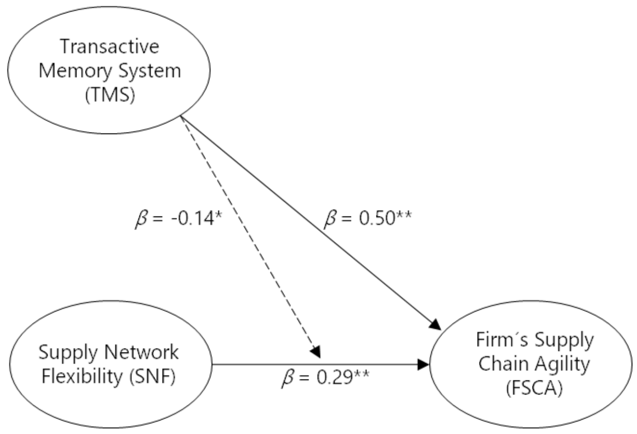


Figure 2: Direct Effect Results



Note. Significant at *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Figure 3: Moderation Results



Note. Significant at *p < 0.05; **p < 0.01; ***p < 0.001

Table I: Reliability and Convergent Validity Results

Measurement Item	Factor loading	R^2	α Cronbach	CR	AVE
Specialization (SP)			0.83	0.83	0.55
SP1	0.68	0.46			
SP2	0.80	0.64			
SP3	0.69	0.47			
SP4	0.78	0.61			
Credibility (CRE)			0.92	0.92	0.73
CRE1	0.81	0.66			
CRE2	0.87	0.76			
CRE3	0.91	0.83			
CRE4	0.83	0.69			
Coordination (CO)			0.91	0.91	0.71
CO1	0.88	0.77			
CO2	0.85	0.72			
CO3	0.84	0.70			
CO4	0.81	0.66			
Supply networks flexibility (SNF)			0.89	0.90	0.76
SNF1	0.75	0.56			
SNF2	0.93	0.86			
SNF3	0.92	0.85			
Firm´s supply chain agility (FSCA)			0.91	0.94	0.62
FSCA1	0.71	0.50			
FSCA2	0.75	0.57			
FSCA3	0.77	0.60			
FSCA4	0.74	0.54			
FSCA5	0.76	0.57			
FSCA6	0.81	0.66			
FSCA7	0.84	0.70			
FSCA8	0.83	0.70			
FSCA9	0.88	0.78			
Delivery (DE)			0.84	0.86	0.67
DE1	0.76	0.58			
DE2	0.94	0.88			
DE3	0.75	0.57			
Production cost (PC)			0.87	0.87	0.68
PC1	0.85	0.72			
PC2	0.81	0.66			
PC3	0.82	0.68			
Product quality (PQ)			0.92	0.93	0.82
PQ1	0.80	0.65			
PQ2	0.98	0.97			
PQ3	0.92	0.85			
Production flexibility (PF)			0.75	0.75	0.60
PF1	0.79	0.62			
PF2	0.76	0.58			

Note. CR = composite reliability; AVE = average variance explained. All factor loadings are significant at least 0.05 level. Goodness of Fit Statistics: : χ^2/df = 797/546 = 1.46; IFI = 0.90; CFI = 0.90; RMSEA = 0.05.

Table II: Mean Values, Standard Deviations (SDs), Average Variance Extracted (AVE), and Bivariate Correlations of Variables

	Mean	SD	1	2	3	4	5	6	7	8	9
1. Specialization	4.66	1,64	***0.74***								
2. Credibility	5.88	1.12	0.39***	***0.86***							
3. Coordination	5.79	1.06	0.30***	0.75***	***0.84***						
4. Supply network flexibility	3.90	1.29	0.01	0.07	0.12	***0.87***					
5. Firm´s supply chain agility	4.60	1.31	0.34***	0.26**	0.34***	0.28**	***0.79***				
6. Delivery	6.09	0.92	0.11	0.18*	0.42***	0.13	0.30***	***0.82***			
7. Production cost	4.26	1.65	0.03	0.06	0.09	-0.01	0.23**	0.34***	***0.83***		
8. Product quality	6.17	0.88	0.30***	0.46***	0.45***	0.12	0.21**	0.51***	0.17*	***0.91***	
9. Production flexibility	4.68	1.66	0.34***	0.10	0.16	0.13	0.61***	0.28**	0.54***	0.35***	***0.77***
10. Firm size	4.31	1.14									
11. Firm age	3.09	0.56									

Note. The AVE appears on the main diagonal in bold italics. Significant at **p* < 0.05; ***p* < 0.01; ****p* < 0.001

Table III. HTMT Ratio

	FSCA	CO	PC	CRE	DE	PF	PQ	SNF	SP
FSCA	1								
CO	0.35	1							
PC	0.22	0.10	1						
CRE	0.28	0.75	0.08	1					
DE	0.33	0.50	0.35	0.19	1				
PF	0.60	0.16	0.53	0.11	0.30	1			
PQ	0.26	0.48	0.21	0.47	0.56	0.37	1		
SNF	0.30	0.12	0.05	0.09	0.17	0.13	0.14	1	
SP	0.35	0.30	0.08	0.38	0.16	0.37	0.35	0.09	1