THE IMPACT OF SUPPLY BASE COMPLEXITY ON FIRM PERFORMANCE

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ABSTRACT

THE IMPACT OF SUPPLY BASE COMPLEXITY ON FIRM PERFORMANCE

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Supply chain complexity has become a significant concern of the companies especially in the past decade. As a response to this, there have been several studies examining supply chain complexity and performance implications. However, studies focusing on upstream supply chain complexity is rather scant. Sources of supply base complexity and their impacts on firm performance is still under-investigated. The aim of this research is to investigate the impact of supply base complexity on firm performance. Supply base complexity is conceptualized as detail (structural) and dynamic (operational) complexity. Supply base size, differentiation between suppliers, and interaction between suppliers represent detail complexity dimensions whereas long/unreliable supplier lead time and instability of suppliers represent dynamic complexity dimensions. Due to its multi-dimensional nature, supply base complexity is predicted to have varying effects on performance and firm performance is conceptualized as cost, quality, delivery, flexibility, innovation and sustainability performance. Based on survey data from 161 large companies operating in the manufacturing and service industries in Turkey, the hypotheses were empirically tested. First, this thesis empirically proves that not all sources of

supply base complexity have negative effects on firm performance. It was found that some of the supply base complexity drivers enhance firm performance. Moreover, this study also supports that the dynamic drivers of supply base complexity have a greater impact than detail complexity drivers. Additionally, the significance of each supply base complexity driver was found for six operational aspects of performance, which helps managers to determine the priorities of each driver over another in managing supply base complexity. Finally, this thesis improves the understanding of supply base complexity by distinguishing between sub-dimensions of both supply base complexity and firm performance.

Keywords: supply chain complexity, supply base complexity, supply base complexity management

ÖZ

TEDARİK TABANI KARMAŞIKLIĞININ
FİRMA PERFORMANSINA ETKİSİ

Memiş, Huriye
Yüksek Lisans, İşletme Bölümü
Tez Yöneticisi: Dr. Öğr. Üyesi Melek Akın Ateş
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Tedarik zinciri karmaşıklığı, özellikle geçtiğimiz son on yılda şirketler için önemli bir ilgi alanı haline gelmiştir. Buna cevap olarak tedarik zinciri karmaşıklığını ve performansa etkilerini inceleyen çeşitli çalışmalar yapılmıştır. Bununla birlikte, tedarik tabanı karmaşıklığına odaklanan çalışmalar oldukça yetersizdir. Tedarik zinciri karmaşıklığının kaynakları ve firma performansına etkileri halen araştırılmaktadır. Bu araştırmada, tedarik tabanı karmaşıklığının firma performansı üzerindeki etkilerinin incelenmesi amaçlanmaktadır. Tedarik tabanı karmaşıklığı kavramı detay (yapısal) ve dinamik (operasyonel) karmaşıklık olmak üzere iki alt başlıklta incelenmektedir. Tedarikçi sayısı, tedarikçilerin birbirinden farklılıkları ve tedarikçiler arasındaki etkileşim yapısal karmaşıklığı temsil ederken uzun ve güvenilir olmayan temin süreleri ve tedarikçi değişkenliği dinamik karmaşıklığı temsil etmektedir. Tedarik tabanı karmaşıklığının çok boyutlu bir kavram olması sebebiyle firma performansına değişen etkileri olacağı beklenmektedir. Firma performansı maliyet, kalite, teslimat, esneklik, inovasyon ve sürdürülebilirlik alanlarındaki performansı içermektedir. Türkiye'de üretim ve hizmet sektöründe faaliyet gösteren 161 büyük şirketten toplanan anket verileri ile hipotezler ampirik olarak test edilmiştir.

Öncelikle, bu tez, tüm tedarik tabanı karmaşıklığı kaynaklarının firma performansı üzerinde olumsuz etkisinin olmadığını ampirik olarak kanıtlamaktadır. Bazı tedarik tabanı karmaşıklığı sürücülerinin firma performansını iyileştirdiği tespit edilmiştir. Ayrıca, bu çalışma aynı zamanda tedarik tabanı karmaşıklığının dinamik kaynaklarının yapısal kaynaklarından daha büyük bir etkiye sahip olduğunu da desteklemektedir. Ek olarak, performansın altı operasyonel alanı için her bir tedarik tabanı karmaşıklığı kaynağının önemi tespit edilmiştir. Bu da yöneticilerin tedarik tabanı karmaşıklığını yönetirken tedarik tabanı karmaşıklığı kaynaklarının önceliklerini belirlemesine yardımcı olmaktadır. Son olarak, bu tez, hem tedarik tabanı karmaşıklığını, hem de firma performansının farklı alanlarına etkilerini kapsamlı şekilde inceleyerek tedarik tabanı karmaşıklığının anlaşılırlığını ve tedarik tabanı karmaşıklığı ile ilgili bilgi birikimini artırmaktadır.

Anahtar Kelimeler: Tedarik zinciri karmaşıklığı, tedarik tabanı karmaşıklığı, tedarik tabanı yönetimi

To My Beloved Family and Friends

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CHAPTER 1

INTRODUCTION

Supply chain complexity is a highly popular and strategic topic that has been paid attention by both academicians and practitioners. Supply chains becoming more complex as a result of an increased level of globalization, customer expectation and technological improvement (Brandon-Jones et al., 2015; Gao et al., 2015; Isik,2011; Lin et al.,2015; Perona and Miragliotta,2004; Vachon et al.,2009).

Globalization gives a chance for the companies to reach human and material resources at low cost, which brings a high level of outsourcing activities (Kotabe and Murray, 2004). Therefore, companies choose to work with suppliers located in different regions of the world, especially low-cost countries (Lorentz et al.,2012). However, expanding the supply chain globally has several handicaps like language and cultural differences between countries, logistics and regulatory issues that create additional complexity and uncertainty for the companies (Kavilal et al.,2017; Lorentz et al.,2012, Manuj & Sahin, 2011).

Customer's continuous expectation for new products and services shortens product life-cycles (Bode and Wagner,2015; Koste, Malhotra and Sharma, 2004). Therefore, the companies are forced to diversify and enrich their product portfolios in order to sustain their competitive position in the market (Guttner et al., 2008; Jacobs,2013; Vachon et al.,2009). Additionally, companies may enter new markets or try to respond to the market niche in order to gain a competitive advantage. It is only achieved a greater and highly differentiated product portfolio (Berman & Korsten, 2010; Fixson,

2005; Narasimhan & Das, 1999; Jacobs,2013). Although increasing the product and service portfolio provides an advantage for the company in the market, it makes the supply chain that the company deals with more complex (Bozarth et al.,2009; Jacobs,2013; Vickers & Kodarin, 2006). Moreover, it is difficult or even impossible for a company to meet all the increasing demand only with its own resources. Therefore, the company outsources the activities requiring specific knowledge and capabilities which are not in the core area of itself (Koufteros et al.,2007). Especially in technology-driven industries, suppliers are deemed as a source of innovation (Blomqvist et al., 2005; Calantone & Stanko, 2007; Nieto and Santamarı´a, 2007; Jacobs,2013). However, working with suppliers specialized in different areas leads to dependence on suppliers, which requires different management approaches that also create complexity for the buyer company (Liao and Marsillac,2015; Wagner, 2009). Therefore, organizations expand their supply chains. As the supply chain expands, it becomes more complex in terms of the number of relationships with supply chain partners, coordinating and controlling efforts required to organize all physical and information flow in order to manage operations of the company effectively and timely (Bozarth et al.,2009; Manuj and Sahin,201; Perona and Miragliotta,2004).

There are several studies in the supply chain literature state that the supply chain complexity affects the performance of the supply chain actors (Choi and Hong, 2002; Isik,2011). Some studies conclude that the supply chain complexity has a negative impact on the operational performance of the company (Bozarth et al.,2009; Kavilal,2017) whereas some of them focus on the harmful effect on financial performance (Lu and Shang,2017). Although the impact of complexity on firm performance is accepted by both practitioners and academicians and there are many studies on this issue, the topic of how supply chain complexity affects each performance area of the firm is still under-investigated. In addition, there is a limited empirical study

to what extent the supply chain complexity affects the firm's performance in specific areas and also its overall performance. Therefore, it is aimed to contribute the literature by empirically investigating the impact of supply base complexity comprising also less and newly studied dimensions on firm performance.

1.1 Research Question

The aim of this master thesis is to examine the impact of supply base complexity on firm performance in varying industries in Turkey. Therefore, the main research question is as follows:

> ***What is the impact of supply base complexity on firm performance?***

As an initial step, the sources of supply base complexity will be used in the study was determined based on an extensive literature review as Supply base size, Differentiation between suppliers, interaction among suppliers, long and unreliable supplier lead times and supplier instability. In addition, the main performance dimensions of interest of this research was determined as Cost, Quality, Delivery, Flexibility, Innovation and Sustainability.

The literature suggests that the supply base complexity affects the firm performance, however, there is no concrete findings show that how each of source of supply base complexity impacts each sub-dimension of the performance separately because of the variation in the industry or size of the company. Therefore, in this thesis, the effects of supply base complexity on firm performance was examined by considering the varying industries and firm sizes.

1.2 Research Objectives

Supply chain complexity is recognized as a critical factor that affects the performance of the company by both practitioner and academicians. Therefore, this study has theoretical and managerial objectives.

1.2.1 Theoretical Objectives

This thesis aims to empirically test the impact of supply base complexity on several dimensions of firm performance. Supply chain complexity is a subject which stream of research has been conducted. Although there are several studies on this issue, the majority of those studies examine the supply chain complexity. However, there are few studies exploring the effects of the supply base complexity, which mainly cases studies. There is a need for empirical research that examines the impacts of supply base complexity on firm performance. The link between strategic purchasing, supply chain management practices and business performance was studied by many authors.

Moreover, in the literature, the supply base size (Bozarth et al.,2009; Bode and Wagner,2014; Brandon-Jones et al.,2015 Choi and Krause,2006), the differentiation between the suppliers (Bozarth et al.,2009; Bode and Wagner,2014; Brandon-Jones et al.,2015 Choi and Krause,2006) and long and unreliable supplier lead times (Bozarth et al.,2009; Bode and Wagner,2014; Brandon-Jones et al.,2015 Choi and Krause,2006;Vachon and Klessen,2002) are the fundamental and highly discussed dimensions of supply base complexity. Almost all of the studies examining the effects of supply base complexity necessarily used these dimensions. Geographic dispersion is also a familiar dimension that many research includes as a source of supply base complexity (Bozarth et al., Bode and Wagner,2015; Brandon-Jones et al.,2015; Choi and Krause,2006; Lorentz et al.,2012). On

the other hand, although the interaction between the suppliers is acknowledged by researchers as a determinant of the firm performance, there is a limited number of studies which are conceptual studies (Choi and Krause, 2006; Jacobs,2013). Moreover, supplier instability is a dimension of supply base complexity that has just started to get attention in the literature (Lorentz et al.,2012). However, no study examines all of these supply base complexity dimensions. Therefore, this study expands the knowledge about each by examining supply base complexity dimensions comprehensively.
Therefore, as a response to these gaps, this thesis aims to improve the understanding regarding supply base complexity by distinguishing between sub-dimensions of both supply base complexity and firm performance. Another contribution is testing the hypotheses in a developing country context, among the top 500 firms of Turkey.

1.2.2 Managerial Objectives

Supply chains have become more complex because of several factors like globalization and high-level of outsourcing activities. As a result, managing the supply chain or supply base complexity has become more challenging for the companies.

In order to achieve better performance, organizations have to manage the supply chain complexity strategically. However, to understand the sources and to distinguish the impacts of complexities are critical for the companies to use the correct strategy to manage the complexity (Aitken et al.,2018; Serddarasan,2012). There are several studies investigating the effects of supply base complexity on firm performance. Most of them focus on the overall performance of the company rather than to examine each sub-dimension of performance. Also, the majority of the supply chain complexity studies are either conceptual or case studies.

Therefore, in this thesis, the impacts of supply base complexity dimensions on different sub-dimension of the performance were comprehensively examined. The findings of this study are highly informative. In fact, this study provides a guideline that helps executives for managing complexity in two different ways. On the one hand, companies supply base management policies may be determined by taking into account the supply base complexity dimensions that the firm face and their effects. On the other hand, organizations may directly focus on the specific complexity dimensions based on their performance goal since the results of this study explicitly show that any performance dimension is affected by which supply base complexity sources significantly.

CHAPTER 2

LITERATURE REVIEW

Supply Chain is a system that includes a number of different interconnected nodes and interaction between these nodes (Blackhurst et al.2004; Craighead et al.,2004; Isik, 2011). Figure 1 illustrates a simple supply chain. The supply chain can be divided into three parts which are upstream supply chain (i.e. suppliers, second-tier suppliers, etc.), downstream supply chain (i.e. retailers, warehouses, customers, etc.), and the focal company. There are several actors in the supply chain which are suppliers, focal company, warehouses, retailers and customers. Focal company is a buying company positioned at the center, and it purchases products, services or materials from its suppliers, then serves these products and services to its customers or retailers after processing. While first-level suppliers directly supply the focal company, lower-level suppliers may supply to each other or one level to suppliers. Retailers or warehouses are the actors that supply the products of the focal company in and provide for the customers. They also balance the consumption and productions in the supply chain (Handfield and Nichols,1999).

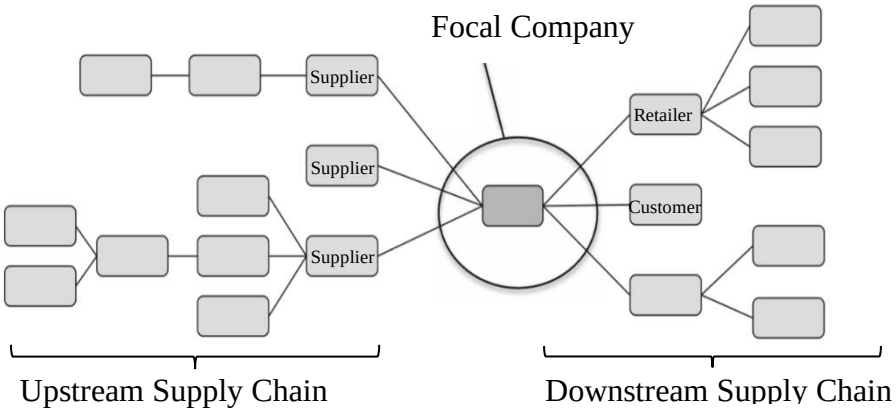

Figure 1. Supply Chain Schema

2.1 Supply Chain Complexity

This thesis focuses on complexity in the upstream supply chain, or in other words; supply base complexity. However, in order to understand the related literature, in this section, we first provide background regarding supply chain complexity, supply network complexity, and supply base complexity.

Complexity has been examined in several disciplines such as biology, computer technology, and healthcare (Auyang, 1998; Csete and Doyle,2002; Kannampallil et al.,2011; Papadimitriou,2003), and often has been conceptualized as a multi-dimensional concept. Similarly, Supply Chain Complexity is also described as a multi-dimensional concept in the literature; however, there is no consensus about the description of supply chain complexity and its dimensions. Researchers have defined supply chain complexity differently with its different dimensions based on their focuses and interest areas in their studies (Jacobs and Swink, 2011; Manuj and Sahin, 2011).

- In some studies, the supply chain complexity is conceptualized as structural and behavioral complexity dimensions. In Vachon and Klessen (2002), supply chain complexity is defined with uncertainty which is related to the number of constituents and complicatedness associated with the interaction among constituents after boiling their initial proposition comprised of numerousness, interconnectivity, and unpredictability. While the number of suppliers represents the structural side, the interaction between the suppliers represents the behavioral side of the supply chain complexity. Similarly, Choi and Krause (2006) define supply base complexity as a construct with structural and behavioral aspects. The number of suppliers and differentiation between suppliers are the structural constituents of supply base complexity, whereas the relationship among the suppliers represents the behavioral constituent.

- Some studies define the supply chain complexity as detail and dynamic complexity. (Bozarth et al.,2009). Similar to structural complexity (Vachon and Klessen,2002; Choi and Krause, 2006), detail complexity covers the number of suppliers and the degree of differentiation. In addition, detail complexity also includes the interaction between the suppliers, which means that the detail complexity comprises both structural and behavioral aspects of complexity. Moreover, they bring a new perspective by focusing on dynamic complexity dimensions which are long/unreliable lead times (Bozarth et al.; Brandon-Jones, 2015; Chen et al., 2000). Therefore, Bozarth et al., (2009) define supply chain complexity as the level of detail and dynamic complexity related to each actor and process of the supply chain. The different constituents of the supply chain represent the detail complexity, whereas the unpredictability of the system represents dynamic complexity. Serdarasan (2013) extend this classification by also distinguishing decision-making complexity.

- Supply chain complexity can also be defined by the parts of the supply chain as a combination of upstream complexity, internal manufacturing complexity, and downstream complexity (Bozarth et al., 2009). Upstream complexity represents the complexity, which arises from the first or lower-level suppliers. Internal manufacturing complexity is associated with the products and processes through the internal manufacturing phase. Downstream complexity represents the complexity that stems from the customer-side like demand fluctuation and unpredictable customer needs (Bozarth et al.,2009).

- Finally, focusing on “managing” complexity; some studies distinguish between Strategic and Dysfunctional complexity (Aitken et al., 2016; Serdarasan, 2013), arguing that in some cases complexity might be needed by the firm and may even have a positive impact on performance and competitive advantage.

• In the literature, there are also studies examining the effects of supply chain complexity with a different unit of analysis. Some studies investigate the effects of the complexity at a network level. Thus, supply network complexity is important topic studied in the literature by many scholars (Choi and Hong, 2002; Pathak et al., 2007; Tachizawa and Wong, 2015). Although the supply chain complexity research focuses on the complexity drivers stems from the actors in the supply chain or supply network, the aim is to investigate the drivers and the impact of the complexity on focal company's performance individually. On the contrarily, supply network complexity studies focus on the impact at the network level. From this point of view, all companies included in the supply network regardless of their direct or indirect connection to the focal company affect the end product of the focal company eventually Choi et al. (2001). In addition, Choi et al., (2001) characterized the supply chains differently as complex adaptive systems based on the dynamic aspects which are associated with the interconnectedness and unpredictability. Since the supply chain includes several different interconnected nodes, it is hard to predict the overall effect of any change at a point in the chain. Moreover, as the number of nodes increases, it is inevitable to observe an increase in the overall complexity of the chain because of the unpredictability characteristics (Blackhurst et al., 2004; Craighead et al., 2004). On the other hand, the summation of individual risk factors of each node causes a higher value of total risk because of the existence of an interaction between each interconnected node (Blackhurst et al., 2004; Craighead et al., 2004). Since supply chains are nonlinear systems, the effect of any change of one node on another cannot be predicted and this leads to an increase in the overall uncertainty (Blackhurst et al., 2004; Craighead et al., 2004) Moreover, there are other studies that narrow their focuses and concentrate on the only upstream portion of the supply chain (Bode and Wagner, 2015; Brandon Jones et al., 2015, Choi and Krause, 2006) In those of studies which focus on the supply base complexity, only the complexity drivers stem from the

suppliers of a focal company are investigated. Therefore, in this thesis, the impacts of supply base complexity dimensions on the firm performance were examined.

It is important to distinguish between complexity types and its drivers in order to respond and manage complexity correctly and accordingly (Serdarasan,2013; Aitken et al., 2016, 2018). There are different approaches that classify the supply chain complexity according to its characteristic, source, origin and structure. Below, we elaborate more on the distinctions discussed above.

First of all, complexity can be classified based on its characteristics as a Detail, Dynamic and Decision-Making Complexity. Most of the researchers conceptualized the supply chain complexity as detail and dynamic complexity (Bozarth et al., 2009; Isik, 2011; Vachon and Klessen; 2002). Detail complexity as the distinct number of components or parts that make up a system, while dynamic complexity refers to the unpredictability of a system's response to a given set of inputs, driven in part by the interconnectedness of the many parts that make up the system (Aitken et al., 2016; Bozarth et al., 2009; Serdarasan, 2013). Similarly, Senge (1990) defined detail complexity as being driven by the number of variables embedded in a system. However, the dynamic complexity is characterized by the ambiguity of an impact of any intervention on the system individually and overall (Senge, 1990). Moreover, Bozarth et al., (2009) showed that supply chain complexity which stems from the dynamic complexity has a more significant impact on the firm performance than complexity that arises from only detail complexity. The typical drivers of detail complexity are the number of actors in the supply chain and the degree of differentiation between the actors whereas drivers of dynamic supply chain complexity are long supplier lead times, supplier delivery unreliability, supplier instability (Bozarth et al., 2009; Lorentz et al., 2012).

In addition to these studies, few researchers propose new categorization for the complexity characteristics. Serdarasan (2013) classifies supply chain complexity in three groups. Static complexity which is related to the connectivity and structure of the subsystems, dynamic complexity that results from the operational behavior of the system and its environment, and decision-making complexity. While static and dynamic complexity corresponds to detail and dynamic complexity, decision-making complexity involves both static and dynamic aspects of complexity. Similar to the classification of Serdarasan (2013), Meylor and Turner (2017) categorize the project complexity as structural, socio-political, and emergent. It is also applicable in the supply chain context in a way that structural, emergent, and socio-political complexities represent the and static, dynamic, and decision-making complexity dimensions of the supply chains.

Secondly, supply chain complexity can be classified according to its origins. It is important to know the origins of the complexity in order to know where to intervene. In the literature, there are two fundamental approaches and corresponding complexity types are Upstream/Internal/Downstream and Internal/External/Interface. Bozarth et al. (2009) divided into three categories based on its origins namely upstream complexity, internal manufacturing complexity, and downstream complexity. Upstream complexity represents the complexity which arises from the first or lower-level suppliers whereas downstream complexity represents the complexity that stems from the customer side. Internal manufacturing complexity is associated with the products and processes through the internal manufacturing phase. Alternatively, Serdarasan (2013) divide supply chain complexity into three categories based on its origins: internal, supply/demand interface, and external/environmental drivers. Internal complexity arises from processes within the company whereas the external complexity is related to the customers or environmental conditions. Supply/demand interface complexity refers to the complexity that stems

from the material and information flows between suppliers and customers. Internal and supply/demand drivers are somewhat manageable since they remain within the span of influence and the level of coordination between supply chain partners plays a significant role when dealing with these drivers (Serdarasan, 2012).

Third, supply chain complexity is classified based on its functionality. Supply chain complexity is deemed as a negative concept that affects company's performance and organizations are faced with; however, there are many studies in the literature that suggest that a specific level of complexity is necessary and required for organizations in order to gain or sustain competitive advantage in the market (Aitken et al., 2016). Therefore, it is essential to distinguish whether complexity can be exploited in order to enhance the firm's position in the market. Because, if a company manages complexity drivers in the market effectively or better, the firm stands out one step ahead of its competitors. There are two main approaches that distinguish the functionality of complexity: Necessary/Unnecessary complexity and Strategic/Dysfunctional complexity. Serdarasan (2013) defined the necessary complexity as a complexity that the company is willing to pay in order to gain a significant competitive advantage while unnecessary complexity as a complexity that brings additional costs and efforts without providing additional benefits to the company or supply chain. Alternatively, Aitken et al. (2016) defined strategic complexity as a complexity that helps to the company to achieve better performance, whereas the dysfunctional complexity refers to complexity drivers that only prevent the company from a higher level of performance. For example, a higher level of product customization or customer heterogeneity can be a strategic complexity when the goal of the company is to reach the market niche (Aitken et al., 2016). On the other hand, product proliferation beyond the demand of existent customer segment of the company or excessive set-

up times are the examples of dysfunctional complexity (Aitken et al., 2016; Gottfredson and Aspinall, 2005).

Although there are differences between supply chain complexity definitions according to the focus of the study, the sub-dimensions of the Supply Chain Complexity are generally similar and commonly accepted. Numerousness, interaction, and unpredictability are the main characteristics that make the system complex (Simon, 1991). It is also applicable to the supply chain context. In this thesis, we focus on the upstream complexity (i.e. supply base complexity) and also distinguish between detail and dynamic complexity in the upstream supply chain.

2.2 Supply Base Complexity

Up to this point, extensive literature review on supply chain complexity was presented. In the first part, research conducted on the supply chain complexity were explained and definitions and dimensions of supply chain complexity were explained. Then, supply chain complexity is classified and explained according to its characteristics, source, and functionality from different perspectives. In this part, the research topic of this thesis, the supply base complexity is examined.

Although anecdotal evidence and prior study findings state that supply base characteristics have a significant impact on the firm performance, there is a limited number of studies examining the effects of supply base complexity (Choi and Krause, 2006; Bozarth et al., 2009; Brandon Jones et al., 2015). In addition, most of these supply base complexity studies are either conceptual or case studies (e.g. Aitken et al., 2016, 2018; Choi and Krause, 2006). On the other hand, studies often focus on a limited number of performance outcomes rather than adopting a multi-dimensional performance approach to investigate performance effects. Moreover, there

are confusing findings related to the effects of supply base complexity. Majority of the previous studies conclude that supply base complexity is a negative factor for firm performance (Bode and Wagner, 2015; Brandon-Jones et al., 2015), while some studies argued that it could be beneficial for specific performance dimension (Aitken et al., 2016; Choi and Krause, 2006; Serdarasan, 2012). Therefore, in order to fill the gap in terms of both empirical study and performance dimensions, the effects of each supply base complexity dimension on each performance dimension of the company were investigated in this thesis.

2.2.1 Supply Base Complexity Definition

Choi and Krause (2006) define the supply base as a part of the supply chain which is actively managed by a focal company. In addition, supply base complexity refers to the upstream complexity of the supply chain, which is created by large numbers of suppliers; the differentiation between the suppliers regarding technical capability, size, operational strategy; long and unreliable supplier lead-times and the broader geographic dispersion of suppliers (Bode and Wagner, 2015; Bozarth et al., 2009; Caridi et al., 2010). Considering this definition, supply base complexity is conceptualized as detail (structural) complexity comprising i) the number of suppliers, ii) degree of differentiation, iii) geographic dispersion and iv) the interaction between the suppliers, and dynamic (operational) complexity comprising i) long and unreliable supplier lead times and ii) supplier instability. In the next sub-sections, we elaborate more on these six supply base complexity dimensions and formulate hypotheses regarding performance effects.

2.2.2 Supply Base Complexity Dimensions

2.2.2.1 Supply base size

Supply base size refers to the number of suppliers that are actively managed by the focal company (Choi and Krause, 2006). Increase in the supply base size leads to increased number of information flows, physical flows and relationships that must be managed (Choi et al., 2001, Goffin et al., 2006; Wu and Choi, 2005). In addition, Bozarth et al. (2009) argued that increased number of suppliers in the supply base means the lengthening planning horizons and higher levels of safety stock for the focal company. As a consequence, the cost of the plant's purchasing and materials management activities and budget increases. Moreover, the level of coordination required to manage operations efficiently also increases (Choi and Krause, 2006; Handfield and Nichols, 1999). Therefore, the most common supply base management practice is reducing the number of suppliers, which is called "supply base rationalization" (Choi and Krause, 2006). The aim of supply base rationalization is the reduction of the costs associated with the administration and transaction and also is to obtain cost savings through the greater volume of purchases from the fewer supplier (Choi and Krause, 2006; Handfield and Nichols, 1999). These findings imply that an increase in supply base size lowers the cost performance of the firm.

Although an increased number of suppliers is often associated with lower-cost performance, there are also some studies that argue for the negative effect of a small supply base. For instance, supply base reduction practices may result in the higher dependency of the focal company on its fewer suppliers (Choi and Krause, 2006). Focal company's production capacities are quite dependent on the capacity of their suppliers (Ahuja, 2000; Choi and Krause, 2006; Handfield and Nichols, 1999). Sheridan (1999) presented the case of Deere in which the company could not meet the demand

fluctuation, although it changed its operations, but because of its suppliers could not adjust their capacities. For this reason, the number of suppliers is an advantage for the focal company for operational flexibility.
Despite few studies suggesting that more suppliers can be beneficial in terms of operational flexibility, majority of the studies argue for a negative effect of a large supply base, often due to increased transaction and coordination costs. Therefore, we formulate the following hypothesis:

> *Hypothesis 1: The higher the number of suppliers, the lower the firm performance.*

2.2.2.2 Differentiation between suppliers

One of the important characteristics of complex systems is the variation among the constituents that construct the system (Price and Mueller, 1986). Similarly, Differentiation between the suppliers is one of the fundamental supply base complexity dimensions discussed in the literature in addition to the number of suppliers in the supply base.

Differentiation between the suppliers in the supply base refers to the degree of variation among the suppliers in terms of size, technical capabilities, organizational culture and operational strategies among the suppliers. Choi and Krause (2006) suggested that higher the number of differentiated elements in the supply base results in the higher the operational load and resources. They concluded that coordinating and managing the supply chain activities associated with the suppliers which have similar characteristics and common culture would be easier for the focal company. This idea is supported by Dooley (2001), who stated that making connections between similar elements is easier than between dissimilar elements. On the other hand, Ateş et al. (2015) find that supplier heterogeneity has no effect on cost performance, whereas it has a positive effect on innovation performance, but only for some purchase categories where supply risk is low, leading to

inconclusive findings about performance effects. Although there are mixed findings about performance effects of supplier differentiation, the majority of the findings suggest a negative effect. For instance, Brandon-Jones et al. (2015) find a significant negative effect of differentiation on supply chain disruptions. Therefore, we formulate the following hypothesis:

> *<u>Hypothesis 2:</u> The higher the differentiation between the suppliers, the lower the firm performance.*

Upon reviewing literature, one can observe that supplier heterogeneity has been mostly examined in terms of geographical dispersion rather than other characteristics. In the next sub-section, geographical dispersion is examined as a separate dimension of differentiation between suppliers.

2.2.2.3 Geographic dispersion of suppliers

Globalization and high-level outsourcing activities lead companies to expand their supply chains internationally (Bozarth et al., 2009; Buckley and Ghauri, 2004; Lorentz et al., 2012). Therefore, companies select suppliers located in several regions, especially low-cost locations, of the world in order to improve their competitiveness and diminish the risk of disruption (Craighead et al., 2007; Lorentz et al., 2012; Prasad and Sounderpandian, 2003).

There are few definitions for the geographic dispersion in the literature. Stock et al. (2000) defined the geographic dispersion as how the distribution of the elements in a firm's supply chain across a wide range of geographic regions and developed an index to measure geographic dispersion. O'Leary and Cummings (2007) suggested that geographic dispersion can be defined in spatial terms regarding physical distances. While Bozarth et al. (2009) used the percentage of purchases made in the home country as a measure of geographic dispersion, Brandon-Jones et al. (2015) and Lorentz et al.

(2012) used the dispersion index developed by Stock et al. (2000) by adopting the equation in accordance with the number of different regions used in the study.

As the supply base of the company extends globally, several problems may emerge. Firstly, an increase in the geographic dispersion of the supply base leads to the higher costs associated with warehousing, logistics, logistics administration and regulations (Lorentz et al., 2012; Platts and Song, 2007; Song et al., 2007). As a consequence, the cost performance of the focal company decreases when the level of geographic dispersion increases. On the other hand, it is also stated that sourcing some items globally provides a cost-saving for the company and thus results in better cost performance.

Second, the geographic dispersion of the suppliers is also argued to affect the quality performance of the firm negatively. Lorentz et al. (2012) concluded that the increased geographic dispersion results in the diminished perfect order fulfillment, including the quality of products and conformance specifications. Also, Wang et al. (2011) argued that low-cost country sourcing leads to quality problems. Moreover, Kadipasaoglu et al. (1998) stated the significant differences in manufacturing practices of the different countries, which may cause several problems to catch common quality standards. These findings lead to the conclusion that, as the geographic dispersion of supply base increases, the quality performance of the firm decreases.

Third, increased geographic dispersion of supply base results in lengthening the response time of the suppliers (Platts and Song, 2007; Song et al., 2007), longer and uncertain lead times (Cho and Kang, 2001), decreased perfect order fulfilment and increased order fulfilment cycle time (Lorentz et al., 2012). Also, globally sourced goods lead to longer supply chains in physical and there are limited shipment options for those of goods. For all of these

reasons, if the focal company does not control and coordinate the process of transportation carefully, it suffers from difficulty adhering to production schedules, which decreases the delivery performance of the firm (Cho and Kang, 2001; Lorentz et al., 2012; Song et al., 2007).

Furthermore, globally dispersed supply base can be accepted as a source of operational flexibility. Companies may purchase random surge products from near-shore locations with rapid response times, which improves not only the flexibility performance but also the delivery performance of the firm (Allon and van Mieghem, 2010; Christopher et al., 2006).

Since there are contrasting findings about the effects of the geographic dispersion on firm performance, considering the common belief on the overall adverse effects of supply base complexity on performance, the following hypothesis was presented:

> *Hypothesis 3: The more geographically dispersed the suppliers, the lower the firm performance.*

2.2.2.4 Interaction among the suppliers

Studies in the complexity literature have necessarily used the interaction attribute in order to describe the complex systems (Casti, 1979; Simon, 1991; Yates, 1978). Similarly, the interaction between the suppliers is also an important driver of supply chain complexity. However, supplier-supplier relationships have recently become a topic that researchers began to pay attention to in the supply chain complexity literature (Choi and Krause, 2006; Wu, 2003; Wu and Choi, 2005). Since data should be collected at the supply network level because of the dyadic nature of the relationships (Brandon-Jones et al., 2015; Choi and Krause, 2006), there is limited study exploring the impact of interaction among the suppliers on firm performance.

There are multiple types of relationships between the suppliers of the focal company. There can be a buyer-supplier relationship between these suppliers, and they may supply components or products to each other. Alternatively, these suppliers may be competitors; and even the firm they compete for can also be one of the firms in the supply base of the focal company (Choi and Krause, 2006; Wu and Choi, 2005). As a result, the complexity arising from these inter-relationships prevents the focal company from achieving better performance. Vachon and Klassen (2002) argued that interconnectivity of the supply chain elements acts as an antecedent of the complicatedness that affects the delivery performance of the firm negatively. Choi and Krause (2006) argued that the focal company having highly interacting suppliers face many challenges in supply base management. This idea is restated by Caridi et al. (2010) with a conclusion that the focal company whose supply base consists of independent suppliers instead of inter-linked suppliers, would be able to better manage its supply base with lower-level complexity due to the lack of operational load caused by the interaction. Therefore, additional administrative activities lower the cost performance of the firm.

On the other hand, Choi et al. (2002) proposed an alternative point of view stating that better communication and information exchange in a cooperative supplier-supplier relationship results in improved conformance to the product specification, better production quantity and better delivery timing. In this case, the supplier-supplier relationship becomes a desired complexity for the focal company to achieve better quality, delivery and flexibility performance (Choi et al., 2002; Choi and Krause, 2006). This view is not as pronounced as the former view; therefore, in line with the majority of the studies we predict a negative effect as well and formulate the following hypothesis:

<u>Hypothesis 4:</u> The higher the interaction among the suppliers, the lower the firm performance.

2.2.2.5 Long and unreliable supplier lead times

Long and Unreliable Supplier Lead Times is another critical supply base complexity dimension highly discussed in the supply chain complexity literature (Bozarth et al., 2009; Brandon Jones et al., 2015). However, long and unreliable lead times differ from the previously explained supply base complexity dimensions. While supply base size, differentiation between the suppliers, and interaction among suppliers are the drivers of detail/structural supply base complexity, long and unreliable supplier lead times is accepted as an essential source of dynamic/operational complexity in the supply base (Bozarth et al., 2009; Brandon Jones et al., 2015; Serdarasan, 2012).

Chen et al. (2000) suggested that the impact of any delays in supplier lead times will be huge on the focal company's performance as a result of the bullwhip effect. Therefore, the unpredictability of the ultimate effects of lengthening lead times creates additional complexity in making supply chain decisions (Blackhurst et al., 2004; Manuj and Sahin, 2011; Serdarasan, 2012). Moreover, Vollman et al. (2005) stated that long and unreliable supplier lead times not only increase the level of dynamic complexity but also detail complexity. As a result of long and unreliable lead times, companies are forced to plan their production schedules and material management processes at longer horizons and in more detail, which raises the level of detail complexity (Bozarth et al., 2009; Vollman et al., 2005).

The findings of supply chain complexity literature show that long and unreliable lead times have significant adverse effects on all performance dimensions of the company (Bozarth et al., 2009; Brandon-Jones et al., 2015; Chen et al, 2000; Vachon and Klessen, 2002). Bozarth et al. (2009) find a significant negative effect of longer lead times on unit manufacturing

cost, schedule attainment, and plant-level competitive performance which is multi-dimensional, including quality, flexibility, and innovation performance of the firm. Brandon-Jones et al. (2015) suggested a significant adverse effect of long and unreliable lead times on the plant performance by increasing the frequency of supply chain disruptions. Therefore, the following hypothesis was formulated:

> *Hypothesis 5: The longer and unreliable the lead times, the lower the firm performance.*

2.2.2.6 Supplier instability

In addition to examining long and unreliable supplier lead times as a source of dynamic complexity in the supply base, we examine another related dynamic complexity characteristic: supplier instability, which is also a significant source of supply base complexity. In the literature, the majority of the studies exploring the effects of supply base complexity on firm performance focuses on the number of suppliers, the degree of differentiation and interaction between the suppliers, and long and unreliable lead times. However, there is a limited number of studies related to the effects of supplier's instability on firm performance in the supply chain complexity context.

Gao et al. (2015) defined supplier stability as the extent to which the focal company changed its suppliers over the last year. Kamp (2005) describe the supplier instability as the occurrence of supplier substitutions on a buyer-specific network. Moreover, the orientation of the focal company for the relationship between the suppliers also refers to supplier stability or instability.

There are several factors that lead to the instability of suppliers. These factors can stem from either the focal company or suppliers. Each

organization employs different supply chain management approaches based on its size, internal structure and operations; and industry (Tan et al., 2002). These supply base management practices may alter in order to respond to the changing market and environmental conditions (Aitken et al., 2018, Manuj and Sahin, 2011; Tan et al., 2002). Besides, the suppliers may not sustain its performance at the desired level of the focal company, or there may be some regulation constraints preventing suppliers from supplying products and services to the focal company.

As a consequence, the focal company may switch its suppliers to maintain its operations and prevent possible disruptions. However, as the frequency of change in suppliers increases, supply base complexity increases in parallel with the instability. The switching supplier requires a considerable amount of time and energy to adapt a new supplier to the focal company's system (Choi and Krause, 2006). In their study, Krause and Handfield (1999) illustrated that Electronix made a minimum two-year investment to the company to understand what is to be an Electronix supplier each time they change a supplier. Moreover, short-term orientation in the relationship with suppliers leads to the probability that suppliers behave opportunistically; it affects the cost performance of the focal company negatively (Tachizawa and Wong, 2015). Also, changing suppliers frequently brings administration costs associated with adaptation, visiting, establishing a relationship (Richardson,1993). The company will lose fixed costs invested in the suppliers at each change unnecessarily. Kamp (2005) concluded that the supplier instability results in the network instability, which induces costs and insufficient added value for the overall competitiveness. Therefore, the conclusion that supplier instability has adverse effects on cost performance was reached.

If the focal company's management practices with suppliers are often short-term, and the focal company changes its suppliers frequently, the inputs of

the focal company's end-product will not be the same (Song et al., 2012). The standard manufacturing and control practices of the focal company may not be captured quickly by the new suppliers. As a result of these frequent changes in suppliers as well as their inputs, the focal company may not maintain the same standard quality performance (Song et al., 2012). Furthermore, supplier instability has adverse effects on flexibility performance of the firm.

Based on those findings illustrating the negative impacts of supplier instability, the following hypothesis was formulated:

> *Hypothesis 6: The higher the instability of suppliers, the lower the firm performance.*

This study aims to investigate the impact of each supply base complexity dimension on individual performance dimension of the firms. Up to this point, six hypotheses representing the adverse effects of each supply base complexity dimension on firm performance was formulated since there is not enough study and findings on the effects of each supply base complexity dimension on a single performance dimension. However, in this study, the impacts supply base complexity were examined on six operational performance sub-dimensions which are Cost, Quality, Delivery, Flexibility, Innovation and Sustainability. Therefore, since the majority of the studies suggested the supply chain complexity is a negative phenomenon, six hypotheses which are in line with this point of view was expanded by considering each performance dimensions. Therefore, a total of 36 hypotheses of this study presented in Table 1.

Table 1 Hypotheses of the study

	Cost Performance	**Quality Performance**	**Delivery Performance**	**Flexibility Performance**	**Innovation Performance**	**Sustainability Performance**
Supply base size	H1.a	H1.b	H1.c	H1.d	H1.e	H1.f
Differentiation between the suppliers	H2.a	H2.b	H2.c	H2.d	H2.e	H2.f
Geographic dispersion	H3.a	H3.b	H3.c	H3.d	H3.e	H3.f
Interaction among the suppliers	H4.a	H4.b	H4.c	H4.d	H4.e	H4.f
Long and unreliable supplier lead times	H5.a	H5.b	H5.c	H5.d	H5.e	H5.f
Supplier instability	H6.a	H6.b	H6.c	H6.d	H6.e	H6.f

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Research Approach

In the literature, many conceptual studies and case studies have been conducted on the effect of supply chain/base complexity on firm performance. However, although these studies improve our understanding of the outcomes of supply base complexity, many contrasting arguments have been proposed. While the majority of these studies concluded that complexity has negative effects on firm performance, some studies state that complexity is beneficial for some performance dimensions. In this study, a comprehensive approach is adopted with the aim to examine multiple dimensions of both SBC and firm performance. Therefore, theory testing approach is adopted in this thesis in order to investigate the relationship between the supply base complexity and firm performance. Based on the fundamental theories on the supply chain/supply base complexity literature, hypotheses were derived. Theory testing is an important methodology since it evaluates the theories according to real-life observations and data.

This research is a correlational study. The aim of the correlation studies is to examine how constructs are related to each other and the significance of this relationship between these constructs by measuring the strength of the relationship. This thesis aims to evaluate the relationship between supply base complexity and performance.

In this thesis, a survey approach was used for data collection. An online questionnaire was constructed to collect information about the supply base

characteristics and performance of the firm. Since the aim of this study is to collect data from the largest 500 companies in Turkey, the questionnaire was quite advantageous in data collection stage by facilitating to reach several respondents in a short time. Additionally, questionnaires have the advantage of minimal researcher interference and creating the same settings and questions for each respondent. Moreover, this study is also a cross-sectional study. The cross-sectional studies provide an advantage to the researchers by facilitating the collection of data associated with more than one variable at a specific point in time.

3.2 Research Design

3.2.1 Unit of Analysis

The main purpose of this research is to investigate the relationship between the supply base complexity and firm performance in detail; therefore, the unit of analysis is the firms. More specifically, the unit of analysis of this study can be defined as the large firms operating in Turkey. The list of the first 500 companies of Turkey, "Capital 500 – Turkey", published as a result of the study conducted by CAPITAL magazine is determined as the target population of this study. The experienced employees who are working in the Purchasing, Supply Chain Management and Logistics departments of the company are the main participants of this study.

3.2.2 Sampling Design

Supply base complexity has become an important subject for both academicians and companies since the complexity is considered as a determinant of the firm performance in an environment with an increased level of globalization and outsourcing (Lorentz et al., 2012; Tan et al., 2002). For this reason, several studies have been conducted investigating

complexity in the supply chain context in developed countries. However, this issue has not been yet adequately studied in developing countries. Therefore, it is remarkable to study Turkey as one of the important representatives of developing countries.

The primary sample of this thesis is determined as the large companies operating in Turkey. In order to specify the large companies, the studies of the business magazines and İstanbul Chamber of Industry were examined. Since the large companies list of İstanbul Chamber of Industry includes only the manufacturing firms, not the other industries, the study of Capital magazine was selected. The first 500 companies of Turkey announced by Capital Magazine, "Capital 500 – Turkey", was determined as the sample of this study. These companies operate in a wide variety of industries such as automotive, electrical and electronics, foods and beverages, defense, energy, petroleum, textile, construction, iron, steel, fast-moving consumer goods, retail, sales and marketing, and service industry.

Although the list of "Capital 500 – Turkey" revealed the large companies in Turkey, there are also many other global companies operating in Turkey, but not included in the list. For this reason, a purposive sampling method was selected as an additional sampling method. Therefore, purchasing and supply chain executives of these global companies were also targeted to be reached. Since the purpose of the research is to investigate the impact of supply base complexity on firm performance, the most accurate and reliable responses can be collected from the executives in the purchasing and supply chain departments of the company (Etikan, Musa, & Alkassim, 2016). This method is called as an expert sampling. In conclusion, 525 companies including 490 companies from Capital 500 – Turkey list (Names of ten companies were not disclosed) is determined as the target sample of this study.

In this study, only an online electronic survey was used for the data collection. The online-questionnaire link was sent to the participants in different ways. First, the colleagues and friends who are working in the companies on the list of Capital were contacted. The aim of the study was explained and they were asked to help for purchasing and supply chain experts of their firms to participate in the study. Then, previously prepared e-mails including the online-survey link were sent to the participants. The e-mail template includes a brief description and aim of the study, an explanation that emphasize the privacy of their answers and thanks for their support in the study. Secondly, the operator of the companies was called to reach the people from purchasing and supply chain management departments. After contacting the related person from these departments, they were informed about this study and then e-mails were sent to them. Moreover, for the companies that cannot be contacted via phone calls, a new email template was prepared to send their info-mail addresses. Lastly, some of the participants who are purchasing manager, supply chain manager, supply chain director mostly were reached via LinkedIn.

As a result of intensive efforts, data was collected from 183 participants who are the employees in the function of Purchasing, Supply Chain, Logistics of the companies and others albeit in small numbers. However, some of the participants completed the survey are working in the same company, which means that there are some companies have multiple respondents in the study. For those of multiple respondent companies, the response of the participants who are working in the unrelated department relative to the procurement and supply chain department was eliminated. Then, the average of the responses was used as a score of the company. After arranging the multiple respondent companies, a total of 161 large-size companies, including 130 companies from “Capital 500 – Turkey” list and 31 companies from purposive sampling methods were examined in this

study. In total 525 companies were tried to reach, and 161 firms participated in the study, resulting in a response rate of 30.6%.

3.3 Measurement

The survey used in this study was constructed based on an extensive literature review. The questionnaire consists of two parts (see Appendix B). At the beginning of the survey, there is a cover page where the aim of the study is briefly described and the voluntary basis of the study is reminded. The first part of the questionnaire contains questions for several measures. Initially, the demographic information of the participants and the experience of the participants in their firm and Purchasing and Supply Chain Management function are involved. There are also questions about the ratio of purchases to total spending and the distribution of domestic and foreign suppliers. The second part consists of questions about supply base complexity and firm performance.

Supply base complexity dimensions, *Supply base size (SIZE), Differentiation between the suppliers (DIFF), Geographic Dispersion (DISP), Interaction among the suppliers (INT), Long and/or Unreliable Lead Times (LEAD) and Supplier Instability (INSTAB),* were measured by asking participants the extent to which they agree with the given statements. Therefore, the scale with an option ranging from "1: strongly disagree" to "7: strongly agree" was used.

Firm performance is measured individually in terms of *Cost (COST), Quality (QUAL), Delivery (DEL), Flexibility (FLEX), Innovation (INNOV) and Sustainability (SUS)* by comparing the past three years' performance with the industry average. Therefore, the scale with an option ranging from "1: much worse" to "7: much better" was used in these constructs.

Most of the items in the questionnaires are adopted from the existing measures used in previous researches in the literature, in such a way that it is aimed to increase the reliability and validity of the study. In the following sub-sections, the constructs representing the supply base complexity and performance dimensions are explained briefly. Then, the items and articles that the items were taken from are mentioned.

3.3.1 Supply Base Complexity

Supply base complexity is measured with six constructs: Size, differentiation, geographic dispersion, interaction, long and/or unreliable lead time and supplier instability.

Upstream supply chains are considered more complex if they involve more actors which are dissimilar, geographically more dispersed, highly interacted with each other and more unstable; and the lead-times are long and/or unreliable (Bozarth et al., 2009; Choi and Krause, 2006).

3.3.1.1 Supply base size

The size of the supply base of the company is measured on a two-item scale adapted from Brandon-Jones et al. (2015), encompassing an item about the number of suppliers and another item about the overall perceptions.

3.3.1.2 Differentiation between suppliers

The degree of differentiation is measured on a four-item scale adapted from Brandon-Jones et al. (2015) covering the size, technical capabilities, organizational cultures and operational strategies of the suppliers.

3.3.1.3 Geographic dispersion of suppliers

To measure geographic dispersion, the index developed by Stock, Greis, and Kasarda (2000) and used by Brandon-Jones *et al.* (2015) was adapted in this study. In the questionnaire, the respondents were asked to specify the percentage of their suppliers located in Turkey, Europe (except Turkey), Asia, North America, and other regions. Then, the dispersion was calculated using the following formula:

$$\mathbf{DISP} = \mathbf{1} - \frac{(\boldsymbol{Turkey}\% - \mathbf{20}) + (\boldsymbol{Europe}\% - \mathbf{20}) + (\boldsymbol{Asia}\% - \mathbf{20}) + (\boldsymbol{N.America}\% - \mathbf{20}) + (\boldsymbol{Other}\% - \mathbf{20})}{\mathbf{160}}$$

The dispersion value has a range from 0 to 1. The dispersion value of 0 shows that all suppliers are located in Turkey whereas the value of 1 means that all suppliers are distributed equally to all five regions.

3.3.1.4 Interaction among the suppliers

Interaction among suppliers is measured on a three-item scale that contains the communication and information sharing between the suppliers and the condition of working on the joint-project. The scale is adapted from Chen, Paulraj, & Lado (2004) and Corsten & Felde (2005).

3.3.1.5 Long and unreliable supplier lead times

Long and unreliable supplier lead time is measured on a two-item scale adapted from Bozarth et al. (2009) containing the length of lead times and reliability of given lead times.

3.3.1.6 Supplier instability

The scale for supplier instability was adapted from Gao et al. (2015) and A two-item scale covers the orientation of the focal company for the relationship with suppliers and to what extent the focal company changed its suppliers.

3.3.2 Firm Performance

Firm performance is measured with six different dimensions which are highly discussed performance dimensions in the literature: *Cost, Quality, Delivery, Flexibility, Innovation, and Sustainability.* In this study, firm performance refers to the purchasing performance of the company regarding the cost, quality, delivery, flexibility and sustainability performances resulting from the suppliers, although firm performance is consisting of a company's performances in different areas such as marketing, finance, operations, social and environmental. Therefore, in this thesis, firm performance is operationalized in a way that it only considers the operational aspects of performance.

3.3.2.1 Cost performance

The cost performance measure is adapted from Luzzini et al. (2012) and it is a two-item scale that includes product/service unit prices and the total cost of purchased inputs.

3.3.2.2 Quality performance

The quality performance measure is adapted from Bozarth et al. (2009). The three-item scale focuses on the quality, conformance to specifications and functionality of purchased items.

3.3.2.3 Delivery performance

The delivery performance measure is adapted from Bozarth et al. (2009). The two-item scale assesses supplier accuracy in delivery dates and quantities, and supplier lead time.

3.3.2.4 Flexibility performance

The flexibility performance is measured on a two-scale item adapted from Bozarth et al. (2009) including the ability to change product mix/volume and the ability to change capacity.

3.3.2.5 Innovation performance

The innovation performance is measured on a two-scale item adapted from Brandon-Jones et al. (2015) that assesses the rate and the speed of new product/service introduction with suppliers.

3.3.2.6 Sustainability performance

The sustainability performance of the firm is measured with a two-item scale adapted from Brandon-Jones et al. (2015). The scale contains environmental compliance and social and ethical compliance from suppliers.

3.3.3 Control Variables

The firm size, industrial sector and the ratio of purchasing expenses to the total expenditures are used as control variables in this study. Therefore, the effect of economies of scale, the different competitive and operational conditions of each sector and the importance of purchasing in the organization were controlled with these variables (Gonzalez-Benito, 2010).

3.3.3.1 Firm Size

Firm size is measured in the logarithm of the number of full-time employees (FTE) working in the organizations.

3.3.3.2 Industry

In this study, there are 161 participant companies, including 130 from the list of Capital Magazine and the 31 from the purposive sampling method. In the list of "Capital 500 – Turkey", an industry of each company is given. For the other companies, the industry of the companies is specified based on the industry classification of "Capital 500 – Turkey". In summary, there were 39 different industries where the participant companies of this study are operating in. However, it was not feasible and also meaningful to include these number of different industries to the study. For this reason, the companies were grouped under a more condensed set of sectors including manufacturing, energy-oil, construction, retail, services, and others. Manufacturing was accepted as a base industry and all analysis was made reference to the manufacturing industry.

3.3.3.3 The ratio of purchasing expenses to total expenditures

In the questionnaires, the participants were asked to specify the ratio of purchasing expenses to the total expenditures of their companies. This ratio is accepted as an indicator of the importance given to the purchasing practices in the firm (Chen et al., 2004). Basically, it was assumed that as the ratio of purchasing expenses to the total expenditures increases in the firm, it becomes an important subject and purchasing activities and issues get the necessary sources and attention.

Table 2 Survey Questions

CONSTRUCTS		REFERENCE ARTICLES
Size of the supply base (SIZE)		
SIZE1	We have a complex supply base.	Brandon-Jones *et al.*, 2015
SIZE2	We have a lot of suppliers.	Brandon-Jones *et al.*, 2015
Differentiation between suppliers (DIFF)		
DIFF1	Our suppliers are of similar size.	Brandon-Jones *et al.*, 2015
DIFF2	Our suppliers have similar level of technical capability.	Brandon-Jones *et al.*, 2015
DIFF3	Our suppliers have similar operational strategies.	Brandon-Jones *et al.*, 2015
DIFF4	Our suppliers have similar organizational culture.	Brandon-Jones *et al.*, 2015
Interaction between the suppliers (INT)		
INT1	Our suppliers communicate with each other.	Chen, Paulraj, and Lado 2004
INT2	Our suppliers share information with each other.	Chen, Paulraj, and Lado 2004
INT3	Our suppliers collaborate with each other on joint projects.	Chen, Paulraj, and Lado 2004; Corsten and Felde,2005

Table 2 (cont'd)

CONSTRUCTS		REFERENCE ARTICLES
Long and Unreliable Supplier Lead Times (LEAD)		
LEAD1	We can depend on on-time delivery from suppliers in this supply chain.	Bozarth *et al*., 2009
LEAD2	We can depend on short lead-times from suppliers in this supply chain.	Bozarth *et al.* 2009
Supplier Instability (INSTAB)		
INSTAB1	We have changed the high proportion of our suppliers in the past two years.	Gao *et al.*, 2015
INSTAB2	We have short-term relationships with our suppliers in general.	Gao *et al.*, 2015
Cost Performance (COST)		
COST1	Reducing product/service unit prices	Luzzini *et al.*, 2012
COST2	Reducing the total costs of purchased inputs	Luzzini *et al.*, 2012
Quality Performance (QUAL)		
QUAL1	Improving the quality of purchased items	Bozarth *et al*., 2009
QUAL2	Improving conformance to specifications	Bozarth *et al*., 2009
QUAL3	Improving the specifications and functionality of purchased items	Bozarth *et al*., 2009

Table 2 (cont'd)

CONSTRUCTS		REFERENCE ARTICLES
Delivery Performance (DEL)		
DEL1	Improving supplier accuracy in delivery dates and quantities	Bozarth *et al*., 2009
DEL2	Improving supplier lead-time	Bozarth *et al*., 2009
Flexibility Performance (FLEX)		
FLEX1	Improving the ability to change product mix/ volume	Bozarth *et al*., 2009
FLEX2	Improving the ability to change capacity	Bozarth *et al*., 2009
FLEX3	Improving the ability to change product features/functionality	Bozarth *et al*., 2009
Innovation Performance (INNOV)		
INNOV1	Improving the rate of new product/service introduction with suppliers	Brandon-Jones *et al.*, 2015
INNOV2	Improving the speed of new product/service introduction with suppliers	Brandon-Jones *et al.*, 2015
Sustainability Performance (SUS)		
SUS1	Improving environmental compliance from suppliers	Brandon-Jones *et al.*, 2015

Table 2 (cont'd)

CONSTRUCTS		REFERENCE ARTICLES
Sustainability Performance (SUS)		
SUS2	Suppliers to meet our expectations in the field of environmental performance (Waste management, energy efficiency, etc.)	Brandon-Jones *et al.*, 2015
SUS3	Improving social and ethical compliance from suppliers	Brandon-Jones *et al.*, 2015
SUS4	Suppliers to meet our expectations in social and ethical fields (Working Conditions, Occupational Health, and Safety, Social Responsibility, Personal Rights, etc.)	Brandon-Jones *et al.*, 2015

3.4 Pre-testing

A preliminary version of a questionnaire was pre-tested before starting the data collection. Based on the extensive literature review, all items and constructs required to measure supply base complexity and firm performance are included in the survey. However, since the translation of the measurement items taken from the articles may cause misunderstanding, it is imperative that the items be reviewed. Additionally, in order to ensure that the survey items are understood by the participants as intended, the questionnaire was pre-tested by the purchasing experts from a large company in Turkey initially. According to their suggestions, some of the statements in the survey and their wording were fixed. Moreover, the order of items was re-arranged according to the feedback for a survey with a smoother flow. Then, the questionnaire is also reviewed by an academician who is studying in supply chain management area, some items were edited, eliminated and added. After all amendments, the questionnaire is finalized considering the viewpoint of both the academy and industry.

3.5 Ethical Considerations

The aim of the study is to examine the relationship between the supply base complexity that firms face and firms' performances. For this reason, in the questionnaire, it is asked to participants to evaluate their firms' performances relative to the industry average and their suppliers in terms of different perspectives. Therefore, confidentiality is critical to get reliable data from firms.

Participants were informed that the purpose of this study and the confidentially of their answers throughout the process in the e-mails sent and on the cover page of the questionnaire. Also, the voluntary basis of the

study is stated at the beginning of the survey. Therefore, the participants can join the study to know that when they feel uncomfortable.

Additionally, the data collection method of this study is approved by METU Applied Ethics Research Center (AERC). The aim of the study, the questionnaire which will be used in the study and data collection methods were presented to the Human Subjects Ethics Committee (HSEC) before starting the survey. HSEC evaluated data collection method used in the study whether it may have potential adverse effects on the participants of the study based on ethical concerns. After this evaluation, it was approved that this survey does not include any contents which may lead to ethical problems (see Appendix A for the Ethics Approval document).

CHAPTER 4

RESULTS

4.1 Descriptive Statistics

In this study, there are 183 participants who have completed questionnaires from 161 different companies. Initially, the data were reviewed to detect outliers based on the time spent to fill out the questionnaire and whether the same answer is given to all questions in the survey (i.e. yea-sayers/nay-sayers). After outliers were extracted, multiple respondent firms were determined. For the cases of more than one person fills out the questionnaire for one firm, the titles of the participants were compared and the response of the person working in the unrelated department was eliminated. Then, the average of the rest of the participants was taken as the response of the company. The distribution of both participants and the companies are shown in Table 3 and Table 4 respectively

Table 3 Respondent Characteristics

Job Title	Frequency	Percentage (%)
Purchasing Manager	79	43,2%
Supply Chain Manager	19	10,4%
Purchasing Expert	43	23,5%
Supply Chain Expert	8	4,4%
Logistics Manager	1	0,5%
Other	33	18,0%
Total	**183**	**100,0%**

Age	Frequency	Percentage (%)
Below 25	0	0,0%
25-34	65	35,5%
35-44	77	42,1%
45-54	38	20,8%
Above 55	3	1,6%
Total	**183**	**100,0%**

Gender	Frequency	Percentage (%)
Female	45	24,6%
Male	138	75,4%
Total	**183**	**100,0%**

Experience in the firm	Frequency	Percentage (%)
Less than 2 years	41	22,4%
2-5 years	49	26,8%
6-10 years	42	23,0%
11-15 years	27	14,8%
More than 16 years	24	13,1%
Total	**183**	**100,0%**

Purchasing experience	Frequency	Percentage (%)
Less than 2 years	17	9,3%
2-5 years	37	20,2%
6-10 years	56	30,6%
11-19 years	53	29,0%
More than 20 years	20	10,9%
Total	**183**	**100,0%**

Table 4 Firm Descriptives

Industry		**Frequency**	**Percentage (%)**	**Firm Size**	**Frequency**	**Percentage (%)**
	Food and Beverages	20	12,70%	0 - 500	24	16,10%
	Electric - Electronics	13	8,30%	500 - 1000	30	20,10%
	Automotive	10	6,40%	1000 - 5000	58	38,90%
	Iron and Steel	9	5,70%	5000 - 10000	19	12,80%
	Textile - Apparel	9	5,70%	More than 10000	18	12,10%
Manufacturing	Defence	7	4,50%	**Total**	**149***	**100%**
	Cement	5	3,20%	(*) The total number of companies is not equal to the sample size since the number of employees working in some companies, especially Turkey branch of the global companies, were not found.		
	FMCG	5	3,20%			
	Machine	5	3,20%			
	Glass and Ceramic	4	2,50%			
	Agriculture	3	1,90%			
	Others (Tobacco, Furniture, Tyre, etc.)	13	8,30%	**Supplier Concentration**	**Frequency**	**Percentage (%)**
Construction		7	4,50%	Below 20%	17	10,6%
Energy - Petroleum		13	8,30%	20% - 39%	28	17.40%
Retail		22	14,00%	40% - 59%	40	24,8%
Service		12	7,60%	60% - 79%	48	29,8%
Other		4	2,50%	Above 80%	28	17,4%
Total		**161**	**100%**	**Total**	**183**	**100%**

4.2 Reliability Analysis

Reliability analysis examines the internal consistency of a single unidimensional construct (Field, 2013). It evaluates whether the items in a construct are measuring the same dimension (Hair et al., 2006). Cronbach's alpha method was used to assess internal consistency (Cronbach, 1951; Nunnaly, 1978). The reliability coefficients values of 0.70 are considered adequate (Cronbach, 1951; Nunnaly, 1978).

After the reliability analysis was performed, INSTAB1 item was extracted from the Supplier Instability construct since the reliability coefficient of the construct was not adequate. Therefore, Suppler Instability construct was measured by a single item. Based on the reliability analysis results presented in Table 5 all constructs except Supply Base Size had a Cronbach's alpha greater than 0.70. Although Supply Base Size had a relatively lower Cronbach' alpha value than the threshold value, the two items were kept in this study to provide conceptual clarity. Therefore, the results suggest the reliability and internal consistency of each construct in this study.

Table 5 Reliability Analysis Results

Constructs	Number of items	Cronbach's alpha
Supply base size	2	0.530
Differentiation between the suppliers	4	0.893
Geographic dispersion*	1	-
Interaction among the suppliers	2	0.884
Long and unreliable supplier lead times	2	0.896
Supplier instability	1	-
Cost performance	2	0.884
Quality performance	3	0.888
Delivery performance	2	0.846
Flexibility performance	2	0.828
Innovation performance	2	0.894
Sustainability performance	4	0.946

* Geographic distribution of suppliers is measured by an index calculated based on the purchasing percentages specified for different regions by participants.

4.3 Non-Response Bias

Non-response bias is a bias that results from a significant difference between those respondents who completed the survey and who did not complete (Sjöström et al., 1999). When respondents differ significantly from the non-respondents, the results of the study become invalid (Sjöström et al., 1999).

In this study, non-response bias was assessed by checking whether the companies having a larger size are more likely to participate in the study or not. In order to check the presence of non-response bias, Capital 500 – Turkey list was used. 25 firms from the 130 companies that completed the survey and 25 firms from those of firms that did not participate were selected randomly. For the comparison of these two samples, firm size which shows the logarithm of the number of full-time employees and sales of companies in 2016 were used. Then, the Independent-Samples T-test was performed for these two samples in SPSS and results are presented in Table 6. Since t-test yielded no significant difference between the respondent and non-respondent firms, non-response bias is not a problem for this study.

Table 6 Independent Samples T-Test Results

Variable	Response Status	N	Mean	Std. Deviation	Sig
Firm Size	Respondents	25	3.335	0.596	0.133
	Non-respondents	25	3.09	0.533	
	Total	50	3.213	0.573	
Sales in 2016	Respondents	25	4,706,303,283	7,604,036,185	0.46
	Non-respondents	25	3,255,618,856	6,067,179,988	
	Total	50	3,980,961,070	6,847,426,166	

4.4 Exploratory Factor Analysis

Exploratory factor analysis was conducted to identify the underlying factors of the study (Thompson, 2004). Varimax with Kaiser Normalization was employed as the rotation method. FLEX3 and INT3 items were extracted from Flexibility Performance and Interaction among the suppliers constructs, respectively, due to high cross-loadings. Then, the exploratory factor analysis was repeated for supply base complexity items, performance items and all items used in the study, the exploratory factor analysis results are presented in Table 7, Table 8 and Table 9 respectively.

In the exploratory factor analysis for all items, the majority of the items had factor loading greater than 0.7 level (Shevlin and Miles, 1998). Although there were few items with cross-loadings, the highest factor loadings were in their respective factor. Therefore, they were not dropped from the study.

Table 7 EFA Results of Supply Base Complexity Items

	Component					
	1	2	3	4	5	6
SIZE1	.808					
SIZE2	.843					
DIFF1		.811				
DIFF2		.897				
DIFF3		.895				
DIFF4		.833				
DISP			.987			
INT1				.943		
INT2				.943		
LEAD1					.923	
LEAD2					.944	
INSTAB2						.970

Table 8 EFA Results of Performance Items

	Component					
	1	2	3	4	5	6
COST1	.918					
COST2	.885					
QUALITY1		.730				
QUALITY2		.796				
QUALITY3		.755				
DEL1		.402	.699			
DEL2			.845			
FLEX1				.767		
FLEX2				.814		
INNOV1					.805	
INNOV2					.787	
SUS1						.819
SUS2						.859
SUS3						.817
SUS4						.864

Table 9. EFA Results of All Items

	Component											
	1	2	3	4	5	6	7	8	9	10	11	12
SIZE1	.930											
SIZE2		.946										
DIFF1			.819									
DIFF2			.886									
DIFF3			.886									
DIFF4			.831									
DISP				.985								
INT1					.942							
INT2					.938							
LEAD1						.907						
LEAD2						.926						
STAB2							.963					
COST1								.917				
COST2								.861				
QUALITY1									.748			
QUALITY2									.729			
QUALITY3									.711			.433
DEL1									.451	.647		
DEL2										.783		
FLEX1										.481	.539	.442
FLEX2											.650	
INNOV1											.808	
INNOV2											.768	
SUS1												.857
SUS2												.874
SUS3												.847
SUS4												.877

4.5 Common Method Bias

For the survey-based studies, the common method bias may be a major concern (Brandon-Jones et al., 2015; Gonzalez-Benito, 2010) because of the respondents' perceptions and tendency. The respondents may answer all items in the questionnaire by exaggerating or underestimating systematically (Gonzalez-Benito, 2010). As a result of this, artifactual correlation occurs between the variables that lead to common method bias (Gonzalez-Benito, 2010). In this study, almost all data was collected from a single respondent within a single firm while there are few firms having multiple respondents. Therefore, because common method bias may lead to trouble for the study, common method bias test was conducted in order to ensure the reliability and validity of the results.

To assess the existence of the common method bias, Harman's (1967) single-factor approach that checks whether a single factor explains the majority of the total variance was used. The acceptable level of variance is 50% for this test to say that common method variance is not problematic for the study. (Podsakoff and Organ, 1986; Doty and Glick, 1998). Therefore, the exploratory factor analysis for the 27 items that measure both supply base complexity dimensions and performance dimension was conducted. The results show that the model comprising of twelve factors explains 87% of the total variance. Furthermore, a single factor captured only 31% of the total variance, leading to the conclusion that common method bias is not a threat to the reliability and validity of the results. In addition, it can be concluded that the model is well-constructed since it explains a highly good portion of the total variance.

Moreover, in order to measure the performance of the firm, participants were asked to compare their performances with the industry averages rather than evaluating their absolute performances. Since relative performance is

not affected by the respondents' tendency to overvalue or undervalue the questionnaire items, the risk of artifactual correlations is eliminated with this way. Therefore, it is concluded that the common method bias is not a concern for this study.

4.6 Construct Descriptives

In order to describe the characteristics of the data of this study; central tendency, variability, and shape of the distribution were analyzed. The basic descriptive statistics of the supply base complexity dimensions and performance dimensions are shown in Table 10 and Table 11.

First, the means of each supply base complexity dimension are reviewed. The respondents find the Supply Base Size of their firms very large. Since Differentiation between the Suppliers is rated medium-scale answers, it can be said that the suppliers are perceived neither highly differentiated nor highly similar in terms of size, technical capability, operational strategy, and organizational culture. Geographic Dispersion index calculated based on the data provided by respondents is low, which means that the majority of suppliers concentrated in a few regions. Respondents think that Interaction among the suppliers is low. Surprisingly, Long and/or Unreliable Lead Times are rated with lower scores, which means that the respondents find their suppliers reliable regarding on-time delivery and short lead times. Mean of Supplier Instability is very low, which indicates that the respondents think that the relationship with the suppliers is long-term in general. The respondents think their firms' Quality and Delivery performances resulting from their suppliers are better than the industry average whereas they think that Cost, Flexibility, Innovation and Sustainability performances stem from their suppliers are similar to the industry average.

Table 10 Supply Base Complexity Construct Descriptive Statistics

	Sample Size	Mean	Median	Std. Deviation	Skewness	Kurtosis
Supply base size	161	5.509	5.750	1.198	-1.152	1.461
Differentiation between suppliers	161	4.630	5.000	1.410	-0.273	-0.967
Geographic dispersion	161	0.267	0.250	0.176	0.215	-0.594
Interaction among suppliers	161	3.155	3.000	1.337	0.314	-0.852
Long and unreliable supplier lead times	161	2.667	2.500	0.980	1.772	4.203
Supplier instability	161	1.955	2.000	1.125	2.097	5.148

Table 11 Performance Construct Descriptive Statistics

	Sample Size	Mean	Median	Std. Deviation	Skewness	Kurtosis
Cost performance	161	5.047	5.500	1.363	-0.833	0.476
Quality performance	161	5.350	5.333	1.008	-0.512	0.848
Delivery performance	161	5.236	5.500	0.976	-0.311	-0.448
Flexibility performance	161	4.831	5.000	0.929	0.121	-0.166
Innovation performance	161	4.969	5.000	0.987	-0.052	-0.048
Sustainability performance	161	5.062	5.000	1.097	-0.274	0.545

The standard deviation of each construct is around 1 in general, which means that the responses of the participants diverse in one-scale. This variation may result from the differences in the firm size and industry. Skewness and Kurtosis are the measures used to describe the shape of data (Pearson, 1895) and they also demonstrate that whether the data is normally distributed (Bulmer, 1979). Skewness indicates the asymmetry in the distribution of the data compared to normal distribution whereas represents the “tailedness", which shows that whether the tail of the distribution is heavy or light (Ho and Yu, 2015). Geographic Dispersion, Interaction among the suppliers, Long and Unreliable Lead Times, Quality and Sustainability constructs are right-skewed whereas Supply Base Size, Differentiation between the suppliers, Supplier Instability, Cost Delivery, Flexibility, and Innovation constructs seem left-skewed.

The normality is an important assumption of the data analysis. Although the skewness and kurtosis give clues about the deviations from normality, they only consider the two aspects. Therefore, Kolmogorov Smirnov and Shapiro-Wilk Tests were conducted to check whether the distribution of the data is significantly different from a normal distribution (Field, 2013). Results of the normality tests prove that all constructs in the study are non-normal (see Table 12).

Table 12 Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Supply base size	0.168	161	0	0.897	161	0
Differentiation between the suppliers	0.119	161	0	0.959	161	0
Geographic dispersion	0.104	161	0	0.955	161	0
Interaction among the suppliers	0.135	161	0	0.942	161	0
Long and unreliable lead times	0.212	161	0	0.816	161	0
Supplier instability	0.341	161	0	0.707	161	0
Cost performance	0.14	161	0	0.931	161	0
Quality performance	0.132	161	0	0.952	161	0
Delivery performance	0.193	161	0	0.933	161	0
Flexibility performance	0.137	161	0	0.952	161	0
Innovation performance	0.127	161	0	0.962	161	0
Sustainability performance	0.11	161	0	0.961	161	0

4.7 Correlations

One of the important assumptions of multiple regression analysis is non-existence of multicollinearity among the variables (Myers and Myers, 1990). If the variables are highly correlated to each other, it means that the data is not reliable and it can lead to several problems for the study (Slinker and Glantz, 1985). In the presence of high multi-collinearity, the results of the regression analysis may not be precise because of the high standard errors' being more likely (Slinker and Glantz, 1985).

Also, correlation analysis is accepted as a representative of the validity of the constructs in the study (Cronbach and Meehl,1955; Drost,2011).In other words, it shows the success of the research design. Therefore, before starting the regression analysis, bivariate correlation analysis was performed to see how variables are related to each other. Correlation analysis provides a basic idea on the relationship between the variables and if any, the strength of this relationship (Field, 2013).

Data of this study is non-parametric since the majority of the data is measured at the ordinal level and the variables are non-normally distributed (Field, 2013). For this reason, Spearman correlation analysis was chosen instead of Pearson's that is appropriate for parametric data (Field, 2013). There is a significant positive relationship between the supply base size and firm size (r_s =.244, p <.01); and supply base size is also positively correlated with the supplier concentration (r_s =.196, p < .05). The results mean that the larger the firm size, the higher the supply base size and the larger supplier concentration. Long and unreliable lead time is negatively correlated with all the performance dimensions significantly. Although the correlation coefficients do not say the direction of causality, similar to the research hypotheses, it can be said that lead time negatively affects the performance of the firm. Bivariate correlation table is presented in Table 13.

Table 13.Correlation Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Firm Size	1																	
2. Manufacturing Industry	-.145	1																
3. Construction Industry	.154	-.063	1															
4. Retail Industry	.075	-.118	-.085	1														
5. Other	.017	-.047	-.034	-.064	1													
6. Service Industry	.149	-.084	-.061	-.113	-.045	1												
7. Supplier concentration	-.178*	.039	.025	-.035	-.062	-.084	1											
8. Supply base size	.244**	-.003	-.040	-.024	-.124	.019	.196*	1										
9. Differentiation between the suppliers	.125	-.029	.145	-.005	-.055	-.043	.035	.038	1									
1. Geographic dispersion	.149	-.159*	.233**	-.285**	-.123	-.078	.040	.065	.095	1								
11. Interaction among the suppliers	.065	-.041	.085	-.086	-.014	.171*	.098	.030	-.134	.017	1							
12. Long and unreliable lead times	.139	-.121	.147	.045	.062	-.104	-.042	.003	.236**	.136	-.015	1						
13. Supplier instability	.062	.052	.199*	.029	.002	-.114	-.198*	.052	-.074	-.042	-.009	.187*	1					
14. Cost performance	.107	.104	-.050	.035	-.016	-.006	.111	.050	-.084	.095	.061	-.236**	-.157*	1				
15. Quality performance	.084	.010	-.172*	.047	-.090	.135	.033	.094	-.256**	-.079	.131	-.202*	-.176*	.549**	1			
16. Delivery performance	.113	.030	-.057	.050	.012	.088	-.054	.095	-.204**	-.032	.075	-.228**	-.039	.506**	.673**	1		
17. Flexibility performance	.153	.002	-.127	.043	.038	.124	-.049	.178*	-.100	-.021	.059	-.235**	-.051	.391**	.489**	.555**	1	
18. Innovation performance	.180*	-.038	-.153	.070	-.157*	.094	-.044	.097	-.095	-.027	.088	-.287**	-.121	.401**	.609**	.522**	.661**	1
19. Sustainability performance	.200*	.047	-.188*	-.031	-.030	.065	-.124	.197*	-.149	-.015	.041	-.243**	-.079	.429**	.596**	.522**	.590**	.602**

Notes: *p < .05 and **p < .01 (two-tailed); spearman correlation coefficients

4.8 Multiple Regression Results

In order to test the hypotheses, multiple regression analysis was performed. It is suitable for the studies where the effects of several independent variables on a single dependent variable are examined (Cohen, Cohen, West, & Aiken, 2003; Field, 2013; Hair et al., 2006). In this study, the regression analysis model consists of firm performance dimensions as the dependent variables and supply base complexity dimensions as the independent variables. Also, firm size, supplier concentration, and the industries are included as control variables in the model.

The regression analysis has two steps and these steps are represented with Model-1 and Model-2 respectively. Model 1 includes only the control variables as the predictors of performance dimensions in order to observe and distinguish the effects of control variables. Since each performance dimension was examined separately in this study, six different models were constructed for each of six performance dimensions: Cost Model-1, Quality Model-1, Delivery Model-1, Flexibility Model-1, Innovation Model-1, and Sustainability Model-1. At the second step, the main variables of interest which are supply base complexity variables were added to each model. Therefore, there were a total of 12 models with the newly added models: Cost Model-2, Quality Model-2, Delivery Model-2, Flexibility Model-2, Innovation Model-2, and Sustainability Model-2.

Since Cost Model-1, Quality Model-1, Delivery Model-1 and Flexibility Model-1 was not statistically significant, the results of regression analysis are not interpreted although the correlation coefficient of the few control variables is significant.

Innovation Model-1 shows that firm size has a positive significant effect on the innovation performance of the firm ($\beta = 0.19$, $p < 0.05$). Moreover, the

firms operating in the construction industry (β = - 0.188, $p < 0.05$) and other industries (β = - 0.158, $p < 0.05$) have a worse innovation performance than those of firms in manufacturing industries. Innovation Model-1 explains 9.2% of the total variance in the innovation performance of the firm ($p < 0.05$).

Sustainability Model-1 shows that similar to Innovation Model-1, firm size has a positive significant effect on the sustainability performance of the firm ($\beta = 0.221$, $p < 0.01$). In addition, the sustainability performance of the firms operating in the Construction industry (β = - 0.206, $p < 0.01$) is significantly worse than those of firms in manufacturing industries. Sustainability Model-1 explains 9.6% of the total variance in the sustainability performance of the firm ($p < 0.05$).

The results of the regression analysis of the Model-2 that includes the supply base complexity dimensions show that each performance dimension model is statistically significant.

Cost Model-2 explains 16.8% of the variance in cost performance ($p< 0.01$). Regression results suggest that geographic dispersion has a significant positive effect on cost performance ($\beta = 0.176$, $p < 0.05$). Long and unreliable lead times have a significant negative effect on cost performance (β = -0.208, $p < 0.05$). Supplier instability has a significant negative effect on cost performance (β = -0.192, $p < 0.05$). On the other hand, supply base size, degree of differentiation between the suppliers and interaction among the suppliers do not have a significant effect on cost performance. Also, the firm size has a significant positive effect on cost performance ($\beta = 0.175$, $p < 0.05$).

Quality Model-2 explains 18.6% of the variance in quality performance ($p < 0.01$). Regression results show that the differentiation between the suppliers

(β = -0.238, $p < 0.01$) and supplier instability (β = -0.168, $p < 0.05$) have significant negative effects on quality performance. Also, the firm size has a significant positive effect on quality performance ($\beta = 0.182$, $p < 0.05$).

Delivery Model-2 explains 13.8% of the variance in delivery performance of the firm ($p < 0.01$). Regression results show that the differentiation between the suppliers (β = -0.180, $p < 0.05$) and supplier instability (β = -0.200, $p < 0.05$) have significant negative effects on quality performance. Also, the firm size has a significant positive effect on delivery performance ($\beta = 0.144$, $p < 0.10$).

Flexibility Model-2 explains 16% of the variance in flexibility performance of the firm ($p < 0.05$). Regression results show that, interestingly, supply base size has a significant positive effect ($\beta = 0.195$, $p < 0.05$) on flexibility performance. In contrast to supply base size complexity, long and unreliable supplier lead time (β = - 0.249, $p < 0.01$) and supplier instability (β = - 0.141, $p < 0.10$) have significant negative effects on flexibility performance. The firm size does not have a significant effect on flexibility performance

Innovation Model-2 explains 16.5% of the variance in innovation performance of the firm ($p < 0.01$). The results show that only long and unreliable supplier lead time has a significant negative effect on innovation performance (β = -0.207, $p < 0.05$). The other supply base complexity dimensions do not have significant effects. Firm size has also a significant positive effect on innovation performance ($\beta = 0.222$, $p < 0.01$).

Sustainability Model-2 explains 18.2% of the variance in sustainability performance of the firm ($p < 0.01$). Regression results show that, interestingly, supply base size has a significant positive effect ($\beta = 0.164$, $p < 0.05$) on sustainability performance. In contrast to supply base size,

differentiation between the suppliers (β = -0.132, $p < 0.10$) and long and/or unreliable lead times (β = -0.177, $p < 0.05$) have negative significant effects on sustainability performance. Also, the firm size has a significant positive effect on innovation performance (β = 0.231, $p < 0.01$).

At first sight, it can be stated that the explanatory power (R^2) of the regression models are rather low. However, it should be noted that the performance of the firms depends on many internal and external factors (Capon et al.,1990, Gonzalez-Benito, 2010). Firm performance is also a combination of different performance dimensions like operational, financial, marketing performance. Moreover, supply base complexity is not argued to be the main determinant of firm performance although it affects the performance. Additionally, the effect of supply-base complexity on each of the six performance dimensions was examined separately in this study. Finally, the explanatory power (R^2) of the models is similar to the findings of prior studies that examine the effect of SBC on performance (Bozarth *et al.*, 2009; Brandon-Jones *et al.*, 2015).

Furthermore, it can be seen that there is a difference between the R^2 and adjusted R^2 values of the performance models. In fact, this is an expected situation in multiple regression models in which one dependent variable is tried to be predicted with multiple independent variables (Hair et al., 2006). R^2 value of models shows how much of the variation in the dependent variable can be explained by independent variables of the model by assuming each independent variable explains the variation in the dependent variable (Field, 2013; Hair et al., 2006; Holt, 2008). As a consequence, each time the new independent variable is added, R^2 value of model increases although these newly added independent variables are non-significant (Field, 2013). However, adjusted R^2 value increases only if an included independent variable significantly improves the R^2 value of the model more than would be expected by chance (Field, 2013; Holt, 2008). Moreover,

adjusted R^2 value of the model represents the percentage of the total variation in the dependent variable explained by only the significant independent variables (Field, 2013).

The possible reason for the difference between the R^2 and adjusted R^2 values in the performance models of this study could be that interaction among the suppliers has no significant effect on any performance dimensions although it is included in the model as an independent variable of firm performance. Moreover, the results also show that each aspect of the operational performance is affected significantly by at most three dimensions of six supply base complexity dimensions. However, since the aim of this study is to investigate the impact of each supply base complexity dimensions on different operational aspects of firm performance, all supply base complexity dimensions are included in the performance models. Therefore, it is normal to observe that a smaller adjusted R^2 value than R^2 value when non-significant supply base complexity dimensions in some performance mode are considered.

Multiple regression results for each performance model represented in Table 14, Table 15, Table 16, Table 17, Table 18 and Table 19 respectively.

Table 14. Cost Models Regression Results

	Cost Model - 1	**Cost Model - 2**
Control Variables		
(Constant)	3.552**	4.449**
Firm Size	0.140 †	0.175*
Supplier Concentration	0.103	0.085
Energy-Petroleum Industry	0.122	0.154 †
Construction Industry	-0.056	-0.022
Other Industry	-0.027	-0.010
Retail Industry	0.040	0.132
Service Industry	-0.088	-0.113
Main Effects		
Supply Base Size		-0.055
Differentiation between the suppliers		-0.019
Geographic dispersion		*0.176**
Interaction among the suppliers		0.020
Long and Unreliable Lead Times		*-0.208**
Supplier Instability		*-0.192**
R^2	0.049	0.168
Adj R^2	0.005	0.095
Sig	0.351	0.009
F	1.123	2.287**
Δ F		3.515**
Sig F Change		0.003

Notes: † $p < 0.10$, *$p < 0.05$ and **$p < 0.01$; the significant coefficients of independent variables are italicized

Table 15.Quality Models Regression Results

	Quality Model - 1	**Quality Model - 2**
Control Variables		
(Constant)	4.419**	5.288**
Firm Size	0.131	0.182*
Supplier Concentration	0.072	0.042
Energy-Petroleum Industry	0.019	0.011
Construction Industry	-0.195*	-0.125
Other Industry	-0.080	-0.101
Retail Industry	-0.018	-0.003
Service Industry	0.108	0.046
Main Effects		
Supply Base Size		0.035
Differentiation between the suppliers		-0.238**
Geographic dispersion		*-0.032*
Interaction among the suppliers		0.083
Long and Unreliable Lead Times		*-0.115*
Supplier Instability		*-0.168**
R^2	0.072	0.186
Adj R^2	0.029	0.113
Sig	0.115	0.003
F	1.690	2.576**
Δ F		3.422**
Sig F Change		0.003

Notes: † $p < 0.10$, $*p < 0.05$ and $**p < 0.01$; the significant coefficients of independent variables are italicized

Table 16.Quality Models Regression Results

	Delivery Model - 1	**Delivery Model - 2**
Control Variables		
(Constant)	4.704**	5.366**
Firm Size	0.103	0.144 †
Supplier Concentration	-0.033	-0.067
Energy-Petroleum Industry	0.053	0.045
Construction Industry	-0.072	-0.005
Other Industry	0.025	0.021
Retail Industry	0.028	0.071
Service Industry	0.078	0.024
Main Effects		
Supply Base Size		0.078
Differentiation between the suppliers		-0.180*
Geographic dispersion		*0.004*
Interaction among the suppliers		0.067
Long and Unreliable Lead Times		*-0.200**
Supplier Instability		*-0.129*
R^2	0.027	0.138
Adj R^2	-0.017	0.061
Sig	0.748	0.047
F	0.608	1.805*
Δ F		3.141**
Sig F Change		0.006

Notes: † $p < 0.10$, *$p < 0.05$ and **$p < 0.01$; the significant coefficients of independent variables are italicized

Table 17.Flexibility Models Regression Results

	Flexibility Model - 1	**Flexibility Model - 2**
Control Variables		
(Constant)	4.107**	4.225**
Firm Size	0.123	0.121
Supplier Concentration	0.012	-0.052
Energy-Petroleum Industry	0.027	0.024
Construction Industry	-0.133 †	-0.070
Other Industry	0.033	0.056
Retail Industry	0.034	0.110
Service Industry	0.119	0.085
Main Effects		
Supply Base Size		0.195*
Differentiation between the suppliers		-0.032
Geographic dispersion		*0.042*
Interaction among the suppliers		0.036
Long and Unreliable Lead Times		*-0.249***
Supplier Instability		*-0.141* †
R^2	0.049	0.160
Adj R^2	0.005	0.086
Sig	0.352	0.014
F	1.122	2.155*
Δ F		3.244**
Sig F Change		0.005

Notes: † $p < 0.10$, *$p < 0.05$ and **$p < 0.01$; the significant coefficients of independent variables are italicized

Table 18.Innovation Models Regression Results

	Innovation Model-1	**Innovation Model-2**
Control Variables		
(Constant)	3.817**	4.207**
Firm Size	0.190*	0.222**
Supplier Concentration	0.039	0.001
Energy-Petroleum Industry	-0.003	-0.018
Construction Industry	-0.188*	-0.129
Other Industry	-0.158*	-0.161*
Retail Industry	0.029	0.062
Service Industry	0.056	0.001
Main Effects		
Supply Base Size		0.074
Differentiation between the suppliers		-0.058
Geographic dispersion		*-0.038*
Interaction among the suppliers		0.08
Long and Unreliable Lead Times		*-0.207**
Supplier Instability		*-0.119*
R^2	0.092	0.165
Adj R^2	0.051	0.092
Sig	0.035	0.01
F	2.222*	2.241*
Δ F		2.146 †
Sig F Change		0.052

Notes: † $p < 0.10$, $*p < 0.05$ and $**p < 0.01$; the significant coefficients of independent variables are italicized

Table 19.Sustainability Models Regression Results

	Sustainability Model - 1	**Sustainability Model - 2**
Control Variables		
(Constant)	3.887**	4.268**
Firm Size	0.221**	0.231**
Supplier Concentration	-0.058	-0.104
Energy-Petroleum Industry	0.067	0.057
Construction Industry	-0.206**	-0.143†
Other Industry	-0.041	-0.033
Retail Industry	-0.092	-0.047
Service Industry	0.034	0.002
Main Effects		
Supply Base Size		0.164*
Differentiation between the suppliers		-0.1324†
Geographic dispersion		*0.002*
Interaction among the suppliers		0.014
Long and Unreliable Lead Times		*-0.177**
Supplier Instability		*-0.106*
R^2	0.096	0.182
Adj R^2	0.054	0.110
Sig	0.029	0.004
F	2.312*	2.515**
Δ F		2.584*
Sig F Change		0.021

Notes: † $p < 0.10$, *$p < 0.05$ and **$p < 0.01$; the significant coefficients of independent variables are italicized

CHAPTER 5

DISCUSSION

In this thesis, supply base complexity dimensions discussed in the literature were examined to what extent they affect different performance dimensions. Most of the studies in the literature have researched only fundamental dimensions of supply base complexity. Moreover, in these studies, either the overall performance of the firm or only a single specific performance dimension was measured. This study differs from previous studies by examining six different operational performance dimensions of the firm, namely cost, quality, delivery, flexibility, innovation, and sustainability. Therefore, the findings of this study are quite informative and comprehensive, which may present a guideline for both academicians and practitioners in the supply chain field.

This thesis employs theory testing as the research approach and examines proposed relationships between each supply base complexity dimension and each performance sub-dimension in the literature individually. In this part, firstly, each performance model's results were interpreted with additional insights. Then, the impacts of supply base complexity dimensions were summarized.

5.1 Cost Performance

Firstly, cost performance, which is the main target of the companies in general, was evaluated for the effects of supply base complexity dimensions. The results show that the cost performance of the company is

affected by three supply base complexity dimensions: *Geographic dispersion, long and unreliable supplier lead times, and supplier instability.* While geographic dispersion has a positive impact, long and unreliable supplier lead times and supplier instability have adverse effects on cost performance.

The positive effect of geographic dispersion is an expected finding, since, with an increased level of globalization, companies are more likely to have alternative suppliers located in different regions of the world. In fact, the primary reason for global sourcing is to get a cost advantage, especially when sourcing from developing and low-cost countries (Kotabe and Murray, 2004; Jeble et al., 2018). Therefore, geographic dispersion seems beneficial for the company to achieve better cost performance. On the other hand, some studies examining the effect of geographic dispersion stated that it has adverse effects on cost performance (Lorentz et al., 2012). The difference in the findings of this study and the studies arguing the opposite view might stem from the cost performance measures. While Lorentz et al. (2012) used inventory, administration, and transportation costs as a performance measure, the cost performance was measured by a reduction in the total costs of purchased inputs as well as unit product prices in this study. Therefore, it can be concluded that geographic dispersion has a positive impact on cost performance, which refers to purchasing cost performance.

Long and unreliable supplier lead times have adverse effects on cost performance, as expected. One possible explanation could be that companies keep a higher level of safety stock against potential supply risks caused by long and unreliable lead times (Giunipero and Eltantawy, 2004). The higher safety stock level leads to additional costs for the companies, which decreases the cost performance (Giunipero and Eltantawy, 2004). Additionally, in order to compensate for long and unreliable lead times,

companies may choose faster transportation methods which bring higher costs to the company. Similarly, Bozarth et al. (2009) found the negative impacts of delivery complexity on cost performance, while Brandon-Jones et al. (2015) found these adverse effects on plant performance through the frequency of disruptions in the manufacturing plant.

Moreover, supplier instability was also found to be a negative factor that impacts cost performance. When there is no long-term orientation with suppliers or the supply base consists of highly unstable suppliers, purchasing processes start from the very beginning and many administrative costs are incurred. In addition, while the focal company might purchase the products with high volume and low cost, supplying products from new suppliers becomes costly to the firm (Prajogo and Olhager, 2012). Therefore, the long-term orientation with suppliers enhances the cost performance of the firm by decreasing the opportunistic behavior of the suppliers through repetitive purchases (Tachizawa and Wong, 2015).

Additionally, it was found that the supply base size does not affect the cost performance. The result seems contrary to many studies arguing that scale complexity has adverse effects on the firm performance. One possible explanation could be the supply base rationalism employed by the companies. Supply base rationalism refers to the practice that companies may increase or decrease the number of suppliers in the supply base in order to reduce the cost associated with the administrative practices and transactions of suppliers (Handfield and Nichols, 1999; Ogden, 2006; Tully, 1995). Since the sample of this study is the largest 500 companies in Turkey, they are more likely to have already implemented supply base rationalism; hence, they do not see any further performance effects regarding cost.

5.2 Quality Performance

The results illustrate that quality performance of firms is affected by two supply base complexity dimensions: *Differentiation between suppliers and Supplier instability.*

The differentiation between the suppliers in the supply base of the focal company has negative effects on quality performance. One possible explanation could be not maintaining the standardization of inputs provided by suppliers. When one of the suppliers of the focal company is unable to produce the required product quantity by itself, the focal company is forced to outsource the required materials from another supplier. However, because of the technical capability, size and operational differences of the suppliers, they cannot supply the same input, which decreases the quality of the end-product eventually.

Moreover, supplier instability also has adverse effects on quality performance. A possible reason could be that the new supplier does not know the quality processes and regulations of a company; which results in the more extended adaptation period of the suppliers as a result of frequent change in the suppliers. From another point of view, supplier instability also prevents the focal company from providing supports for the suppliers to enhance their quality level in the long-run (Lin et al., 2005). Therefore, the quality performance of the company decreases.

5.3 Delivery Performance

The findings of this study demonstrate that the delivery performance of a company is negatively affected by two of the supply base complexity dimensions: *Differentiation between the suppliers and Long and Unreliable supplier lead times.*

First of all, similar to previous study findings (Choi and Krause, 2006), this study empirically showed that the differentiation between the suppliers has a significant negative effect on the delivery performance of the company. One possible reason is that the supply base consisting of highly differentiated suppliers reduces the interchangeability of suppliers whenever needed. This idea is supported by Choi and Krause (2006) who suggested that when the suppliers of the focal company have similar size, technical capability, and operational strategy, it is easy to substitute one supplier with another for the focal company. Toyota has operationalized this logic and managed its suppliers in such a way that all suppliers in the supply base learn the Toyota production system and adapt their own operational systems accordingly. Therefore, in case of any problem with a supplier, there are other suppliers already familiar with the Toyota production system (Choi and Krause, 2006; Liker, 2004).

Moreover, as expectedly, long and unreliable supplier lead times have a significant negative impact on the delivery performance since it is the major determinant of the delivery performance of a company (Bozarth et al., 2009; Milgate, 2001; Vachon and Klessen, 2002). The focal company having suppliers with long,unreliable and different lead-times has to re-arrange the production schedule continuously and because of delays in lead time, it is difficult to attain on-time delivery performance as Bozarth et al. (2009) argued. Therefore, based on these results, it can be concluded that the companies put emphasis on the length and reliability of supplier lead times in order to achieve better delivery performance.

Interestingly, the geographic dispersion has no significant effect on the delivery performance unlike the findings of the studies in the literature suggest that increase in geographic dispersion of suppliers leads to drop in delivery performance of the firms (Lorentz et al., 2012). One possible explanation is the compensating effect of the firm size, which facilitates

better coordination of supply chain activities and management of suppliers in distant countries (Cousins and Menguc, 2006; Salmi, 2006). Another explanation may be the better delivery performance of the suppliers than their geographic location (Bozarth et al., 2009).

Moreover, supply base size also considered as a negative factor that impacts on-time delivery of performance by increasing the controlling and coordinating activities in the supply base (Choi and Krause, 2006; Handfield and Nichols, 1999). However, there is no significant relationship was observed in this study similar to the study of Bozarth et al. (2009).

5.4 Flexibility Performance

The flexibility performance of the company is affected by the three supply base complexity dimensions: *Supply base size, long and unreliable supplier lead times and supplier instability*. While the supply base size has a positive impact, long and unreliable supplier lead times and supplier instability have adverse effects on flexibility performance.

Firstly, the larger supply base provides an opportunity for the focal company to change the suppliers according to the required quantity and type/mix of products. On the other hand, long and unreliable supplier lead times decreases the flexibility performance of the company (Swafford et al., 2008). When the company wants to increase order quantity or change the mix of the order, if a supplier gives a longer delivery time, the focal company cannot take the risk of missing the delivery date. Especially, in case of the company is dependent on its suppliers (Sanchez and Perez, 2005; Tang and Tomlin, 2008), it is difficult for the focal company to react to the environmental changes (Swafford et al., 2008) and adapt itself accordingly; which decreases the flexibility performance.

Moreover, supplier instability was also found as a negative factor that prevents the focal company from to be flexible. One possible explanation is that the focal company working with the suppliers in the long-term may easily rearrange its orders. Since the suppliers continue their manufacturing processes in order to supply products to the focal company, they may deliver some of the products beforehand or change the product dispersion of orders based on the request of a focal company; which improves the flexibility performance of the company.

5.5 Innovation Performance

This study shows that the innovation performance of the firm is only affected by the *long and unreliable lead times* negatively; which is expected since long and unreliable lead times are an essential source of supply base complexity that affects performance negatively regardless of specific performance dimensions.

However, this is also a surprising result since there are many studies in the literature suggested that the drivers of supply base complexity improve the innovation performance of the firm (Choi and Krause, 2006; Flynn and Flynn, 2005; Koufteros et al., 2007). There are several studies which concluded that the number of suppliers (Choi and Krause, 2006; Dooley and Van de Ven, 1999), the heterogeneity and interaction between suppliers increase the innovativeness of the focal company result in higher competitive power in the market and more innovative ideas from suppliers (Choi and Krause, 2006; Dooley and Van de Ven, 1999; Flynn and Flynn, 2005). According to the Knowledge-Based View and Resource Dependency Theory, the factor that makes a firm's performance sustainable is accessing the heterogeneous knowledge which is critical, specific and inimitable (Barney, 1991; Flynn and Flynn, 2005).

From this point of view, supply base complexity looks like beneficial for the firm by facilitating to access many different knowledge-based resources. First, a large number of suppliers create and increase the number of channels to reach knowledge (Blome et al., 2014; Corsten and Felde, 2005). Second, the higher level of differentiation between the suppliers in terms of size, technical capabilities, organizational culture, operational strategy enhances the heterogeneity of knowledge, which improve the innovation performance (Gao et al., 2010; Phelps, 2010). Moreover, the interaction between the suppliers not only increases the heterogeneity but also facilitates the creation of new ideas through co-operation (Choi and Krause, 2006; Rebolledo and Nollet, 2011). Similarly, supply chain collaboration literature shows that idiosyncratic knowledge from suppliers improves firm performance (Flynn et al, 2010). Social network theory also supports the Knowledge-Based View in a different way that the firms occupying a central network position have better access to knowledge-based resources, and therefore, they are likely to achieve better performance (Lu and Shang, 2017; Rebolledo and Nollet, 2011). Although the previous studies argued that the number of suppliers, the variety between the suppliers and interaction between suppliers enhances the innovation performance of the firm, it was found to have neither positive nor negative effects on innovation performance in this study. It could be that our empirical setting in a developing country context is one possible explanation for this controversial finding. There is clearly need for more research in this area.

5.6 Sustainability Performance

Finally, the findings of this study demonstrated that sustainability performance is affected by three supply base complexity dimensions: *supply base size, differentiation between suppliers and long and unreliable supplier lead times.* While supply base size has a significant positive impact,

differentiation between suppliers and long and unreliable supplier lead times have adverse effects on sustainability performance.

First of all, sustainability has been becoming a significant part of the business strategy of the companies recently in the world (Gimenez et al., 2012; Gunasekaran and Spalanzani, 2012; Kleindorfer et al., 2005). As a consequence, companies might be employing the supplier selection and evaluation process that takes into account suppliers' commitment to sustainability (Brandon-Jones et al., 2015; Krause et al., 2009). Therefore, as the size of the supply base, including the suppliers having high sustainability commitment rises, the overall sustainability performance of the focal company also increases. Brandon-Jones et al. (2015) stated that "As competition has shifted to the level of supply chains, it is clear that an organization is no more sustainable than its supply base." In addition, there could be another possible explanation for the positive effect of supply base size on the sustainability performance of the firm. As the firm size increases, it is more likely that the importance given to the sustainability performance also increases. In large size companies, sustainability becomes an important issue for the firm since the environmental, social ethical practices of the firm are critical factors that impact the brand value and reputation of the firm (Carter and Rogers, 2008; Gimenez, Sierra & Rodon, 2012; Porter and Kramer, 2006). For this reason, these companies have adopted triple bottom line framework and include social and environmental responsibilities in their business strategies (Carter and Rogers, 2008; Porter and Kramer, 2006). As a result of the practices that consider social and environmental issues, they achieve better sustainability performance. It is more likely that large size companies have a large number of suppliers in their supply base. Therefore, it can be suggested that the companies having better sustainability performance, inherently, have a larger supply base, unlike the idea that companies having a larger supply base achieve better sustainability performance.

Moreover, Vachon and Klessen (2006) stated that in order to achieve better environmental and social performance, the focal company should collaborate with suppliers, arrange sustainability awareness seminars and help the suppliers to establish their own environmental programs (Gunesakaran et al., 2017). However, when the suppliers are highly differentiated, it is difficult to arrange and coordinate those of environmental practices, which eventually decreases the sustainability performance of the company.

Furthermore, long and unreliable supplier lead times also have negative impacts on the sustainability performance of the company. The effects of long and unreliable supplier lead times can be explained with two different approaches. On one hand, long and unreliable supplier lead time is the most effective source of dynamic complexity that impacts firm performance negatively overall regardless of the specific performance objectives. From this point of view, it is expected that long and unreliable lead times decreases also the sustainability performance of the firm. On the other hand, there could be a more specific relationship between the long and unreliable lead time and the sustainability performance of the company. One possible explanation could be that suppliers may disregard some environmental and social responsibilities in order to deliver their products or services in a shorter time. Although suppliers are aware of the components or modules that do not meet the required environmental standards, they may still use these components to produce and supply their products to the focal company in order not to postpone the delivery dates. Moreover, suppliers may violate the workers' right or occupational health and safety issues to achieve shorter delivery performance. Therefore, the sustainability performance of the company decreases eventually as a result of supplier practices implemented to compensate for the long and unreliable supplier lead times.

While the supply base size has a positive impact, differentiation between the suppliers has an adverse impact on the sustainability performance of the company. It seems there is a contrasting finding for sustainability performance. However, it is not necessary that as the supply base size increases, the variation between the suppliers also increases. In this study, the pure effects of supply base size and the differentiation between suppliers were examined individually. The interaction effects between the supply base size and differentiation between the suppliers could be the possible explanation of sustainability performance; therefore, it should be explored by future studies.

5.7 Overall Remarks

Significant sources of supply base complexity dimensions that impact the individual performance dimensions are presented in Table 20 as a summary of the results.

Table 20 Summary of the significant supply base complexity drivers and their effects

	Cost Performance	Quality Performance	Delivery Performance	Flexibility Performance	Innovation Performance	Sustainability Performance
Supply base size				*0.195**		*0.164**
Differentiation between the suppliers		*- 0.238***	*- 0.180**			*- 0.132*†
Geographic dispersion	*0.176**					
Interaction among the suppliers						
Long and unreliable lead times	*- 0.208**		*- 0.200**	*- 0.249***	*- 0.207**	*- 0.177**
Supplier instability	*- 0.192**	*- 0.168**		*- 0.141*†		

Based on the performance model results, these findings imply that performance is affected by some of the supply base complexity dimensions positively while it is affected by some of them negatively. Therefore, in order to achieve better performance, the companies must find the optimal level of complexity based on their size, industry and organizational practices. After examining each performance model individually, supply base complexity dimensions were reviewed as a summary.

Long and unreliable supplier lead times are found to be the most crucial source of the supply base complexity as expectedly. Unreliable and long supplier lead times impact all performance sub-dimensions except for the quality performance of a company negatively. When the lead time of a component is too long, a focal company has to purchase the components or products from the hoarder at very high prices to catch its own delivery time, which decreases the cost performance. With similar logic, the unreliability of lead times not only decreases the delivery performance but also decreases the flexibility performance of the company, especially when the focal company is dependent on the suppliers. It is also argued that long and unreliable lead times and dependency argued as one of the obstacles that prevent the firm to be agile (Choi and Krause, 2006; Christopher and Towill, 2000). Although there are no specific findings that show the adverse impact of unreliable and long supplier lead times on innovation and sustainability performance of the company, the idea that long lead times decreases the rate and speed of the new product introduction makes sense. Therefore, it can be concluded that the companies must focus on the supplier lead times to improve overall firm performance.

Supplier instability was also found to be a significant source of supply base complexity that impacts the cost, quality and flexibility performance of the focal company. This finding was expected based on the previous study findings. They argued that the long-term orientation with the suppliers

reduces the opportunistic behaviors of the suppliers (Tachizawa and Wong, 2015) and facilitates large volume purchases (Bozarth et al., 2009), which improves the cost performance of the companies. Moreover, when the suppliers are stable, common quality practices and regulations can be built by both the focal company and suppliers to maintain the standard quality level. Furthermore, it enhances the flexibility in changing the volume and type of orders since when the suppliers keep producing the products to the focal company in long-horizon. Therefore, if there is no long-term orientation with suppliers, which causes supplier instability decreases firm performance.

In this study, it was found that long and unreliable lead times and suppliers' instability, which are sources of dynamic complexity, were the most effective dimensions of supply base complexity on performance. These findings also support the study of Bozarth et al. (2009), where dynamic complexity was found to have a greater impact than detail complexity on plant performance.

Moreover, the degree of differentiation was another critical source of supply base complexity that impacts the quality, delivery, firm performance adversely. The main reason could be that the higher the differentiation between the suppliers, the lower the interchangeability of products or suppliers. In case of a supplier is unable to supply the product, the quality and delivery quantity of the products of other suppliers will not be the same because of the size, technical ability and operation strategy differences. Based on these findings, it can be concluded that the performance of the firm decreases as the suppliers in the supply base differentiated from each other.

In contrast to long and unreliable supplier lead times, supplier instability, and differentiation between suppliers that have an adverse impact on firm

performance, supply base size and geographic dispersion have a positive impact on firm performance.

Supply base size was found to be a source of supply base complexity that has positive impacts on the flexibility and sustainability performance of the company. The larger supply bases give a chance to the focal company to change their order in terms of volume and product mix (Bozarth et al., 2009; Brandon-Jones et al., 2015), which improves the operational flexibility of the company.

Geographic dispersion is another important dimension of the supply base complexity. In the literature, there are several studies that arguing the geographic dispersion of suppliers is an advantageous or a disadvantageous sourcing strategy, while some studies found that it has no effects on the performance. In fact, these results depend on the focus of the study and performance measures. In this study, geographic dispersion was found as a factor that improves the cost performance of the company similar to the results of many of the studies examining global sourcing. On the other hand, unlike the common expectation that the geographic dispersion has a negative effect, it was found neither positive nor negative effects of geographic dispersion on delivery performance. The shadowing effect of firm size may be the possible reason for this surprising result.

Lastly, in this study, neither positive nor negative significant effect of the interaction among the suppliers in the supply base was found on any performance dimension. In the literature, there is no empirical evidence that supports the impact of the interaction between the suppliers on firm performance except the conceptual study propositions (Choi and Krause, 2006). Nevertheless, there are a few possible explanations for this result. First, any potential adverse effects of the interaction among suppliers may be dominated by the effects of firm size. Since the sample companies of this

study are the largest in Turkey, they might have effective management practices to handle the complexity that arises from the interaction. Secondly, the items used to measure the interaction among suppliers may be insufficient to identify the interaction construct of the supply base complexity correctly. Moreover, interaction among the suppliers was measured based on the focal company's perspective in this study. Maybe, as Brandon-Jones et al. (2015) suggested, measuring the interaction among the suppliers requires a data collection at the network level. Therefore, some points must be taken into account in order to investigate the impact of the interaction among the suppliers on firm performance.

CHAPTER 6

CONCLUSION

6.1 Theoretical Contributions

The main reason to choose supply chain complexity to study is that there are confusing findings in the literature. Many of the studies concluded that the supply chain complexity has adverse effects on firm performance (Bode and Wagner, 2015; Bozarth et al., 2009; Brandon Jones et al., 2015; Wachon and Klessen, 2002), whereas some studies state that the supply chain complexity is beneficial for some performance areas (Aitken et al., 2016; Choi and Krause, 2006; Serdarasan, 2012).

Moreover, studies investigating the impact of supply chain complexity on firm performance include upstream supply chain complexity, internal/manufacturing complexity, and downstream supply chain complexity. These studies are more general as they examine all the complex factors that arise from customers, internal operations, and suppliers. Although they also explored the complexity stemming from the suppliers, it is not possible to examine all of the supply base complexity dimensions and their effects in detail. Therefore, this thesis focuses on upstream complexity and adopts a comprehensive approach to discuss dimensions of supply base complexity in detail. In the literature, supply base size (Bode and Wagner, 2015; Bozarth et al., 2009; Brandon-Jones et al., 2015; Choi and Krause, 2006), differentiation between the suppliers (Bozarth et al., 2009; Brandon-Jones et al., 2015; Choi and Krause, 2006), long and unreliable lead times (Bozarth et al., 2009; Brandon-Jones et al., 2015; Choi and Krause, 2006; Vachon and Klessen, 2002) and geographic dispersion of suppliers (Bode

and Wagner, 2015; Brandon-Jones et al., 2015; Choi and Krause, 2006) are widely studied dimensions of the supply base complexity. However, the interaction between the suppliers is not discussed much in the supply base complexity context, though it is recognized as an essential source of supply base complexity. There are few conceptual studies that investigate the interaction among suppliers as a source of complexity (Choi and Krause, 2006), but there is no empirical study regarding the interaction among the suppliers.

In the literature, although the main interest is on the impacts of supply chain complexity on performance, there are also studies that focus on the supply base complexity effects on firm performance (Bode and Wagner, 2015; Brandon-Jones et al., 2015; Choi and Krause, 2006). However, most of them are either case studies or conceptual studies (Choi and Krause, 2006; Serdarasan, 2012). While there is a limited number of empirical studies, most of them focus on the effects of supply base complexity on overall firm performance rather than exploring the impacts on each sub-dimension of firm performance in general. Those of studies where multi-dimensional performance approach was employed include some sub-dimensions of the performance like quality, cost or flexibility. However, they only provide general insights into the effects on the performance; they do not improve the knowledge about the impact of supply base complexity on different sub-dimensions of performance. Albeit in the limited number, there are empirical studies that examine the effects of supply chain complexity on a single performance sub-dimension which are mostly cost (Bozarth et al., 2009; Brandon-Jones et al., 2015) and delivery performance (Bozarth et al., 2009; Milgate, 2000; Vachon and Klessen, 2002).

Furthermore, unlike the common findings suggest that the complexity is a negative factor that affects the firm performance, few conceptual and case studies in the literature proposed that the supply chain complexity can be

beneficial (Choi and Krause, 2006; Aitken et al., 2016; Serdarasan, 2012). Moreover, Serdarasan (2012) categorized supply chain complexity as necessary and unnecessary complexity and Aitken et al. (2016) classified strategic and dysfunctional complexity based on the functionality of the complexity for the firm. Strategic or necessary complexity is argued as a factor that improves firm performance and provides a competitive advantage if they managed effectively. Conversely, unnecessary or dysfunctional complexity is suggested that it hinders firms from achieving a better performance (Aitken et al., 2018). Although this discrimination is supported conceptually, it has no empirical evidence in the literature. Therefore, this thesis also contributes to the literature by proving the proposition that supply chain complexity can improve firm performance and provide a strategic advantage for its competitiveness.

In summary, this master thesis provides more comprehensive findings by investigating the impact of each supply base complexity dimensions on each performance area individually as well as by examining the not so much studied supply base complexity dimensions. Therefore, it expands the knowledge about the supply base complexity effects on firm performance.

6.2 Managerial Contributions

Supply chain complexity has become a major concern of the firms (Aitken et al., 2018; Perona and Miragliotta, 2004; Serdarasan, 2012; Tan et al., 2002). Globalization, high-level of outsourcing activities and shorter product lifecycles force firms to expand their supply chains as well as supply bases (Bozarth et al., 2009; Brandon-Jones et al., 2015; Isik, 2011; Choi and Krause, 2006). Therefore, managing the supply chain complexity is vital for the firms to achieve better performance (Bozarth et al., 2009; Manuj and Sahin, 2011; Perona and Miragliotta, 2004; Vachon and Klessen, 2002).

In the literature, it is commonly accepted that supply chain complexity is one of the determinants of firm performance (Bode and Wagner, 2015; Bozarth et al., 2009; Brandon-Jones et al., 2015; Choi and Krause, 2006; Perona and Miragliotta, 2004; Tan et al., 2002). However, there are limited findings that show the effect of any dimension of supply base complexity on each performance objectives and to what extent it will affect. In this thesis, all of the supply base complexity dimensions discussed in the literature were examined on the contrary to the many studies that focused on only fundamental supply base complexity dimensions. In this way, the knowledge and understanding of supply base complexity were expanded, which may help to managers to foresee the complexity drivers in their firms beforehand. Therefore, this study provides a comprehensive guideline for the managers to make better supply chain management decisions since understanding and foreseeing the complexity characteristics accurately beforehand help to develop better strategies (Aitken et al., 2016; Manuj and Sahin, 2011; Serdarasan, 2012). This guideline containing the results of the study help the managers with two different perspectives. From one point of view, supply base management policies may be determined by considering the effects of the supply base complexity dimensions that the firm face. From another point of view, executives will know which supply base complexity dimensions to be concentrated on according to the company's performance goals. Since our research shows the significant complexity determinants of each performance sub-dimension, supply chain managers may devise strategies by focusing on certain supply base complexity dimensions over others (Manuj and Sahin, 2011).

Moreover, the majority of the studies in the literature stated supply chain complexity as a factor that has adverse effects on firm performance (Bode and Wagner, 2015; Bozarth et al., 2009; Brandon-Jones et al., 2015). As a result of these widely accepted findings, the supply chain complexity management approaches mainly based on the reduction and prevention of

complexity (Manuj and Sahin, 2011; Perona and Miragliotta, 2004). However, this research showed that supply base complexity might enhance firm performance. Moreover, the findings of the study also provide managerial insight that if the supply base complexity managed effectively in line with the strategic goals of the company, it provides a significant contribution to the competitive power of the company in the market. Therefore, in addition to the complexity management approach that reduce/eliminate the unnecessary or dysfunctional complexity drivers, this study shows the importance of other management approaches which are absorbing the complexity (Aitken et al, 2016; Galbraith, 1977) or managing the complexity (Perona and Miragliotta, 2004; Serdarasan, 2012).

The studies on the responses to the supply chain complexities are generally in the list of solution strategies or actions for different types of complexity drivers (Serdarasan, 2012). There is also a conceptual framework introduced by Aitken et al. (2016) that guides the managers to decide how they should respond to the complexity based on its functionality. Since using correct strategy to manage supply chain complexity affects both operational performance and financial performance of the company (Cousins et al., 2006; Gonzalez-Benito, 2007; Krause et al., 2001; Tan et al., 2002), the managers must have adequate knowledge about the complexity and its effects (Aitken et al., 2016; Manuj and Sahin, 2011; Serdarasan, 2012). Therefore, this thesis made a significant contribution by expanding the knowledge on the supply base complexity drivers and their individual effects on performance sub-dimensions of the company comprehensively.

6.3 Limitations and Future Research Suggestions

This thesis makes a significant contribution to the supply chain literature and provides comprehensive findings that improve managerial knowledge

on supply base complexity. Nevertheless, the study has also some limitations, which will provide opportunities for further research.

First of all, in this study, perceptual measures were used for both independent variables which represent supply base complexity dimensions and dependent variables which represent the operational performance dimensions. However, in order to measure the effects of supply base complexity on performance objectively, the financial performance may be employed as the dependent variable by using the secondary data of the company.

Additionally, the primary assumption of this research, like many other studies in the literature, is that the relationship between the supply base complexity and performance is linear. There are few studies which propose that there is a non-linear relationship between complexity and firm performance (e.g. Choi and Krause, 2006; Li and Shang, 2017). In these relationships, there is an optimal level of complexity that results in the highest firm performance. Therefore, this study can be reviewed by considering the quadratic relationship between the supply base complexity and firm performance.

Moreover, this research can also be repeated to examine the effects of supply base complexity on different industries individually. Although industries were taken into account as a control variable, it is difficult to say the results are precisely applicable for all industries since each industry has its own varying environmental circumstances, operational strategies, and supply chain practices. For example, construction industries are mainly project-oriented, and suppliers may rapidly change based on the size and duration of the project. Also, there can be many suppliers that fulfill the requirements for the projects, and they can easily interchange, which prevent the dependence to the suppliers. However, in the electrical -

electronics manufacturing industries, there are few big suppliers for some fundamental components or modules generally. For this reason, companies are dependent on those suppliers. Therefore, the supply base complexity drivers may vary across industries; which implies the need for industry-specific research settings.

In this thesis, the pure effects of supply base complexity characteristics on performance were examined. However, the performance is not only affected by the complexity, but also by how this complexity drivers are managed (Galbraith, 1974; Tan et al., 2002, Dittfeld et al., 2018). Therefore, supply base complexity management practices of the firm depend on several factors related to the organization. First of all, recognition or awareness of supply base complexity is an essential factor that determines the company's strategies will be used to manage the supply base (Aitken et al., 2016). If there is an awareness about the complexity in the organization, organizations may employ different approaches considering the type characteristics and functionality of complexity. They use complexity reduction practices for the dysfunctional or unnecessary complexity, whereas they exploit the strategic complexity to gain a competitive advantage. Therefore, in addition to the impacts of supply base complexity, the moderating role of organizational awareness on supply base complexity should be included in a new study to investigate the firm performance. Moreover, there are also some other concepts as a factor that may enhance the positive effects of supply base complexity and may reduce the potential adverse effects in supply chain complexity literature. The moderating roles of these factors namely “Purchasing Status” (Luzzini and Ronchi, 2016), “Strategic Purchasing” (Chen, Paulraj, and Lado, 2004),” Top Management Support” (Luzzini et al, 2019), “Information Integration” (Prajogo and Olhager, 2012) and “Visibility” (Brandon-Jones et al., 2014) could be explored in future studies.

Notwithstanding these limitations, this thesis contributes to both literature and practice by providing useful insights regarding the varying effects of supply base complexity dimensions on different aspects of firm performance.

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APPENDICES

A. HUMAN SUBJECTS ETHICS COMMITTEE APPROVAL FORM

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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Sayı: 28620816 / 242

10 Mayıs 2019

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Dr. Öğretim Üyesi Melek Akın ATEŞ

Danışmanlığını yaptığınız **Huriye MEMİŞ'in "Tedarikçi Tabanı Karmaşıklığının Firma Performansına Olan Etkileri"** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve **230-ODTÜ-2019** protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

Prof. Dr. Tülin GENÇÖZ
Başkan

Prof. Dr. Tolga CAN
Üye

Doç.Dr. Pınar KAYGAN
Üye

Dr. Öğr. Üyesi Ali Emre TURGUT
Üye

Dr. Öğr. Üyesi Şerife SEVİNÇ
Üye

Dr. Öğr. Üyesi Müge GÜNDÜZ
Üye

Dr. Öğr. Üyesi Süreyya Özcan KABASAKAL
Üye

B. SURVEY

This survey is part of a study conducted within the Middle East Technical University Department of Business Administration, which investigates the impact of supply base complexity on firm performance. Your answers will be kept confidential and will be used by the researchers for scientific purposes only.

Participation in the study is entirely voluntary. If you feel uncomfortable for any reason, you can leave the survey at any stage. The survey duration is approximately 10-15 minutes.

If you want to learn more about the study can reach the researchers, whose contact information is given below. The detailed results of the study will be shared via e-mail.

Thank you in advance for allocating time to contribute to this study.

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METU
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SECTION 1

1. **Gender :**

    a. Female
    b. Male

2. **Age:**

    a. <25
    b. 25-34
    c. 35-44
    d. 45-54
    e. >55

3. **What is your current job title?**

    a. Supply Chain Manager
    b. Supply Chain Expert
    c. Purchasing Manager
    d. Purchasing Expert
    e. Lojistics Manager
    f. Other:
        …….....

4. **How long have you been working in your current company?**

    a. Less than 2 years
    b. 2-5 years
    c. 6-10 years
    d. 11-15 years
    e. More than 16 years

5. **How long have you been working in the purchasing and supply chain field?**

    a. Less than 2 years
    b. 2-5 years
    c. 6-10 years
    d. 11-19 yıl
    e. More than 20 years

6. **What is the percentage of your company's purchase expenses to the total expenses?**

    a. Less than %20
    b. %20 - %39
    c. %40 - %59
    d. %60 - %79
    e. More than %80

SECTION 2

Please indicate the extent you agree/disagree with the following statements (1: strongly disagree; 7: strongly agree)

		1	**2**	**3**	**4**	**5**	**6**	**7**
		Strongly Disagree						**Strongly Agree**
1	We have a complex supply base.	1	2	3	4	5	6	7
2	We have a lot of suppliers.	1	2	3	4	5	6	7
3	Our suppliers are of similar size.	1	2	3	4	5	6	7
4	Our suppliers have similar level of technical capability.	1	2	3	4	5	6	7
5	Our suppliers have similar operational strategies.	1	2	3	4	5	6	7
6	Our suppliers have similar organizational culture.	1	2	3	4	5	6	7
7	Our suppliers communicate with each other.	1	2	3	4	5	6	7
8	Our suppliers share information with each other.	1	2	3	4	5	6	7
9	Our suppliers collaborate with each other on joint projects.	1	2	3	4	5	6	7
10	We can depend on on-time delivery from suppliers in this supply chain.	1	2	3	4	5	6	7
11	We can depend on short lead-times from suppliers in this supply chain.	1	2	3	4	5	6	7
12	We have changed the high proportion of our suppliers in the past two years.	1	2	3	4	5	6	7
13	We have short-term relationships with our suppliers in general.	1	2	3	4	5	6	7

Please evaluate your company performance in the following areas relative to your competitors in the past three years (1: much worse, 7: much better):

		1	**2**	**3**	**4**	**5**	**6**	**7**
		Much worse than						**Much better than**
14	Reducing product/service unit prices	1	2	3	4	5	6	7
15	Reducing the total costs of purchased inputs	1	2	3	4	5	6	7
16	Improving the quality of purchased items	1	2	3	4	5	6	7
17	Improving conformance to specifications	1	2	3	4	5	6	7
18	Improving the specifications and functionality of purchased items	1	2	3	4	5	6	7
19	Improving supplier accuracy in delivery dates and quantities	1	2	3	4	5	6	7
20	Improving supplier lead-time	1	2	3	4	5	6	7
21	Improving the ability to change product mix/ volume	1	2	3	4	5	6	7
22	Improving the ability to change capacity	1	2	3	4	5	6	7
23	Improving the ability to change product features/functionality	1	2	3	4	5	6	7
24	Improving the rate of new product/service introduction with suppliers	1	2	3	4	5	6	7
25	Improving the speed of new product/service introduction with suppliers	1	2	3	4	5	6	7
26	Improving environmental compliance from suppliers	1	2	3	4	5	6	7

27	Suppliers to meet our expectations in the field of environmental performance (Waste management, energy efficiency, etc.)	1	2	3	4	5	6	7
28	Improving social and ethical compliance from suppliers	1	2	3	4	5	6	7
29	Suppliers to meet our expectations in social and ethical fields (Working Conditions, Occupational Health, and Safety, Social Responsibility, Personal Rights, etc.)	1	2	3	4	5	6	7

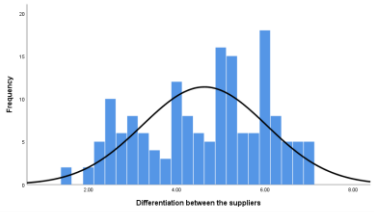
You have reached the end of the survey.

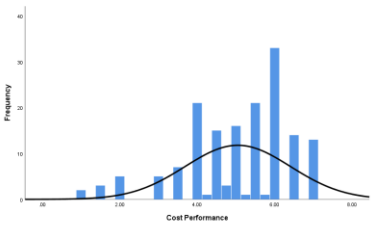
Thank you very much for your time and participation.

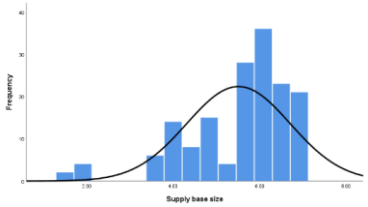
Please note that if you wish to receive a brief summary of this survey and thesis results, please indicate your email address below:

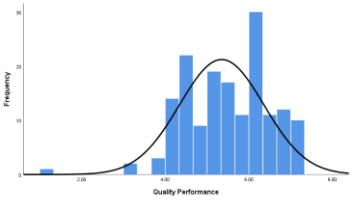
Please indicate that if you have any comments, questions or suggestions about the survey:

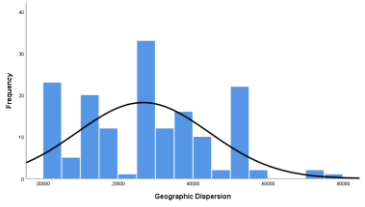
C. HISTOGRAMS

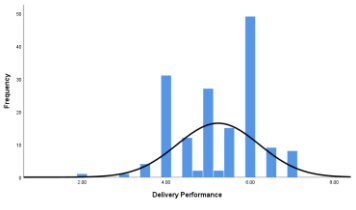


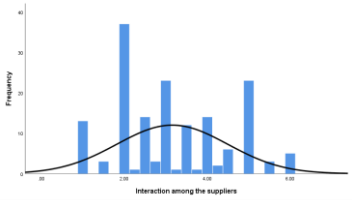


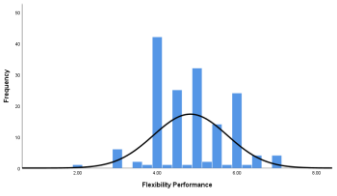


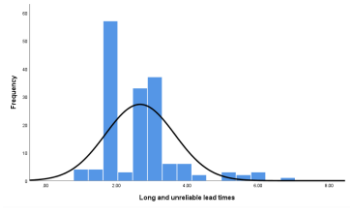


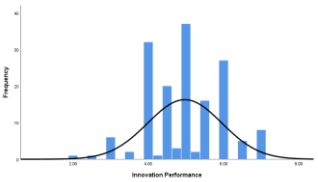


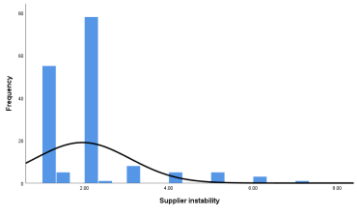


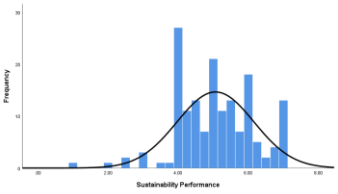












D. TURKISH SUMMARY / TÜRKÇE ÖZET

1. Giriş

Tedarik zinciri karmaşıklığı, hem akademisyenler ve hem de tedarik zinciri alanında çalışanlar tarafından odukça önem verilen yaygın ve stratejik bir konudur. Tedarik zincirleri, artan seviyede küreselleşme, müşteri beklentisi ve teknolojik ilerlemeler sonucunda gittikçe daha kompleks bir hal almaktadır (Brandon-Jones, ve diğ., 2015; Isik, 2011; Perona ve Miragliotta, 2004).

Küreselleşme, şirketlere insan ve malzeme kaynaklarına düşük maaliyetle ulaşma imkanı sağlamakta ve bu da yüksek düzeyde dış kaynak kullanımını beraberinde getirmektedir (Kotabe ve Murray,2004). Bu nedenle şirketler, özellikle düşük maliyetli ülkeler başta olmak üzere dünyanın farklı bölgelerinde bulunan tedarikçilerle çalışmayı tercih etmektedir (Lorentz ve diğerleri, 2012). Fakat tedarik zincirlerinin küresel olarak genişlemesi; ülkeler arasındaki dil ve kültür farklılıkları, lojistik konular, farklı yönetmelik ve mevzuatlar gibi şirketler için ek karmaşıklık ve belirsizlik yaratan çeşitli engellere sahiptir (Kavilal ve diğ., 2017; Lorentz ve diğ., 2012, Manuj ve Sahin, 2011).

Müşterilerin yeni ürün ve hizmetler için sürekli beklentisi, ürün yaşam döngüsünü kısaltır (Bode ve Wagner, 2015; Koste, Malhotra ve Sharma, 2004). Bu nedenle şirketler, pazardaki rekabetçi konumlarını korumak için ürün portföylerini çeşitlendirmek ve zenginleştirmek zorunda kalırlar (Guttner ve diğerleri, 2008; Jacobs, 2013; Vachon ve diğerleri, 2009). Buna ek olarak, şirketler rekabet avantajı elde etmek için yeni pazarlara girebilir veya pazar nişine cevap vermeye çalışabilirler. Bu rekabet avantajı da daha büyük ve farklılaşmış bir ürün portföyü ile sağlanabilir (Berman ve Korsten,

2010; Fixson, 2005; Narasimhan ve Das, 1999; Jacobs, 2013). Ürün ve hizmet portföyünün genişletilmesi, şirket için pazarda avantaj sağlasa da, şirketlerin uğraştığı tedarik zincirini daha karmaşık hale getirir (Bozarth ve diğ., 2009; Jacobs, 2013; Vickers ve Kodarin, 2006). Ayrıca, bir şirketin tüm bu artan talepleri sadece kendi kaynaklarıyla karşılaması zor ve hatta imkansızdır. Bu nedenle, şirketler, kendi ana alanında olmayan, özel bilgi ve yetenekler gerektiren faaliyetleri dış kaynaklardan temin etmektedir (Koufteros et al., 2007). Özellikle teknolojiye dayalı endüstrilerde, tedarikçiler bir inovasyon kaynağı olarak da kabul edilmektedir (Blomqvist ve arkadaşları, 2005; Calantone ve Stanko, 2007; Nieto ve Santamarı´a, 2007; Jacobs, 2013). Ancak, farklı alanlarda uzmanlaşmış tedarikçilerle çalışmak, tedarikçilere bağımlılığa yol açar ve şirketler farklı yönetim yaklaşımları sergilemek durumunda kalırlar. Bu durum da şirket için ek karmaşıklık yaratmaktadır (Liao ve Marsillac, 2015; Wagner, 2009). Bu nedenle, tedarik zinciri genişledikçe, tedarik zincirindeki ortaklarla ilişkilerin sayısı artar ve şirketin tüm fiziksel ve bilgi akışı faaliyetlerini etkili ve zamanında yönetmek için gerekli kordinasyon ve kontrol çabaları daha karmaşık hale gelir (Bozarth ve ark., 2009; Manuj ve Sahin, 2011; Perona ve Miragliotta, 2004).

Literatürdeki birçok çalışma tedarik zinciri karmaşıklığının tedarik zincirindeki aktörlerin performansını etkilediğini belirtmektedir (Choi ve Hong, 2002; Isik,2011). Bazı çalışmalar tedarik zinciri karmaşıklığının operasyonel firma performansını olumsuz etkilediği sonucuna varırken (Bozarth et al.,2009; Kavilal,2017), bazıları da finansal firma performansına olan negatif etkilerine odaklanmıştır (Lu and Shang,2017). Tedarik zinciri karmaşıklığının firma performansını etkilediği kabul edilmiş olmasına rağmen, nasıl etkilediği ve farklı performans alanlarına etkileri halen araştırılmaktadır. Ek olarak, literatürde tedarik zinciri karmaşıklğının belirli performans alanlarını ve genel firma performansını ne ölçüde etkilediğini inceleyen sınırlı sayıda ampirik çalışma bulunmaktadır. Bu sebeple, bu

çalışmada tedarik tabanı karmaşıklığının firrma performansına olan etkileri ampirik olarak araştırılarak literatüre katkı sağlamak amaçlanmıştır.

1.1 Araştırmanın amaçları

Tedarik zinciri karmaşıklığı ve firma performansı arasındaki ilişiki birçok araştırmacı tarafından incelenmiştir. Bununla birlikte, tedarik zinciri karmaşıklığı, gerek akademisyenler gerekse tedarik zinciri alanındaki uygulayıcılar tarafından firma performansını etkileyen kiritik bir faktör olarak kabul edilmektedir (Bozarth et al.,2009; Brandon-Jones et al., 2015). Bu nedenle, araştırmanın hem teorik ve yönetimsel hedefleri vardır.

1.1.1. Teorik Hedefler

Tedarik zinciri karmaşıklığı, ilgi gösterilen ve üzerine çokça çalışma yapılan bir konudur. Bu konuda çok sayıda araştırma olmasına rağmen, ilgili literatürün çoğunluğu tedarik zinciri karmaşıklığına odaklanmıştır. Bununla birlikte, tedarik tabanı karmaşıklığının firma performansına etkilerini araştıran az sayıda araştırma vardır. Ayrıca, tedarik tabanı karmaşıklığı ile şirket performansı arasındaki bağlantıyı kapsamlı bir şekilde inceleyen bir çalışmaya rastlanmamaktadır. Bu nedenle, tedarik tabanı karmaşıklığının firma performansı üzerindeki etkilerini inceleyen ampirik araştırmaya ihtiyaç vardır. Bu boşluğu doldurmak için, bu tez, tedarik tabanı karmaşıklığının firma performansının çeşitli operasyonel boyutları üzerindeki etkisini ampirik olarak test etmeyi amaçlamaktadır.

Ayrıca, literatürde tedarik tabanı büyüklüğü (Bozarth ve ark., 2009; Bode ve Wagner, 2014; Brandon-Jones ve diğ., 2015 Choi ve Krause, 2006), tedarikçiler arasındaki farklılıklar (Bozarth ve ark., 2009; Bode ve Wagner, 2014; Brandon-Jones ve diğerleri, 2015 Choi ve Krause, 2006) ve uzun ve güvenilmez tedarikçi temin süreleri (Bozarth ve diğerleri, 2009; Bode ve

Wagner, 2014; Brandon-Jones ve diğerleri, 2015 Choi ve Krause, 2006; Vachon ve Klessen, 2002), tedarik tabanı karmaşıklığının temel ve çokça araştırılan boyutlarıdır. Tedarik tabanı karmaşıklığının etkilerini inceleyen çalışmaların neredeyse hepsinde mutlaka bu boyutlar kullanılmıştır. Aynı zamanda coğrafi dağılım da birçok araştırmanın bir tedarik tabanı karmaşıklığı kaynağı olarak incelediği bir boyuttur (Bozarth ve ark., Bode ve Wagner, 2015; Brandon-Jones ve ark., 2015; Choi ve Krause, 2006; Lorentz ve ark., 2012). Öte yandan, tedarikçiler arasındaki etkileşim, araştırmacılar tarafından firma performansının belirleyicisi olarak kabul edilmesine rağmen, bu boyuyu inceleyen sınırlı sayıda kavramsal çalışma bulunmaktadır (Choi ve Krause, 2006; Jacobs, 2013). Ayrıca, tedarikçi değişkenliği de literatürde dikkat çekmeye başlayan bir tedarik tabanı karmaşıklığı boyutudur (Lorentz ve ark., 2012). Bununla birlikte, literatürdeki hiçbir çalışma tedarik tabanı karmaşıklık boyutlarının tamamını incelememektedir. Bu nedenle, bu çalışma, tedarik tabanı karmaşıklık boyutlarını derinlemesine ve kapsamlı bir şekilde inceleyerek tedarik tabanı karmaşıklığı ve etkileri üzerine olan bilgileri genişletmektedir.

Ayrıca, tedarik zinciri karmaşıklığı gelişmiş ülkelerde yaygın şekilde araştırılan bir konu iken gelişmekte olan ülkelerde bu konu halen araştırılmaktadır. Bu nedenle, bu araştırmanın gelişmekte olan ülkelerin önemli temsilcilerinden biri olan Türkiye'de incelenmesi oldukça önemli ve dikkat çekicidir.

1.1.2. Yönetimsel Hedefler

Tedarik zincirleri, küreselleşme ve yüksek oranda dış kaynak kullanımı ile günden güne daha karmaşık bir hal almaktadır. Bunun soncunda, tedarik zinciri karmaşıklığını yönetmek şirketler için daha zorlayıcı hale gelmiştir.

Şirketlerin daha iyi performans elde etmek için tedarik zinciri karmaşıklığını stratejik şekilde yönetmeleri gerekmektedir. Ancak, tedarik zinciri karmaşıklık kaynaklarını anlamak ve etkilerini ayırt etmek doğru yönetim stratejisini belirleyebilmek için kritik öneme sahiptir (Aitken ve diğ., 2018; Serdarasan, 2012).

Literatürde tedarik tabanı karmaşıklığının firma performansı üzerindeki etkilerini araştıran çalışmalar genellikle kavramsal veya vaka çalışmaları olup çalışmaların çoğu performansın her bir alt boyutunu incelemek yerine, şirketin genel performansına odaklanır.

Bu nedenle, bu tezde, tedarik tabanı karmaşıklık boyutlarının farklı operasyonel performans hedeflerine etkileri kapsamlı bir şekilde incelenmiştir. Bu nedenle çalışmanın bulguları yöneticiler için iki farklı şekilde faydalı olabilir. İlk olarak, şirketler tedarik tabanı yönetim politiklarını karşılaştıkları tedarik tabanı karmaşıklık kaynaklarını ve etkilerini dikkate alarak belirleyebilirler. Öte yandan, şirketler performans hedeflerine göre doğrudan belirli tedarik tabanı karmaşıklık kaynaklarına odaklanabilirler çünkü araştırma sonuçları her bir performans boyutunun hangi karmaşıklık kaynaklarından önemli derecede etkilendiğini göstermektedir.

1.2 Araştırma Sorusu

Bu tezin amacı, tedarik tabanı karmaşıklğının Türkiye'de farklı sektörlerde faaliyet gösteren firmaların performansına etkilerini incelemektir. Bu nedenle, ana araştırma sorusu aşağıdaki gibidir:

> ***Tedarik tabanı karmaşıklığının firma performansı üzerindeki etkisi nedir?***

İlk adım olarak, kapsamlı literatür taramasına dayanarak çalışmada incelenecek tedarik tabanı karmaşıklığı kaynakları belirlenmiştir: Tedarikçi tabanı büyüklüğü, tedarikçi farklılıkları, tedarikçi etkileşimi, uzun ve belirsiz tedarikçi temin süreleri ve tedarikçi değişkenliği. Bununla birlike, çalışmada ilgilenilen ana firma performansı alt başlıkları Maliyet, Kalite, Teslimat, Esneklik, İnovasyon ve Sürdürülebilirlik performansıdır.

Literatür tedarik tabanı karmaşıklığının firma performansına etkisi olduğunu belirtse de, endüstri ve firma büyüklüğündeki farklılıklar sebebiyle her bir karmaşıklık kaynağının her bir performans alanını ayrıca nasıl etkiledğine dair net sonuçlar bulunmamaktadır. Bu nedenle, bu tezde tedarik tabanı karmaşıklığının firma performansına etkileri incelenirken şirketlerin büyüklükleri ve faaliyet gösterdikleri sektörler de dikkate alınmıştır.

2. Tedarik Zinciri Karmaşıklığı

Tedarik zinciri, birbirine bağlı elementleri ve bu elementler arasındaki etkileşimi içeren bir sistemdir (Blackhurst ve diğ., 2000; Craighead ve diğ., 2004; Işık, 2011). Tedarik zincirinin ana aktörleri odak şirket, tedarikçiler, depolar, perakendeciler ve müşterilerdir. Odak şirket, tedarik zincirinin merkezinde olan şirkettir. Odak şirket, tedarikçilerinden aldığı ürün veya hizmetleri işledikten sonra son ürünü müşterilerine veya perakendecilere sunar. Tedarik zinciri, yukarı yönde tedarik zinciri (tedarikçiler, ikinci kademe tedarikçiler, vb.), Aşağı yönde tedarik zinciri (perakendeciler, depolar, müşteriler, vb.) ve odak şirketi olarak üç parçaya ayrılabilir (Bozarth ve dig., 2009).

Karmaşıklık, biyoloji, teknoloji ve sağlık gibi çeşitli disiplinlerde incelenmiş (Csete ve Doyle, 2002; Kannampallil ve diğerleri, 2011; Papadimitriou, 2003) ve genellikle çok boyutlu bir kavram olarak kabul edilmektedir. Benzer şekilde, tedarik zinciri karmaşıklığı da literatürde çok

boyutlu bir kavram olarak tanımlanmaktadır. Fakat, tedarik zinciri karmaşıklığının tanımı ve kaynakları hakkında fikir birliği bulunmamaktadır. Araştırmacılar, çalışmanın odalandığı alana ve amacına göre tedarik zinciri karmaşıklığını farklı boyutlarıyla farklı şekillerde tanımlamaktadır (Jacobs ve Swink, 2011; Manuj ve Şahin, 2011).

Bu tezde yukarı yönde tedarik zinciri karmaşıklığı, bir başka deyişle, tedarik tabanı karmaşıklığı incelenmektedir. Ancak, hem literatürü daha iyi anlamak amacıyla hem de karmaşıklık çalışmalarının çoğunlukla tedarik zinciri üzerine olması sebebiyle, literatürdeki tedarik zinciri karmaşıklığı tanımları ve sınıflandırmaları ele alınmıştır.

- Tedarik zinciri karmaşıklığı yapısal ve davranışsal karmaşıklık özellikleri ile tanımlanabilmektedir. Vachon and Klessen (2002), tedarik zinciri karmaşıklığını tanımlarken tedarikçi sayısının yapısal karmaşıklığı, tedarikçiler arasındaki etkileşimin ise davranışsal karmaşıklığı temsil ettiğini söylemektedir. Benzer şekilde, Choi ve Krause (2006), tedarik tabanı karmaşıklığını yapısal ve davranışsal olarak tanımlar. Ayrıca, tedarikçiler arasındaki farklılıkları da bir yapısal karmaşıklık kaynağı olarak savunurlar.

- Tedarik zinciri karmaşıklığı kavramı detay ve dinamik karmaşıklık başıkları altında da incelenmektedir (Bozarth ve diğ., 2009). Detay karmaşıklık hem yapısal hem de davranışsal karmaşıklık özelliklerini içermekte olup; detay karmaşık kaynakları tedarikçi sayısı, tedarikçilerin birbirinden farklılıkları ve tedarikçiler arasındaki etkileşim olarak kabul edilmektedir. Bozarth ve diğ. (2009), uzun ve güvenilir olmayan temin sürelerini dinamik karmaşıklık kaynağı olarak tanımlayarak yeni bir bakış açısı getirmiştir. Uzun ve güvenilir olmayan temin süreleri tedarik zinciri karmaşıklığının en etkili kaynaklarından biri olarak kabul edilmektedir (Bozarth ve diğ., 2009; Brandon-Jones ve diğ., 2015). Bozarth ve diğ.,

(2009), tedarik zinciri karmaşıklığını, tedarik zinciri aktörlerine ve süreçlerine ilişkin detay ve dinamik karmaşıklık seviyesi olarak tanımlamaktadır. Tedarik zincirinin bileşen sayısı ve bileşen farklılıkları detay karmaşıklığı temsil ederken, sistemin öngörülemezliği dinamik karmaşıklığı temsil eder. Serdarasan (2013) bu sınıflandırmayı karar verme karmaşıklığını da ekleyerek genişletmiştir.

• Tedarik zinciri karmaşıklığı, tedarik zincirinin ana kısımlarına göre, yukarı yönde karmaşıklık, iç/üretim karmaşıklığı ve aşağı yönde karmaşıklığın kombinasyonu olarak da tanımlanabilir (Bozarth ve ark., 2009). Yukarı yönde karmaşıklık, birinci seviye veya daha düşük seviyeli tedarikçilerden kaynaklanan karmaşıklığı temsil eder. İç/üretim karmaşıklığı, odak şirketin kendi iç süreçleriye ve/veya ürünleriyle ilişkilidir. Aşağı yönde karmaşıklık ise, müşteri tarafında talep dalgalanması ve öngörülemeyen müşteri ihtiyaçları gibi karmaşıklığı temsil eder (Bozarth et al., 2009).

• Literatürde, tedarik zinciri karmaşıklığının etilerini farklı analiz birimi ile inceleyen çalışmalar da bulunmaktadır. Bazı çalışmalar, karmaşıklığın etkilerini tedarik ağı seviyesinde incelemektedir ve tedarik ağı karmaşıklığı literatürde birçok araştırmacı tarafından incelenen önemli bir konudur (Choi ve Hong, 2002; Pathak ve diğ., 2007; Tachizawa ve Wong, 2015). Tedarik zinciri karmaşıklığı araştırmaları her ne kadar tedarik zinciri veya tedarik ağındaki aktörlerden kaynaklanan karmaşıklığa yoğunlaşsa da, bu çalışmalarda amaç karmaşıklığın odak şirketin performansına etkisini araştırmaktır. Aksine, tedarik ağı karmaşıklığı çalışmaları, karmaşıklığın ağ seviyesindeki etkilerine odaklanır. Tedarik ağı bakış açısına göre, tedarik ağına dahil olan tüm şirketler, odak şirketi ile bağlantıları doğrudan veya dolaylı da olsa, odak şirketin son ürününü etkilemektedir (Choi ve diğ., 2001). Ek olarak, Choi ve diğ., (2001) tedarik zincirini, içiçe geçmiş ve tahmin edilemez olması sebeiyle dinamik özelliğe sahip karmaşık adaptif

sistemler olarak tanımlamıştır. Tedarik zinciri birbirine bağlı farklı ögelerden ve ögelerin etkileşiminden oluştuğundan, herhangi bir değişikliğin zincirdeki bir diğer ögeye veya sistemin bütününe olan etkisini tahmin etmek kolay değildir. Ayrıca, tedarik zincirindeki aktör sayısı arttığında, tedarik zincirinin genel karmaşıklık seviyesinde artış kaçınılmazdır (Blackhurst ve diğ., 2004; Craighead ve diğ., 2004). Öte yandan, tedarik zinciri riski, birbirine bağlı aktörlerin etkileşiminden dolayı, her aktörün bireysel risk faktörlerinin toplamından daha yüksek bir riske neden olmaktadır (Blackhurst ve diğ. 2000, Craighead ve diğ., 2004). Ayrıca, odağını daraltıp tedarik zincirinin sadece yukarı yönde karmaşıklık kaynaklarına, bir başka deyişle, tedarik tabanı karmaşıklık kaynaklarına yoğunlaşan başka çalışmalar da bulunmaktadır (Bode ve Wagner, 2015; Brandon Jones ve diğ., 2015, Choi ve Krause, 2006). Bu çalışmalarda, yalnızca bir odak şirketin tedarik tabanında bulunan tedarikçilerinden kaynaklanan karmaşıklık kaynakları araştırılmaktadır. Bu tez çalışmasında, tedarik tabanı karmaşıklık boyutlarının firma performansı üzerindeki etkileri incelenmiştir.

Karmaşıklığı etkili ve doğru şekilde yönetebilmek için karmaşıklık çeşitlerini ve aralarındaki farkları ayırt etmek önemlidir (Serdarasan, 2013; Aitken ve diğ., 2016; Aitken ve diğ., 2018). Tedarik zinciri karmaşıklığını karakter özelliklerine, kaynağına ve işlevselliğine göre sınıflandıran farklı yaklaşımlar vardır. Bu yaklaşımlar aşağıda daha ayrıntılı şekilde açıklanmıştır.

İlk olarak, tedarik zinciri karmaşıklığı karakter özelliklerine göre detay karmaşıklık, dinamik karmaşıklık ve karar verme karmaşıklığı olarak sınıflandırılabilir. Literatürde karmaşıklık genellikle detay ve dinamik olarak sınıflandırılmaktadır (Bozarth ve diğ., 2009; Isik, 2011; Vachon ve Klessen; 2002)

Bir sistemi oluşturan bileşen sayısı ve bileşenlerin farklılıkları detay karmaşıklığı, çok sayıda birbirine bağlı bileşenden oluşan sistemin herhangi bir etkiye vereceği tepkinin öngörülemezliği ise dinamik karmaşıklığı ifade eder (Aitken ve diğ., 2016; Senge,1990;Serdarasan, 2013). Ayrıca, Bozarth ve diğ. (2009), dinamik tedarik zinciri karmaşıklığının firma performansı üzerinde, detay karmaşıklıktan daha büyük bir etkiye sahip olduğunu göstermiştir. Detay karmaşıklığının kaynakları tedarikçi sayısı, tedarikçilerin farklılıkları, tedarikçiler arasındaki iletişimken; dinamik karmaşıklık kaynakları uzun ve güvenilir olmayan temin süreleri ve tedarikçi değişkenliğidir (Bozarth ve diğ. 2009; Lorentz ve diğ., 2012). Bu çalışmalara ek olarak, Serdarasan (2013), tedarik zinciri karmaşıklığını statik, dinamik ve karar verme olarak sınıflandırmıştır.

İkincisi, tedarik zinciri karmaşıklığı kaynağına göre sınıflandırılabilir. Karmaşıklığın kaynağı nereye müdahale edilmesi gerektiğini göstereceği için önemlidir. Literatürde iki temel yaklaşım vardır. Bozarth ve diğ. (2009) karmaşıklığı tedarikçilerden kaynaklanan yukarı yönde karmaşıklık, iç süreçlerden kaynaklanan dahili karmaşıklık ve müşterilerden kaynaklanan aşağı yönde karmaşıklık olarak sınıflandırır. Alternatif olarak, Serdarasan (2013) karmaşıklığı dahili, arz/talep arayüzü ve dış/çevresel olarak üç kategoriye ayırmıştır. Dahili karmaşıklık, şirket içindeki süreçlerden kaynaklanırken, dış karmaşıklık müşterilerle veya çevresel koşullarla ilgilidir. Arz/talep arayüz karmaşıklığı ise tedarikçiler ile müşteriler arasındaki bilgi ve malzemeden akışından kaynaklanan karmaşıklığı ifade eder. Dahili karmaşıklık ve arz/talep arayüz karmaşıklığı, odak şirketin etki alanı içinde olduğundan daha kolay yönetilebilirler ve tedarik zinciri aktörleri arasındaki koordinasyon seviyesi karmaşıklığın yönetilmesinde önemli bir rol oynar (Serdarasan, 2013).

Tedarik zinciri karmaşıklığı aynı zamanda işlevselliğine göre de sınıflandırılmaktadır. Tedarik zinciri karmaşıklığı, genellikle şirketin

performansını olumsuz etkileyen bir kavram olarak kabul edilir. Ancak,literatürde, şirketlerin piyasada rekabet avantajı elde edebilmesi veya mevcut rekabetçi konumunu sürdürmek için belirli bir seviyede karmaşıklığın gerekli olduğunu gösteren birçok çalışma bulunmaktadır (Aitken ve ark., 2016). Bir şirket piyasadaki karmaşıklık kaynaklarını daha etkin veya daha iyi yönetiyorsa rakiplerinden bir adım önde olacağı savunulmaktadır. Bu nedenle, şirketin rekabetçi gücünü artırmak için karmaşıklığın kullanılıp kullanılmayacağını belirlemek gerekmektedir. Karmaşıklığın işlevselliğini ayırt eden iki ana yaklaşım vardır: Gerekli/Gereksiz (Serdarasan, 2013) ve Stratejik/İşlevsiz Karmaşıklık (Aitken ve diğ.,2016). Gerekli veya Stratejik karmaşıklık firmaya önemli rekabet avantajı getiren ve firmanın daha iyi performans elde etmesini sağlayan karmaşıklık olarak tanımlanır. Gereksiz veya İşlevsiz karmaşıklık ise şirkete herhangi bir fayda sağlamadan ek maliyetler getirerek iyi performans elde etmesini engelleyen karmaşıklığı ifade eder.

2.1 Tedarik Tabanı Karmaşıklığı

Choi ve Krause (2006), tedarik tabanını, tedarik zincirinin bir odak şirket tarafından aktif olarak yönetilen parçası olarak tanımlamaktadır. Ek olarak, tedarik tabanı karmaşıklığı; çok sayıda tedarikçiden, tedarikçiler arasındaki teknik kapasite, büyüklük, operasyonel strateji ve kültür farklılıklarından, uzun ve güvenilir olmayan tedarikçi temin sürelerinden ve tedarikçilerin geniş coğrafi bölgelere dağılımından kaynaklanan yukarı yönde tedarik zinciri karmaşıklığını ifade etmektedir (Bode ve Wagner, 2015; Bozarth ve diğ., 2009; Caridi ve diğ., 2010).

Tedarik tabanı karmaşıklığı yapısal ve dinamik karmaşıklık olmak üzere iki alt başlıkta incelenmektedir. Yapısal karmaşıklık, i) tedarikçi sayısı, ii) tedarikçilerin farklılaşma derecesi, iii) tedarikçilerin coğrafi dağılım ve iv) tedarikçiler arasındaki etkileşimi içerirken; dinamik karmaşıklık i.) uzun ve

güvenilir olmayan tedarikçi temin süreleri ve ii) tedarikçi değişkenliğini içermektedir.

Tedarik tabanı büyüklüğü odak şirketin tedarik tabanında bulunan ve aktif şekilde yönetilen tedarikçi sayısını ifade eder (Brandon-Jones ve diğ.,2015; Choi ve Krause, 2006).

Tedarikçiler arasındaki farklılıklar, tedarikçilerin büyüklük, teknik yetenekler, organizasyonel kültür ve operasyonel stratejiler açısından farklılaşma derecesini ifade eder (Brandon-Jones ve diğ.,2015; Choi ve Krause, 2006).

Tedarikçilerin coğrafik dağılımı odak şirketin tedarikçilerinin Tükiye, Asya, Avrupa, Kuzey Amerika ve diğer bölgelerde olan dağılımını ifade eder (Brandon-Jones ve diğ.,2015).

Tedarikçiler arasındaki etkileşim tedarikçiler arasındaki iletişim ve bilgi paylaşım seviyesini ifade eder (Chen, Paulraj, ve Lado, 2004; Corsten ve Felde, 2005).

Uzun ve güvenilir olmayan tedarikçi temin süreleri, tedarikçilerin verdiği kısa temin sürelerinin güvenilirliğini ifade eder (Bozarth ve diğ., 2009).

Tedarikçi değişkenliği, son iki yılda tedarikçilerin büyük kısmının değiştiğini ve ve tedarikçilerle kısa vadeli ilişkileri ifade eder (Gao ve diğ.,2015).

Bu tezde tedarik tabanı karmaşıklığının firma performansına etkilerinin araştırılması amaçlanmıştır. Firma performansı sadece performansın operasyonel yönlerini dikkate alacak şekilde, tedarikçilerden kaynaklanan Maliyet, Kalite, Teslimat, Esneklik, İnovasyon ve Sürdürülebilirlik performansları ile operasyonel hale getirilmiştir.

Maliyet, ürün/hizmet birim fiyatlarını ve satın alınan girdilerin toplam maliyetini içermektedir (Luzzini ve diğ., 2012).

Kalite, satın alınan ürünlerin şartnamalere uygunluğuna, güvenilirliğine ve işlevselliğine odaklanmaktadır (Bozarth ve diğ., 2009).
Teslimat, tedarikçinin teslimat tarihleri ve adetlerindeki doğruluğu ve tedarikçi temin sürelerinin iyileştirilmesini içermektedir. (Bozarth ve diğ., 2009).

Esneklik, tedarikçinin siparişteki ürün miktarındaki ve türündeki değişikliklere yanıt verme kapasitesini ifade etmektedir (Bozarth ve diğ., 2009).

İnovasyon, tedarikçilerle birlikte yeni ürün/hizmet tasarlama/ geliştirme hızını ve yeni ürün geliştirme oranını içermektedir (Brandon-Jones ve diğ.,2015).

Sürdürülebilirlik, tedarikçilerin çevresel,sosyal ve etik bilinç ve duyarlılığının iyileştirilmesini ve bu alanlarda odak şirketin beklentilerini karşılamasını ifade etmektedir (Brandon-Jones ve diğ.,2015).

3. Yöntem

Literatürde tedarik tabanı karmaşıklığının firma performansına etkileri üzerine birçok kavramsal çalışma ve vaka çalışması bulunmaktadır. Bu çalışmalar, tedarik tabanı karmaşıklığının etkilerine dair anlayışı geliştirmiş olsa da, aynı zamanda karmaşıklığın etkileri üzerine birçok zıt argüman öne sürmüştür. İlgili literatürün çoğunluğu tedarik tabanı karmaşıklığının şirket performansına olumsuz etkisi olduğu sonucuna varırken, bazı çalışmalar belirli alanlarda şirket performansını iyileştirdiğini savunmaktadır. Bu nedenle, bu tezde, tedarik tabanı karmaşıklığı ile firma perfromansı

arasındaki ilişkiyi araştırmak için teori test yaklaşımı benimsenmiştir. Tedarik zinciri ve tedarik tabanı karmaşıklığı literatüründeki temel teorilere dayanarak araştıma hipotezleri türetilmiş ve hipotezler şirketlerden toplanan veriler ile test edilmiştir. Teori test yaklaşımı, teorileri gerçek hayattaki gözlem ve verilere göre değerlendirdiği için önemli bir metodolojidir.

Araştırmanın amacı tedarik tabanı karmaşıklığının şirket performansına etkilerini incelemek olduğundan, araştırmanın analiz birimi şirketlerdir. Bu nedenle, çalışma örneklemi CAPITAL dergisinin yürüttüğü çalışma sonucunda yayınlanan Türkiye'nin ilk 500 şirketi olarak belirlenmiştir. Daha spesifik olarak, bu çalışmanın analiz birimi Türkiye'de üretim ve hizmet sektöründe faaliyet gösteren büyük şirketler olarak tanımlanabilir. Çalışmanın ana örneklemi Capital 500 listesindeki firmalar Türkiye'nin en büyük firmalarını içermesine rağmen, listede yer almayan fakat Türkiye'de faaliyet gösteren birçok global firma da bulunmaktadır. Bu sebeple, ilave örnekleme yöntemi olarak "amaçlı örnekleme" seçilmiştir.

Bu tez çalışmasında, veri toplama yöntemi olarak anket uygulaması seçilmiştir. Anketler kısa sürede çok sayıda katılımcıya ulaşmayı sağladığından ve çalışmada Türkiye'nin ilk 500 firmasından veri toplanmak amaçlandığından, anket uygulaması bu araştırma için avantajlı bir yöntemdir.

Ayrıca, bu araştırmada kullanılan veriler, en doğru ve en güvenilir veriler bu alanda yetkin kişilerden elde edilebileceği için, şirketlerin satın alma ve tedarik zinciri yönetimi ve lojistik bölümlerinde çalışan yöneticiler veya deneyimli çalışanlar tarafından doldurulan anketler ile toplanmıştır. Bu yöntem "uzman örnekleme" olarak adlandırılmaktadır.
Araştırma verileri internet üzerinden doldurulan elektronik anketlerle 183 katılımcıdan toplanmıştır. Anket verileri çok sayıda katılımcı olan firmalar dikkate alınarak düzenlendiğinde, CAPITAL Türkiye-500 listesinden 130

firma ve amaçlı örnekleme yöntemi aracılığıyla 31 firma olmak üzere toplamda 161 firmadan kullanılabilir anket verileri elde edilmiştir.

4. Bulgular

Bu tezde, araştırma yaklaşımı olarak teori testi kullanılmıştır. Literatürde yer alan her bir tedarik tabanı karmaşıklık boyutu ile performans boyutları arasındaki ilişkiler ayrı ayrı incelenmiştir. Öncelikle, altı farklı performans modelinin sonuçları sırayla yorumlanmıştır. Ardından, tedarik tabanı karmaşıklık boyutlarının etkileri özetlenmiştir

İlk olarak, genellikle şirketlerin temel hedefi olan maliyet performansı, tedarik tabanı karmaşıklık boyutlarının etkileri açısından değerlendirilmiştir. Sonuçlar, şirketin maliyet performansının üç tedarik tabanı karmaşıklık boyutundan etkilendiğini göstermektedir: Coğrafi dağılım, uzun ve güvenilmez tedarikçi temin süreleri ve tedarikçi değişkenliği. Coğrafi dağılımın maliyet performansı üzerinde olumlu bir etkisi varken, uzun ve güvenilmez tedarikçi temin sürelerinin ve tedarikçi değişkenliğinin performansı olumsuz etkilediği tespit edilmiştir.

Kalite performansı, tedarikçilerin birbirinden farklılıkları ve tedarikçi değişkenliği olmak üzere iki tedarik tabanı karmaşıklığı boyutundan etkilenmektedir. Tedarikçiler arasındaki farklılıklar ve tedarikçi değişkenliği odak şirketin tedarik ettiği ürünlerde standardı sağlayamamasına ve böylelikle nihai ürünün kalite performansının azalmasına sebep olmaktadır.

Bununla birlikte, çalışma sonuçları, bir şirketin teslimat performansının tedarikçilerin birbirinden farklılıkları ve uzun ve güvenilir olmayan tedarikçi temin sürelerinden olumsuz yönde önemli ölçüde etkilendiğini göstermektedir. Tedarikçilerin birbirlerinden farklı olmaları, odak şirketin ihtiyaç duyduğunda bir tedarikçinin yerine diğer tedarikçiyle çalışma

ihtimalinin azalmasına yol açmaktadır. Tedarikçi temin sürelerinin uzun ve güvenilmez olması teslimat performansının en önemli negatif etkenidir.

Şirketin esneklik performansı, üç tedarik tabanı karmaşıklık boyutundan etkilenmektedir. Tedarik tabanı büyüklüğü esneklik performansını olumlu etkilerken, uzun ve güvenilmez tedarikçi temin süreleri ve tedarikçi değişkenliğinin esneklik performansı üzerinde olumsuz etkileri vardır.

Çalışma sonuçları, ilginç bir şekilde, inovasyon performansının sadece uzun ve güvenilmez tedarikçi temin sürelerinden olumsuz etkilendiğini göstermektedir. Birçok çalışma tedarik tabanı karmaşıklığının, bilgi bazlı kaynak çeşitliliği ve etkileşimi aracılığıyla, odak şirketin inovasyon performansını artırdığını savunsa bu çalışmada böyle bir bulguya rastlanmamıştır (Choi ve Krause, 2006; Flynn ve Flynn, 2005; Koufteros ve diğ., 2007).

Son olarak, sürdürülebilirlik performansının üç tedarik tabanı karmaşıklık boyutundan etkilendiği tespit edilmiştir. Tedarik tabanı büyüklüğü sürdürülebilirlik performansını iyileştirirken, tedarikçiler arasındaki farklılıklar ve uzun ve güvenilmez tedarikçi temin süreleri sürdürülebilirlik performansını olumsuz etkilemektedir.

Çalışmade incelenen altı operasyonel performans modeli sonuçları, bazı tedarik tabanı karmaşıklık boyutlarının, literatürdeki çalışmaların savunduğu şekilde, performansı olumsuz etkilediği; ancak bazı karmaşıklık boyutlarının ise performansı iyileştirdiğini göstermektedir. Bu nedenle, şirketler daha iyi bir performans elde etmek için şirketin büyüklüğünü, endüstri şartlarını ve şirket iç ve dış uygulamalarını göz önünde bulundurarak şirket için en uygun karmaşıklık seviyesini bulmalıdır.

Uzun ve güvenilmez tedarikçi temin süreleri, beklendiği şekilde, tedarik tabanı karmaşıklığının en etkili kaynağı olarak görülmektedir. Güvenilmez ve uzun tedarikçi temin sürelerinin, şirketlerin kalite performansı dışındaki tüm operasyonel performans boyutlarını (Maliyet, Teslimat, Esneklik, İnovasyon ve Sürdürülebilirlik) olumsuz yönde etkilediği tespit edilmiştir. Bu nedenle, şirketlerin firma performansını iyileştirmek için tedarikçi temin sürelerine mutlaka odaklanması gerektiği sonucuna varılabilir.

Tedarikçi değişkenliğinin, tedarik tabanı karmaşıklığının bir diğer önemli kaynağı olduğu; ayrıca, odak şirketin olumsuz etkilediği tespit edilmiştir. Bu bulgu literatürdeki önceki çalışmaları desteklemektedir. Tedarikçilerle uzun vadeli yönelimin, tedarikçilerin fırsatçı davranışlarını azalttığı (Tachizawa ve Wong, 2015), şirketlerin maliyet-etkin alımlarını kolaylaştırdığı (Bozarth ve ark., 2009) ve ortak kalite uygulamalarını artırdığını (Song ve diğ., 2012) ve böylelikle performansı artırdığı savunulmaktadır. Bu sonuçlar, tedarikçilerle uzun vadeli bir yönelim olmadığında maliyet, kalite ve esneklik performansının olumsuz yönde etkilendiğini göstermektedir.

Bu araştırmada, dinamik karmaşıklık kaynakları olan, uzun ve güvenilmez tedarikçi temin süresinin ve tedarikçi değişkenliğinin, şirket performansı üzerinde en etkili karmaşıklık boyutları olduğu tespit edilmiştir. Bu bulgu, Bozarth ve diğ. (2009) çalışmasında savunulan, dinamik karmaşıklığın şirket performansı üzerinde detay karmaşıklıktan daha büyük bir etkiye sahip olduğu, bulgusunu desteklemektedir.

Ayrıca, tedarikçilerin birbirinden farklılaşma derecesi, kalite, teslimat ve sürdürülebilirlik performansını olumsuz yönde etkileyen bir diğer önemli tedarik tabanı karmaşıklığı kaynağı olarak bulunmuştur. Bunun sebebi, tedarikçiler arasındaki farklılaşma arttıkça, ürünlerin veya tedarikçilerin değişebilirliğinin azalması olabilir. Tedarikçiler birbirinden farklılaştıkça, tedarikçilerden alınan ürünler, tedarikçilerin büyüklüğü, teknik yeteneği ve

üretim stratejisi farklılıkları nedeniyle aynı olmayacaktır. Bu bulgulara dayanarak, tedarik tabanındaki tedarikçiler birbirinden farklılaştığında firmanın performansının azaldığı sonucuna varılabilir.

Firma performansını olumsuz etkileyen uzun ve güvenilmez tedarikçi temin sürelerinin, tedarikçi değişkenliğinin ve tedarikçiler arasındaki farklılığın aksine, tedarik tabanı büyüklüğünün ve tedarikçilerin coğrafi dağılımının firma performansı üzerinde olumlu bir etkisi olduğu tespit edilmiştir.

Tedarik tabanı büyüklüğünün, şirketin esneklik ve sürdürülebilirlik performansını artıran bir tedarik tabanı karmaşıklık kaynağı olduğu tespit edilmiştir. Daha çok tedarikçiye sahip odak şirketlerin daha iyi esneklik ve sürdürülebilirlik performansına sahip olduğu gözlemlenmiştir (Bozarth ve diğ., 2009; Brandon-Jones ve diğ., 2015).

Tedarikçilerin coğrafi dağılımı, tedarik tabanı karmaşıklığının bir diğer önemli boyutudur. Literatürde, küresel kaynak kullanımının, dolayısıyla tedarikçilerin geniş coğrafi dağılımının, firma için hem avantajlı olduğunu savunan hem de dezavantajlı olduğunu savunan çalışmalar bulunmaktadır. Bazı çalışmalar ise tedarikçilerin coğrafi dağılımının performans üzerinde bir etkisi olmadığını tespit etmiştir. Bu çalışmada, tedarikçilerin coğrafi dağılımı, birçok araştırmanın sonuçlarına benzer şekilde, şirketin maliyet performansını artıran bir faktör olarak bulunmuştur. Öte yandan, coğrafi dağılımın teslimat performansı üzerinde ne olumlu ne de olumsuz etkisi olduğu bulunmuştur. Bu durumun sebebi odak şirketin büyüklüğü veya tedarikçilerin temin sürelerinin kısalığı ve güvenilirliği olabilir (Bozarth ve diğ.,2009; Lorentz ve diğ.,2012).

Ayrıca, bu çalışmada, tedarikçiler arasındaki etkileşimin şirketin herhangi bir performans boyutuna olumlu ya da olumsuz bir etkisi bulunamamıştır. Literatürde, kavramsal çalışmaların önermeleri haricinde, tedarikçiler

arasındaki etkileşimin firma performansını etkilediğin destekleyen ampirik bir kanıt bulunmamaktadır (Choi ve Krause, 2006). Ayrıca, bu bulgunun birkaç olası sebebi olabilir. Birincisi, tedarikçiler arasındaki etkileşimin olası olumsuz etkisi firma büyüklüğü tarafından domine edilebilir çünkü bu çalışmanın örneklemi Türkiye'deki en büyük firmalardır. Bu şirketler tedarikçi etkileşimlerinden kaynaklanan karmaşıklığı yönetmek için etkili uygulamalara sahip olabilirler. İkincisi, tedarikçiler arasındaki etkileşimi ölçmek için kullanılan ölçekler tedarik tabanı karmaşıklığının etkileşim yapısını doğru tanımlamak için yetersiz olabilir. Ayrıca, tedarikçiler arası etkileşim odak şirketin bakış açısına göre ölçülmüştür. Belki, Brandon-Jones ve diğ. (2015),çalışmasında öne sürüldüğü gibi, tedarik ağı düzeyinde veri toplamak gerekmektedir. Bu nedenle, tedarikçiler arasındaki etkileşimin firma performansı üzerindeki etkisini araştırmak için bazı hususlar dikkate alınmalıdır.

Bu tezde, literatürde tartışılan tüm tedarik tabanı karmaşıklığı boyutları ve bu karmaşıklık boyutlarının şirketlerin farklı performans hedeflerini ne ölçüde etkiledikleri incelenmiştir. Literatürdeki çalışmaların çoğu tedarik tabanı karmaşıklığının sadece temel boyutlarını araştırmış ve bu çalışmalarda, firmanın genel performansı ya da sadece belirli bir performans boyutu ölçülmüştür. Fakat, bu tez, hem tüm tedarik tabanı karmaşıklık boyutlarını hem de firmanın altı farklı operasyonel performans boyutunu (maliyet, kalite, teslimat, esneklik, inovasyon ve sürdürülebilirlik) inceleyerek önceki çalışmalardan farklılık göstermektedir.

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