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THE EFFECT OF SUPPLY CHAIN AGILITY ON FIRM PERFORMANCE

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Abstract:
In the current rapidly changing, developing and complicating global world, the companies are constantly in a competition with one another. In this competitive environment, the companies need to use their resources in the most accurate manner in order to survive. Companies gain a competitive advantage by responding to variable customer demands in different markets within the shortest time and at the right time. They can also gain this by concentrating the agility factor in the supply chain. In case of uncertainty, the supply chain must be agile for the companies to gain a competitive advantage. In this study, the effects of agility and technological uncertainty on the performance of the company in the supply chain management are examined. In the research, it has been observed that technological uncertainty affects the supply chain agility and the supply chain agility also affects the performance of the company in a positive way.

Keywords: Supply Chain Agility, Uncertainty, Technological Uncertainty, Firm Performance

1. Introduction

Recently, the companies focus on the word "competition" in an environment where the global trade is increasing every passing day and the world becomes the only market. The companies must take many administrative and operational steps in order to remain capable to compete, to survive and to maintain this level of competition in the long term. Along with the global trade, the companies have begun to focus on access to emerging markets and strategies for potential customers by concentrating on supply chain management. The companies attach importance to technology and agility, which play an important role in the supply chain management in order to create the most accurate solutions to the market and customer needs and also to keep their costs in balance. The concept of technological uncertainty, especially in terms of technology selection, usage and internal and external customer potential emerging as a result of them is an issue which needs to be focused. It is a very critical situation for companies to implement the concept of agility in the event of such a problem.

The problems in the delivery periods, sudden changes in the supply and demand and variations in the product life cycles have led companies to adapt and keep up with these determinants in order to meet the developing, changing and increasing customer demands in the current world with the accurate solutions within a short time (Christopher, 2000). The companies try to gain a competitive advantage by taking positions in the developing and changing markets in the global world. The companies canalizing in this strategic plan attach importance to the concept of agility in the supply chain in order to minimize risks, to take precautions against the uncertainties such as customer demand, supplier and technology(Braunscheidel & Suresh, 2009) (Yu, 2001) (Butz Jr. & Goodstein, 1996). When the research conducted is examined, it is indicated that the companies may take necessary steps to these uncertainty factors in the supply chain with the agility.
The companies try to prevent uncertainties to determine successful strategies in supply chain management. For this, the companies focus on turning uncertainties into advantages in the best way by prioritizing supply chain agility (Kim

& Chai, 2017). Much research has been conducted on how companies gain a competitive advantage by developing this solution and similar solutions additionally (Morash, 2001) (Selness & Sallis, 2003).

Further researches related to the supply chain management are reviewed in the literature. There is much research dealing with the importance of the supply chain management for companies in this competitive race in the current environment where the level of competition between the companies is developing quickly in a complex structure. These conducted researches related to the supply chain have focused on integration, flexibility, cooperation, and agility within the chain and have introduced many new concepts into the supply chain.

It is observed that the supply chain agility affects the performance of the company in a positive way in the environment of technological uncertainty and uncertainty as stated in the aforementioned examples related to the literature. In this paper, the relationship between technological uncertainty and supply chain agility and the effect of supply chain agility on the performance of the company are examined through questionnaires conducted with the participation of the companies.

2. Service Quality in Public Transportation

2.1. EN 13816 Service Quality Standard in Public Transportation

Along with the globalization, the companies have attached importance to the supply chains and increased their investments in this area in order to respond quickly to the customer demands and shorten product presentation time in the global markets where competition rises to the top. The supply chain is the structure that organizes all stages such as the supply of raw materials and intermediates to be used in the production process by the suppliers and the production of intermediate or final products by gathering all the means of production, capital, labor and technology and delivery of these products to the customers. The supply chain is the whole set of systems establishing the relationship between the source where the products manufactured and the final purchaser in the trade.

According to Meindl and Chopra (2007), the supply chain is a chain that not only consists of manufacturers and suppliers but also consists of providers of warehousing service, retailers, forwarders, customers and other partners involved in the all entire system in order to meet customer demands directly and indirectly. In this definition, similar processes in the other definitions and the actors in the process are mentioned.

Delivery of a raw material supplied in the supply chain as a final product to the final consumer requires a whole range of processing steps. This process constitutes the supply chain structure of the companies in which this process is carried out and the relationship system established between the companies operates in this processing step. The companies in each step of the system are the customers of the company in the previous step and the supplier of the company in the next step. The aim of the system is to provide the best service to the consumer in the last step and as a result of this to achieve customer satisfaction. According to Çemberci and et. al (2015), the supply chain structure consists of suppliers, production centers and distribution. The raw materials, stocks in the process and the final products carried within the system as well as retail stores, are other factors constituting the supply chain structure. The chain starts when the raw materials have emerged and ended when the product is reused or disposed of.

Although the supply chain is an excellent system, it is complex due to having many factors in the chain. One of the reasons for this complexity is that the companies represent the product, process, and organizational structures and possess these different systems. The supply chain system may be called an organizational system from an administrative perspective. Because the supply chain consists of three administrative levels as strategic, tactical and operational decisions in terms of supply chain decisions.

The supply chain management consists of internal and external organizations manufacturing products based on customer demands and contribute to the formation of a value chain enabling these products to be distributed to customers. In the elementary idea, the supply chain management deals with the selection and determination of participants who undertake strategic tasks within the supply chain (Cox, 1996). According to Çemberci et al. (2015), supply chain management is actually a flow management. The flow of information, money, and product is managed

by the supply chain management. One of the most important points in this chain is that the supply department establishes a connection with the outside world for the company. The effectiveness of the purchasing system depends on the various functions of the company and the flow of information from the supply department to the other functions of the company. The supply chain management is a strategically and systematically planned and structured management system in order to achieve the long-term goals of efficiency, coordination and business organization between the supply chains of the companies and the companies within this chain. The company, taking part any other point of the chain, must always maintain strong relations and communication with the other companies. The most important factor for the effectiveness of this communication may be defined as a predetermined supply chain management strategy. Moreover, communication and relationships strengthen the environment of dependence, coordination, cooperation and trust between companies.

The concept of the supply chain management, which is able to improve customer service, reduce costs, maintain and increase competitiveness additionally, has emerged for the high customer satisfaction against high-quality, effective and high-level product demands of the knowledgeable customers on the product demand(Franks, 2000). The companies require a well-organized information management system to achieve the desired competitive advantage by applying the supply chain management to administrative and business organizations. The supply chain management focuses on support activities, especially those assisting in information sharing and operations for business processes. High-quality products and services may be produced/rendered in the production if the decision makers at various points in the management system function correctly and healthfully. Information factor, one of the most important factors in the decision-making process, has made information management successful.

2.2 Supply Chain Agility

It is a very important factor for the success of the companies operating in the global markets to respond to the competitive challenges they face in the market and to use these capabilities to gain a competitive advantage over other companies. It is a strategic decision for the companies to maintain their long-term effectiveness in variable and movable market conditions and to attach importance to agility in order to be successful. Agile manufacturing, which is an important issue for the companies, is expressed as the changes in the tools, techniques and initiatives enabling a facility or company to develop under unpredictable circumstances. Agile manufacturing not only enables a facility to quickly respond to customer needs, but also includes reacting with the unpredictable speed to quickly respond to operations and strategic alliances. In some cases, agile manufacturing also includes "mass privatization" concept to meet unique customer requirements. In a broad sense, agile manufacturing includes the ability to react quickly to technical or environmental surprises.

The supply chain agility arises from the ability of a company to quickly identify changes, opportunities, and threats (vigilance). To quickly access relevant data (accessibility); to decisively decide how to act (decisiveness); to quickly implement those decisions (swiftness); and to modify the range of tactics and operations to the extent needed (flexibility) (Gligor , 2015). The characteristic, which an agile supply chain should possess first, is indicated as the market sensitivity. Observing the demands in the market environment and perceiving priorities and finding solutions for them are expressed as the market sensitivity. The second feature, which is at the forefront, is virtual networks. The virtual network is defined as the fact that the chain elements within the supply chain processes share accurate and full-time information with each other through information technologies. Another main feature is process integration. In this feature, supply chain partners work together in processes and take an active role in product development processes with mutual trust and cooperation. The network integration, which is the last feature, is the organization of the chain network in order that supply chain participants may work on a single network (Güner & Gündoğan, 2017).

2.3 Uncertainty

Uncertainty is defined as the processes arising from lack of information. Along with the globalizing world, the markets where the companies maintain their operations have acquired an international dimension and the priority has been given to meet customer demands. The companies taking part in activities and customer demand-oriented markets focus on continuously monitoring the changes in demands of their customers, developing the quality level,

and bringing solutions to increase the level of trust and delivery speed. The uncertainty is defined as the main idea, prejudice and techniques which have an effect on the decisions of the managers who take the risk in uncertainty decision process in the definitions made by many researchers regarding the uncertainty. It is stated that the uncertainty situation arises from changes in suppliers, demand and technology apart from expectations. Concordantly, the concept of uncertainty is discussed in three sub-factors: demand, supplier and technological uncertainty (Çemberci , 2011).

Demand uncertainty is defined as the changes resulting from uncertainty and unpredictability in demands, expectations, and preferences of the customers in the product and service groups. The concept of demand uncertainty is also defined as the uncertainty about the demand side to be aimed to meet by the supply chain. Urgent order requests, increase in the amount and variety of the products needed, decreasing the time to meet orders, increase in the resources of the products to be provided, increase in the speed of innovation in the products may be indicated as the customer expectations increasing the demand uncertainty.
Supplier uncertainty is defined as the unpredictability of the quality and delivery level of the products supplied by the suppliers of the companies in the supply chain and the uncertainties resulting from these changes. Delays and damage of raw materials and semi-products provided by suppliers to be used in the production process lead to huge uncertainty and causes companies to stop or even postpone their production processes. This uncertainty situation starting from the supply process will have an effect on supply chain processes and the inefficient use of resources will result in increased costs for companies such as logistics costs and stock-keeping costs.
Technological uncertainty is defined as the uncertainty occurred as a result of the unpredictability whether the new technologies offered by the organizations are able to meet the needs that they aim to meet. According to Moriarty and Kosnik (1989), five factors give rise to technological uncertainty. The first issue is whether the new innovation will function as promised. The second issue is an unpredictable problem of supply periods for products offering a high level of technology. Another issue is the companies and vendors providing products to the customers. The main issue is that the customers demand a high-quality service in terms of the products they will purchase from the companies. The fourth issue is whether the technology-based products will create undesirable results and effects. The fifth and last issue is when the level of technology used by the companies currently will become unresponsive.

2.4 Firm Performance

Firm performance has been tried to be defined by many performance factors in many sectors from past to present. As the evaluations performed for firm performance in the literature increase, the changes in the performance criteria and developments are observed. The concept of company performance, which is a significant evaluation criterion, is evaluated from the point of view of the companies in terms of efficiency in activities, competitiveness in markets, minimization of costs from the production process to the distribution and profit dimensions to be obtained as a result of the works performed.
The measurement of the firm performance is an approach directing the determination of levels of performance of the companies, namely, efficiency in the business activities of the organizations and their use of financial and non-financial resources, determination the level of how they are able to perform the effectiveness and economic principles, the problems, which may be faced, and solutions to these problems (Ağca & Elitaş, 2006). According to Li et al.(2006), the firm performance is defined as the level showing how the companies compete at the highest level with their competitors in their business processes and how they achieve their goals at what stage as a result of these operations.

3. IETT in Istanbul Public Transportation System

3.1. The Relationship between Technological Uncertainty and Agility in the Supply Chain

Moriarty and et al. (1989) have focused on situations that have been effective in the emergence of technological uncertainty in their research. In another study, Chizzo (1998) stated that the use of information technologies of the companies and their continuous development on these systems has an effect on the integration of supply chains and business processes in a positive way. Çemberci (2011) has stated that the uncertainty has a moderating effect between supply chain management performance and firm performance in his study. In this research, the agility in the

supply chain has been considered as one of the performance indicators of supply chain management. That is to say, the technological uncertainty, which is one of the sub-headings of the uncertainty, affects agility in the supply chain.

3.2. The Relationship between Supply Chain Agility and Firm Performance

In another study related to agility, Swafford et al. (2008) have stated the importance of supply chain agility in organizational structures of the companies. They have also stated that the flexibility of the supply chain and the use of information technologies have a positive effect on achieving supply chain agility in their research. They have further shown that the relationship between these three concepts has a supportive effect on firm performance. Çemberci (2011) has also established a relationship between supply chain agility, supply chain management performance and firm performance in his research. The supply chain management as one of the performance indicators has proven that the concept of agility in the elaborated supply chain affects supply chain performance in a positive way and the supply chain performance also affects the firm performance in a positive way.

It has been observed that the concept of agility in the supply chain has been examined in many studies conducted in recent years. These studies stated that the supply chain agility is a very important factor in the supply chain management strategy. In addition, the effect of agility on firm performance in the supply chain has also been discussed (Goldsby et al., 2006; Khan et al., 2009; Vickery et al., 2010; Tallon and Pinsonneault., 2011; Ngai et al., 2011; Gligor and Halcomb., 2012; Vinodh et al., 2013; Yang., 2014; Gligor et al., 2015; Sangari et al., 2015; Kabra et al., 2016; Çalışkan et al., 2016; Chan et al., 2017; Kabukçu et al. 2017).

Table 1. Summary of Hypotheses

H1: Technological uncertainty affects the supply chain agility in a positive way.
H2: Supply chain agility affects the firm performance in a positive way.

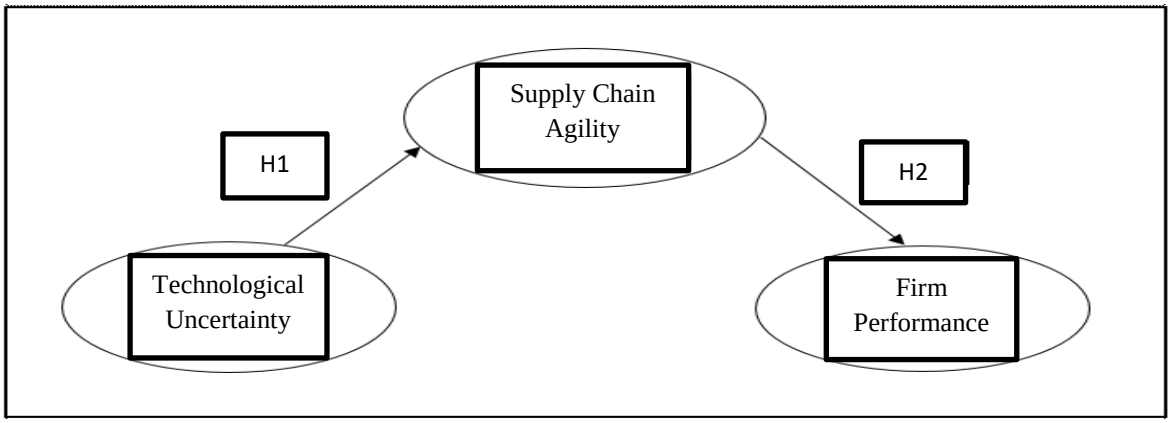

Figure 1. Conceptual Model

4. IETT Service Quality Measurement Model

4.1. Measures and Sampling

The answers in the questionnaire have been presented for consideration in the format of the multiple-choice 5-point Likert hypothesis scale in order to test the hypothesis results. The agility scale, consisting of 7 questions developed by Swafford et al. (2006), has been used for the agility scale concept in the supply chain. The uncertainty scale, which was created by Chen and Poulraj (2004)and having 3 sub-sections has been used in order to measure the uncertainty concept in the supply chain. The sub-sections of the uncertainty are explained as the technological uncertainty, demand uncertainty and supplier uncertainty. The dimensions of the technological uncertainty have been measured by 4 questions; the dimensions of the demand uncertainty have been measured by 5 questions; and the dimensions of the supplier uncertainty have been measured by 4 questions. Total 13 questions have been benefited from the uncertainty scale. The company performance scale, consisting of 13 questions, created by Ellinger et al. (2002) and received and developed by Akgün et al(2009) has been used for the company performance scale. The questionnaires have been conducted to 125 companies through e-mail and face-to-face interviews and 97 of these questionnaires have been received feedback. It is observed that the feedback rate for questionnaires is 78%.

4.2. Test of Hypotheses

Preliminarily, the verification and validity of the scale have been analyzed in the statistical analysis section and the results have been checked with confirmatory factor analysis, reliability and Cronbach's Alpha methods. In addition, correlation and regression analysis have been used for data analysis. The method of structural equation modeling tests the conformability of the existing data with the research model at first. The scales of CMIN/DF, CFI, AGFI, GFI, RMSEA are well-accepted (Çemberci, 2012).

Table 2. Confirmatory Factor Analysis Results

Question	Conceptual Variable	Standard Factor Loads	Non-standard Factor Loads	Standard Error	t-Value (Critical Ratio)
TKB0110	Technological Uncertainty	0,801	1		
TKB0312		0,404	0,467	0,212	2,210
TZÇ0327	Supply Chain Agility	0,644	1		
TZÇ0428		0,781	1,229	0,218	5,963
TZÇ0529		0,820	1,447	0,242	6,092
TZÇ0630		0,560	0,880	0,190	4,637
FIP1279	Company Performance	0,692	1		
FIP0168		0,689	0,842	0,127	6,631
FİP0269		0,700	0,852	0,157	5,439
FİP0673		0,478	0,618	0,155	3,988
FİP0572		0,603	0,863	0,177	4,873
FİP0471		0,610	0,797	0,162	4,911

Note: For all values P<0,01

The standard factor loads of the confirmatory factor model are given in Table 7. The standard factor loads are above 0,50 and the compliance scale values close to the threshold values and this indicate the convergence validity of the scales used. As a result of the confirmatory factor analysis, reliability analysis has been performed for the questions

the scale validity of which is determined and creating the dimensions. In the analysis conducted, the value of the Cronbach's Alpha has been found above 0.7 for each dimension. The values greater than 0,7 indicate that the internal reliability of the scale used is sufficient. Another value used in the calculation of the scale reliability of each dimension is the composite reliability coefficient. It may be said that the Composite Reliability is achieved when the value of the Composite Reliability is 0.70 and above (Raykov, 1997) The correlation values between Cronbach's Alpha, AVE and CR values and research variables calculated for each dimension are shown in Table 3.

Table 3. Correlation Dimensions and Reliability Results

	Avg.	Std. Dev.	1	2	3
1. Supply Chain Agility	3,87	0,80	(0,709)		
2. Company Performance	3,81	0,75	0,567	0,633	
3. Technological Uncertainty	3,83	0,75	0,289	0,415	0,634
Cronbach's Alpha Reliability Coefficient			0,789	0,888	0,488
Composite Reliability Coefficient (CR)			0,798	0,798	0,549
Explained Average Variance (AVE)			0,503	0,401	0,402

The hypotheses involved in the conceptual model of the study have been tested and created as shown in Figure 2 in the path analysis results of the structural model.

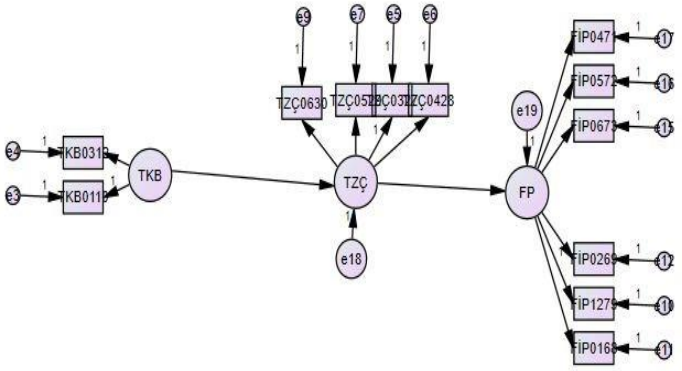

Figure 2. Path Analysis Results

The results of the hypothesis testing are as shown in Table 4.

Table 4. Hypothesis testing results

Hypothesis Relations	Standard β	P	Acceptance/Rejection
H_1: TKB → TZÇ	0,467	0,086	Supported
H_2: TZÇ → FP	0,696	0,000	Supported

Note: the significance level of 10%

The H1 hypothesis has found significant that the technological uncertainty statistically affects the supply chain agility in a positive way. The standard β coefficient with 0,467 value and at the significance level of 0,05 obtained as a result of path analysis of this hypothesis has been accepted. The H2 hypothesis has found significant that the agility in the supply chain statistically affects the performance of the company in a positive way. The standard β coefficient with 0,696 value and at the significance level of 0,05 obtained as a result of path analysis of this hypothesis has been accepted. H1 and H2 hypotheses have been supported at the significance level of 10%.

5. Conclusion

In the current globalizing world trade large, medium and small scale companies need to adapt various applications inside and outside the company to their systems in order to participate in this global market system and to maintain their position in the existing markets. From the past to the present, the rapid growth of and complexity of the world trade, and the difficulties regarding the establishment of the organizations have led companies to perform solution-oriented operations and to strengthen their new working systems and technological structures. In recent years, it has been seen that not only companies are not involved in the competition, but also the supply and value chains of the companies have become competitive with the evaluation of the supply chain management at a high level of significance. Along with this situation, companies are working on the most efficient operation of their systems by creating their supply chains or even expanding their existing supply chains. Recently, the supply chain management is considered as a chain of values for the companies. Supply chain management perpetuates companies to maintain customer satisfaction by providing support against possible sudden developments especially in global markets.

The concept of globalization has turned technology into an important factor for the international trade. The companies benefit from the use of technology at maximum while creating future strategies. Companies using technology effectively and efficiently within the organizational structure gain a competitive advantage in the market. Technological uncertainty leads companies to take faster and more stable action in the market conditions. Therefore, it has been observed that the companies have flexed their qualifications against these negative changes and have turned to agile behavior in the supply chain. Agility in the supply chain is perceived as a form of performance providing mobility to the company in here. Companies have created new patterns of behavior against the constantly changing developments in the current market conditions. Agility is one of these patterns of behavior. In fact, agility is the strategy of recognizing the market and creating a pattern of behavior accordingly. Especially in the events of technological uncertainty, supply chain agility provides companies with freedom of movement in order to maintain their activities.

Companies are able to make decisions quickly and flexibly and try to maintain their competitiveness even in the most adverse conditions. The aim here is to minimize the adversities of the companies resulting from technological uncertainty thanks to their agility. Supply chain agility is one of the most important factors affecting the firm performance in the case of challenging market competition for companies. Agility provides companies with maneuverability against their competitors and enables companies to gain a competitive advantage. Moreover, agility has been considered as the ability to eliminate risks that have not been encountered before and to turn changes into opportunities. Creating a good perception of supply chain management is only possible by understanding customer demands. Controlling all operational performances by the company, understanding the customer demands, analyzing their competitors in the market and using all information within its own capabilities will only be possible with agile supply chain structure.

This study may be considered as a guide for future studies to be conducted on these issues. In particular, the effects of agility and technological uncertainty on firm performance in the supply chain may be examined by selecting a particular sector. The questions in the questionnaires prepared may be useful if they are developed for the companies in the selected sector.

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