

# The Relation between Use of Information Technologies in Logistics Firms, Customer Satisfaction and Business Performance

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**Abstract**—Logistics sector, is a market where the competition is high. Flexibility, fully and timely delivery and increasing e-trade applications in logistics operations change the customer expectations. At this point, logistics enterprises are expected to benefit from information technologies in their operations. Information technologies connect together all the different components (supply chain, headquarters and vehicles) in transportation chain. Accordingly; efficiency and productivity of transportation operations increase. This study analyses the relation between the use of information technologies to ensure customer satisfaction in logistics firms and the business performance. As a result of this research, significant relations have been found between the information technology applications utilized by the logistic firms in their land route operations and performance indicators of the business. Also, recommendations concerning the potential benefits logistic firms can gain in the performance indicators by supporting their business activities with information technologies have been included in the study.

**Index Terms**—Firm performance, information technology, logistics management.

## I. INTRODUCTION

We encounter a term called as electronic commerce with elimination of international commercial borders and advancement of information technologies. Thus, now consumers can reach to products and producers from all over the world more easily in electronic environment. Accelerated and wide spread of electronic commerce activities entails measures for simplification of commerce and making customs transactions easier. Thanks to these advancements, customers request to receive products that they purchase on time without any damage and loss. In line with such requests of customers, delivery of products can be provided by carrying out activities of logistic companies which act as a bridge between customers and producers more efficiently and effectively. Having recently and rapidly developed, logistic industry is one of the most important elements of supply chain and are associated with speed, flexibility and technology in the globalizing world. In other words, using information technologies are of vital importance in order to enable logistic companies to accurately meet requests and needs of customers on time in an intensive competition environment.

This study argues that the information technologies is important to understand the role of logistics services level to

in enhancing customer satisfaction and firm performance. By incorporating logistics information technologies in the study, we seek to offer better explanations on how customer satisfaction and influence firm performance.

In this study; results of a quantitative research conducted on logistic companies which use information technologies in order to provide customer satisfaction in highway operations and relationships of information technologies usage and company performance.

## II. LOGISTICS INFORMATION TECHNOLOGIES

Information technologies make collected data available for enterprises and turn them into a meaningful information form. In addition; they enable data to be stored and transferred from one user to another through networks [1].

Use of information technologies in enterprises started in 1960s first with data processing applications. Today, new trade and operation approaches becoming efficient have started to change by integrating information technologies. These technologies can be listed as EDI, intranet, extranet and internet.

With spreading Internet far and wide and trend of liberalization of trade in the world, concepts of E-business and E-trade have showed up as a product of technological developments facilitating information communication. E-trade both refers to as any commercial business activity through which logistics enterprises can communicate with other parties electronically without direct or physical connection or physical exchange process, and information, performing processes including good and service exchange between two and more parties through electronic instruments and methods [2]. E-business is explained as a management instrument in managing human resources, material and financial assets, information and network input for logistics enterprises to achieve their goals [3].

Vehicle tracking systems and driver tracking systems which are information technologies applications in highways transportation operations are mostly used. Thanks to vehicle tracking systems, a logistics enterprise can track its vehicles used for operations of highways transportation constantly; customers can monitor them by communicating their own carrier. Real time vehicle tracking systems play an important role in supporting supply chain management and minimizing risks in logistics activities [4].

With driver tracking systems and in-vehicle camera systems, desired speed limit can be defined in vehicles and driver is warned vocally in the event that such speed limit is exceeded. In case of an accident, all users can be informed about place and time of the accident with these systems. They

also allow for drivers to call for help in difficult situations [5].

Warehouse management system which is one of the software mostly used in information technologies applications is defined as a software that is developed to manage use of personnel, efficiency and warehouse resources, monitor and control stock activities from entrance of products into the warehouse to shipping [6]-[8]. There are automated identification/data collection (Barcode, RFID) methods designed to gather information through warehouse management system faultlessly and transfer to the ERP system [9].

### III. RESEARCH METHODOLOGY

Logistics information technology can be examined both internally and externally. Inner logistics information technologies refer to in-house information sharing. Generally, databases and applications that integrate business functions such as finance, accounting, etc. on a logistical system basis. Outsourced logistics information technologies represent information technologies and applications that enable logistics-based communication and information exchange among business partners working together.

Technology is a valuable tool for logistics businesses in the production, sharing and use of information. Using logistics information technologies effectively by firms gives them a competitive edge. In this context; the success of logistics businesses depends on their ability to build solutions that will provide customer satisfaction by structuring technology that can contribute to business performance. The benefits that logistics companies have achieved as a result of using information technology is a field to explore. In other words, the study of the relationship and level of use of information technology with business performance indicators is a study to be investigated.

These systems enable businesses to obtain information that will improve both their customer and supplier operations. There are various studies in the literature conducted on contributions of information technologies usage on company performance indicators in order to provide customer satisfaction in logistic management.

Porter and Millar (1985) review strategic advantages of information technologies for enterprises in competition, and give recommendations to the managers of enterprises regarding this issue in their researches. In this research, authors stated that information technologies may provide competition advantage as following [10];

- Use of information technologies allow for suppliers and customers to connect each other. In addition, industrial advantage is created thanks to value chain and product information.
- It changes competition scope of enterprise. With use of information technologies, enterprise can have an opportunity to compete in different industries and geographies.
- Information technologies lead to cost reduction and diversification strategy.
- It enables new intrabusiness operations.

It raises coordination and control capability on information business operations. Therefore; it allows for logistics enterprise to develop solutions quickly by increasing the

performance of this enterprise [11].

Use of information technologies at each stage of logistics activities provides sharing of sales, shipping, production chart, stock level, order status information and other beneficial information between intrabusiness functions (marketing, production, purchase, logistics, etc.) and members in the supply chain (supplier, customer) [12].

McFarlan (1984) reviews strategic impacts of information technologies on the enterprise in his research. The requirement of the enterprise to designate its financial resources by deciding which function enterprise will invest in and what kind of investment will be made are analyzed. Impacts of information technologies on enterprises under the titles of constituting entrance barriers, increasing change costs for customers, changing competition bases, differentiating power balance between suppliers, and allowing for the enterprise to produce or develop new products [13].

Tracey and Tan (2001) reviews relationship between choice and participation of business partners in supply chain, logistics activities and relationship between customer satisfaction and performance of the enterprise. In the research, a survey study is applied for top managers working in the production industry. In the research, as indicators of enterprise performance; financial factors such as growth in sales of the enterprise, active profitability, market share and competitor position are handled [14].

Zhao and Stank (2001) reviews the relationship of information-orientation and customer oriented approaches with indicators of enterprise performance in their researches. Especially increasing importance of both approaches in the logistics industry [15].

Kim v.d. (2006) reviews impact of innovations in supply chain and logistics activities on channel relationship and indicators of marketing performance. In the research, a survey study is applied for managers of supply chain and logistics. In the research, impacts of technological and managerial innovations on information sharing, system integration, intrabusiness coordination, capability of developing quick solutions and indicators of marketing performance of the enterprise is put forward. They determine the indicators of marketing performance as growth in sales of the enterprise, market developing and product developing [16].

GreenJr v.d. (2006) research relationship between supply chain management, market trend and enterprise performance. They review indicators of enterprise performance under two titles as indicators of financial and marketing performance. They handle growth in market share, sales volume and sales revenue of the enterprise within last 3 years as indicators of marketing performance. They also determine indicators of financial performance as revenue of the enterprise, growth in revenue of the enterprise and sales revenue within the last three years [17].

Information technologies undertake important duties in terms of each management level of an enterprise. For low level management, information technologies support business processes and procedures. For medium level management, it contributes to the decision-taking process of the enterprise. For top management; they play an important role in providing competitive advantage strategies [18], [19]. Information technologies also support development of a transparent organization structure by maximizing organizational

flexibility [20].

TABLE I: VARIABLES OF THE STUDY

<b>Demographic information of the firm;</b>
– Operating Period of the firm
– Structure of the firm
– Information technologies used by firm
<b>Variables related to general information technology applications in the firm</b>
– Information technology is used effectively in all parts.
– The most advanced information technologies are used in all parts.
– New information technologies quickly can be adapted in all parts [16]
– Operational information effectively has been shared internally.
– Logistics operating and planning databases are integrated across applications.
– My firm has adequate ability to share both standardized and customized information internally.
– Logistics information systems capture and maintain real time data [15].
<b>Variables related to information sharing</b>
– My firm is aware of the importance of sharing information with our customers
– Operational information has been effectively shared externally with selected customers
– My firm has adequate ability to share both standardized and customized information externally with customers.
– Logistics operating and planning databases are integrated across applications with customers
– Logistics information systems capture and maintain real time data shared with customers[21].
<b>Variables related to logistics information technology applications in the firm</b>
– My firm has invested in technology designed to facilitate cross-organizational data exchange
– Information system capability is better than last year
– Current logistics information systems are satisfactory in terms of meeting our requirements [22]
– Information system capability in warehouse operations is better than last year
– Vehicle tracking system capability in transportation operations is better than last year
– Information system capability in customs transactions is better than last year
<b>Benefits of Information Technology Applications to Business Performance</b>
<b>Logistics Performans</b>
<b>1. Transportation Management</b>
– Shortening transport times [23]
– Reduced transportation costs [24], [25]
– Improvement of route planning processes [24]
– Increased delivery reliability [24]
– Increased delivery speed
– Increased flexibility at delivery time
<b>2. Order Management</b>
– Increasing order fulfillment rate [16]
– Increase of correct order rate
– Reduced rate of lost orders
– Increasing flexibility in order management
<b>3. Warehouse Management</b>
– Improvement of planning processes
– Shortening cycle times [24]
– Decrease in inventory level [23]
– Increased accuracy in inventory management [23]
– Decrease in the number of labor required [24]
<b>4. Marketing Performance</b>
– Customers can more easily meet special needs and needs [24]
– Increased service quality
– Increase in customer satisfaction [21]
– Decrease in customer complaint rate
– Developing long-term business partnerships with customers [24]
<b>5. Financial Performance</b>
– Increase in profitability in the last year
– Increase in investment in last year
– Decrease the total cost of our operation [16], [24]

It has been decided to use 3 main variable groups in the study by using these studies. In the first phase of the research, variables specified with italic characters were included in the questionnaire after consultation with the managers of both academic and sectoral businesses. So that the exploratory part of the research is completed. As a result of literature scanning which is the next stage of the research, other variables determined are also added to the survey form, and definitive research is started. In this scope, variables of the study can be represented as follows according to their groups.

#### IV. CONCEPTUAL MODEL AND HYPOTHESES

If based on the previous literature review the conceptual model presented in Fig. 1.

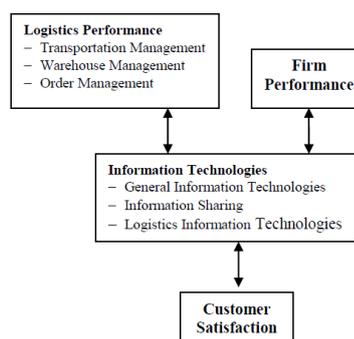


Fig. 1. The proposed research model.

The research questions to be asked in this study was aimed to be answered by supporting the aforementioned hypotheses as it is summarized;

1) Is there a relationship between the use of general information technologies in firm and logistics management, business performance and customer satisfaction of the business?

H1<sub>a</sub>: There is a relationship between the use of general information technology and the transportation management of the business.

H1<sub>b</sub>: There is a relationship between the use of general information technology and the warehouse management of the business.

H1<sub>c</sub>: There is a relationship between the use of general information technology and the order management of the business.

H1<sub>d</sub>: There is a relationship between the use of information technology and firm performance.

H1<sub>e</sub>: There is a relationship between the use of general information technology and customer satisfaction of the business.

2) Is there a relationship between information sharing and logistics management, business performance and customer satisfaction of the business?

H2<sub>a</sub>: There is a relationship between information sharing and the transportation management of the business.

H2<sub>b</sub>: There is a relationship between information sharing and warehouse management of the business.

H2<sub>c</sub>: There is a relationship between information sharing and the order management of the business.

H2<sub>d</sub>: There is a relationship between information sharing and firm performance.

H2<sub>e</sub>: There is a relationship between information sharing and customer satisfaction of the business.

3) Is there a relationship between the use of information technology in logistics management and logistics management, business performance and customer satisfaction of the enterprise?

H3<sub>a</sub>: There is a relationship between the use of information technology in logistics management and the transportation management of the business.

H3<sub>b</sub>: There is a relationship between the use of information technology in logistics management and the warehouse management of the business.

H3<sub>c</sub>: There is a relationship between the use of information technology in logistics management and the order management of the business.

H3<sub>d</sub>: There is a relationship between the use of information technology in logistics management and firm performance.

H3<sub>e</sub>: There is a relationship between the use of information technology in logistics management and customer satisfaction of the business.

## V. DATA ANALYSIS AND FINDINGS

In order to develop the correct sample, the respondents were selected from the member lists of UND (International Transport Association of Turkey). UND currently has 1032 members. Convenience sampling method is used in the study. 480 people were randomly contacted to remain within the budget and time restrictions of the study. The questionnaire is delivered to the chief executive officers, board members, operations managers, sales and marketing managers, and fleet directors by e-mails. There are 90 participant in this study. IBM Statistical Package for the Social Sciences (SPSS) version 19.0 for Windows was used for statistical analysis of this study. In the analysis of the study, 0.05 was taken as the significance level.

Descriptive analysis is important for understanding how frequently the said phenomena exist. In this study, percentages and cumulative percentages of each demographic variable were presented in tables.

TABLE II: OPERATING PERIOD AND STRUCTURE OF FIRM

Operating Period of Firm (Years)			
	Frequency	Percent	Cumulative
0-10 years	25	27,8	27,8
11-20 years	37	41,1	68,9
21 and more	28	31,1	100,0
Total	90	100,0	
Firm Structure			
	Frequency	Percent	Cumulative
Domestic partnership	84	93,3	93,3
%50 more domestic partnership	2	2,2	95,6
%50 more foreign partnership	2	2,2	97,8
Foreign partnership	2	2,2	100,0
Total	90	100,0	

In terms of operating period of firm approx. 41 percent of them were operating maximum 10 years while 31 percent of them were operating more than 21 years. The table and the bar chart above show the result. In terms of firm structure, 93 percent of the firms were built with Turkish capital.

According to the frequency analysis for information

Technologies used by logistics firms, 15,6 percent of firms were using ERP, 28,9 percent of firms were using CRM, 43,3 percent of firms were using BILGE, 91,1 percent of firms were using Vehicle Tracking System, 37,8 percent of firms were using Driver Information System, 36,7 percent of firms were using Warehouse Management System.

The Cronbach Alpha Coefficient, which is prepared to measure the information technology in logistics, consisting of 19 variable scales is 0.94. The Cronbach Alpha Coefficient, which is prepared to measure the benefits of information technology in logistics, consisting of 24 variable scales is 0.929. Both of which are above the generally accepted value of 0.70. Based on the reliability analysis findings of both scales can be seen is satisfactory.

TABLE III: INFORMATION TECHNOLOGIES USED BY FIRM

		Frequency	Percent	Cumulative
ERP	Yes	14	15,6	15,6
	No	76	84,4	100,0
	Total	90	100,0	
CRM	Yes	26	28,9	28,9
	No	64	71,1	100,0
	Total	90	100,0	
BILGE (About Customs Transaction)	Yes	39	43,3	43,3
	No	51	56,7	100,0
	Total	90	100,0	
Vehicle Tracking System	Yes	82	91,1	91,1
	No	8	8,9	100,0
	Total	90	100,0	
Driver Information System	Yes	34	37,8	37,8
	No	56	62,2	100,0
	Total	90	100,0	
Warehouse Management System	Yes	33	36,7	36,7
	No	57	63,3	100,0
	Total	90	100,0	

## VI. FACTOR ANALYSIS

Firstly, Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy test and Bartlett's Test of Sphericity was done to see whether the data for Information Technologies in logistics and yararları variables was convenient for conducting factor analysis or not.

TABLE IV: THE FACTOR ANALYSIS OF INFORMATION TECHNOLOGIES

Kaiser-Meyer-Olkin Örnekleme Yeterliliği Testi	0,871
Bartlett Küresellik Testi	$\chi^2 = 1254,190$ df = 153 Sig = 0,00

It was seen that KMO value was 0.871 and Bartlett's Test of Sphericity was significant ( $p = 0.000 < 0.001$ ); which indicated that the data was adequate and appropriate to conduct factor analysis.

Principal Component Analysis with Varimax rotation were conducted, and 19 items were discarded one by one resulting with the same 18 items of the scale showing the same three factors. The results show that those three factors explain the 68,869 % of the total variance.

It was seen that KMO value was 0.841 and Bartlett's Test of Sphericity was significant ( $p = 0.000 < 0.001$ ); which indicated that the data was adequate and appropriate to conduct factor analysis.

TABLE V: THE FACTOR STRUCTURE OF INFORMATION TECHNOLOGIES IN LOGISTICS

VARIABLE	1	2	3
<b>General Information Technologies</b>			
X3 New information technologies quickly can be adapted in all parts	0,862		
X15 Current logistics information systems are satisfactory in terms of meeting our requirements	0,831		
X2 The most advanced information technologies are used in all parts	0,830		
X13 My firm has invested in technology designed to facilitate cross-organizational data exchange.	0,801		
X14 Information system capability is better than last year	0,768		
X1 Information technology is used effectively in all parts	0,725		
X8 My firm is aware of the importance of sharing information with our customers.	0,545		
<b>Information Sharing</b>			
X5 Logistics operating and planning databases are integrated across applications	0,802		
X11 Logistics operating and planning databases are integrated across applications with customers.	0,765		
X7 Logistics information systems capture and maintain real time data.	0,740		
X10 My firm has adequate ability to share both standardized and customized information externally with customers.	0,696		
X12 Logistics information systems capture and maintain real time data shared with customers.	0,693		
X9 Operational information has been effectively shared externally with selected customers.	0,665		
X4 Operational information has been effectively shared internally.	0,665		
X6 My firm has adequate ability to share both standardized and customized information internally.	0,660		
<b>Logistics Information Technologies</b>			
X18 Vehicle tracking system capability in transportation operations is better than last year		0,826	
X19 Information system capability in customs transactions is better than last year		0,811	
X17 Information system capability in warehouse operations is better than last year		0,610	

TABLE VI: THE FACTOR ANALYSIS OF BENEFITS OF INFORMATION TECHNOLOGIES

Kaiser-Meyer-Olkin Örnekleme Yeterliliği Testi	0,841
Bartlett Küresellik Testi	$X^2 = 1687,353$ df = 231 Sig = 0,00

Principal Component Analysis with Varimax rotation were conducted, and 24 items were discarded one by one resulting with the same 22 items of the scale showing the same three factors. The results show that those three factors explain the 77,258 % of the total variance.

### VII. CORRELATIONS

Correlation analysis was conducted for examining the relationships between variables.

As a result of the correlation analysis, which the relationship between the use of information technologies (IT) (general and logistics), logistics management, business performance and customer satisfaction hypotheses have been accepted. Besides, which the relationship between information sharing and logistics management, business performance and customer satisfaction hypotheses have been accepted. The H3a hypothesis was rejected because there was

no significant relationship between the use of IT in logistics management and the transport management of the business.

TABLE VII: THE FACTOR STRUCTURE OF BENEFITS OF INFORMATION TECHNOLOGIES IN LOGISTICS

VARIABLE	1	2	3	4	5
<b>Firm Performance</b>					
X22 Increase in profitability in the last year	0,822				
X21 Increase in profitability in the last year	0,801				
X23 Increase in investment in last year	0,796				
X20 Developing long-term business partnerships with customers	0,764				
X19 Decrease in customer complaint rate	0,762				
<b>Warehouse Management</b>					
X14 Increased accuracy in inventory management	0,909				
X11 Improvement of planning processes	0,900				
X13 Decrease in inventory level	0,874				
X12 Shortening cycle times	0,846				
X15 Decrease in the number of labor required	0,763				
<b>Transportation Management</b>					
X5 Increased delivery speed	0,835				
X1 Shortening transport times	0,769				
X4 Increased delivery reliability	0,757				
X6 Increased flexibility at delivery time	0,638				
X3 Improvement of route planning processes	0,609				
<b>Order Management</b>					
X10 Increasing flexibility in order management			0,848		
X9 Reduced rate of lost orders			0,708		
X8 Increase of correct order rate			0,663		
X7 Increasing order fulfillment rate			0,592		
<b>Customer satisfaction</b>					
X17 Increased service quality				0,794	
X16 Customers can more easily meet special needs and needs				0,763	
X18 Increase in customer satisfaction				0,653	

TABLE VIII: RESULT OF THE CORRELATION ANALYSIS

	General IT	Information Sharing	IT in Logistics Management
Transportation Management	,423 (**)	,346 (**)	,166
Warehouse Management	,371 (**)	,637 (**)	,408 (**)
Order Management	,503 (**)	,557 (**)	,255 (*)
Firm Performance	,463 (**)	,457 (**)	,256 (*)
Customer Satisfaction	,626 (**)	,466 (**)	,248 (*)

(\*\*) Correlation is significant at the 0.01 level.

(\*) Correlation is significant at the 0.05 level.

### VIII. CONCLUSION

As a result of correlation analysis; it has been detected that companies can be rapidly adapted to the new information technologies of all departments of companies, they generally use cutting-edge information technologies, they make technological investments for knowledge share and they use these technologies efficiently and companies have

relationship with transportation, warehouse and order management. According to this; as more information technologies applications generally increase, it is obvious that logistic activities of companies improve. These improvements can be referred to as shortening of transportation times, increase of delivery reliability and speed in transportation management, and decrease of inventory level, shortening of conversion times, improvement of planning processes, decrease in the number of manpower needed in the warehouse management, and decrease of loss order rate and increase of accurate order rate and increase of order fulfillment rate in order management.

It is obvious that companies increase their service quality and meet special requests and needs of customers much better by using general information technologies. In addition, as a result of correlation analysis, it is determined that there is a relationship between general information technologies used in the companies and company's performance. It can be said that companies will be able to increase their profitability, customer portfolios and investment returns by using information technologies.

It is required that logistic companies should make studies and investments in order to increase their service capacity, service diversity, efficiency and their quality by receiving support from technology to deal with their competitors. However, when considered that investments for information technologies are high risk and cost, companies must prefer applications that they need. Therefore, logistic companies are able to determine to what extent they need information technologies, by analyzing operation processes better. As a result, usage of information technologies by logistic companies not only improves their company's performance, but also supports transportation, storing and order activities. Moreover, it benefits on needs of customers and increases customer satisfaction by assisting value-added service production. It is considered that this study contains interesting tips for logistic companies which are planning to invest in information technologies. In addition; it is highly important that logistic companies affirm to invest in information technologies and enable these investments to provide understanding possible benefits for their activities. With a different paradigm in future studies, scope of the research can be expanded. In addition; national and international companies can be compared. Besides, public transportation systems and applications of logistic information technologies of Turkey can be reviewed at macro level. On the other hand; the relationship between usage of information technologies in the logistic industry and popularization of electronic commerce and business applications can be researched in the future studies.

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