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The Holistic Perception of Information Technology and The Importance on the Supply Chain Management

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Abstract

Supply Chain Management (SCM) includes management of materials, products, services, information and financial flows which network of consisting suppliers, manufacturers, logistics service companies, and clients. The individual elements of this chain with coordination and integration of each element to perform themselves ensure successful of SCM. Information technology has a very important role in activities for coordination and integration of supply chain. Acceleration of sharing information, simplification and increasing of reliability provide effective use of time in logistics companies, cost savings like effective management ways. In this prepared study which taking into account the positive impact on supply chain of information technologies, it was investigated on the effectiveness of sharing information of supply chain by examining infrastructure of the information technology, ranging from the production of raw materials to the end user in SCM. The results of the analyses by using the structural equation model indicate that the use of information technology in supply chain management enhances the relationship between buyer-supplier; the enhancement of such relationship improves the quality, safety, and flexibility of products and reduces the cost of products; as a result, it increases firm performance.

Key words: *Supply Chain Management, Information Technologies, Performance Factors*

JEL classification: *L21, L25, L86, M15*

Introduction

In order to be successful in the global competitive environment, the condition of products that are expected to meet the requirements of customers of dispersed in various places in the world and indistinct nature is becomes more of an issue. This situation is increases the importance of logistics sector among the whole operational activities. However, by utilizing the information technologies the performance of the companies that operates in Information technology (IT) sector, increases considerably.

IT technology usage level of the logistics companies that operate in Turkey will be important in terms of the defining the overall effect of the IT technologies on the operational performance. The supply chain of a company consists of with raw materials manufacturers, transforming the raw materials and semi-finished products into final product, that means the whole bodies of supply companies and the distribution channels that bring the final products to the end consumers. If we express this definition from the consumer point of view, the supply chain is the sum of all steps and elements of value that is required towards fulfilling the demands for a product or service (Hill, 1998). The environment of global competition, forces the companies towards manufacturing the products in better quality with economic prices, to provide more effective service quality, and deliver the goods in required place, location and required time that demanded by the customer.

Supply Chain Management system (SCM) may also be defined as a basic operation system to manage the supplying bodies outside company and in order to maintain effective partnership with them to utilize internal resources of a company as a whole. The starting point of the Supply Chain Management system is a consumer and the end point is the suppliers that provide raw materials. Exchange of knowledge is the basic element in the Supply Chain Management. The members of the Supply Chain Management, have to reach the required knowledge in time in order to coordinate their efforts effectively. With the development of the information technologies, the exchange of knowledge has been eased among companies and it has been observed that the companies that achieved the exchange of knowledge, have displayed important successes in integration of supply chain.

The information technologies (IT) technologies have created the essential changes in most of the fields of industrial and service sectors, and hence forced the changes in competition rules at the end. The information technologies (IT) have not only changed the internal activities of the managements such as business methods, organizational forms, production means, and distribution channels of the trade world, but also basic foundations of the intended success that is required to sustain in the competitive environment (Samiee et al., 2007).

The success of the logistics activities depends on to structure all kind of technologies that contribute the management performance and to produce solutions to maintain the customer satisfaction.

Consequently, the information technologies that are widely used in all departments of the management effectively in our day, will also offer an important insight into the companies that operate in the logistics sector.

Information Technologies, Scope, and Implementations

The developments in computer and communication technologies, affect and change the company activities continuously in cost, time, quality and service issues. Especially, the changes in the information technologies, cause essential changes in management structure, and present the companies new routes in entering the new markets, presenting their products and services, increasing the efficiency of their processes, gaining new customers, and maintaining the loyalty of the customers (Altunışık et al., 2004).

Generally, the information technologies can be defined as, the technologies maintaining for ‘collection, processing, preserving, and conveying of knowledge to certain location whenever required or to reach this knowledge from any location' and also the technologies serving for the ‘collection, preserving, processing, reaching and distribution of knowledge', the sum of implementations and services, the totality of data over the system. In practice, there is an operating IT system in most of the managements. The systems of structured IT's are used in all departments of companies. Information management system is an information system that collects, processes, preserves and reports the required data from various sources

to render the manager to make decision. Information management system provides many important benefits in marketing; especially for the monitoring of sales, market surveys, evaluation of data from market surveys, preparation and classification of sales reports, distribution of products, estimation of amount of sold products and amount of the products in distributor stocks, follow-up of the in hand products, and for order of the products (Yüksel, 2002).

In production; due to improved software for production planning and production controls, these kinds of processes being made more easily and faster. Planning on financial issues, forecasting, keeping and following up the accounting records, invoicing, etc many activities are being made easier and faster by means of information technologies. Nowadays, information technologies play a critical role in providing a competitive advantage for a company.

Developments in the field of information technologies, present new opportunities for the change in competition structure in the market and gaining competitive advantages due to the cost reductions in license property rights of these systems and improvement in technologic infra-structure and qualified manpower recruitment.

The companies are obliged to re-design their internal organizational and technical processes, to change their traditional and basic product distribution channels, customer service procedures and to train their employees in order to reach the IT-based supply chain. While, developing an integrated structure between IT and Supply Chain Management (SCM) some possible problems might be encountered as follows (Gunasekaran and Ngai, 2004); Lack of integration between It and operational model, lacking proper strategic planning, insufficient IT infra-structure, insufficient IT implementation in virtual operation, IT implementation in SCM with shortfall information.

Information Technologies that are used in Supply Chain Management Integration

Information Technologies have the critical importance in planning and implementing stages of Supply Chain Management. Information Technologies have three important effects over Supply Chain Management as, planning in strategic level, planning in tactical level, and planning in operational level (Talluri and Silberman, 2000).

a) Planning in strategic level, including the supply chain network design that facilitating the determination of key issues such as what will be the optimum amounts of suppliers? definition of distributors, etc

b) Planning in tactical level, include the supply planning that provides the best form of effective flow of products and services in the network. The decisions at this level contain the issues such as what kind of products will be produced in what amount in which organizations? and from which sources the raw materials will be supplied?

c) Planning in operational level, contain the issues such as production planning in daily and hourly basis in all organizations. It is observed that Information Technologies play a critical role in integration of suppliers and partners in supply chain in any organization. There are many kinds of technologies in Supply Chain for analyzing and sharing the information.

The frequently used samples of these technologies can be cited as Electronic Data Changing (EDC), Internet, Enterprise Resource Planning (ERP), Radio Frequency Identity Definition (RFID), and Supply Chain Management/Planning (SCM/SCP). Presently, the managers are in a position to decide that what kind of technologies they will use, how they will integrate these technologies into their organizations and the organizations of their partners. While the adequacy of these technologies increases the relevant decisions are becoming more important day by day (Burges et al., 1997).

Electronic Data Interchange (EDI)

Exchange of knowledge between buyer and supplier is considered one of the key indicators of Supply Chain Management (SCM) usage. While the information flows in both the ways the effect of this process is realized as creating a virtual Supply Chain. In practice, the data transfer is used in order to integrate the

whole value chain into a longer chain. In the context of Supply Chain Management (SCM), the term of integration is related with the extent of supply chain's ability to operate how close and behave as a single unit. Coordination undertakes a role for a complementary part for integration of supply chain (Pearson and Ellram, 1995).

In more specific saying, Electronic Data Interchange (EDI), can be defined as the interchange of the right operational data/processes from computer to computer. Electronic Data Interchange (EDI) is not a common channel, and it is the set of standards that are agreed on and enable the transfer of data). It is possible to consider the EDI as an opportunity that changes/eliminates the intermediate processes (Gunasekaran and Nath, 2005). EDI provides the means to the organizations to give order to their suppliers on time and document-free. EDI is not only an effective way but also reducing the required delivery time for bringing the products to relevant customers. Because, if the transactions are compared with the hard copy document/paper process, the transactions with EDI are made faster and more appropriate (Chopra and Meindl, 2007; Küçükgörey, 2000).

Once the suppliers and customers are benefited from EDI in distribution operations, one can see the considerable improvement in customer service quality. Some part of the service elements that are benefited from EDI, can be listed as follows (Lim and Palvia, 2007);

a-Lead time of the order, b- Product usability, c-Distribution flexibility, d-Distribution information, e-Distribution irregularities.

Although organizations have gained important benefits from EDI usage, due to some limitations in EDI technology (high cost, non-flexible technology, etc), they tend to use internet. However, not all of the information systems have the feature to be integrated through internet (Themistocleous et. al., 2004). With the aid of this system, the stock levels continuously monitored and EDI purchasing order is conveyed to suppliers automatically. This process reduces the safety stock level for purchased part on one hand and also reduces the cycle time on the other hand.

Internet

In order to define the usage of internet for maintaining the supply chain integration to meet targets, "e-management" term is referred. There are many "e-management" categories, depending on the different kind of the commercial partnerships (Lin, 2013).

Some of the examples for these categories can be given as; (Business to Business / B2B), (Business to Consumer / B2C), (Consumer to Business / C2B), (Consumer to Consumer / C2C), (People to People / P2P), (Government to Citizen / G2C), (Citizen to Government / C2G), (Exchange to Exchange / E2E), and inter-organization (from one organizational unit into another one) (Applegate and Collins, 2005).

Before using the face to face operations, all 'e-management' transactions are realized by using the computer and communication networks in an electronic form. The main three categories for e-management implementation are classified as follows;

1. Electronic markets or e-markets: buying and selling of goods and services.

2. Inter-organizational systems: to ease the flow of goods, services, information, communication, and co-operation in-organization and inter-organizations.

3. Customer service: Maintaining of customer service, aid, complaints processing, monitoring of orders, etc. (Gölcü, 2003; Lin, 2013).

Internet provides some means to organizations in order to manage their own supply chain efficiency by promoting strong relations with business partners and adding values into the goods and services that are sold to customers (Kücükgörkey, 2000).

Enterprise Resource Planning (ERP)

The ERP systems are the kind of systems that enable organizations to render the information to present visibility and follow up the information in-organization and during the whole supply chain of the

organization. The ERP systems trace the information and differ from internet that provides only one method to see the information (Chopra and Meindl, 2007).

Most of the organizations believe that ERP systems are utilized by any organization with own features and enabling the company abilities to do integrated transactions, hence providing 'e-commerce' priorities and finally fostering the company's performance. To manage any company in e-commerce environment, requiring the competency to measure the right information and resultant effect instantly (Akkermans et. al, 2003). To meet the requirements of the ever-changing organization environments most of the ERP providers develop their systems in such a way to be able to transaction through the web. Consequently, ERP systems are able to meet the satisfaction of customers and suppliers and may also increase the overall efficiency. However, ERP systems themselves have some limitations as well, and to support the organizational processes and supply chains fully, they need some alterations as per the specific needs.

Radio Frequency Identity Definition (RFID)

RFID is one of the methods that to read the data and re-code it to obtain relevant data related to any object without utilizing human power (Smith, 2005). The RFID technology consists of an active or passive radio frequency tag that is affixed on the traced part and a radio frequency reader/transmitter. The passive tag takes the power from a reader, however active tag has its own battery to take power.

The full implementation of RFID eliminates the processes such as manual counting and bar-code scanning in in-coming goods department (Güles et al., 2002). Once we encounter the implementation stage of RFID or any developing technology similar to RFID, some problems arise such as recognition problem and disadvantages to user or financial.

Among those problems; cost, deficiency in usable tags, failure rate, radio-frequency interference problems, ordinance problems, unconscious user, safety and confidentiality etc. can be cited (Malhotra,1999; Wu et al., 2006). Within the next few years, although it is projected in a plan to see the considerable reductions in tag costs, the existing cost element itself plays a preventer role for most of the routine implementations (Malhotra, 1999).

Software of Supply Chain Management/Planning (SCM/SCP)

In Supply Chain Management, there are some needs for other type of software support systems with the tendency to focus external sources. One of these, newly emerging software of Supply Chain Management/Planning (SCM/SCP) technology.

The software of Supply Chain Management/Planning (SCM/SCP), in addition to information visibility, utilizes the information that is embedded in ERP, in order to provide analytical decision support. While ERP systems guide the company to realize the happenings, on the other hand, SCM (Supply Chain Management) systems aid to company for deciding 'what to do'.

Prime benefit of Supply Chain Management/Planning (SCM/SCP) systems is better operational planning and business planning. Supply Chain Management/Planning (SCM/SCP) systems, use the real-time planning abilities that provide the companies to react quickly to supply and demand changes and finite capacity planning algorithms that do not require iterative arrangements in the main plan. Coordinated planning and flow of materials and information among supply chain partners reduce the whipping effect (Hendricks et. al., 2005).

The Objectives of the Software

The objective with the relevant software is, to collect and analyze the right information and share it with business partners. These objectives are defined below;

- To collect the right information at every point of the supply chain from production to delivery, to the purchasing point and to provide observability to the business partners.

- To reach any kind of data in the system from a single contact point.

- To plan and analyze the business processes, depending on the information in the whole supply chain.

- To manage the uncertainty with the supply chain partners, to realize co-operation with them towards objectives for risk sharing (Kpmg llp., 1999).

The basic objective of IT in the supply chain is to make planning, follow up and analyze depending on the real data. Each business partner in the chain is able to obtain the whole information relevant to the product.

Each objective can be detailed as follows;

• Collection of Information: Retailers and suppliers want to know the status of the orders to be received from manufacturers. This situation necessitates the access needs of the other organizations in the chain into information systems.

For example, Federal Express realizes this objective with a follow up system that provides the location information of the parcels of customers to convey the customers during the whole delivery period (Johnson et. al., 2007).

• Access to Data: Different systems are being used in which production and distribution processes in customers, suppliers and manufacturers can be followed up. Effective transferring of required data among these systems and accessing the needed data of the business partners as real timed are the rights of the concerned parties (Johnson et al., 2007).

• Analysis to be Made Depending on the Supply Chain Data: In order to realize the relevant processes in the whole chain such as purchasing, production, distribution, …etc effectively, it is essential to benefit the acquired information.

The decisions to clarify the following issues such as; to find the most effective way in order to realize the orders, to decide which kind of products will be kept in which stores, where to locate the stores, have to be taken through analysis of the relevant data (Johnson et. al., 2007).

• Co-operation with Supply Chain Partners: Cooperation of any organization with supply chain partners is inevitable for achieving success. It is necessary to make connections with customer systems and to provide suppliers to connect their own systems as per their roles in the supply chain (Douglas and Craig, 2006).

In the recent years, since to establish effective co-operation with suppliers, and to work effectively with them is the focusing point, Suppliers Relations Management (SRM) has gained prime importance.

In order to understand and manage the customer requirements effectively, Customer Relations Management (CRM) software being integrated at the other side of supply chain (Johnson et al., 2007).

The structures in the supply chain are sequenced as follows;

Standardization: IT standards are the elements that enable the systems to work together.

IT Infra-structure: Unless providing the required infra-structure that enables the database and communication capacity of the systems working coherently in the organization or outside the company, some of the intended objectives may not be realized.

Electronic Commerce: In the recent years, 'Electronic Commerce' has become the most widely used field of information technologies, and most of the organizations have realized the implementations. Not only increasing the efficiency of the company but also it supports the co-operation with supply chain partners (Burgess et al.,1997; Hsiu, 2013).

The Components of Supply Chain: These components are related directly to the supply chain planning and contain the various systems such as short term and long term decision support systems.

Consolidation: In order to realize the implementation objectives of the information technologies in the supply chain, the following issues must be clarified; how to arrange the priorities? what kind of investments have to be made? (Johnson et. al., 2007).

Supply Chain Management System Components

ERP systems provide more effective management of the organizations by gathering the whole job functions at one side, however, in the context of optimization, they have the deficiencies in replying the questions such as; which object, when, where and by whom have to be made?

At this point, in order to optimize the critical elements such as production characteristics of the planners, transporting costs, inventory costs, Decision Support Systems (DSS) tools are required.

For example, if the highest cost of an organization is the transporting costs, the first DSS implementation will be fleet routing systems or network design (Johnson et. al, 2007).

In Supply Chain Management, the software that is in the context of information technologies, realizes the following classified processes:

Strategic Network Design: With the aid of Strategic Network Design, the following processes are maintained; determination of store location, amount, and magnitude by the planners, determination of the stores to provide services for certain customers, to ascertain the optimum external resource use strategy, implementation of the most suitable distribution channel strategy.

The main objective is to reduce the overall costs by considering the activities of external resource usage, production, transporting, storage and inventory usage (Johnson et. al., 2007).

Supply Chain Main Plan: In order to increase the profitability and reduce the overall costs in the scope of the supply chain, supply chain resources have to be allocated in an effective manner and hence effective co-ordination of production, distribution, and storage processes are maintained (Johnson et al., 2007; Devaraj et al., 2007).

Operational planning: These systems are designed in such a way to increase the effectiveness of the production, distribution, inventory and transportation activities for short-term planning periods. In planning process, the main focus is only a single function; for example, production function.

Operational Planning Processes include the following factors (Zahra et al., 2013);

Demand Planning: These systems realize the demand forecasting depending on the past data by utilizing the statistical methods. The users that use the system, realize the analysis of activities such as promotion, new product publicity.

Production Scheduling: Depending on the supply chain main plan and demand forecasting, detailed production scheduling operations are maintained. Limit based feasibility analysis is made by considering the whole production limitations. Information Technology implementation and the structure that is formed toward definition in Supply Chain Management. The indicated template structure defines the Information Technology implementations and their effects in Supply Chain Management. This template structure has been based on the relevant information technology literature in Supply Chain Management (SCM) technology. This reviewed literature supports the critical success factors, applicable technologies and the definition of most important strategies in Supply Chain Management for information technology (IT) implementations (Harland et al.,2007; Bala, 2013).

- With the objective of achieving the information technology potential the most important technology, strategy, decision-making ways are classified toward IT implementations in effective supply chain management and the development.

-This sub-classification aims to aid the researchers and implementers in definition of critical success factors and potential improvement fields for the success of information technology implementations in SCM.

-The gap between implementation and the theory of Supply Chain Management is sorted with IT analysis and modeling.

The effectiveness of information technology that is integrated in Supply Chain Management, is related to the following factors;

a) Strategic Planning in Supply Chain Management toward Information Technology

b) Supply Chain Management and virtual organization

c) SCM and e-commerce

d) IT infra structure in SCM

e) IT management and information in SCM

f) IT implementation in SCM is related with the indicated factors (G. Stefansson,2002; Kpmg llp., 1999, see Figure 1).

Methodology and Assumptions

The arrangements and developments of buyers and suppliers' relations in SCM have critical importance in terms of providing the organization's competitive advantage. Utilization of information technologies for sharing information among the supply chain members, provide effective management of supply chain. Having quick access to information when needed by the organizations, renders them more sensitive to customer expectations and meeting the customer demands faster comparing to their competitors (Olhager et al., 2004).

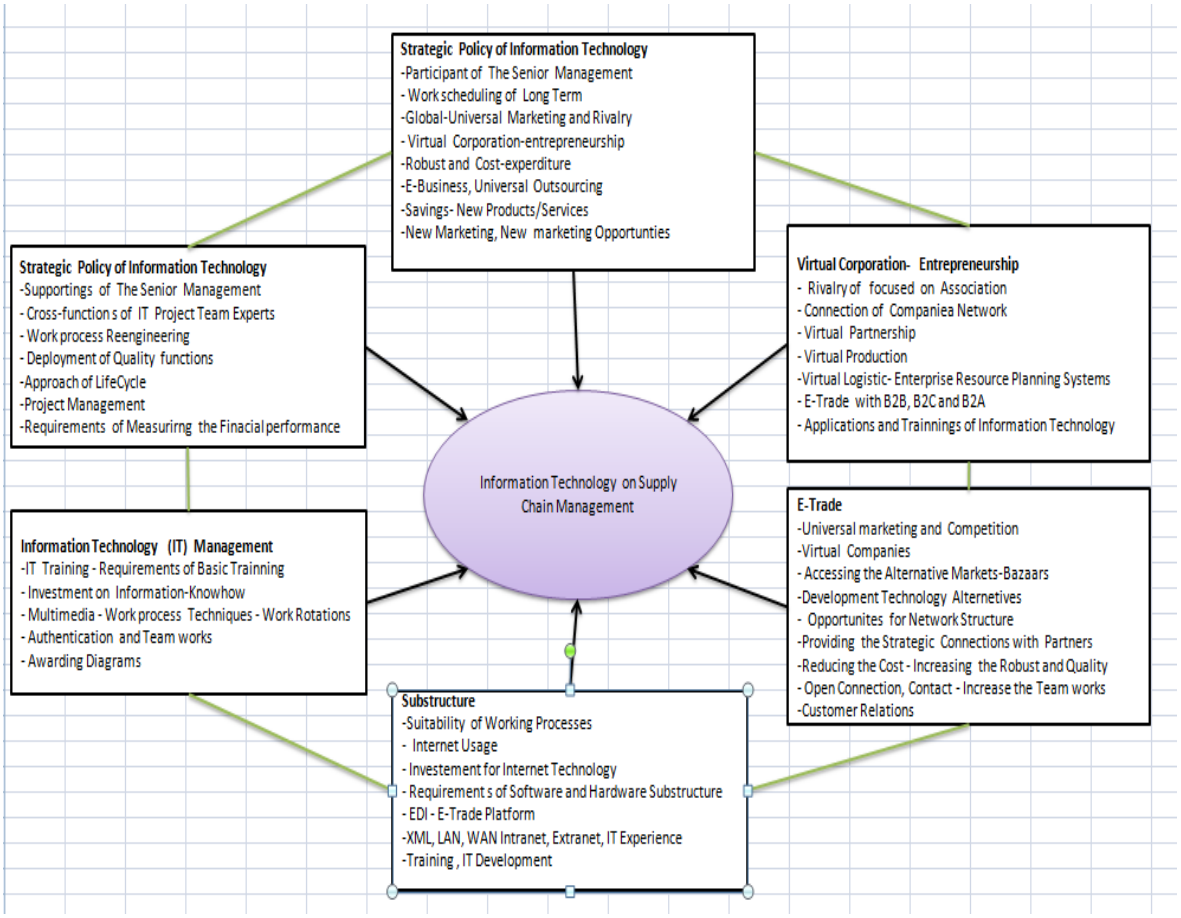

Figure 1: The Formed Structure in Supply Chain Management towards Information Technology Definition

Consequently, the organizations have a strong place in the market. In this study, it is attempted to define the role of information technologies in Supply Chain Management, in Figure 1.

In the scope of the study, buyer and supplier co-operation in implementation of information technology in SCM, performance of buyer and supplier relations, and their effects over the organizational performance are considered.

The sub-items aim that will be able to bring to main objective can be defined as follows (Hill and Scudder, 2002):

To define the information technology usage levels in supply chain,

To define the effect of information technology usage on the buyer and supplier relations performance,

To define the effect of information technology usage on the organizational performance.

To define the effect of information technology usage on the buyer and supplier co-operation

Assumptions in the Scope of the Study: The assumptions within the scope of the study model and objectives are defined below;

H1: There is relation between information technology usage level and buyer and supplier co-operation in supply chain.

H2: There is a relation between buyer and supplier co-operation and buyer and supplier relations performance.

H3: There is a relation between the information technology usage and buyer and supplier relations performance.

H4: Information technology usage level affects the organizational performance.

H5: There is a relation between the buyer and supplier relations performance and organizational performance.

H6: There is a relation between the buyer and supplier co-operation and organizational performance.

In order to meet the objectives of the study and to test the hypothesis, survey questions and expert views have been developed by considering the previous applied and theoretical works in the literature on supply chain management, information technology and performance fields (Giacobbi, 2002).

Unfortunately, due to lack of established database for the small and medium-sized organizations that uses information technology, and considering the large-scale organizations since they have the sufficient resources with regard to literature survey on information technologies, forced us to steer the implementation research toward large-scale organizations.

The assumptions are tested with structural equity model. The study of the data collection tool from the reliability and validity point of view is especially important in terms of the strength of the results (Güles et al., 1997; Hooper et al., 2007). Reliability indicates the consistency of the survey questions with each other and shows the reflection level of the used scale for relevant question in the study (Hair et al., 1998).

Table 1: Statistical values for the Reliability Analysis of the Scales

Current-Used Scale	Measuring Range	Units of Total Scope	Cronbach Alfa Coefficient
Corporation with Customer and Supplier	5- Likert Scale (Between 1-5)	10	0.9
The Relation Performance between Customer and Supplier	5- Likert Scale (Between 1-5)	11	0.95
Information technology Usage with Suppliers	5- Likert Scale (Between 1-5)	5	0.8
Business Performance	5- Likert Scale (Between 1-5)	6	0.96

In order to test the reliability of the scales in the study, Cronbach alfa co-efficient is utilized. The reliability coefficient of the scales is changed between 0.8 and 0.97. These results indicate that used scales have the high-reliability level (see Table 1).

Conclusion

In our study that is intended to define the relation between information technology usage and performance in Supply Chain Management, it is not attempted to focus on a certain sector and hence the data is collected from almost all kind of sectors. It is also ascertained with our study that all organizational departments are benefited from the investments made for information technologies, information technologies are being used in entire organization and with effective co-operation with other organizations.

As the result of the reliability and validity analysis of the scales that are used for defining the information technology usage and performance relation in supply chain, it is found that used scales in the study are both reliable and valid. In order to define the companies' information technology usage level in SCM, six basic technologies have been reviewed.

These technologies have been sequenced as per the average usage level of the organizations with relevant suppliers as such order; Internet, Enterprise Resource Planning, Electronic Data Interchange, Radio Frequency Systems, Geographic Information Systems, and Barcode. As the result of factor analysis that is developed for information technologies in supply chain, the technologies are divided into two groups as; Follow up Information Systems and Enterprise Information Systems. Follow up Information Systems express of %55.15 of total variance and contain Radio Frequency Systems, Geographic Information Systems, and Barcode Technologies.

Consequently, it is observed that the use of information technologies in SCM does not increase the organizational performance directly. However, the use of information technologies in SCM, increases the buyer and supplier co-operation, hence buyer and supplier co-operation increases buyer and supplier performance and causes to increase the organizational performance. Standardized regression co-efficient show the weight of each dimension over the other dimensions. According to this result, each variable takes values between (+1 and -1), and standardized, relevant comment is made similar to typical regression analysis standardized regression coefficient (Sharma, 1996; Altınısık et al.,2004). However standardized regression coefficient enables the researcher, comparison of relative effect of independent variable over the dependent variable (Hair et al., 1998).

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