Original Article

Presenting a model for assessing the effect of information sharing on supply chain performance (Case study: Ahwaz Pipeline Company)

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ABSTRACT

In order to assess supply chain performance, a comprehensive model, along with reliable data, can be useful. It helps to improve the whole chain. In this paper, the suitable model is presented for evaluating the effect of information sharing on the performance of the supply chain in the mentioned case that is Ahwaz Pipe Company. By means of performance enhancement model and cost reduction, supply chain systems can be improved. In this research, the statistical population consists of all procurement, production and sales staff of Ahwaz Pipe Company. The results of the research showed that two goals of increasing efficiency and reducing costs led to several research projects proposal, resulting in the ever-increasing development of supply chain systems. In the meantime, one of the solutions that have been able to find a special place in research in the supply chain area is information sharing; therefore, in this research, a field study was conducted to cost analyze of sharing information.

Keywords: Information sharing, supply chain performance, Ahwaz Pipeline Company.

Introduction

So far, an important set of different studies has been presented in the field of organizational performance evaluation models. Supply chain management is an integrated philosophy designed to manage the overall flow of the distribution path from the supplier and end-user and as a management philosophy, it includes the extent and limits of integrated behaviors for cooperation between the customer and the supplier in the course of external integration [1].

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Supply chain management as a set of management processes involves a process of management relationships, information flow, and material flow within the defined boundaries for the delivery of services and economic value to the customer through the management of physical channels and relevant information from the resources for consumption [2].

Supply chain performance assessment models have been developed in recent years and include supply chain operational reference (SCOR) model, the global supply chain, and consumer responses. The supply chain operational reference model does not provide information about how a particular organization within the chain should manage its business performance and information flow. According to the presented models, it can be concluded that each model has its own strengths and weaknesses, and none of these models are suitable for all organizations and performance evaluation purposes. Some of these models are only suitable for internal evaluation and some for external evaluation and comparison between organizations. Also, in many models, more emphasis is placed on operational and tactical levels of indicators, while strategic

levels need to be applied to reliable results over a long period of time [3].

Therefore, in order to evaluate the performance of each decision-making unit, functional indicators must be taken from different strategic, process, and operational levels. On the other hand, a supply chain is a decision-maker unit that does not only have input and output indicators but also uses intermediate indicators that flow from the previous stage to the next. Each stage may also have its own inputs and outputs [4]. Consequently, the network or multi-stage nature of traditional data envelopment analysis models supply chain is not capable of accurately assessing the supply chain performance [5].

Modern Supply Chain Management is obtained from researches which have been carried out in the late 1950s about the transfer of stock inventory to and from the company. Required raw material planning which was done in the 1970s is the real start of supply chain operations [4]. Farazel sees the supply chain as the latest and most important issues that organizations, by using it, are seeking to create value for shareholders [6].

Currently, organizational knowledge is recognized as an invaluable intangible resource for gaining competitive advantage, and organizations have paid special attention to manage such intangible assets to acquire and maintain organizational competitive advantage [7].

The sharing of knowledge and learning methods among staff facilitate the knowledge management (KM). Without knowledge sharing, the organization cannot effectively manage organizational knowledge and the organization will lose its competitive superiority gradually [8]. Knowledge sharing has been mentioned as an essential element for organizations to expand integrated services, share resources and promote organizational learning and creativity and innovation [9].

One of the main aspects of creating coordination is the sharing of information so that in the context of the supply chain coordination, the high level of interdependence depends on the high level of information sharing. Information sharing is described as "Fundamentals", "The basic element", "Nervous Center" and the "main need" of coordination.

As mentioned, one of the main aspects of creating coordination is information sharing. Information sharing can be defined as the extent in which a company communicates a variety of information with its supply chain partners. In general, there are two main streams of information sharing researches. The first is focused on the value of information sharing. These studies, by comparing it with traditional strategies or other decision-making processes, identify the value of information sharing and in line with value assessing, they mention information sharing and the factors affecting the value of information sharing. The second step is related to supporting frameworks or technologies and the factors needed to share information. These studies focus on factors that are needed to ensure timely and accurate sharing of information.

The main task of supply chain management is to manage and coordinate various flows within it. One of the key management challenges in this regard is the coordination of the flow of materials among several organizations and within each organization. In order to achieve this important objective, it requires the use of technologies and tools for tracing material from the source to the destination and recording information at each stage.

Sharing information is a key element of any supply chain management system. In our day, given the speed of environmental change, technological advancement and the globalization of markets, organizations are increasingly in need of optimizing the entire supply chain performance. Hence the sharing of information in the supply chain is very beneficial for survival and successful competition.

Theoretical fundamentals and research background

One of the new models of network economics is supply chain management, which continues as a set of methods for managing and coordinating the entire chain from the supplier(s) to customer(s) service management [10]. Supply chain management, like any other system and management approach in line with identifying success, needs determining the extent of meeting the needs of customers, helping the organization to understand processes, discovering the knowledge that has not been recognized by organizations before and ultimately realizing the planned improvement. Performance measurement has had a significant impact on the survival and growth of an organization. So that it has attracted the attention of many scholars and organizations over the last two decades. In parallel with the evolutionary process, organizations have evolved from a single approach and a network and supply chain approach, performance measurement systems have undergone a shift and enter into the context of the measurement of network and supply chain performance. Also, performance measurement based on reliable data is one of the factors considered essential for the company's full use of investment values [11].

Jalali et al. (2007), by investigating previous studies in this regard, classified the effective factors in the adoption of information technology in the supply chain as follows:

- Organizational size (scope)

Organizations that are large in scope, due to high financial resources, have a greater willingness to accept information technology, and in this regard, the associated risks are more acceptable. For that reason, there is a positive and significant correlation between organizational scope or size and the adoption of information technology.

- Organizational success rate

Organizations, due to previous successful performance, tend to be stable against strategy change, so the likelihood of a change in organizations that have had better performance in the past few years is very small.

-The impact of existing partners in the chain

One of the environmental factors that affect the organization's decision making in adopting information technology is the effect of the business partners in the chain. The pressure exerted by the partners on the supply chain can affect the adoption of information technology.

-Uncertainty

Uncertainty in supply chain management is one of the most important issues that its main cause is the lack of accurate and complete information for decision making. Therefore, the likelihood of the adoption and acceptance of information technology in organizations that are facing with uncertainty is more than other organizations [11].

In a study by Seyyed Mahmoud Hosseini et al., a model for selecting a supply chain strategy and selecting a suitable production system was presented and the presented model was implemented in a petrochemical company as a research organization. In fact, after presenting a new framework that rationalizes the strategic objectives of the supply chain with a three-dimensional approach, production systems for chemical production are selected and prioritized, as a result, four manufacturing systems were prioritized according to the company's supply chain strategy. As it was seen, the continuous production system was recognized as a top priority, which is due to the importance of cost efficiency over other strategic objectives, because the continuous production system has a comparative advantage in terms of cost efficiency. This study states that if a company is willing to re-examine its manufacturing processes, it is necessary to focus its attention on the production of continuous production and avoid investing in other production systems [12].

In case of demand increase and dispersion, the existing confidence should be increased for each of the supply chain members, or integrated system of information circulation be established throughout the supply chain network so that the system will not be deficient. This will lead to improvements in system costs and also prevent obsolete demand in the inventory of each member of the chain. It is also possible to consider the price chain variable or the price of other chains that are effective in the demand of the customer as future research topics [12].

Mehdi Maboodi and colleagues showed that investigating the supplier's relationship management is effective on the suppliers' satisfaction. According to assumptions, the relationship management with suppliers was divided into six dimensions. All aspects of the management of supplier relationships, including communication, collaboration, commitment, compliance, dependency, and trust, are directly related to customer satisfaction. The most important aspect that affects customer satisfaction is communication and the least one is dependence. Therefore, the management of relations with the suppliers of textile products increases customer satisfaction and the quality of textile products [13].

In a paper, Abolfazl Kazemi presented a two-objective model for the issue of integrated production planning-distribution in a three-level supply chain, including manufacturing plants, distribution centers, and final customers. The problem model includes two non-aligned goals with minimizing the total cost of the chain, including the costs of preparation and production, the cost of carrying and maintaining inventory at the producer level, as well as for distribution centers and sending them to customers, and minimizing all related costs of distribution centers include shipping and purchasing and inventory costs [14].

Mohammad Reza Tabibi et al. based on the findings of this study; indicated that strategic management consists of three processes of strategic analysis, strategic selection and implementation of the strategy. Managers of active businesses in the agricultural commodity exchange in order to carry out strategic analysis in their strategic supply chain management strategy have to pay attention to five components of complementary capabilities, social exchange features, transaction characteristics, power characteristics and network features. In the next step, based on the analysis done at the previous stage, they have to choose the appropriate strategy for their business in the supply chain. It is suggested that this choice, which is called strategic choice, be done based on two components of operational acceptance and credit acceptance, and it must be an underlying factor for determining how business can work in the chain or the strategy implementation [15].

In a study by Amir Manian et al. with the aim of identifying the factors affecting the supply chain performance, they examined the variables that affect it. By using Delphi technique and related literature, the variables affecting the supply chain performance were identified and then, by the means of factor analysis, their significance was investigated and based on that the conceptual model of the factors affecting performance in auto parts manufacturing industry was developed. According to the supply chain model (SC) presented in this paper, the factors affecting supply chain performance include the dimensions of the supplier, cost, flexibility, process, customer and time [16].

Based on research by Hossein Safari and colleagues, the model of sharing of information in the supply chain of Iran Khodro Co., Khorasan has been investigated. In this model, the quantity and quality of information sharing are directly affected by institutional enablers (IT capability, leadership support, participatory culture, and organizational structure). In fact, the capabilities of information technology are among the core enablers for information sharing. As with the development of information technology (such as the Internet, Intranet, and Extranet), much of the transaction costs associated with data transfer have been reduced, and a large amount of information at the right time and with desirable quality can be shared. Also according to the fact that leadership support plays an important role in shaping organizational values and attitudes, leader's understanding of the particular interest in sharing information would help to align the information sharing strategy with the business strategy, obtaining the resources needed to successfully

implement information sharing and creating a participatory culture of its support [17].

Many studies have shown that the sharing of information has a significant effect on the supply chain performance and the reduction of the bullwhip effect [18].

Information sharing enables companies to make better decisions for their operations, which results in better use of resources and lower costs for the supply chain. Better information management, allowing the company to be more responsive to customer demand [19].

Lee et al., through a mathematical model, analyzed four different causes of bullwhip effect: demand signal processing, rationing, batch orders, and price change. They suggested the sharing of information and the simplified pricing table as countermeasures [20].

Kachen et al. by comparing three scenarios of sharing complete information, sharing partial information and the lack of information sharing, concluded that the sharing of full information would be the most cost-effective compared with the other two scenarios [21].

Fu uses information sharing as a mechanism to establish coordination, he founds that the coordination of the supply chain (through information sharing) improves the distribution function. This flow, which can also be referred to as quantitative or mathematical flow, is methodologically based on research models in operation and optimization, and in most cases, the value of information sharing is the elimination or reduction of uncertainty in the random operating management models in the supply chain. Although the results of this dominant approach have led to valuable and unquestionable findings on the value of information sharing, but due to the methodology of the research and the parameters studied limited to examining and showing quantitative results, in particular, for reducing costs and increasing efficiency at the chain level and is inadequate to study the qualitative outcomes, backgrounds, effective factors, organizational challenges, and so on, which are among the main concerns of managers in decision-making processes related to information sharing [22].

Yu et al. investigated the importance of information sharing in nine different scenarios, they showed that sharing information only for inventory and capacity would not improve chain performance, but should also be applied to customer demand [23].

Dekkoğlu and colleagues have surveyed the top 500 Turkish companies in 2010; they investigated the simultaneous integration of supply chain and information sharing on supply chain performance. Their results show that the integrity affects the information sharing and information sharing affects the chain performance [24].

Zhou et al. compared the effect of information sharing on the inventory system (S, s) of the periodic review with the instant review, and their results showed that the sharing of information in the instant review system leads to a reduction in the cost of inventory [25].

Su et al. also emphasize the importance of the quality of relationships and cooperation throughout the supply chain and consider the relationship between supply chain elements as one of the most important factors in the success of the organization [26].

Method

The present research is a reasoning research because it seeks to identify a model for research .

This research is among field studies and in terms of implementation examines the following factors:

- It presents the mathematical modeling of information sharing in the Ahwaz Pipeline Company.

Research variables

In this research, the LST (Lee, So and Tang) mathematical model is used. In this model, information sharing and lack of information sharing are discussed. In 2000, an investigation was provided by Lee, Su, and Tang, on two levels of supply chain management delivered by customer and buyer on request. The purpose of this task was to provide the seller with the maximum amount of profits and to provide the goods to the buyer.

Before describing the model, we describe the symbols used in the formulation

$$\gamma_t = D_t + \frac{\rho\left(1-\rho^{l+1}\right)}{(1-\rho)}\left(D_t - D_{t-1}\right)$$

Y_t: the amount of buyer's order at the end of the period

D_t: ordering good by the buyer in the period of time

$$M_t = \frac{d}{1-\rho}\left\{(L+1) - \frac{\rho(1-\rho^{L+1})}{1-\rho}\right\} + \frac{\rho(1-\rho^{L+1})}{1-\rho}\gamma_t$$

L: Latency of the supplier's supply and delivery

T: time interval is 0,1,2,4

St: The highest order level of the buyer for the time period

T_t: Maximum optimal order for the seller for time interval t without sharing information

I: Average seller's assets in case of no sharing of information

I': Average seller's asset in case of sharing information

L: Latency of preparation and supply of goods by the buyer

H: Maintenance fee per the seller's time period

H: Maintenance fee per the time period of the buyer

p: Cost of the deficit (shortage) for the time period of the buyer

P- Cost of the deficit (shortage) for the time period of the seller

The hypotheses used in the LST method are as follows:

*The demand model is as follows

$$Dt = d + \rho D_{t-1} + \varepsilon_t$$

In this model, the parameter ε_t is located normally in the range of zero and deviation of $\sigma 2$

$$d << \sigma$$

$0<\rho<1$

A- A state without sharing information

$$y_{t+1} = \frac{1-\rho^{l+2}}{1-\rho}\, d + \frac{\rho^{l+2}(1-\rho)}{1-\rho^{t+2}} \sum_{i=o}^{t-1} \left(\frac{\rho-\rho^{l+2}}{1-\rho^{l+2}}\right) y_{t-i} + \rho^{l+2}\left(\frac{\rho-\rho^{l+2}}{1-\rho^{l+2}}\right) D_0 + \frac{1-\rho^{l+2}}{1-\rho}\, \varepsilon_t + 1$$

B-A state with sharing of information

$$\left[\left(\rho^{t+2}\left(\frac{\rho-\rho^{t+2}}{1-\rho^{t+2}}\right)\right) + \left(\frac{1-\sigma^{t+2}}{1-\rho}\right)\right]\rho^2 < \left[\left(\frac{1-\rho^{t+2}}{1-\rho}\right) + \rho^2\left(\frac{1-\rho^{t+1}}{1-\rho}\right)\right]\rho^2$$

Population, sample, and method of sampling:

In this research, the statistical population consists of all purchasing, selling and producing staff of Ahwaz Pipe Company, (n=1400). By Using Cochran's formula, 100 individuals will be considered as the sample size. The sample studied in this research is Ahvaz Pipe Company.

Data analysis method

In this research, we use the field method to collect information about answering the questionnaire questions, also in line with providing a preliminary model and collecting basic information the library methods were used (studying books, articles, journals, and research and Internet databases). For demographic data such as age, education level, service record, occupational exposure, and time frame, job relationship with the procurement organization will be extracted.

- Mathematical modeling is done by GAMS or MATLAB software.
- To rank the influential factors, the score and servqual models were used.

Data Analysis

Collection and estimation of required numerical data and model simulation in Ahvaz pipe company

In order to apply the research model in Ahwaz Pipeline Company, which is a simulation model, it is necessary to collect the required numerical data. The numerical data required in this study can be categorized into two general groups. The first group of numerical data is decisive, and this data is obtained by examining the documents, in particular, the company's industrial accounting records. Another group of data is needed data that is associated with uncertainties. This type of data is mainly related to the probable data required in the research. Obtaining data that is associated with uncertainty becomes more difficult than definitive data. In the present study, data associated with uncertainty is determined by reviewing the company's past history and records, as well as by experts. According to the above description, the numerical data for Ahwaz Pipe Company is as follows:

d = 1000 d means the average of the minimum demand in each period, this parameter is usually estimated according to the company's long-term contracts and orders relative to the length of the simulation period.

ρ = 0.35 ρ means the previous period effectiveness in this period. Given that customers usually do not complete their demand purchase period and usually purchase lasts for several periods, this coefficient is used as a parameter to represent this feature.

ε ~ N (0,300) Due to the uncertainty in the demand level in each period, the normal distribution function with a means of 0 and standard deviation of 300 is used to represent this uncertainty.

t = 1000 t shows the number of simulation periods.

l = 5 l is the time required to get the ordered product to the retailer. This time includes the time required for office work, loading and shipping.

L = 5 L is the time required to deliver the ordered products to the retailer. This time period is composed of the start-up time, the production time and the time of transfer to the warehouse.

H = 1200 H is the cost of maintaining the product for the producer, which includes the costs of storage and sleeping of the capital.

P = 4000 P is the cost of a shortage, which is mainly due to a reduction in the credibility of the company in the market.

After collecting the required numerical data, each of which is briefly explained, simulation of the payment problem can be mentioned and MATLAB software will be used in order to do simulation and the simulation steps are coded in MATLAB. The simulation results are presented as follows:

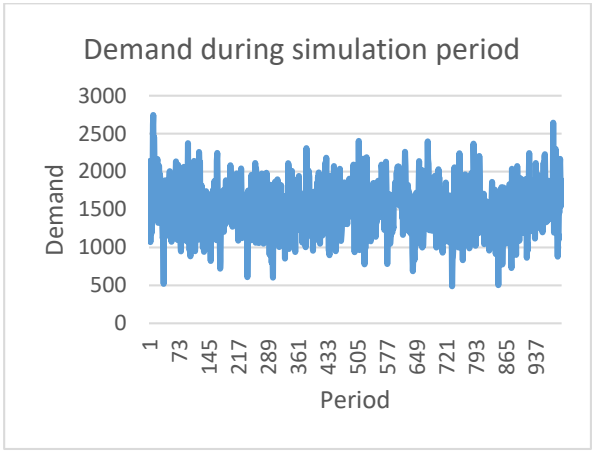

Figure 1: Demand during simulation periods

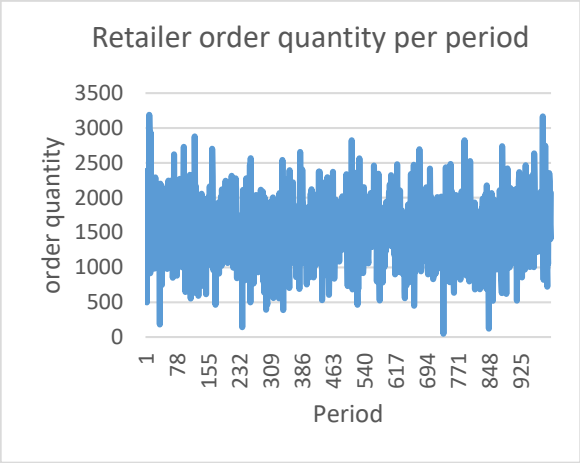

Figure 2: Retailer order quantity per period

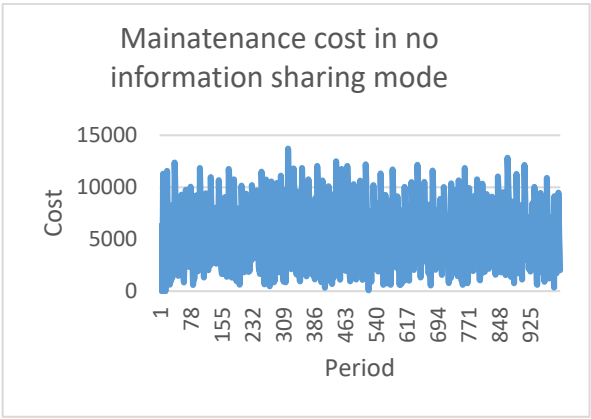

Figure 3: Maintenance cost in no information sharing mode

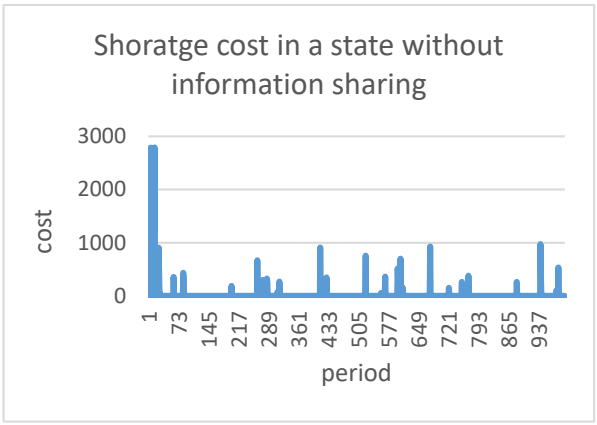

Figure 4: Cost of deficiency in no information sharing mode

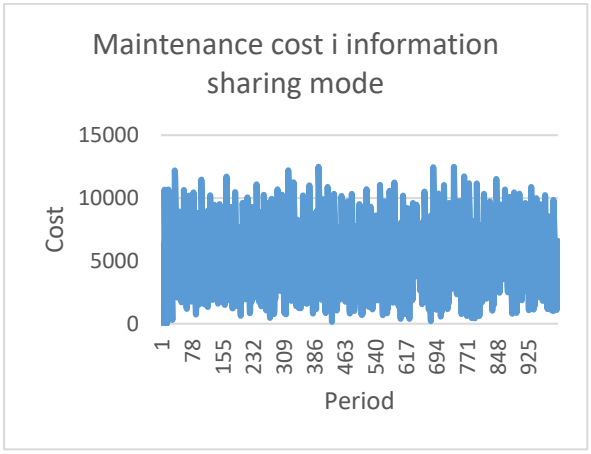

Figure 5: Maintenance cost in information sharing mode

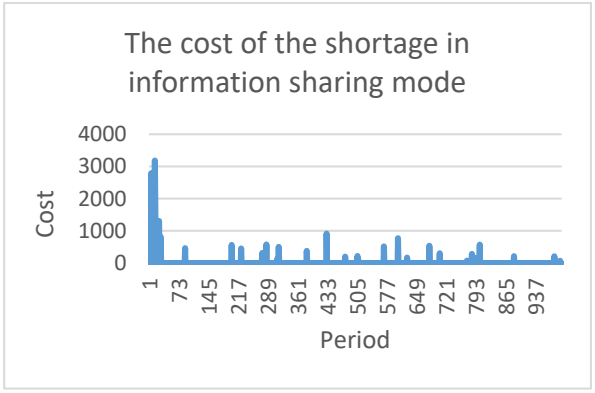

Figure 6: The cost of the shortage in information sharing mode

The figures 1 to 6 which are shown above, indicate the results of the simulation of the problem. Figure 1 shows the demand received by retailers in each period. As shown in the mentioned figure, demand varies from about 500 units to around 2800 units.

Figure 2 refers to the retailer's order quantity to the manufacturer. As indicated in the research model, the retailer's order quantity is based on its estimation from the market and, therefore, due to market demand fluctuations, the retail order quantity is fluctuating as shown in Figure 2.

Figure 3 shows the cost of maintaining an inventory in each period in the state without sharing of information. Given that maintenance varies in each period, the cost varies from zero to about 14000.

Figure 4 shows the cost of shortage in each period in the state without information sharing. Figure 4 shows that in many periods, the shortage cost is zero, which means that retailer orders have been fully met in those periods.

Figures 5 and 6 are the same as figures 3 and 4, except that these figures point to the simulation results in the information sharing mode. In order to compare the impact of information sharing on company costs, it is necessary to compare the costs of maintenance and shortages in each of the above situations. By summing up the total cost of the above simulation, it is observed that the total cost of state without information sharing is 6243596210. This is while in the information sharing state this cost is reduced to 6085519796, so, in the case of

information sharing, saving will be done as 158076414 monetary units, which is a significant figure. This indicates the importance of sharing information.

Discussion and Conclusion

This paper focuses on the development of indicators and a comprehensive model tailored to the nature of the supply chain by assessing supply chain performance. At first, the indices were determined at different levels by the analytical model and the weight and importance of each of indicators were determined from the components and performance indicators. The result of the confirmed indicators indicates that it was in the supply chain at Ahwaz Pipeline Company. Supply chain systems are of particular interest to researchers and policymakers because of the importance and important role they play in business enterprises. Hence, researchers are looking for solutions to improve supply chain efficiency and reduce costs. Two goals of increasing efficiency and cost reduction have led to numerous research initiatives that have led to an ever-increasing supply chain system. In the meantime, one of the solutions that have been able to find a special place in supply chain research is information sharing. Therefore, in this research, a field study was conducted to analyze the cost of sharing information.

Therefore, since organizational capital lies primarily in the minds of individuals, this crucial knowledge is at the disposal of the organization when employees tend to cooperate and share knowledge, and, in addition, they provide effective measures and mechanisms by the organization. Also, the highly valuable knowledge that exists in organizations will be eliminated unless the organization utilizes those individuals and creative workers who are so eager to use their knowledge in the organization and transform the knowledge and experience of the individual to make organizational knowledge. Employees leaving the organization also take their valuable knowledge, skills, and experience, and those who remain may be assigned to new posts and never use the knowledge collection that they have gained over the years in a sector and do not transfer that knowledge to others.

In this way, the challenge facing organizations is to strive for knowledge that enhances competitive advantage, creativity and innovation, and organizational learning, and adds to the richness of organizational knowledge; this will also be achieved by creating opportunities for knowledge sharing.

In analytical and optimization problems, various methods are used to model the problem. Due to the method used for modeling, various tools are also used to solve the model. Simulation models are one of the modeling methods that apply to uncertainty issues. These models have the ability to properly capture the real world conditions and are very much considered. In this research, a simulation model was used and the simulation model was solved by MATLAB software.

By investigating related literature, it was found that although a lot of research has been done on the role of information in the supply chain, little research has been done in relation to economic studies in this field. Also, due to the importance of cost in huge factories and businesses, economic studies are necessary in this regard. Therefore, the advantage of the present study is to add economic studies and analyzes in assessing the role of information sharing in the supply chain and also the output of this research is economic analysis in this regard. These analyzes are mainly presented as diagrams.

To investigate a simulation model, firstly, the factors and parameters that influence the model should be extracted. Therefore, in this regard, it is important to determine the boundary of the model's influence. This is such that many factors can be effective in the model, but ignore factors that have no significant effect, that is to say, we constitute an effective boundary for the model.

We try to determine the auxiliary variables in order to help the reader to understand the model. Excessive use of auxiliary variables leads to an enlargement in the model and hardening of its analysis. Also, using auxiliary variables less than the extent that we need them, and it makes the model inaccurate.

Determining the relationship between the model and the information used in this work is very accurate and sensitive, and the mistake in this section leads to a lack of proper conclusion from the model.

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