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Lead Time Improvement by Supplier Relationship Management with a Case Study in Pompaj Company

[1]Alireza Momiwand and [2]Arash Shahin

[1]Control and Planning Engineer in Hejrat Distribution Ltd.Co.Iran
Department of Industrial Engineering, Islamic Azad Univeristy, Najafabad Branch, Isfahan, Iran
[2]Department of Management, University of Isfahan, Isfahan, Iran

Abstract: In today market, transferring product to customers at the shortest possible time is an advantage. In contrast, delay provides undesirable results for a company. There might be many reasons in the supply chain for this delay, but focus can be placed on the first stage of a supply chain, which is related to suppliers and supplier relationship management (SRM). The concentration of this paper is on long lead time (LT) as a critical problem and also as an indicator of suppliers' relationship performance as well as an indicator of the whole supply chain. In fact, the aim is to propose an SRM approach for reduction of LT. Casual Loop Diagram (CLD) has been used to find two main reasons for the long LD, i.e. poor communication between the procurement department and suppliers and problems in procurement management. A manufacturing supplier company has been selected for empirical study and the results imply that after implementing SRM approach, products are delivered five days earlier. This approximately shows 33% time reduction, from period of 10 to 15 days to the period of 5 to 10 days. Therefore, the LT indicator has been cut by one third, which indicates the effectiveness of SRM in supply chain.

Key words: SCM · SRM · Casual Loop Diagram · Lead time

INTRODUCTION

Today's competitive marketplace requires companies to operate at low-cost. For this purpose, optimization of logistics systems is necessary and has resulted in improvements such as reduced costs, shorter Lead Times (LTs) and better customer service [1]. To reach the improvements, logic of influence diagram, i.e. Casual Loop Diagram (CLD) which provides symbols for mapping business systems in terms of diagrams and equations and a programming language for making computer simulation [2], could contribute to systematic thinking. This method was introduced by Forrester at the Massachusetts Institute of Technology (MIT) in the late 1950s. Based on CLD, deep communication between the procurement department and suppliers becomes important for the company that seeks growth and full control of suppliers. A supply chain typically consists of the geographically distributed facilities and transportation links connecting these facilities [3]. While, the design of co-ordination processes of suppliers-manufacturer-customers is important for successful supply chain management [4], it is vital for the company and its suppliers to live up to new logistics demand. Therefore, companies need to enhance relationship with their suppliers.

For this purpose, suppliers should be classified for identification of their importance. They are mapped by i) identifying the most important commodities and; ii) identifying the important suppliers. After identifying the critical commodities, suppliers providing these goods should be identified and categorized into "problem suppliers". These are the suppliers that should be developed and emphasized. Pareto analysis can be used for identifying these suppliers [5]. Once they are classified and prioritized, supplier relationship can be defined. There are many different ways to define a supplier relationship. The two most common ways are to look at such a relationship either from an economic or a behavioral perspective. [6]. This will lead to a sub-optimization. Therefore, it is important to combine the two approaches with each other [7]. After defining supplier relationship, Supplier Relationship Management (SRM) is considered

Corresponding Author: Dr. Arash Shahin, 1.242 Saeb Avenue, Isfahan, Iran.
Post code: 81848, Tel: +98-311-7932040, Fax: +98-311-6682910.

which is a set of principles, processes, templates and tools that help companies maximizing relationship value and minimizing risk and management overhead over the entire supplier relationship lifecycle [8].

In this paper, the Pompaj Co. as a manufacturer and supplier of spare parts and parts for Irankhodro and Saipa, the two major car maker companies in Iran, has been selected for investigation. The company has recently started its make-to-order program. This has led to a higher demand when it comes to flexibility and planning within the supply chain. Initially, the contracts with suppliers were conducted by a separate department of purchasing. Neither Sufficient nor efficient communication exists in the main manufacturing department. This has raised conflict in interactions between Pompaj Co. and its suppliers. Long and fluctuated LT caused delay to meet the demand of customers and raised conflict in production scheduling of the company. It is important to note that longer LTs imply more uncertainty than shorter ones, since forecasts are related to production time. Smaller LTs imply lesser inventory and less of a need for forecasting. For this reason, recognition of supplier relationship becomes significant.

The main object of the research is to show how LT as an indicator can be decreased through improving SRM and by the means of CLD. For this purpose, four major questions need to be investigated and answered as i) how long does it take to deliver the products to the customers from the time of ordering at the current situation of Pompaj Co.?; ii) what are the factors causing delay in meeting the demands of the customers by means of CLD?; iii) how can the influence of the factors be improved?; and iv) what is the new delivery time of Pompaj Co. after implementing of the new approach?

In the following, the concepts of CLD, systems dynamics, SRM and mapping supplier development are introduced. Then, the research methodology is described, followed by case study and findings and finally the findings are discussed and conclusions are made.

Casual Diagram: The notion of causality and causal diagrams are used by researchers in disciplines interested in mental models and/or causality – for different purposes ranging from studying to influencing causal reasoning [9,10,11,12].

The System Dynamics (SD) literature has been the stage for a brief dispute concerning causal loop Diagrams. SD has its own definition of mental models [13,14]: “A mental model of a dynamic system is a relatively enduring and accessible, but limited, internal conceptual representation of an external system (historical, existing or projected) whose structure is analogous to the perceived structure of that system". This definition does not mean “causality” nor “polarity”; neither did the related study deal with ways to represent mental models. However, mental models are used to study causal reasoning and frequently use “causal maps” [12].

Casual Loop Diagram (CLD): CLD was first used as a means to communicate selected insights in a simulation study [15]. Once this diagram language existed, it became tempting to use it further in other phases, especially for articulating causal beliefs in the early phases of modeling projects. This diffusion of CLD has led to two debates, i.e. there is argument on if simulation is always necessary or recommendable; and there has been criticism of the simplification of polarity.

In SD, the arrows represent the causal link has the usual arrowhead to indicate the direction of influence and also a “+” or “-” indicat the link’s polarity. Polarity determines an essential quality of the cause’s effect. The simple or “popular” definition of polarity is if a causal link from one element to another element is positive, it means a change in the first element produces a change in the second in the same direction and if a causal link from one element to another element is negative, it means a change in the first element produces a change in the second in the opposite direction.

System Dynamics (SD): The approach of SD was created and developed by a group of researchers led by Forrester at the Massachusetts Institute of Technology (MIT) in the late 1950s. This is the study of the information-feedback characteristic of industrial activity to show how organization structure, amplification and time delays interact to influence the success of the enterprise [16,17]. It is a framework for thinking about how the operating policies of a company and its customers, competitors and suppliers interact to shape the company’s performance over time [18].

The application of SD in Supply Chain Management (SCM) has its roots in industrial dynamics [18,19]. Towill (1996) [20] explains that in order to manage the supply chain efficiently, a clear understanding of managing dynamics in the supply chain is of high priority [21-26]. As dynamics of the supply chain become a matter of great concern, a number of causes of dynamics of the supply chain are identified in terms of rational and irrational factors [23,26,27]. Yang (2009) conducted a study on the model of supply chain inventory management based on SD [28]. Jin and Zhang (2009) established a model of the

jointly managed inventory (JMI) for iron and steel enterprises based on SD [29]. Ding and Gan (2009) introduced a system dynamics model of a traditional/closed loop supply chain system and investigated it in the manufacturer echelon chain under APIOBPCS (Automatic Pipeline Inventory and Order Based Production Control System) [30]. Patel *et al*. (2010) developed an SD Model to optimize the stock in production and distribution points of a manufacturing supply chain [31].

Supplier Relationship Management (SRM): Identification of when supplier relationships are appropriate, the dimensions of effective relationships and how relationships can be a source of competitive advantage have received considerable attention in the literature [6]. A supplier relationship is a relationship that differs with different suppliers [32].

The goal of SRM is to streamline and make the processes between an enterprise and its suppliers more effective. Peront and Roodhooft (2008) investigated the supplier management control system of a Volvo Cars production facility by means of an in-depth case study [33]. Pazirandeh and Mattsson (2009) by a research sought after ways to develop a strategic and systematic method of dealing with suppliers [34]. Based on results derived from an empirical study of 398 Chinese manufacturing companies, Cai *et al*. (2010) found that volume consolidation enhances supplier performance, buyer learning from the supplier and its environment learning ability [35]. Villena *et al*. (2010) considered the "dark side" of social capital in buyer–supplier relationships (BSRs) [36]. Their study confirms that building social capital in collaborative buyer–supplier relationships (BSRs) positively affects buyer performance, but that if taken to an extreme it can reduce the buyer's ability to be objective and making effective decisions as well as increasing the supplier's opportunistic behavior. Their study also examines how a buyer can delay the emergence of the dark side. To handle ambiguity and fuzziness in supplier selection problem effectively, a new weighted additive fuzzy programming approach is developed by Yucel and Guneri (2011) [37]. Aksoy and Ozturk (2011) proposed a neural network based supplier selection and supplier performance evaluation approach, which can assist manufacturers in selecting the most appropriate suppliers and in evaluating supplier performance [38]. The proposed neural network based systems are tested with data taken from an automotive factory and the results show that the proposed systems can be used effectively.

Table 1: Commodity portfolio matrix [5]

	Low volume purchase	High volume purchase
Strategic item Suppliers	Bottleneck suppliers	Strategic suppliers
Non-strategic item Suppliers	Noncritical suppliers	Leverage suppliers

Mapping Supplier Development: Mapping supplier development is a step by step process. This process is described as follows:

I) Indentifying the most important suppliers - Studies indicate that normally only 20 percent of suppliers are responsible for 80 percent of the cost of material. Therefore, using the same strategy for all suppliers is not the best choice. Thus, a company should utilize a mix of different approaches that can be individualized for any specific supplier or specific type of suppliers [39]. Four types of suppliers are addressed in Table 1. Respectively, for non-critical suppliers arm's length relationship; for leverage suppliers mid-term relationship and taking advantages of economies of scale; for bottleneck suppliers long-term relationship or switching to internal production; and for critical strategic suppliers long -term partnership could be applied as effective approaches.

II) Identifying important suppliers: after strategic segmentation and realizing which suppliers the organization wants to build longer term relations with, the most important suppliers are identified as the "Problem Supplier" category.

III) Starting from within - The organization should start and make adjustments internally first in order to achieve harmony inside out. This is the step were the organization attempts to change the mindset of the inside players.

IV) Informing the suppliers: This is a delicate stage in which the organization attempts to change the mindset of suppliers. Furthermore, Handfield *et al*. (2000) express the need to be professional in relationship with suppliers to build trust and reliability [5]. At this stage, the following points should be considered:

- Have the objectives and the performances integrated with the organization
- Communicating the SEM measures of the organization
- Communicating organization's expectation from the development program

- Providing new angles to the existing knowledge of the suppliers
- Providing necessary education and resources for execution of expectations

V) Selecting key projects - After all the above mentioned stages, the organization should study the projects and decide which are the most important and have priority in execution. The aspects to take into consideration are feasibility, finance, duration and return on investment.

VI) Setting details of Implementation - After deciding which projects to execute first, the details of implementation should be listed.These details include required resources, time frames, desired outcomes, setting the contribution parties, joint programs (risk/development), sponsorship, education and standardization.

VII) Monitoring implementation - After execution is conducted according to the set details, the implementation should be monitored. Standards should be maintained and changes and modifications must be made in places of need [34].

In case of problems, like any other program in any other business area, the implementation of the selected programs might be faced with obstacles. These problems are associated with the supplier's side shortcomings, the buyer company side, or both.

Research Methodology: The focus of this paper is mainly on the relationships between buyers and suppliers and on ways to improve supplier relationships in order to achieve LT reduction and to improve delivery performance.

This study is typically both empirical and theoretical work. CLD is used to analyze and improve SRM. The current time of LT is measured through performing a case study at Pompaj Co. and studying the ways that the company deals with its suppliers. The reason of this delay is found; the weaknesses and strengths are noticed and listed; and then, by improving SRM based on the framework introduced by Pazirandeh and Mattsson (2009) as a guideline and a step by step map for supplier development program, the problems and difficulties are tried to be removed. Finally, the improvement is measured by the amount of the reduction in LT [34]. The proposed approach includes the following steps:

I) Measuring current LT by the use of sub indicators which are applicable for all suppliers.

II) Analyzing the long duration of LT and the associated causes by CLD

III) Performing improvement action on reduction of LT:

- Classifying suppliers into strategic, bottleneck, leverage and noncritical suppliers by Mapping supplier development (section 4-1).
- Improving relationship with suppliers by providing consulting services to suppliers; organizing meetings with suppliers; increase of contact with suppliers; information technology (IT) enhancement; and risk sharing.

IV) Analyzing the improved (i.e. reduced) LT

The required data from Pompaj Co. includes the current relationship with suppliers, information on problem suppliers in order to visualize examples of shortcomings, current communications with the procurement department and specially LT, time of production and time of transportation from factory to customers. In order to gather all this data, several interviews with purchasing department and some of the suppliers are conducted. A questionnaire is prepared and submitted to different authorities such as Pompaj managers and supplier managers.

In this research, both quantitative and qualitative data are used for analysis. Two different methods of sampling are used in order to make the necessary analysis. For analysis, reactive and particularly proactive methods of thinking are utilized. Reactive method is used for the existing shortcomings and for fixing problems when they occur, while the focus of proactive method is mostly on methods and notions to prevent any problems from the beginning.

Case Study and Findings: Pompaj Co. was established in 1986. It is a manufacturer and supplier of spare parts and parts for Irankhodro and Saipa, the two major car maker companies in Iran. This company in turn like other companies has different suppliers which are located in different zones of Iran. It has 24 suppliers that supply ordered items to the company to be assembled/ manufactured for the two mentioned customers. Those suppliers are divided into four groups based on their locations. The supply chain is illustrated in Figure 1.

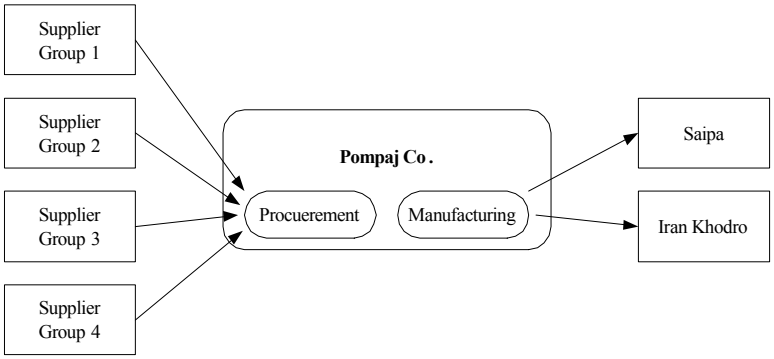

Fig. 1: Supply chain at Pompaj Co.

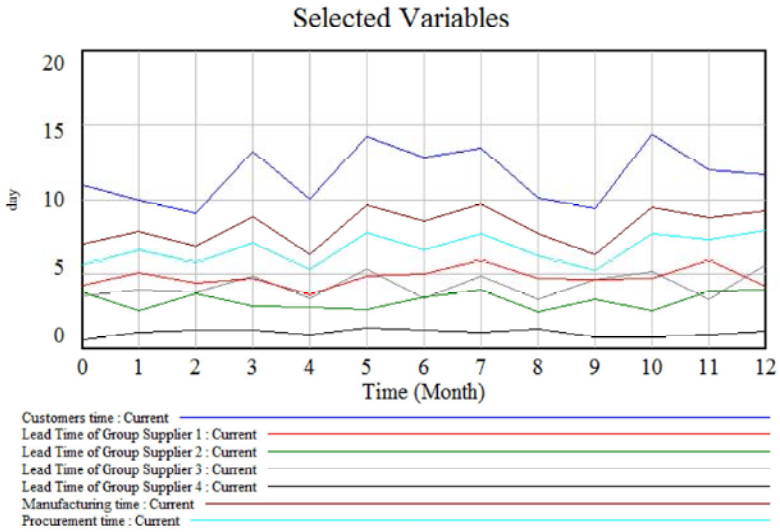

Fig. 2: Current LT of the supply chain at Pompaj Co.

As illustrated, the Pompaj co. has a simple supply chain. It should be mentioned that the two departments of procurement and manufacturing are selected for more concentration, since they are sections to which the long LT delay is mostly related.

Current LT: For measuring the current LT, the following sub indicators are measured:

- Procurement time - Average time of ordering, receiving and inspecting plus bottleneck time
- Supplier LT - From ordering raw material to the reach shipments to the four groups of suppliers
- Manufacturing time - Accumulation of the time of bottleneck, procurement and manufacturing
- Customers time - Time that products reach the customers, including manufacturing time plus transportation time from factory to customers (customers are near each other)

It should be noted that in this study no buffer inventory is assumed in finding the bottlenecks. In fact, each raw material has a date of ordering and if it is out of date, it means it is from buffer and is omitted from data analysis. Respectively, after all of the raw materials reach Pompaj Co., manufacturing is started. So, the longest LT would be the bottleneck time. The results are summerized in Figure 2.

Figure 2 illustrates different kinds of time (day) of the current supply chain over 12 months. As it is clear, except LT of the suppliers, other times are accumulation of previous ones and among LT of Suppliers, bottleneck time is the LT of suppliers 1 and 3, which are around five days in a year. Customers' time which is accumulation of all previous times fluctuates between from 10 to 15 days.

Mapping CLD: In order to find the causes of long duration of LT, CLD is used in order to highlight the underlying reasons for the problems.

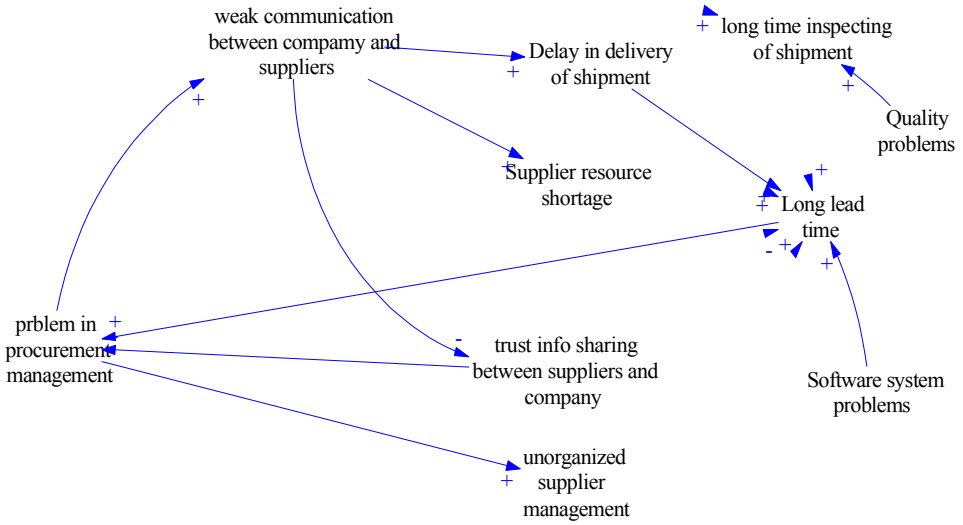

Fig. 3: CLD of long supply chain LT

As illustrated in Figure 3, the cause and effect loops are mapped by the contribution of Pompaj experts, engineers and staff who have worked in the company for years.

According to the diagram, two main problems are highlighted as he limitations brought upon by poor communication between the procurement department and suppliers and problems at the procurement management, where the latter could cause unorganized SRM as considerable factors, which in turn could be the main reasons for most of the problems such as delay, source shortage of supplier due to delay and problem in reciprocal info transferring, lack of trust in relationship, poor quality of shipment and software problems. Therefore, deep communication between the procurement department and suppliers can solve many associated problems and as a result, the main problem which is long LT will be reduced.

After the above addressed causes had been found as the reasons of long LT, attempt is made to solve them by the contribution of experts and approaches addressed in the literature and finally, SRM is improved. The next section describes how improvements are made in SRM at Pompaj Co. which is the answer of the third question of the research.

Suitable SRM Approaches for Pompaj Co.: The suppliers are divided into four groups of strategic, bottleneck, leverage and noncritical suppliers and in each group; six suppliers are included which are located in the closest location to the company. For each of the supplier groups, one SRM advisor is assigned and their interrelationships are improved. The frequency of communications is

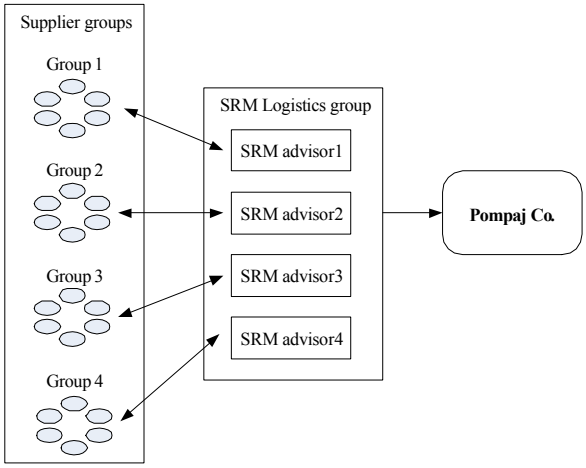

Fig. 4: New supplier structure at Pompaj Co.

determined as an indicator for evaluating suppliers. For each group of suppliers and corresponding advisor, follow up meetings and closer relationship through face to face talks are planned and conducted. As an important subject, the risks involved are shared between the company and groups of suppliers and attempt is made to make suppliers as one of the key players in the success of the company. Finally, by active use of internet supplier portal, faster, easier and more accessible means of communication is achieved.

Figure 4 shows the new supplier structure at the Pompaj Co., in which a new SRM Logistics group facilitates the communications of company with suppliers. As it is addressed, all suppliers of a group communicate through one corresponding SRM advisor. All problems and issues are directly reported to the SRM advisor and

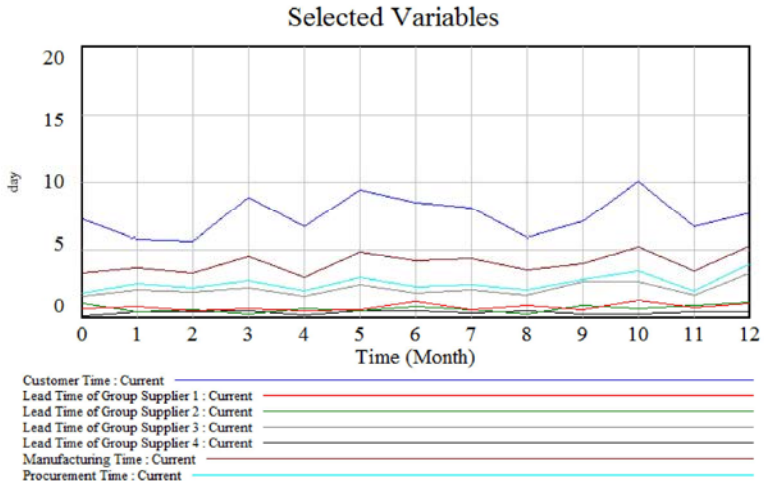

Fig.5: Improved supply chain LT at Pmpaj Co.

they classify, evaluate and resolve them altogether. The advantages of the new structure might include integration of the performances and interactions; administrative cost reduction; personnel reduction; and closer interrelationships due to more personal communications.

An important subject which should be recognized is the SRM advisor's personality and marketing skills. It seems by the suggested structure, almost all of the problems causing long LT can be eliminated.

Improved LT: In this section, the LT indicator is reevaluated and its reduction is analyzed. Figure 5 shows the improved LT over 12 months in which new SRM is implemented. According to the Figure, LT of group Supplier 1 and 3 which are the bottleneck time are decreased and fluctuated around 3 days, which is justifiable. The LTs of other group suppliers are also decreased considerably.

By comparing the two graphs of Figure 2 and Figure 5, which show the LTs before and after implementing SRM approaches, it is apparent that LTs of group suppliers which were very long are decreased strikingly and the bottleneck time is decreased from five to three days. Procurement time fluctuation was between five to eight days and now it is between one to three days. Finally, Customers' time which was between 10 to 15 days, is now between 5 to 10 days.

DISCUSSION

In this study, suppliers were selected by means of a strategy in which, volume plays an important role. Volume consolidation enhances supplier performance, buyer learning from the supplier and its environment learning ability [35]. The approach of this study assisted Pompaj Co. in selecting the most appropriate suppliers and consolidating relationship with them, based on Donaldson and O'Toole (2000) methodology [6]. The findings imply a considerable decrease in LT, which is a significant competitive advantage to the company.

This investigation was conducted with the aim of improving relationship with suppliers as a part of supply chain. Although considerable studied have been done on the subject, this research is compatible with the work of Pazirandeh and Mattsson (2009) [34]. They conducted a research in Volvo company in order to determine strategies of developing relationship with suppliers, based on social critical factors. In this investigation, the causes for delays and defects were determined by using CLD and the LT indicator was analyzed as a basis for improving supplier relationship in Pompaj Co. It is important to note that while this investigation was done in a smaller scale compared to the Volvo case; and cultural, social, economic and political differences exist between the two cases, most of the results are the same, of which the most important one is the competitive advantage achieved via improved relationship with suppliers.

As managerial implications, it is recommended to managers and practitioners to have a deep understanding of their current position compared to their competitors in case of supplier relationships prior to apply the proposed approach. It is necessary to classify suppliers based on their organizational strategies, capabilities and products. In addition, setting targets and defining improvement plans for relationship development, mutual trust and

loyalty of the organization and suppliers are critically necessary for the success of such programs. Finally, at the end of each development, it is essential to control the enhanced relationship and continuously attempt to improve it.

In the proposed approach, it was suggested to classify suppliers into strategic, bottleneck, leverage and noncritical categories. In fact this classification is performed with consideration of the strategic type of supplied products and their volume of purchase. Then, improvement of relationship with suppliers based on the determined priorities is becomes reasonable. In this regard, providing consulting services to the suppliers, handling meeting sessions with them, increasing contact and interaction with suppliers, development of IT and risk sharing lead to improvement of relationship with suppliers, which in turn result in reduction of LT.

However, it should be noted that as increasing number of organizations employ SCM and SRM methodologies, the importance of continuous improvement as a business opportunity increases. In contrast, underestimation of such importance might result in a potential threat to the organization. Meanwhile, SRM acts as a competitive leverage in surviving and developing dynamic organizations for which, new approaches and technologies can speed up the development process.

CONCLUSIONS

In today of businesses, suppliers play an important role in the success of business and provide competitive advantage to organizations. As globalization increases, procurement function becomes a critical activity for firms to succeed. In this regard, supplier selection plays a key role in achieving the objectives of supply chain management and managing a good relationship with suppliers is necessary for their survival and growth. Pompaj Co. is a company which manufactures spare parts for two car makers. It has a procurement department to establish relationship with suppliers, order, receive and deliver to the manufacture section. Long LT was a problem which caused delays and other problems in manufacturing. This problem had major effects on the time of delivering the products to the customers. This delay caused customer dissatisfaction and threatened success of competitors. The use of CLD addressed different causes for the problem. Among those causes, two main reasons were underlined as the main problems which mostly contributed to long LT as poor communication between the procurement department and suppliers and problems in procurement management. By the participation of experts and literature study, SRM approaches were selected as techniques to solve the problems and in particular, the main problem of long LT.

In order to propose an approach for improvement of SRM, a number of actions were undertaken and the approach was examined in the Pompaj Co. Table 2 summarizes the values of LT in pre and post implementation of the proposed approach.

As it is addressed, the bottleneck time is strictly reduced from 5 to 3 days; procurement time which is the average time of the ordering, receiving and inspecting is also decreased from 6.5 to 1.5 days on average. In addition, the fluctuation of bottleneck LT is decreased from 5-8 days to 1-3 days. Customers' time which starts from the time of ordering from suppliers to time of delivering the product to the customers is reduced from 10 to 5 days on average. Its variance was between 10 to 15 days and now it is reduced to 5 to 10 days.

It is important to note that in this study due to constraints in time and resources, there was limitation to study different aspects of SRM in detail. In this study it was assumed that the suppliers were previously evaluated and selected. This is due to the small number of suppliers and their monopoly in supplying some parts of raw materials; otherwise, they should be evaluated and prioritized based on specific criteria and the suggestions of this study. Due to the fact that techniques such as handling joint training programs with suppliers and utilizing update IT were not cost effective in the studied company, applying such programs were neglected in the proposed approach. Some other research limitations included the lack of infrastructures for relationship improvement and problems in integration of supply chain; lack of understanding the necessity of effective relationship among the units of the supply chain; non-competitive and monopoly market of the studied industry; and unfamiliarity of managers with SRM subjects in Iran as a developing country.

Table 2: Results of implementing SRM approaches

Type of LT	LT before Implementing SRM approaches (day)	LT after Implementing SRM approaches (day)	LT reduction (day)
Bottleneck Time			
(LT of suppliers 1 and 3)	5	3	2
Procurement time	5-8	1-3	5
Customer Time	10-15	5-10	5

In future studies, researchers are encouraged to investigate improving supplier relationship by taking into account other various aspects, such as IT, contractual issues, demand management, etc. Furthermore, subjects such as risk management and forecasting are other areas which can be studied. In addition to the proposed approach of this study, researchers can use fuzzy programming approach for multi-criteria supplier selection. Also, Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA) and Neural Network (NN) and a hybrid method that integrates these techniques into an evaluation process in order to select competitive suppliers in supply chains can be developed.

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