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Order Processing in Supply Chain Management with Developing an Information System Model: An Automotive Manufacturing Case Study

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Abstract. Nowadays, high competitive market needs fast, effective, high responsiveness, online interactive, 24 hours 7 days availability and easy to follow up order processing. Consequently, there is a need for a model in which interdisciplinary approaches for understanding the range of Supply Chain Management (SCM) Information System (IS) capabilities are provided. In this study, an integrated model of SCM IS was developed that is supported by empirical evidence specific to SCM IS implementations. The developed model integrates and enriches theories of competitive strategy, supply chain management and inter-organizational information systems. Then, a case study of an automotive manufacturing industry was conducted to demonstrate the proficiency of the proposed model. As a result, better understanding of capabilities of implemented supply chain management information systems and expected future capabilities could be identified by practitioners and decision makers. Finally, findings of this study are listed together with some future works.

Keywords: Supply Chain Management, Information System modeling, SCM IS, Order Processing.

1 Introduction

Since early 1990s, information system has been applied in order to coordinate the flow of materials together with information inside the company; this process was named supply chain management [1]. During these years, supply chains have been reengineered using information system such as electronic data interchange (EDI) and point-of-sale (POS) systems [2]. Intensified competition in worldwide markets resulted in an increasing demand of supply chain management (SCM) and information systems (IS) activities within companies [3]. Basically, information integration plays an important role in managing a supply chain process between its stages. Consequently, organizing and sharing supply chain information resources can lead to facilitate the progress of this integration [4]. So, Enhanced supply chain management highly depends on the use information system ideas followed by reconstructing business practices and strategic plans within the whole organization

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[5]. Subsequently, information system is applied by companies in order to develop the supply chain process [6]. Electronic commerce as a very fast rate developing issue has been enabled by progressing in information system [7]. Enhancing the information sharing level between the supply chain stages is as important as controlling order fulfillment process in a flawless manner [8]. Supply chain management often requires the integration of different types of flows within and outside organizational relationships and management of inside the whole supply chain organization. Moreover, improved supply chain performance is related to Intercompany integration and coordination via information system [1].

In many organizations, it is becoming essential to eliminate or ignore sources of turbulence and volatility. Information and, significantly, agile information systems have been recognized as being an important issue to approach agility in the supply chain [9]. Supply Chain Management Information System acting as increasingly vital basis in the ability of companies to decrease costs and raise the responsiveness of their supply chain. However, there is a very few research articles [10,11] that show the influence of information system in supply chain management. Fundamentally, information system is like a backbone system for supply chain management. In this research, an integrated model of SCM IS capabilities was developed which is supported by empirical evidence specific to SCM IS implementations. After that, a SCM IS prototype was designed. The advantages of developed model are to integrate and enrich theories of competitive strategy, supply chain management, and inter-organizational information systems. The developed model can fill the existing gap of many manufacturing and non manufacturing companies regarding the complex information flow among supply chain members.

2 Literature Review

The success of many companies are involved with the supply chain management information systems [12,13] but received inadequate consideration in experiential information system study [14]. The profits and abilities of various kinds of supply chain management information systems such as EDI [15,16], electronic market [17,18] or extended enterprise resource scheduling [19] systems have been investigated by few researches. Also, there are few experimentally extracted models appropriate for examining the scope of supply chain management information systems options [20]. An organizational skill is the aptitude of an organization to attain its objectives by leveraging its different resources [21]. Supply chain management information systems abilities are organizational abilities [22] to form the desired competitive policies [23]. Stephen Hays Russel (n.d) lists four types of information systems in sustaining supply chain operations: Enterprise resource planning (ERP) software, Electronic data interchange (EDI), Electronic product code technologies and Supply chain analytics [24]. Supply chain management and information systems are firmly attached. Consequently, execution of supply chain strategies will be extremely complicated without supporting of information systems [25]. Supply chain management information systems are the information systems between companies that employ information and communication technology to arrange information inside and among the participator of a supply chain like the clients, sellers, providers, and distributors included in the utilization and supply of a special product or service [16].

Companies have identified the advantages of using supply chain management information systems to synchronies information between the customers and producers of a supply chain since the Electronic Data Interchange (EDI) discovered [16].

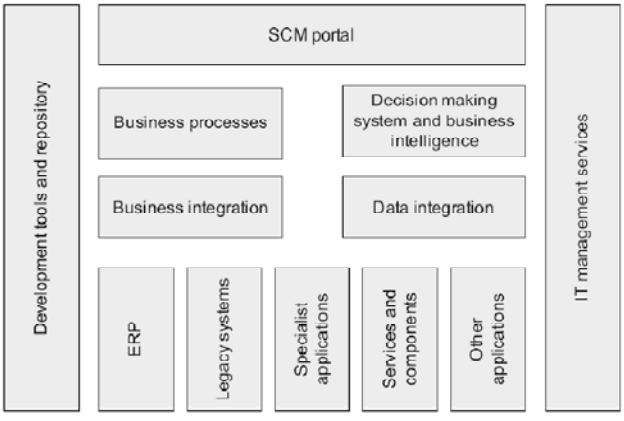

Fig. 1. Structure of the supply chain management information system [32]

As shown in Figure 1, the central components of the structure are business processes and the decision-making system [25]. Factors and applications of the supply chain information system can be requested while implementation of the business processes. Information flows between factors and applications are as well determined by method of an exchange of messages [26]. The production information exchange categories are: product definition information, production capability information, production schedule information and production performance information, this includes feedback information needed to respond to the business system request to make product [27]. Also, there are seven major types of organizational units included in the supply chain: a supply chain headquarters, parts suppliers, warehouse, retailers, distributor, a final assembly plant, and a transportation network [28]. It is long time that researchers have recommended and discussed models for investigate the appropriateness of competitive policies with different high stage information systems concepts [29]. In this paper, a system was developed which shows the vital role of information system in supply chain management. It is illustrated that how well SCM IS facilitate different organizational potential in a company. Moreover, it is shown that decreasing the complexity of estimating different supply chain management information system is dependent on SCM IS. The rest of this paper is arranged as follows. In section 3, the methodology of this research is shown. This is followed by section 4 which explained the case study and results. Finally, conclusion is presented.

3 Methodology

The proposed methodology, illustrated in Figure 2, used in this paper can be used as a road map to improve the data flow between members in a supply chain system. For

this purpose, a database was developed in which after a certain period of revising and improving the new system a decrease in terms of costs and data flow time could be expected to occur. Microsoft Access and Ms Project software were utilized to design an efficient information system for SCMIS which shows the flow of information. The proposed method consists of three main phases as follows:

- Phase 1: Data collection
- Phase 2: Developing the database
- Phase 3: Implementation of the database

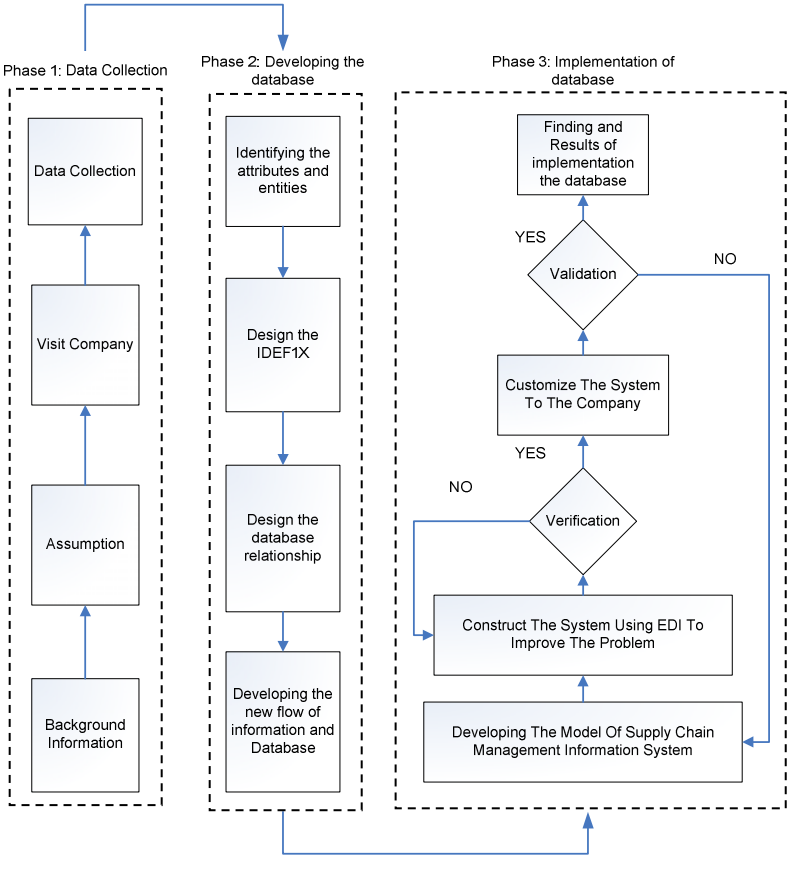

Fig. 2. Proposed methodology

4 Case Study and Results

In this section, the case study along with the obtained results is presented. This task is done by integrating the description of different phases and steps of proposed method

together with conducting the case study for better demonstration purposes for the readers. Vehicle Axle Manufacturing Company (VAM) was selected to be as case study in order to evaluate the proficiency of the method. This company was established in 1986 and it is located in Nazar Abad, an industrial city, in Iran. In this research, the cover of rear axle for light vehicles was selected as the case product.

Phase 1. Data collection. The first step involves in designing a model for information system in supply chain in order to define a real supply chain with its parameters. Then, an input and the output measurement were carried out so that the perceptual models were shaped. After that, the quantitative step starts; this step consists of working on technical problems such as progression and evaluation of mathematical models, simulation models and control theory techniques. Figure 3 shows the flow of information in the factory before developing the database.

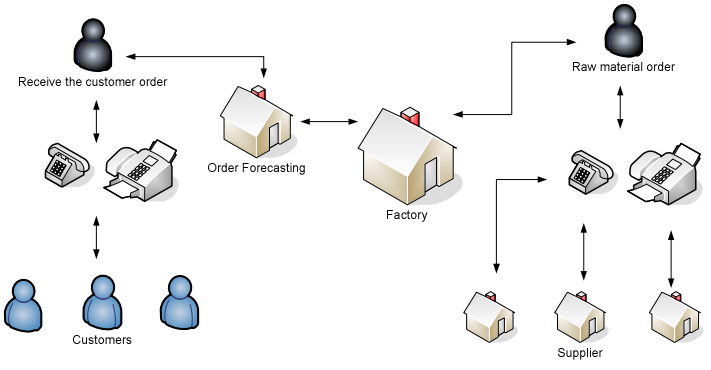

Fig. 3. Current flow of information in the factory

In order to run and model SCMIS, three different levels are involved. These levels consist of tactical, operational and strategic. The focus of this research is on strategic modeling of a supply chain management information system. Moreover, Strategic decisions are long term decisions are interrelated to the company's strategy. Furthermore, they are usually engaged with most of the supply chain members. As a matter of fact, one of the basic necessities for supply chain implementation is visibility of appropriate information in the exact time and in the exact arrangement. In inventory control strategy, these elements might be used at the level of inventory safety, reorder point, stock level of finished goods, raw material and middle parts and inventory location. When it comes to purchase and logistics, significant factors are supplier lead time, supply lot size, supplier capacity, and purchase time. Significant order information consists of parameters such as due date, preference, start and end information and order pattern. Strategic information constitutes order control policies and dispatch policies. In the design modeling step of the supply chain, the first mission is to find the most significant variables like inputs and outputs and the effect of these variables on the supply chain system. To develop the database, these data are collected:

1. Production data: Production rate, part number, product number, product price, product type, part type.

2. Customer data: Customer order, due date, order date, order number.
3. Supplier data: Part description, supplier list, part price.
4. Information flow: Information within supplier, manufacture and customer.

Phase 2. Developing the database. This database was created with Microsoft Access and it is utilized to improve the flow of information between suppliers, manufacturer and customers. This database should be installed in a server inside the organization with regard to the point that the only way to access the database is by operators of the organization. Customers can only enter their data by internet. Moreover, customers can order online at any time they want via using internet. After that, the order data will automatically goes to the database and after less than 8 hours their order will be processed in the organization.

The users of the database are the customers, manufacturing company and the suppliers of the selected product. The users of this database need to have Microsoft Access 2007, Microsoft Outlook 2007 and Microsoft Info path 2007 in their computers. The database is designed to help the customers dealing with their order requests step by step. By following these steps, customers are able to request their order at any time that they want.

i) Design the Entity relationship diagram (IDEF1X). IDEF1X is a data modeling language for the developing which relates data models [30]. It is used to produce graphical information model which represents the structure and relation of information within an environment or system. IDEF1X of the company is shown in Figure 4.

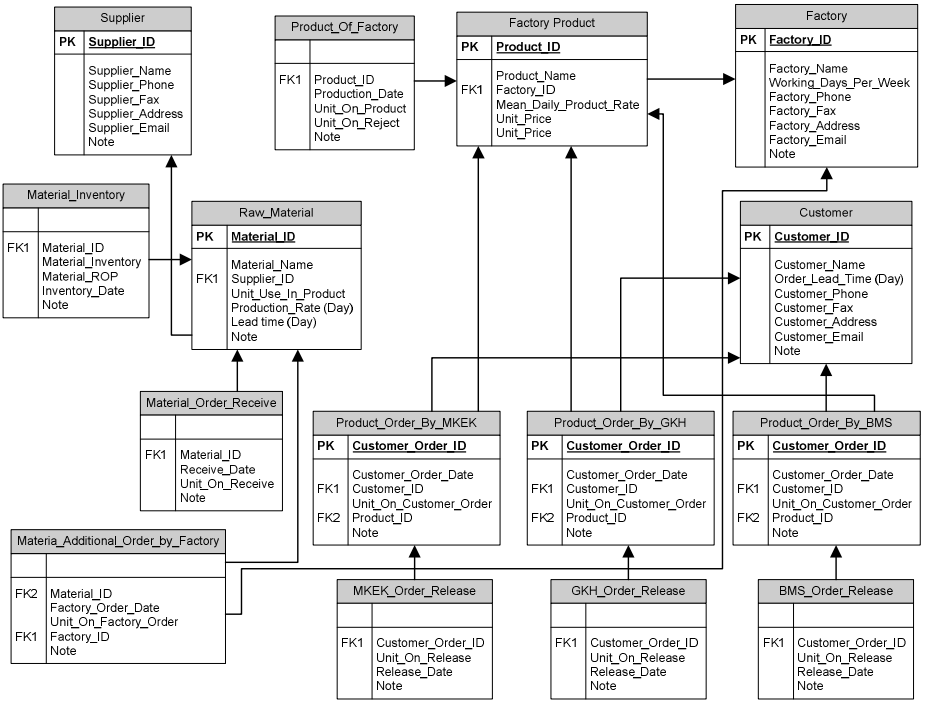

Fig. 4. IDEF1X diagram of the company

ii) Design the database relationship. Figure 5 shows the relationship between supply chain members.

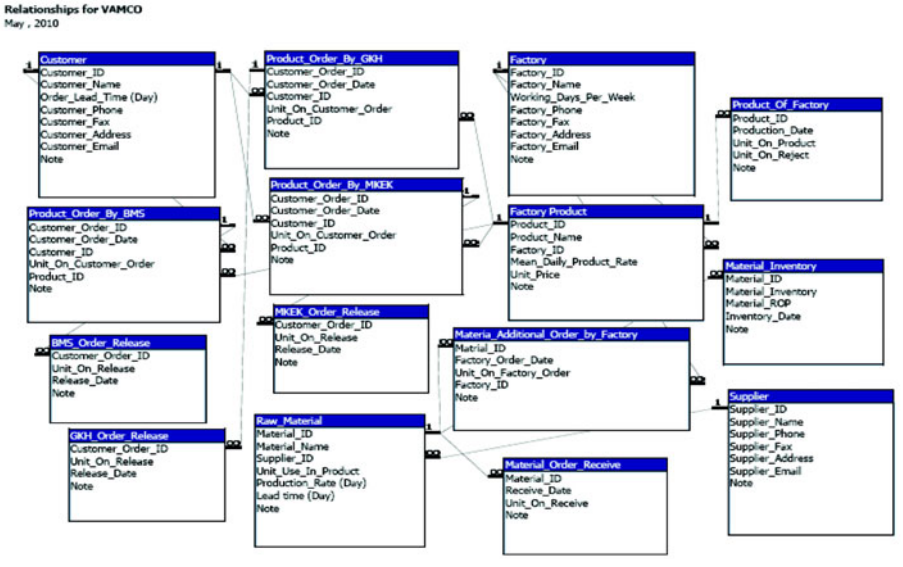

Fig. 5. Data relationship Microsoft Access

iii) Developing the database and flow of information in the factory. In this figure, developed flow of information in the factory can be seen. In the developed system, the factory use EDI for the flow of information between supply chain members so moving the data between supply chain members became fast which resulted in decreased order time.

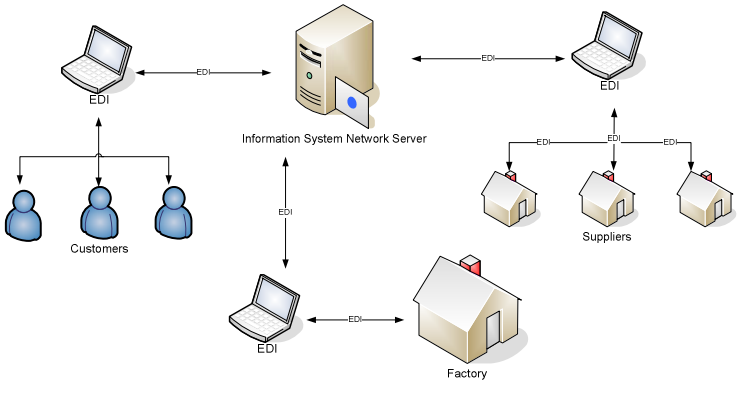

Fig. 6. Developed flow of information in the factory

vi) SCMIS Database. In this database, customer can key in his order information online and all the entered order information goes direct to the factory server. In the

next step, at the end of the day factory operator should key in the amount of daily production and rejection, product released to the costumer, raw material received from supplier to the factory, received raw material for each type of raw material separately and the raw material for additional order. The last part is to send the report to the customers and make them aware of the estimated release date for their order. Also, factory operator can send the report of raw material order to each supplier by clicking on the supplier order report. Consequently, suppliers would be aware of the detail of raw material order. Also estimated delivery time for costumer's order would be known.

Phase 3. Implementation of the Database. Figure 7 shows the main page (Home Page) of the database, daily production plan is shown in the figure.

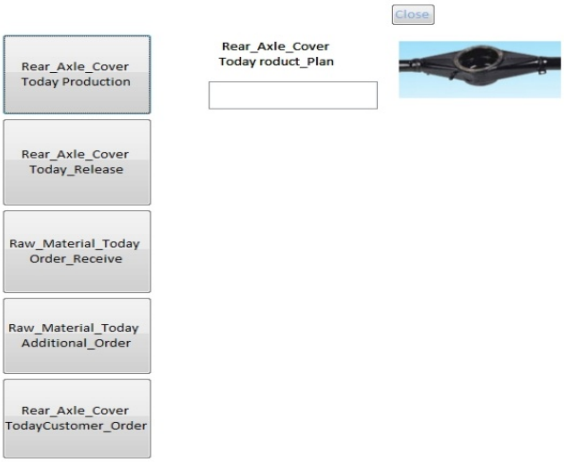

Fig. 7. Home page of the database

In Figure 8, the daily amount of order that should be released to a specific customer is shown. Also, total amount of product that the factory owes to specific customer is found.

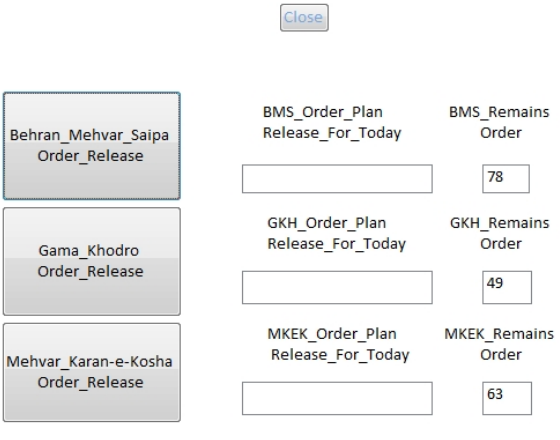

Fig. 8. Product order by customer page in database

In Figure 9, the amount of raw material which should be received as a daily basis can be observed. This numbers are automatically calculated and shown on this box.

Fig. 9. Raw material order and information page in database

The three important elements in calculating the amount of additional order are shown in Figure 10. These three elements are daily raw material rejection, daily raw material inventory and daily raw material ROP.

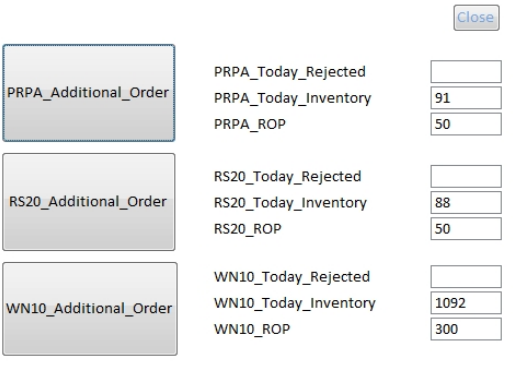

Fig. 10. ROP and inventory information page in database

Comparison between old system and developed one. As it shown in Table 1, the end result of this study is that the company has decreased the cost of production by using the database within one month. The comparison between the old system and the newly developed system can be seen in table below in order to illustrate the proficiency of the proposed model. All presented information for old system is taken from the historical records of the case company. Also, information regarding the new system is obtained from the outputs of the proposed SCM IS model.

Table 1. Comparison between old system and new system

Element	Old System	New System	Unit
Product in inventory	400	44	Number
Respond Time	56	8	Hour
Transport Cost	55000000	10000000	IRR
Production Lain Stop	1.5	Almost Zero	Hours
Cost Of Production Lain Stop	5000000	Almost Zero	IRR

This study has five major findings which are discussed as follows:

i) **Ordering cycle time is shortened:** The order cycle time in the newly developed system decreased in comparison to the old system. This is because of that the time spent on paper work in the newly developed system is removed. Supply members connect with each other via the internet.

ii) **Product inventory decreased**: Prior to the implementation of the database, the factory in this study keep their stock for seven days to avoid out-of-stock problems in inventory. This led to high cost for inventory and maintenance. The implementation of database enables the factory to reduce the number of days from seven to one, which results in reduction of cost for inventory and maintenance.

iii) **Transportation cost decreased:** The case factory used to spend considerably huge amount of money on transportation. They had to send their customer's order in different parts because they couldn't meet the release time of the order. So, they used to send the order in different points of time until the order was completely sent out. The newly developed system allows the production of total order to be finished at specific point of time so that when the factory sends the product to the customer, their cost on transportation and constant delivery of product can be saved.

iv) **The amount of production line stop decrease to almost zero:** In the newly developed system, factory receives the required raw material from suppliers on time and in the right amount, but in the old system due to lack of information flow between suppliers and the factory, usually there was a lacking of raw material in the production line which that makes the production line stop.

v) **The cost of production line stop become almost zero:** In the newly developed system when there is no production line being stopped; as a result, there is no extra cost for production line stop.

5 Conclusion

The goal of this study was to develop an integrated model of SCMIS capabilities that is supported by empirical evidence specific to SCMIS implementations. The model developed integrates and enriches theories of competitive strategy, supply chain management, and inter-organizational information systems. According to a forementioned

literature, supply chain management information systems are progressively important to the prosperity of many companies. The advantage of SCMIS among others is that it synchronizes information among the customers, producers, distributors, and other members in a supply chain. Despite the fact that SCMIS has many advantages to offer, there are only a few experimentally extracted appropriate models that examine the scope of supply chain management information systems options. In addition, if company wants to develop its business, manager also can control all of branches using network system. In conclusion, implementing Information system in supply chain management can help to manage system efficiently and effectively because it can provide information and communication properly.

The contributions of this research activity are as follows:

i. SCM IS model in order to facilitate the information flow within the members of supply chain.
ii. Reduced amount of ordering cycle time.
iii. Reduced logistic costs within the whole supply chain stages.

In this particular case, computer system only covers activities within manufacturing system. Networking only covers relationships between main office, each branch, customer and supplier. Future researcher can use PHP web programming language and visual basic to facilitate the flow of information in the whole supply chain area.

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