The Effect of Requirements for Implementing E-Business Models on Supply Chain Performance in the Automotive Industry of Iran

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Abstract-Nowadays, the applications of information technology and the Internet in supply chains are changed into a facility for obtaining the competitive advantage. The main goal of this paper is to study the influence of the factors in implementing e-business models on the supply chain performance in auto industry. In this research, firstly, we will address the identification of the set of factors required for implementing e-business in the auto industry. Furthermore, the various dimensions of supply chain performance evaluation in Iran's auto industry are identified through presenting a new framework to evaluate the indices of supply chain performance. Then various dimensions in two subjects of necessary factors for implementing e-business and supply chain performance are considered. Subsequently, we study the effects of necessary aspects for implementing the e-business on the dimensions of supply chain performance. The identification of different dimensions in the subject of research has been carried out based on a confirmatory factor analysis and then with the help of correlation analysis, we will study the relation of every identified aspect with the performance of the supply chain in the auto industry. According to performed research, it was specified that the necessary factors for implementing the e-business shall have the highest degree of correlation with the operational aspects of supply chain performance evaluation criteria. Then the highest degree of correlation was observed with technical criteria, finally with strategic criteria. We intend to find out the influence of the necessary aspects for implementing e-business on supply chain management (SCM) in the auto industry. So innovative aspects of this research are 1) Expression of factors needed for implementation of the e-business, 2) A newly combined framework for SCM assessment indices, and 3) Study the relation of the factors required for implementing the e-business with supply chain performance criteria.

Keywords- Supply Chain Management; Supply Chain Performance; Electronic Business; Integration; Automotive Industry

I. INTRODUCTION

Internet is one of the most crucial innovations in the computer network area known as a facility in the business environment. The business models derived from the Internet can not only act as a key communication channel for customers' access, but also provide an active method for finding potential customers and maintaining stable relations with current customers. We can also consider the e-business models as a strengthening tool in globalization process [1]. Furthermore, the competition of the companies in the world's markets has experienced a growing trend since 1990s [2]. In order to achieve a higher competitive power, the companies are seeking to increase customer satisfaction and improve the efficiency of business [3]. The on time delivery of the products to the customers with fewer costs can increase the competitive ability of the companies [3]. The companies have found out that they are not able to improve the efficiency in their organization and establish their business performance without focusing on the supply chain [4]. The achievements resulted from Supply Chain Management (SCM), which include all activities for materials' shipment (raw materials through the finished goods), flow of information and financial exchanges [5], would increase the business performance and even the competitive power of the companies [3], so we can state that SCM is considered as a suitable resource for achieving a competitive advantage [2].

A number of researches have mentioned the role of information systems over Business Performance and Supply Chain performance; some of them include [6] who have referred to the positive impact on usage of information systems on the increase of integration and improvement of relations in the supply chain processes. [7] have pointed out the influence of information systems on supply chain performance through impacting flexibility; communication and integration of the supply chain. [8] addressed the financial impacts of using information systems on supply chain performance. Finally, SCM requires an efficient and effective management of the processes and developments among all members in all stages (including design, materials supply, distribution, after-sales services and final consumption) in order to reach the maximum value [9, 10]. Consequently, it is considered an important issue to study the importance of SCM as a stimulus for organizations to increase the integration of organizational processes and improve the performance of information systems through distributing the information along the supply chain.

The reason for selecting the automobile industry in this research can be known that this industry, along with the oil industry is the largest and most lucrative industry in Iran that has multiple-layers supply chain with numerous collaborations and with a variety of different companies. On the other hand, this research has been done on the two giant Iran Khodro and SAIPA Co.,

that they have obtained over 90 percent market share of automobile industry in Iran [11]. On the other hand, studying ebusiness in Iran is so necessary that a plan has been entitled as the e-business development comprehensive guideline, and all organizations involved are bound to perform this plan (E-Business Development Comprehensive Plan of Iran [12]). Therefore, all the Iranian companies are required to implement the e-business models in their companies. Due to this matter, in this research, we seek to recognize the essential factors for implementing the e-business among the existing companies in the supply chain.

Now in this research we are to find out the influence of the necessary aspects for implementing the e-business on SCM in the auto industry. So we can express the innovative aspect of research as follows:

- a) Study the relation of the factors required for implementing the e-business with supply chain performance criteria. The main purpose of this research is to further identify the different aspects of e-business in supply chain and declare their correlation with dimensions of supply chain performance.
- b) In expression of factors needed for implementation of the e-business within the supply chain.
- c) A new combined framework for SCM assessment indices.

In continuation we will address the theoretical fundamentals of research. The first section of the theoretical fundamentals of research is related to the literature of e-business models and the required factors for implementing e-business and the second section is related to the literature of supply chain performance. The third section describes the research methodology. In the fourth section, the findings are discussed. Finally in the fifth section, the conclusion and recommendations are presented.

II. LITERATURE REVIEW

A. E-Business

Besides giving value to one or more sections, the e-business model can be applied in: (i) the company's architecture and its cooperation networks for creating; (ii) marketing and presenting this value and its relation with investment in order to produce income and constant profits [13]; (iii) with its general approach being as generation of income and obtaining and conquering value in business [14]. Using new e-business models is no longer discussed as a suggestion, but as a requirement, through which the powerful presence of the organization in a competitive environment can be guaranteed. Having a systematic approach toward the business problem in the today's complex and turbulent world is a requirement, because the key trends in traditional businesses have been very much changed, and they go forward for rapid and global access, speed throughout the whole supply chain and carry out business in an electronic form [15]. The e-business model can be considered as a concept, a structure and a governance of the transactions designed for creating added value through exploiting and using business opportunities [16]. Accordingly, these opportunities can be known in three common features, including access to a large number of players and products, richness and ability in information and communication and digital presentation [17] and they influence the business models in three levels of resources, organization's activities and presenting proposals [18]. Accordingly, we can state that the e-business pursues to digitalize the value chain and business processes and achieve the financial and operational elevations in the organization through creating new values [19]. Also, it looks for its internal relation and transaction with other participating systems through automating different processes in the organization that through this way, a large number of invaluable processes are eliminated. As a result, the efficiency will be improved through increased speed of the processes, achieving the level of automation and reduced errors. Finally, the system will improve the relations; increase the loyalty of customers and business partners and movement of the organization towards the profit-making and competitive advantage [20].

In order to classify various types of business models, which indicate the necessary factors for selecting a proper e-business model in the organizations, there are different criteria and indices that can be mentioned as: (1) income and position in the value chains; (2) transaction and integration pattern in the value chains; (3) operational integration and the level of innovation; (4) core activities and price/value equilibrium; (5) economic control (hierarchical and self-organizing market) and integration in value; (6) sourcing (what and how do the entities buy?) which can be either systematic and urgent [21]. However, generally speaking, we can divide them into five aspects as: (1) economic control, (2) operational integration (internal integration), (3) supply chain integration (external integration), (4) innovation and (5) sourcing [11, 22]. We give a brief explanation about each one of them as follows:

- 1- Economic Control: It refers to the level of hierarchy or self-organizing of a market. In order to put this feature into operation the Porter's five competitive forces are measured. These five forces include the following:
 - Threaten by the Newly-Entered Competitors: It includes such issues as the advantage of scale, discrimination, need
 for capital, variable expenses, access to distribution canals and raw materials, governmental policies and access to
 the learning curve.
 - *Suppliers' Bargaining Power*: It includes such issues as dominance on the raw materials' market, raw materials' share in total assets, costs of transformation, volume of transactions and suppliers' focus.

- *Customers' Bargaining Power*: It includes the customers' dominance on the product, diversified range of products, the inclination to use substitute goods, backward merging.
- *Competition*: It includes such issues as price sensitivity, the importance of trademark, number and power of competitors in controlling the market.
- Product Substitution Power: It includes the substitution of products with other products of other companies [23].
- 2- Operational Integration (internal): It refers to the degree of integration and the cohesiveness among a set of functions and processes existing in a business.
- **3-** Supply Chain Integration (external): It represents the integration of functions and processes of a business with other members in a supply chain.

In order to evaluate the different types of integration, we can analyze the resource planning system of the concerned company. In general, we can divide the processes and duties in organization's resources planning system into the following four categories [24, 25]:

- *Production, Operations and Logistics*: It includes production planning, materials and capacity requirements planning, inventory, quality assurance, transportation, repairs and maintenance as well as distribution.
- Sales and Marketing: It includes order placement, sales planning, contracts, distribution channels, pricing, and aftersales services.
- *Financial and Accounting*: It includes cost accounting, profit analysis, general ledger, cash flow, amounts received and paid investment and budget allocation.
- Human Resources: It includes personnel management, human resource planning, job classification, and training.
- 4- Innovation: The organization and technological innovations act as a key factor for improvement of competitive performance in the organizations and countries as well as long-term growth of the world's economy [26]. Tornatzky and Fleischer [27] classified the innovation into three dimensions as: organizational, technological and environmental. Hayes and Finnegan [22] mentioned the effective factors on the innovation in four aspects: (i) development of information technology tools, (ii) decentralism and flexibility in duties, (iii) intensity of competitive price and (iv) intensity of centralization in the market (market share). The first issue is related to the technological aspect, the second issue to organizational factors and the last two items are related to the environmental aspect [11].
- 5- Sourcing: It refers to a set of methods through which the organization supplies its inputs or sources. Sourcing could be either systematic and/or spot [22].

So at the end of this section, we can say that according to the presented literature, the factors required for implementing the business include: the economic control (consisting of Porter's five competitive forces); the internal and external integration of processes and activities (including internal and external integration from four aspects of production and operations, marketing and sales, financial and accounting and human resources); the organizational innovation (including development of information technology tools, flexibility and decentralism in duties, intensity of competitive price and volume of centralization in industry) and sourcing.

Due to the aforementioned literature, it can be declared that there is not any specific research focusing on the factors needed for implementing the e-business in supply chains that has not been performed. Therefore in this research, in addition to identification of the essential factors for implementation of e-business in the automotive supply chain, their relationship with supply chain performance is evaluated.

B. Supply Chain Performance

Supply chain includes all processes that directly or indirectly participate in fulfillment of the customers' requests [9], and it shall include a range of customers of the customers to suppliers of the suppliers. In a chain, there are three major events in the process that include information, physical and monetary events [28]. The main goal of the supply chain is to achieve maximum added value for the customers [9], and control the changes in the chain and achieve minimum changeability among the members of the chain [29]. Following this main goal, the market-oriented objectives (including increased productivity, reduced inventory, profit for all members, etc.) and financial objectives (like Return on Investment Rate, profit margin, etc.) shall be discussed [2].

Today, a wide attention is given to the performance measurement. What important is the evaluation of supply chain performance. It was previously more based on cost/efficiency, profit-orientation, and short-term time periods with individual indices. In spite of the fact that upon the spread of competition among industries, modern approaches have been set forth for the evaluation of the supply chain performance including: value-orientation, customer-orientation, long-term time periods, and using a set of group indices [47]. Performance measurement is a process to quantify efficiency and effectiveness of the processes [48]. By supply chain performance, we mean production of products at lower cost and timely delivery of product to the customer and increasing customer satisfaction [9]. In the same line, some of the strategies of the supply chain including information sharing, processes integration, reducing changes in the supply chain, increasing the accountability rate and using

compatible information systems will increase the performance of the supply chain. So, one of the capabilities that is essential for competitiveness of the supply chain is information sharing. Information sharing refers to the ability of the company to share knowledge with supply chain partners in an effective and efficient way [49]. The factor that can set forth the whole organizational processes as a competitive advantage is the use of a strategy that integrates organizational processes [50]. Some of the researchers have argued that integration is a main factor for increasing the performance of supply chains [31, 51]. All these issues lead to increased efficiency, higher return on investment and finally obtaining a competitive advantage.

The SCM performance measurement methods are classified into five general categories. These categories include the traditional performance evaluation method and the global performance evaluation method. The evaluation models are done based on Balanced Score Card (BSC), SCORE model and special models of each supply change [31]. The first four categories are related to general researches and comparison made between different supply chains, but in the researches carried out on specific supply chains, it is better to use special models for evaluation of supply chain performance (the 5th category), such as this paper, which addresses the supply chain in the auto industry. In this paper, due to the absence of a specified system for assessing the auto industry performance, the most important criteria in supply chain performance were generally collected based on BSC. However, the important point is that the selection of indices and appropriate approaches for evaluation of supply chain performance must have three key characteristics: "informing, steering and controlling" [52].

Although there have been plenty of methods for measuring the supply chain performance, the BSC technique has got advantages over other methods. These advantages include: directing the SCM processes that lead to customer satisfaction, improvement of operational objectives and development of the level of operational criteria, a mechanism for identification of improvement areas, focusing on supply chain activities towards a strategic targets and integrated evaluation system in the organization at managerial levels [31]. The important criteria in the auto industry were then extracted from the afore-said criteria. The technique used in the proposed SCM framework has got a similar structure to that of BSC throughout the management of the organizations presented by Kaplan and Norton. These two scientists presented the supply chain criteria along with a framework for measuring the SCM performance. They mainly used short-term financial criteria in order to measure the performance of the supply chain. So they mostly focused on the financial aspect of BSC [31]. Bhagwat and Sharma (2007) also used BSC model in evaluation of the supply chain performance. Although these two researchers have placed the evaluation criteria from four aspects in a similar context [31], due to a small number of the studied criteria and the generality of research, we cannot consider this research effective in a specific industry. So in this paper, BSC for these criteria has been used in a comprehensive way with the goal of evaluating the supply chain performance and in the same line, a number of 40 supply chain performances measuring criteria have been presented in Table 1 through the combination of the BSC model and the 3-level strategic, technical and operational model [53, 54].

Researchers	Level Evaluation	Assessment index	Dimension
[3,30,32]	S	Response time to customer Demand	
[7,31]	S	Extensive products and services	
[3,7,24,31,33]	S	Order preparation	
[7,30,31,33]	S	Flexibility of service systems to access of internal parts to customer requirements	
[31,37,34]	S	Cooperative Level between buyers and sellers	
[7,32,33,38,39]	S	Delivery Time	1
[3,31,36]	S	Create a further level of confidence among supply chain members	
[31,3]	S	All members of the supply chain being involved in marketing programs, service and manufacturing	
[3,35,40,41]	S	Use of formal and informal information sharing between customers and suppliers	Customers
[3,37]	Т	Provide new ways for integration of supply chain management activities	
[31]	Т	Ability of instant deliver	-
[31,39]	Т	Effectiveness of delivery methods	
[31]	0	Information Exchange Cost	
[3,7,8,31,35]	0	Creating information systems and consistent communication to members of the supply chain	
[31]	0	Documents quality of goods Delivery	
[31]	0	Stimulus to increase supply chain performance	

TABLE 1 PROPOSED FRAMEWORK FOR SUPPLY CHAIN PERFORMANCE EVALUATION CRITERIA (S: STRATEGIC, T: TECHNICAL O: OPERATIONAL)

[3,7,31,39]	0	Quality of delivered goods		
[31]	0	Achieving to zero defect in delivery		
[3,30,32]	S	Response time to the customers		
[3,40,42]	S	Desired integration among suppliers in SCM		
[31,33,43]	S	Investment return rate		
[31,33-34]	S	Cooperation level of Buyer and seller		
[3,31,35,44]	Т	The amount of innovations to reduce suppliers costs	Financial	
[31]	Т	Efficiency of the delivery process		
[3,31,40]	0	Degree of suppliers Rejection		
[31]	0	Cost of Information Exchange		
[31,43]	0	Production Cost in per hour]	
[3,37,42]	S	Desire for integration in supply chain management between suppliers		
[31,33,38]	S	Ordering time of supplier according to the industry		
[3,31]	S	Create a further level of confidence among supply chain members		
[3,40,45]	S	Participation in decisions on resources for suppliers		
[31]	S	Total inventory turnover time		
[7,30,31,33]	S	Flexibility of service systems to access the internal parts of to customer requirements		
[3,40]	S	Creation of Future communication strategies with suppliers		
[6,31]	Т	Accuracy in Forecast Process	Internal Processes	
[3,37]	Т	Provide new ways for integration of supply chain management activities		
[31]	Т	Cycle time of the planning process		
[31,33]	Т	Cycle time of ordering process		
[31]	Т	Improving product cycle time		
[3]	0	Creating information systems and consistent communication to members of the supply chain		
[3,7,8,30,31,33,43]	0	Total Holding costs include: (input inventory, Work in Process, disposed goods, the finished products in stock and in the direction of the final post)		
[31]	0	Efficiency of Purchase Orders Cycle		
[3]	S	Participate in marketing to customers		
[3,3]	S	Determining the customers futures needs		
[7,30,31,33]	S	Flexibility of service systems to access the internal parts of to customer requirements	Learning	
[31]	Т	Efficiency of Orders methods	and Growth	
[3,31,35,44]	Т	Supplier innovation to reduce costs		
[3,31,45,46]	Т	Supplier collaboration to solve technical problems		
[31]	Т	Supplier ability to respond to quality problems		

III. RESEARCH METHODOLOGY

In terms of results, this research is an applied one and in terms of variables, it includes qualitative variables. Also, this research is categorized as a descriptive and correlative research. The tools used in this research are the questionnaires based on Likert range and the spatial domain of the research includes auto manufacturing companies in Iran Khodro and SAIPA (as the largest companies in the automotive industry of Iran), as well as their suppliers and providers of after-sales services in Iran. In order to achieve this issue, in addition to the studies made in research literature, a scientific interview was carried out with the specialists and experienced employees in this regard, and their opinions and instructions were also used. In the same line, a questionnaire including necessary factors for implementation of e-business and SCM was prepared. A pilot survey was used to study the attainment of appropriate validity in the questionnaire and reduction of existing risks in deviation of the results of questionnaires. The pilot survey was carried out through a pre-test targeting 13 specialists and production and planning managers. Since the size of the society is almost infinite and unrecognizable, with an assurance level of 99% and accuracy of 10%, the sample size must include at least 166 persons [55]. However, 171 questionnaires were distributed. After the initial

study, in the next step, a number of 171 questionnaires were distributed among the production and planning managers, specialized and experienced employees and administrators in SCM in a group of auto companies and suppliers and manufacturers of auto parts at the tiers 1 and 2 of the supply chain of auto manufacturing companies. It is worth mentioning that almost 45% of the respondents had postgraduate studies and over 5 years of work experience in the auto industry.

Furthermore, in order to approve the validity of the contents of the questionnaire, some of the university professors and experts of the statistical community reviewed the questionnaire, and their corrective viewpoints were incorporated in order to better complete the questionnaire. The reliability of the questionnaire was checked, using Cronbach's Alpha index by the help of SPSS 16 software. The Cronbach's alphas of the questionnaire were obtained as: (i) for implementing the e-business models (a1=0.874) and (2) for the supply chain performance questionnaire (a2=0.783). Since some of the variables were omitted after the factors analysis, the reliability of the questionnaire was once again checked, and the final Cronbach's alphas were measured as (a1=0.879) and (a2=0.788), respectively [56]. As the Cronbach's alpha is higher than 0.7, the reliability of the questionnaire is approved [57]. Moreover, for sampling adequacy, the KMO index was also used [58] and if this figure is higher than 0.6, the sampling adequacy of the research will also be approved [59].

Finally, it is mentionable that for better analyzing the research findings and providing the results, also, two automobile industry experts are consulted in order to validate the study, for helping to researches.

IV. FINDINGS AND DISCUSSION

As shown in Table 2, the KMO indices for e-business implementation factors and supply chain performance criteria are 0.846 and 0.773, respectively.

TABLE 2 VALIDATION ANALYSES (CALCULATED BY USING SPSS)

Notes	Items	КМО	Scale
"Internal Integration of Human Resources Functions" was			

Notes	Items	KMO	Scale
Item 9 i.e. "Internal Integration of Human Resources Functions" was dropped resulting in a value $\alpha = 0.849$.	18	0.846	Implementation of E-business Models
"Partnership in marketing activities to the customers" and "ability to instant deliver" were deleted and KMO = 0.778	40	0.773	Supply Chain Performance

We now try to identify the key factors based on factor analysis. From the viewpoint of data summarization, the factor analysis gives the researcher a clear understanding of which variables can operate better and how many of them can be actually effective in the analyzes [60]. In continuation, using the Varimax cycle, the role of factors in the whole changes of the variables was studied. The results of these surveys are shown in Tables 3 and 4.

TABLE 3 FACTOR ANALYSES OF FACTORS REQUIRED FOR IMPLEMENTING E-BUSINESS MODELS IN SUPPLY CHAIN

(ACCEPTED FACTOR: ✓ REJECTED FACTOR: ×)

Criterions	Factors required for implementing e-business models in supply chain	Factor loading	Decision
	Suppliers' Bargaining Power	0.723	✓
Economic Control	Buyers' Bargaining Power	0.794	\checkmark
	Threat of New Comer Competitors	0.832	~
	Competition among Existing Companies in Industry	0.723	~
	Threat of Replaced Products or Services in Industry	0.696	~
	Internal Integration of Production, Operation and Logistic Functions	0.725	✓
Functional (Internal)	Internal Integration of Sales and Marketing Functions	0.734	\checkmark
Integration	Internal Integration of Financial Functions	0.683	\checkmark
	Internal Integration of Human Resources Functions		×
Supply Chain	External Integration of Production, Operation and Logistic Functions	0.665	✓
	External Integration of Sales and Marketing Functions	0.742	\checkmark
(External) Integration	External Integration of Financial Functions	0.673	✓
-mogration	External Integration of Human Resources Functions	0.564	×
Innovation	Development of Information Technology tools	0.754	✓
	Degree of decentralization and flexibility in duties	0.615	\checkmark
	Degree of Competitive Price	0.733	✓
	Degree of centralization in industry (market share)	0.745	~
Sourcing	Supply of producing and operating resources	0.836	✓

Decision	Factor loading	Measures of Supply Chain Performance	Decision	Factor loading	Measures of Supply Chain Performance
~	0.753	Efficiency of Orders methods	✓	0.728	Effectiveness of delivery methods
×	0.451	Total inventory turnover time	✓	0.632	Total Holding costs
×	0.563	All members of the supply chain being involved in marketing programs, service and manufacturing	~	0.679	Use of formal information sharing between customers and suppliers
~	0.803	Flexibility of service systems to access of internal parts to customer requirements	~	0.832	Use of informal information sharing between customers and suppliers
\checkmark	0.675	Order Time of Supplier	✓	0.768	Quality of delivered goods
~	0.623	Provide new ways for integration of SCM activities	✓	0.634	Determining future needs of customers
~	0.683	Stimulus to increase supply chain performance	~	0.743	Supplier ability to respond to quality problems
~	0.674	Create further level of confidence among supply chain members	~	0.716	Creating information systems and consistent communication to members
✓	0.639	Cooperation Level of Buyer and seller	~	0.792	Documents quality of goods Delivery
~	0.754	Delivery Time	×	0.554	Extensive products and services
×	0.473	The amount of innovations to reduce suppliers costs	~	0.622	Supplier collaboration to solve technical problems
×	0.459	Cycle time of the planning process	×	0.432	accuracy in Forecasting process
~	0.656	Cycle time of ordering process	~	0.723	Efficiency of Purchase Orders Cycle
\checkmark	0.721	Improving product cycle time	✓	0.765	Efficiency of the delivery process
\checkmark	0.711	Achieving to zero error in delivery	✓	0.694	Order preparation Time
✓	0.681	Degree of suppliers Rejection	✓	0.734	Cost of Information Exchange
✓	0.832	Desire to integration between suppliers	~	0.652	Response time to customers
\checkmark	0.728	Investment return rate	✓	0.742	Production Cost of per hour
~	0.764	Creation of Future communication strategies with suppliers	\checkmark	0.676	Participation in decisions on resources for suppliers

FABLE 4 FACTOR ANALYSES	OF SUPPLY CHAIN	PERFORMANCE EVA	ALUATION CRITERIA

(ACCEPTED FACTOR: ✓ REJECTED FACTOR:★)

In this research, the confirmatory factor analysis technique has been applied in order to protect the structure and framework of the proposed model [61]. To this end, the main factor analysis method by Varimax cycle by SPSS software was used. In this line, those indices are confirmed that the special quantity is higher than 1 (one) and the absolute value of factor loading is higher than 0.5 and other indices are eliminated from the proposed framework of the model. Of course, in this research, the absolute value of factor loading higher than 0.6 has been used in order to ensure a decisive selection of the indices.

In order to study the volume of correlation and the effect of the subjects discussed in the research, the Spearman's rank correlation test is used, because of the ranking of the variables. The values mentioned in Table 5, each represents the significance of the test or sig. In order to accept the assumption that there exists a correlation between the two variables, this measure must be lower than 0.05, which has been marked with star in the table of variables having correlation with each other.

TABLE 5 CORRELATION ANALYSIS RESULTS BETWEEN THE FACTORS REQUIRED TO IMPLEMENT E-BUSINESS MODELS WITH THE DIMENSIONS OF SUPPLY CHAIN PERFORMANCE ASSESSMENT (99% CONFIDENCE) (CALCULATED BY USING SPSS)

Learning & Growth	Financial	Internal Processes	Customer	Supply Chain Performance Criteria E-Business Factors
(0.432,0.213)	(0.852,0.009*)	(0.709,0.023*)	(0.488,0.093)	Economic Control
(0.556,0.045*)	(0.592,0.037*)	$(0.863, 0.007^*)$	$(0.688, 0.028^*)$	Functional (Internal) Integration
(0.681,0.030*)	(0.712,0.021*)	(0.832,0.014*)	(0.763,0.017*)	Supply Chain (External) Integration
(0.842,0.012*)	(0.572,0.041*)	(0.555,0.047*)	(0.681,0.030*)	Innovation
(0.459,0.174)	(0.693,0.025*)	(0.673,0.033*)	(0.662,0.035*)	Sourcing

Right hand number of each cell is significant amount of testing and the left number is the Spearman correlation coefficient. *: Accepting Correlation between two Components

Tables 3 and 4 show that the results of factor analysis on 18 factors of those required for implementing the e-business models in supply chain and 38 factors of supply chain performance include four aspects (as it was mentioned in Table 1). The internal and external integration factors in the activities and duties of human resources from the factors for implementing the e-business models and the total time for inventory turnover, the engagement of all members of the supply chain in marketing

plan, services and production, the wide range of products and services, the level of suppliers' initiatives, the duration of planning process working cycle and the accuracy of the prediction process were all eliminated from the supply chain performance in automotive industry, because their factor loading was less than 0.6.

According to Fig. 1, we can understand that the necessary factors for implementing the e-business models have a positive influence on the supply chain performance. The interesting point is that the necessary factors for implementing the e-business are mostly effective on the operational (technical) aspect of the supply chain, and we can observe this in the correlation relations existing in Fig. 2. It is interesting to say that there exists no correlation relation between the economic controlling factor and the customer's criteria and the growth and learning in the supply chain performance. To analyze this, we can note that the economic control aspects have more focus on different aspects of the industry, while customer's criteria and growth have more focus on individuals and the aspects within the organization. With a further look, we can find out that the existence of external and internal integration has got the highest degree of correlation relation with internal process criteria in the evaluation of supply chain performance. The interesting point is that the organizational innovation has got a critical influence in improvement of supply chain performance, especially with respect to the customer indices (68%) and learning and growth (84%) in the supply chain. On the other hand, selecting the type of sourcing does not have a specific correlation relation with the learning and growth criteria and the correlation is almost equal to other indices of supply chain performance evaluation.



Fig. 1 Correlation analysis results between the factors required to implement e-business models with the dimensions of supply chain performance

(99% confidence)



Fig. 2 Correlation analysis results between the factors required to implement e-business models with the levels of supply chain performance assessment (99% confidence) (Numbers indicate Spearman correlation coefficients)

Considering the levels of evaluation of supply chain performance and the study of the factors required for implementing the e-business models in supply chain, as shown in Table 2, the necessary factors for implementing the e-business models have more correlation relation with operation criteria of supply chain (correlation index= 0.856), technical criteria (0.732) and strategic criteria (0.641), respectively. These results show that there exists a powerful correlation relation between the necessary factors for implementing the e-business models and the lower level of the supply chain.

With a look at the previous researches, which only focused on specific dimensions of supply chain performance and/or the organizational business, we can state that Gunasekaran et al, (2004) emphasized the influence of sharing of targets among the members of the supply chain and more coordination between the chain members and its effect on the increased performance of supply chains [54]. The researches carried out by Kannan & Choon (2005) also refer to the positive influence of establishing

more coordination with suppliers and members of the supply chain (external integration) on increased quality of the products and competitive power, and by that means on the improved performance of the supply chain [3]. On the other hand, such researchers like Walker (2001) and Xiaoying et al (2008) have mentioned the effect of implementing information systems on the increase of competitive ability of participation in industry, and by that, on the increase of organizational business [62, 63]. In their researches, Chen et al. (2007) also emphasized the role of applying information systems and coordination among the members of the supply chain, including Coordinated Planning Forecast and Replenishment (CPFR) on the efficiency of the supply chain, which can be considered as an evidence of the effect of the external integration aspects of the supply chain on the increased efficiency of supply chain performance [6]. In his research [64], emphasized the role of integration of supply chain activities on the increased coordination of the chain, and by increasing the efficiency of supply chain performance. In his researches, he also mentioned the role of JIT system on reducing wastes and by then the effect of the system on increasing the performance of the supply chain. In their researches, [65] refer to the effect of using communication systems and coordination in the supply chains such as Kanban in JIT system on the increasing of supply chain performance. Flynn et al. (2010) have referred to the effect of applying integration of the supply chain on the increased performance of the supply chain [37].

So we can say that considering different aspects needed for e-business models in supply chain, the researchers in this research have addressed the correlation relation of these aspects with different aspects of evaluating the supply chain performance within a new framework.

V. CONCLUSION AND SUGGESTIONS FOR FUTURE RESEARCH

The principal subject of the research can be stated as the identification of the type of relation and the effect of necessary factors for implementing the e-business on the performance of the supply chain. Through this research, it becomes clear that the necessary factors for implementing the e-business highly influence the operational aspects and the lowest levels of supply chain performance measuring criteria. Further, the highest degree of correlation with technical criteria and finally with strategic criteria is observed. Also, we can say that the economic control factor has got the highest correlation with financial criteria related to internal process of supply chain performance. The innovation criteria have also got the highest degree of correlation with growth and learning criteria and sourcing has got the highest degree of correlation with financial criteria. Future researchers can also use the framework of this research in other industries and carry out a comparative study with the results obtained in this research.

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