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Methodology for Measuring the Level of Collaboration in a Supply Chain by Making Surveys

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Abstract: Faced with uncertain environments, companies have strived to achieve greater collaboration in the supply chain, achieve alignment of actions, objectives, decisions and sharing of information. The objective of the study is to measure the level of collaboration in the supply chain by making use of a survey and designing a generic process for carrying out the measurement in any company, through a reliable and valid instrument for this construction. The data were collected through a survey of clients of the company chosen for research. Statistical methods used include reliability analysis and AHP analysis for obtaining and verifying results. The results show a medium-low level of collaboration in the supply chain of the company towards its customers and a collaboration efficiency of 69%. There were no significant differences in the scores on the level of collaboration of the different indicators, due to the versatile characteristics of the companies, such as: Size, market and differences of charge between the people surveyed.

Keyword: Collaboration in supply chains, strategic alliances, supplier relationships, customer relations, information exchange

1. INTRODUCTION

In today's market, the success of a company lies in the way it manages relationships with suppliers and customers in its supply chain, defining it as all the processes that relate client-supplier companies to bring finished products to the final consumers from raw materials [1]. These processes are carried out in a coordinated and integrated manner in order to obtain better economic benefits and the delivery of high quality products. To achieve this it is necessary the synchronization of various agents involved in the chain; this means that long-term relationships must be set and aligned actions, objectives, decisions and information sharing among members.

When this coordination is not achieved, companies must resort to the implementation of new strategies to achieve stability in the economy of companies and the connection between the members of the chain, because there are often fluctuations in orders to the extent In which the chain advances, generating an increase in the accumulation of inventory and in some cases inability to satisfy the demand due to the limited level of inventory at the necessary moment, this phenomenon is known like amplification of demand. This phenomenon occurs

along the supply chain, is also known as bullwhip effect or whip effect, which as a consequence creates the decrease of profits in organizations [2], it is then there where the importance of maintaining a communication Efficient and adequate within the company and its business partners.

To establish a collaborative strategy in the supply chain, it is necessary to measure the current level of collaboration; If companies do not measure the dimensions of levels of collaboration in the supply chain, it would be complex, the elaboration and planning of pricing strategies, reduction of operating costs, reduction of commercial risks, uncertainties, immediate response to demand, Quality management and innovation in processes, preventing the identification of key factors for business success.

Therefore, it is considered important and necessary a methodology to diagnose the level of collaboration in a supply chain, in order to determine the current state of collaboration in a given supply chain.

This research has as main objective the design of a method that allows to diagnose the level of collaboration in a supply chain of two levels making use of surveys; this will be carried out in a manufacturing company manufacturing plastic bags. In the first instance, a scoreboard was designed to measure the level of collaboration in the selected supply chain; An instrument for measuring the level of collaboration in the selected supply chain was then designed, applied and validated; Finally, a generic process was carried out to measure the level of collaboration in a selected supply chain using the experimental results obtained in the selected supply chain.

2. RESULTS ANALYSIS

2.1. Scoreboard for Measuring Collaboration in the Supply Chain

Collaboration in the Supply Chain (CCS) has been defined in different ways, and basically they are divided in two groups of conceptualization: approach of processes and relations of approach. The CCS has been seen as a business process whereby two or more supply chain partners work together toward common goals [3], while CCS has also been defined as the formation of close partnerships Term, where supply chain members work together and share information, resources, and risk to achieve mutual objectives [4]. The literature review reveals the importance of planning activities [5], the integration of multi-functional processes [6], supply chain coordination [7], the establishment of supply chain objectives [8]. The establishment of information exchange parameters [9].

Synthesizing the literature, this study defines the supply chain collaboration as seven components of interconnection: information exchange, goal congruence, decision synchronization, incentive alignment, resource sharing, communication, and joint knowledge creation. It is expected for this research that these seven dimensions, although related to each other, add value to providing collaboration in the chain by reducing costs and response time, leveraging resources and improving innovation.

Information exchange: refers to the degree to which a company shares a variety of relevant, accurate, complete and confidential information in a timely manner with supply chain partners [10]. Information exchange is described as the “heart” [9], collaborative in the supply chain.

Objective Congruence: the degree to which chain partners perceive that their own objectives are met by the achievement of supply chain objectives. It is the degree of congruence that exists to achieve common goals among supply chain partners [10].

Decision Synchronization: refers to the process by which supply chain partners orchestrate supply chain planning and operations decisions that optimize the benefits of the supply chain [11].

Incentive Alignment: refers to the process of sharing costs, risks and benefits among partners in the supply chain [12].

Resource Sharing: refers to the process of leveraging capabilities and assets. Investment in capabilities and assets with supply chain partners includes physical resources, such as the manufacture of equipment, facilities and technology [13].

Communication: it is the contact and the process of message transmission between the partners of the supply chain in terms of frequency, direction, mode and strategy influence, open, frequent, balanced, two-way, multilevel communication is generally an indication of close inter-institutional relationships [14].

Joint knowledge creation: refers to the extent to which supply chain partners develop a better understanding and response to the market and the competitive environment through joint work [15].

For the development of the present investigation, a survey (Table I) was carried out, which delves into the measurement of the seven dimensions, developed by Cao and Zang in 2011 [2], it was applied to 34 different clients in their totality, In terms of market, number of employees, frequency of orders, among others, provided in full by the company Manufacturer of Plastic Bags.

Following the application of the tool, a tabulation of the results was done through the internal consistency method based on Cronbach's alpha which allows to estimate the reliability of the results obtained from the survey application. Measurement of reliability using Cronbach's alpha assumes that indicators (measured on the Likert scale) measure the same construct and are highly correlated. The closer the value of the alpha to 1 is, the greater the internal consistency of the analyzed indicators. The coefficient result was 0.691 which is acceptable for this type of tool. The above coefficient is due to the versatile characteristics of the clients surveyed, which include both senior executives, managers and mid-level executives (ie directors, purchasing managers, etc.) to operators and middle positions. There may be significant differences in the perceptions ratio between senior and middle managers, managers and managers who play important roles when measuring reliability.

With the use of the Analytical Hierarchy Process (AHP), a hierarchical multi-criterion approach to decision-making developed by Dr. Thomas Saaty, a classification of importance of the seven indicators and items of the survey was performed, this weighting was performed By three professors in collaboration of the supply chain of the University of Autonomous of the Caribbean. The weights of the dimensions by the expert judgment are shown in Table I.

Table 1
Weighting of indicators according to UAC experts

<i>Weighting</i>	
EXCHANGE OF INFORMATION	0,36
The company and customers of the supply chain exchange relevant information (price changes, inventory policy, needs / demand)	0,33
The company and customers of the supply chain exchange timely information. (answer's capacity)	0,31
The company and customers of the supply chain exchange accurate information. (Necessary, convenient, useful, accurate)	0,19
The company and customers of the supply chain exchange complete information.	0,11
The company and customers in the supply chain exchange confidential information.	0,04
CONGRUENCE OF THE OBJECTIVES	0,19
The company and customers of the supply chain have agreements on the objectives of the supply chain	0,49
The company and customers in the supply chain have agreements on the importance of collaboration across the supply chain	0,07
The company and customers in the supply chain have agreements on the importance of improvements that benefit the supply chain as a whole	0,07

The company and customers in the supply chain have agreed that their own goals can be achieved through work towards supply chain goals	0,15
The company and customers of the supply chain jointly carry out the pre-design to achieve the objectives of the supply chain	0,19
SYNCHRONIZATION OF DECISIONS	0,16
The company and customers of the supply chain jointly plan promotional events	0,36
The company and customers of the supply chain jointly develop the demand forecast	0,31
The company and customers of the supply chain jointly manage the inventory.	0,16
The company and customers of the supply chain jointly plan the product assortment.	0,05
The company and customers in the supply chain work together on problem solutions.	0,1
ALIGNMENT OF INCENTIVES	0,11
The company and customers in the supply chain develop systems to evaluate and make known the performance of each (eg key performance index, dashboard, and resulting incentive)	0,38
The company and customers in the supply chain share costs (eg loss of order changes)	0,26
The company and customers in the supply chain share the benefits (eg savings in reduced inventory costs)	0,11
The company and customers in the supply chain share the risks in the supply chain.	0,23
RESOURCE SHARING	0,04
The company and customers of the supply chain have organizational (cross-organizational) teams frequently for the design and development of processes	0,25
The company and customers of the supply chain have personnel dedicated to the management of the collaboration process	0,45
The company and customers of the supply chain share technical supports	0,11
The company and customers of the supply chain share equipment (eg, computers, networks, machines)	0,08
The company and customers in the supply chain bring together financial and non-financial resources (eg time, money training)	0,09
COMMUNICATION	0,08
The company and customers of the supply chain have frequent contact	0,46
The company and customers of the supply chain have an open and bidirectional communication	0,28
The company and customers of the supply chain maintain informal communication	0,1
The company and customers of the supply chain have different channels of communication	0,07
The company and customers of the supply chain influence the decisions of each one through the dialogue or debate	0,06
JOINT KNOWLEDGE CREATION	0,02
The company and customers of the supply chain jointly acquire new knowledge	0,4
The company and customers of the supply chain assimilate and apply, together, the most relevant knowledge	0,13
The company and customers of the supply chain determine the needs of the final customers of the chain	0,26
The company and customers of the supply chain choose to jointly discover new emerging markets	0,12
The company and customers of the supply chain jointly seek to know the intentions and capabilities of its competitors	0,06

With the application of this tool it is possible to establish the generic equation for the measurement of the collaboration of the supply chain (NCG) of a company, given by:

$$NCG = \sum_{i=1}^7 P_i \left(\sum_{k=1}^n A_{jk} * p_k \right) \forall j \quad (1)$$

Where:

P_i = Weighting of indicator i

A_i = Qualification of company j for item k

P_k = Item weight k

According to the measurement of the collaboration, it can be said that an indicator value less than 2 is deficient, between 2 and 3 low, between 3 and 3.5 is medium low, between 3.5 and 4.0 medium high, between 4.0 and 4.5 high and 4.5 and 5.0 very high. As a result of the survey application the measurement of the seven indicators measuring supply chain collaboration is shown as shown in the following figure:

It is established that the company is still in a medium-low level of collaboration with its clients, with a rating of 3.44 according to the scale selected, with a global collaboration efficiency of 69%, in the analysis of the measurement no differences were observed Significant in the indicators of collaboration of the company. Regarding the information exchange, the company has a level of collaboration, medium-low, but according to any of the other measurement indicators the company has a medium-high level of collaboration. Therefore, the company is recommended to develop strategies to improve the exchange of information with its clients to be able to achieve a significant impact in the increase of the level of collaboration.

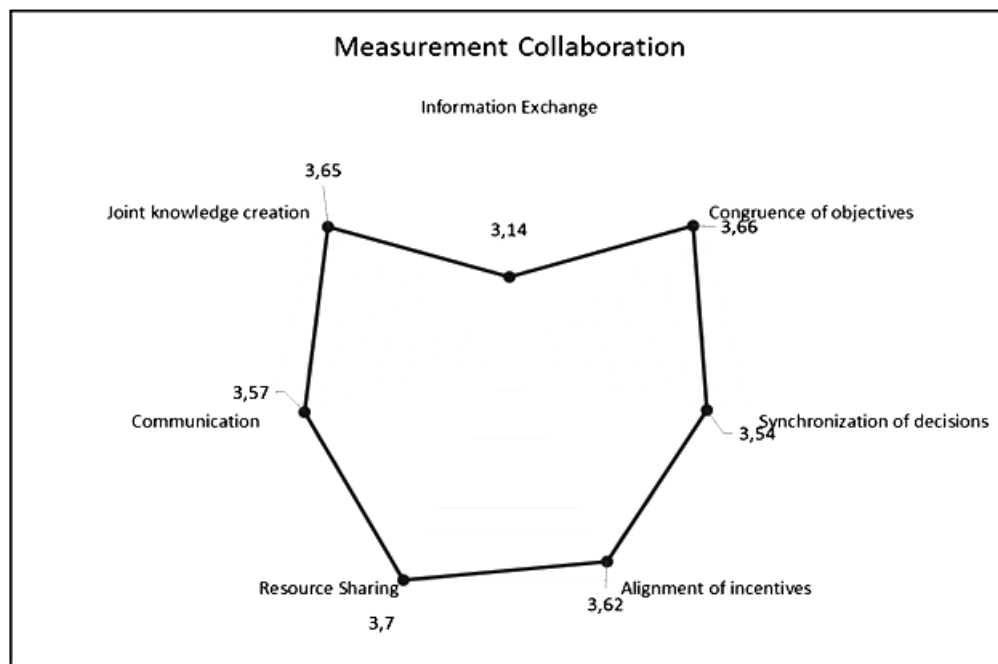


Figure 1: Measuring Collaboration

Generic process for performing the measurement of collaboration in a supply chain: For the application of the measurement of the level of collaboration in a supply chain the following steps are followed [17]:

Step 1 - Measurement Indicators: Implement the indicators that allow to measure the collaboration through a literary analysis, through a validated survey select the questions that will allow to qualify the state of the chain by indicator.

Step 2-Application of the tool: Select the supply chain to which the tool will be applied and apply it.

Step 3-Analysis of the results: For the analysis of the results, we proceed to tabulate the data obtained with

the application of the tool and validate the data with a reliability analysis, then proceed to perform a cluster or cluster analysis that will help to characterize partners in the supply chain.

Step 4-Application of the AHP tool: The AHP tool performs an analysis of the item weighting with respect to its importance and relevance within the chain measurement, in addition it applies this tool to the items of the indicators to determine its importance value within each indicator. With the obtaining of the weighting by indicator and items of the survey, the generic equation for obtaining the supply against the indicators is applied. Promoting the qualification of the seven indicators that make up the supply chain collaboration shows the overall state of the collaboration in the chain.

3. CONCLUSIONS

The research has provided a precise and complete definition of collaboration in the supply chain. The study has identified a set of seven indicators that make up an effective supply chain: information exchange, goal congruence, decision synchronization, incentive alignment, resource sharing, communication collaboration and joint knowledge creation. The advantages of supply chain collaboration will take place when all parties in the supply chain from suppliers to customers cooperate together with the creation of a common rhythm of information exchange, replenishment and supply. When there is synchronization in a supply chain can reduce excess inventory, avoid costly whip effect, increase business synergy and quality, providing flexibility and increased joint innovation.

The study has developed a valid and reliable tool for measuring supply chain collaboration.

This study contributes to the literature on collaboration in the supply chain, both theoretically and in practice. It presents internal and external factors that could motivate companies to adopt collaboration between companies, as well as identifying areas of collaboration that manufacturers must consider in order to effectively connect with suppliers and customers.

While collaboration is an important strategy for manufacturers, collaborative efforts are implemented in a non-synchronized way. It is clear that supply chain collaboration must go beyond information exchange and for structural collaboration, which means that information exchange must be embedded in standardized systems aimed at the integration of processes. On the other hand, to achieve long-term partnership, trust among Supply Chain partners is critical, since collaboration is more than information sharing, but a commitment to share decision-making power in critical operations. The supply chain, such as collaborative planning, forecasting, distribution and product design.

Por lo tanto, una posible razón de la baja tasa de adopción de colaboración en la cadena de suministro en la empresa seleccionada puede ser atribuida a la naturaleza de la relación que existe con los clientes, los datos ilustran que la empresa todavía tiene que estar abiertos a la colaboración y alianzas estratégicas.

REFERENCES

- [1] Ribas Villa, I., & Companys Pascual, R. (2006). Estado del arte de la Planificación Colaborativa en la Cadena de suministro: Contexto Determinista e Incierto. *Working Paper del Departament d'Organització D'empreses de la Universitat Politècnica de Catalunya.*, 21.
- [2] Guerol, S., & Sendra, N. (2008). La Colaboracion en la cadena de suministro mejora el servicio y disminuye los costes. 7.
- [3] Mentzer, J., DeWitt, W., Keebler, J., Min, S., & Nix, N. S. (2001). Defining supply chain management. *Journal of Business Logistics* 22, 1-25.
- [4] Bowersox, D., Closs, D., & Stank, T. (2003). How to master cross-enterprise collaboration. *Supply Chain Management Review* 7, 18-27.
- [5] Boddy, D., Macbeth, D., & Wagner, B. (2000). Implementing collaboration between organizations: an empirical study of supply chain partnering. *Journal of Management Studies* 37, 36-43.

- [6] Lambert, D., Emmelhainz, M., & Gardner, J. (1999). Building successful logistics partnerships. *Journal of Business Logistics* 20, 118-165.
- [7] Kim, K. U. (2005). Information transfer in B2B procurement: an empirical analysis and measurement. *Information and Management* 42, 813-828.
- [8] Peck, H., & Juttner, U. (2000). Strategy and relationships: defining the interface in supply chain contexts. *International Journal of Logistics Management* 11, 33-44.
- [9] Lamming, R. (1996). Squaring lean supply with supply chain management. *International Journal of Operations and Production Management* 10, 183-196.
- [10] Angeles, R., & Nath, R. (2001). Partner congruence in electronic data interchange (EDI) enabled relationships. *Journal of Business Logistics* 22, 109-127.
- [11] Simatupang, T., & Sridharan, R. (2002). The collaborative supply chain. *International Journal of Logistics Management* 13, 15-30.
- [12] Simatupang, & Sridharan. (2005). The collaboration index: A measure for supply chain Collaboration. *International Journal of Physical Distribution & Logistics Management*, 44-62.
- [13] Harland, C., Zheng, J., Johnsen, T., & Lamming, R. (2004). A conceptual model for researching the creation and operation of supply networks. *British Journal of Management* 15, 1-21.
- [14] Goffin, K., Lemke, F., & Szwejczewski, M. (2006). An exploratory study of close supplier-manufacturer relationships. *Journal of Operations Management* 24, 189– 209.
- [15] Malhotra, A., Gasain, S., & El Sawy, O. (2005). Absorptive capacity configurations in supply chains: gearing for partner-enabled market knowledge creation. *MIS Quarterly* 29, 145-187.
- [16] Cao, M., & Zhang, Q. (2011). Supply chain collaboration: Impact on collaborative advantage and firm performance. *Journal of Operations Management*, 163-180.
- [17] Vilorio, A., Robayo, P. (2016). Inventory Reduction in the Supply Chain of Finished Products for Multinational Companies. *Indian Journal of Science and Technology*, Vol 9 (47), 1-5.