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THE EFFECT OF INFORMATION SHARING ON PERFORMANCE EVALUATION AND SUPPLY CHAIN IMPROVEMENT BY USING SCOR AND KPI MODELS

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ABSTRACT

The evaluation and improvement of supply chain is one of the critical issues for gaining competitive advantages for companies. The supply chain set supported by more than 650 member organizations (academic and industrial) around the world developed the SCOR model of supply chain operation reference. SCOR model is the process of a reference model aimed at having the industrial standards and enabling the supply chain management for the future generation. This model included the description of management processes or the relationships between standard processes, standard criteria for measuring the implementation of processes and management works producing the best degree of implementation and regulation of software properties. The proposed framework for the supply chain improvement analyzed the dependent relationships between a set of KPI in a quantitative way. This framework can determine the costs of KPI certain implementation based on the central information sharing and suggest the performance improvement strategies based on analytical hierarchy process (AHP) in a supply chain.

Keywords: *Supply Chain, Information Sharing, Key Performance Indicators (KPI), SCOR Model.*

INTRODUCTION

Supply chain management is a set of approaches attempting to integrate the providers, producers, warehouses, and consumers effectively to produce and distribute the products in the appropriate amount, place, and time. These approaches attempted to minimize the system costs which they satisfy a specific level of service (ANeely, 2005). It was proven that the effective management of a supply chain is a very effective mechanism for the rapid and reliable delivery of products and services with high quality and minimum cost 1. (Wanga et al., 2004). Recently, the marketing, distribution, planning, production, and sale units worked in an independent supply chain. The evaluation of a supply chain performance refers to the evaluation of marketing, distribution, planning, production, and sale unit performance in an independent way.

Information sharing and inventory control were two important factors in improving the supply chain. Simulation method was used for showing the relationship between information sharing indicators and their effect on supply chain performance (Costantino et al., 2015). Performance measurement and metrics have an important role to play in setting objectives, evaluating performance, and determining future courses of actions (Gunasekaran et al., 2004).Information sharing between the inventory order of producer and retailer in the closed loop supply chain was of great importance (Hosoda et al., 2015). Fransisco et al (2015) studied

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the effect of information sharing on ordering policies in improving the supply chain performance and stated information sharing in supply chain as an essential factor for minimizing the Bullwhip effect in supply chain. They defined information sharing and supply chain indicators with mathematical models to cope with the Bullwhip effect. The order point in the i-th level of supply chain was broken into two signals at time t. The first signal of information was the customer demand in the supply chain with ordering policy (R, D), and the second signal was the demand adjustment in (R, S). Based on the IS policy, each level i of supply chain was created according to the real information and customer need.

(Rashed et al., 2015) studied the evaluation of information sharing value and effect on the performance of different partners in supply chain. They developed the information and communication technology and the real time of information sharing in the total single-product supply chain and considered two main objectives such as estimating the benefits of partners in the preliminary cost and determining the information sharing effect in the total supply chain. They presented a mathematical model for developing and evaluating the information sharing value in some conditions of logistic costs for different hybrid relationships with or without information sharing along the three indicators of upstream and downstream information. Finally, a relative equilibrium was created in the benefits resulted from information sharing and motivation, it was suggested to create the mutual interests commitments among the supply chain loops.

A complicated performance management system includes many management processes such as identifying the measurement scales, setting the goals, planning, communications, monitoring, reporting, and feedback. These processes were replaced in most information system outputs. These systems measure and monitor the key performance indicators (KPI) which are certain for supply chain optimization, In the light of this, a system dynamics-simulation model, in AnyLogic, is presented to obtain the set of enterprises that have higher levels of alignment in its strategies. (Andres et al., 2015). To support the paradigm and solve key issues, a six-layered framework with four viewpoints for data-driven computational experiments is proposed.This framework systematically presents conceptual and technical solutions for data-driven computational experiments and decision support in the domain of inter-organizational collaborations in supply chain networks (Long, 2017).

Performance measurement is critical for companies to improve the supply chain effectiveness and efficiency (Beamon, 1999; Shphard and Gunter, 2006). Decision-makers in supply chain are supply focused on developing the measurement matrix for performance evaluation (Beamon, 1999; Gunasekaran and Patel, 2004). In fact, the managers must identify the key performance indicators (KPI) which need to be improved. Although discovering the complicated relationships between different KPIs and discipline in priorities of implementing individual KPIs is difficult, determining the priorities inside a certain set of KPIs is considered as a problem for many companies attempting to use it for their supply chain management (SCM). This problem will still remain without paying any attention to real needs and effective solutions to satisfy them. To solve these problems, in this study, a major approach in analyzing and selecting the KPI groups and some strategies for their implementations were suggested to improve the supply chain performance.

It combines two fuzzy TOPSIS models for evaluating and categorizing the suppliers in four groups depending on their performance evaluation. According to their categorization, directives for action plans are proposed (Rodrigues et al., 2016).

This study organized the deductions in this field and discussed the challenges of supply chain performance improvement in two parts of theory and practice. Then, this study proposed a framework for analyzing the supply chain performance management and a principled approach for allocating the priority of different KPIs as the repetitive costs for improving each KPI.

Supply chain management

Different definitions of supply chain management were presented:

- Supply chain management refers to a target based on collaboration for relating the business operations to provide a common attitude on the market opportunity. Thus, this comprehensive management can continue from supplying the raw materials sources to purchasing the final customer (Kleijnen, 2003).
- An integrated and process-oriented approach for preparing, producing, and distributing the products and services to customers (2001).

The challenges of supply chain performance management

Supply chain management is one of the considerable examples in the present era created for improving the competitive status of organizations and integrating the activities and institutions in the chain to achieve a reliable and stable competitive status. Supply chain management deals with two parts of internal and external. The internal part receives the materials and converts them into an appropriate output and deliver to the distribution network while the external part is related to the external upstream members and external downstream members.

Improving the supply chain performance is a consecutive process which requires the performance measurement analytical system and a mechanism for realizing the KPI goals. In this case, the mechanism to achieve the KPI goals was called "KPI implementation" which relates the planning and implementation of production stages for the realization of goals in daily repeated working activities to each other. For evaluating the supply chain efficiency, there is a set of variables of real work supply chain affecting the revenues and total system costs (Ramdas & Spekman, 2000). After identifying the KPI, the managers have to improve the performance through the continuous planning, monitoring, and implementing the indicators. Based on the results of KPI implementation, the managers may provide some reports on KPI for comparing the different plans of supply chain management. In this performance management cycle, there are many challenges in relationship to performance measurement and its improvement.

- ***The complexity of performance measurement in a supply chain***

Many standards were designed in evaluating the supply chain performance to measure the effective performance, evaluate the effectiveness improvement, and test the total supply chain strategic approach (Beamon, 1999). The individual indicators and scales of supply chain performance management were categorized in four groups: quality, time, cost, and flexibility. In addition, these scales were grouped based on quality, quantity, cost/non-cost features, strategic/operational/ and tactical focus, and supply chain processes (Gunasekaran & Patel, 2004; Shphard & Gunter, 2006), although many measurement systems lack any strategy regulation, balanced approach, and systematic thinking (Chan & Qi, 2003; Beamon, 1999).

The research confirms the importance of the balanced scorecard (BSC) approach, with BSC, SCOR and economic value added being the most commonly used tools. Economic metrics dominate, focused on cost and customer service. While social and environmental-related measures are of emerging importance, they appear to be of similar importance to economic metrics only when backed up by a legal obligation (Cuthbertson, 2015).

However, one of the newest methods of performance evaluation in supply chain is a model known as the operational reference model which is based on process determining and explaining five main areas of supply chain processes (planning, resources, production, delivery, and return). Any of these areas includes the processes. The accurate implementation of the related activities will guarantee the efficiency and effectiveness of the required supply chain. Supply chain includes all activities related to commodity flow and converting the materials including purchase, cash flows, materials freight, production control, planning, inventory control, logistic, distribution, and delivery. supply chain management is an integrated approach for managing the supply and distribution networks such as materials management, services, information, money, and time to minimize the activities without value added, increase the responsibility to customer services, improve the supply chain, reduce the production cycle time, and improve the production cycle. The reference model of supply chain is a valuable tool for this purpose (Costantino et al., 2015).

To solve this problem, some researchers used balanced score cards method (BSC) and activity based on cost (ABC) to evaluate the supply chain performance (Liberator & Miller, 1998). In addition, other researchers suggested a similar balanced framework such as performance measurement matrix, results/decision-makers framework, performance pyramid, etc.(ANeely, 2005). In the SCOR model, a balanced performance measurement system was developed at different levels including five cores of supply chain process (including design, resource, production, delivery, and return) (Kleijnen, 2003; Huang & Sheoran, 2004; Lockamy & McCormak, 2004). Although the measurement models (including the developed BSC and SCOR) had their constraints for evaluating the supply chain performance, the first constraint was the presence of many used individual measurement in the area of supply chain. The extensive experiments prove that SCoR outperforms previous techniques while demonstrating its improved stability and high performance (Papadakis et al., 2017).

However, these scales which provided valuable information for making decision, selection, and exchange of many indicators for the effective realization and certain improvement strategies, was a problem or the participants in the supply chain.

- ***Setting the performance measurement goals***

Determining the importance of individual performance was another challenge for decision-makers in the SCM. Managers are encountered with two problems while implementing a good structure of performance measurement system.

- ***The contradictions and dependencies of work performance improvement***

After identifying and selecting the critical KPIs, there was another challenge in coordinating the stages of KPI implementation.

In general, there were two methods of solving this problem: one method included the discovery of constraints in supply chain by implementing the KPIs. For example, the theory of constraints (TOC) (Rahman, 2002). which was a set of concepts and tools can be used in the broad implementation of consecutive improvement management philosophy. The second method was

focusing on performance optimization. The philosophy of optimization assumed an efficiency point when the maximum or minimum point of the index was identified. Although the performance optimization approach was widely accepted by researchers in the theory, it was difficult to ensure the use of implemented KPI strategy by different members of the chain.
For optimizing the supply chain implementation, identifying the importance of sizes at different levels was more important than maximizing and minimizing the identified indicators. The evaluation approach of the importance of indicators or Fuzzy logical reasoning was a tool for solving the problem to use the ambiguous and inaccurate information for obtaining a certain decision (Dweiri, 2006). Although a certain function of fuzzy reasoning tool for decision making was presented in the hierarchical measurement system (Chan & Qi, 2003), there were few studies on the use of this tool in performance management compared to other areas (such as project management) (Dweiri, 2006).It adopts VGM model to construct a mixed integer program to measure the various stages of supply chain management in manufacturing practice (Franklin & Liu, 2017).
The results also show that the manufacturer managers' perception of a greater use by distributors increases their own use for decision control, enhancing the usefulness of PMS information. Although all managers belong to the same manufacturing firm, they report different levels of PMS use, and these are at least in part related to their level of perceived decisionmanagement use (Jose et al., 2017).

An improved model for business performance management cycle

Traditional supply chain performance management always follows a top-down process in six stages of management cycle (Figure 1) (Zhang, 2007). Managers conclude the objectives from an integrated strategy, making models for feasibility analysis, making plans for goal realization, and monitoring the development of these plans (Zhang, 2007; Liberator & Miller, 1998). They analyzed the deviations and reported the results to the senior management group. When the real results are not consistent with the expected results, the manager must understand the reasons of inconsistency and propose the relevant modifying activities. Thus, the KPIs and objectives which were not consistent with reality for a long time were adjusted.
Although the relationships between KPIs in supply chains were more complicated, it was very difficult to measure the dependencies and contradictions with the current methods. When the KPIs and objectives were defined, the managers can implement the KPIs adjustment before six stages of changes. This fact makes the feedback loop very long. For example, most organizations have an annual planning process called budget including the financial targets modeling and constraints, supply chain integrity, comparing the real results to previous plans and modifying the KPIs and plans. Since the organization needs the faster response to new opportunities and risks in the market, it is essential to summarize the performance management cycle.
Thus, adding a new stage was suggested such as analyzing the KPI among the management cycle and making a feedback mechanism (Figure 1).
After the first stage, i.e., identifying and effective (operational) factors and making management models, a new stage occurred including the analysis of complicated relationships among the KPI and simulation of its implementation, and furthermore, analyzing the feasibility of KPISs and financial estimate, the operational collision of implementing these KPIs and creating skills and a complete vision for the managers connecting the KPIs to operational plans.

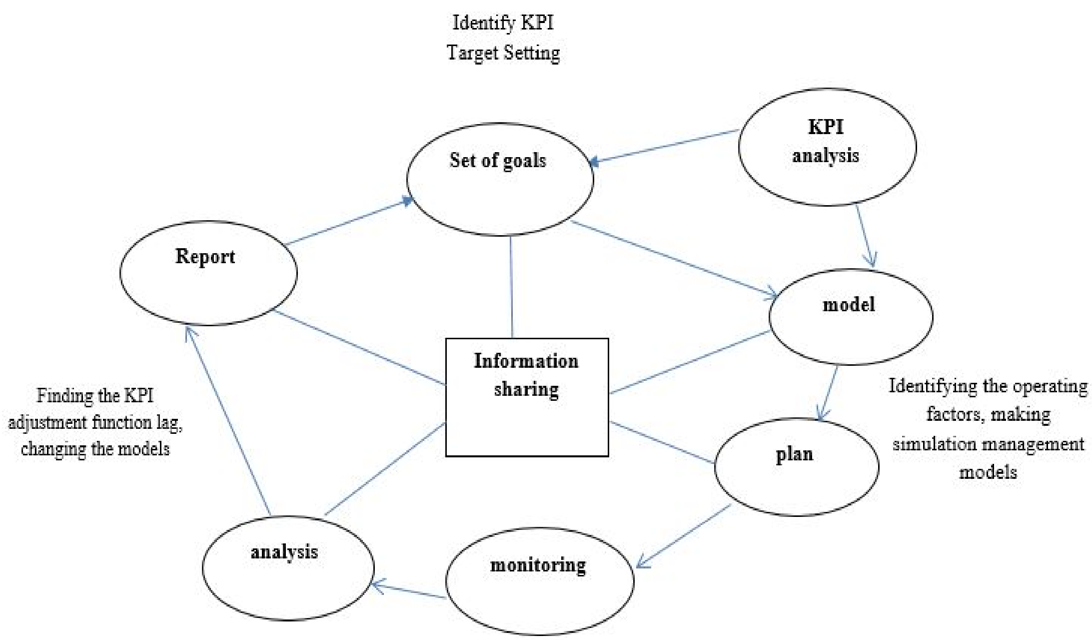

Figure 1. An improved model for business performance management cycle

- ***Reviewing the KPI analysis method***

The dependent KPI implementation analysis was proposed for improving the supply chain performance management. This implementation method was a smaller feedback loop among three main stages of performance management including the set of goals, model, and plan.

Firstly, the managers identify and define the KPIs and their relationships. Then, the costs of implementing these KPIs were estimated and their dependencies were studied. Optimization calculations (e.g. computer simulation and analyses) were used to estimate the convergence of total KPI implementation cost and discover the critical KPIs and their improvement patterns.

After that, the performance management strategy could be adjusted by interpreting the analysis results.

- ***Identifying the KPI and the relationships among their models***

Managers in the supply chain usually identify the KPIs based on their medium-term goals and practical experiences. However, they widely consider some identified models such as BSC and SCOR to measure the principled or balanced performance.

This model defines many criteria for supply chain performance involving the general indicators to highly detailed operational indicators. The main indicators measuring and explaining the general performance of chain are the key performance indicator (KPI). These criteria often include more operational criteria and indicators due to the hierarchical nature of SCOR model. For example, the KPI of delivery included two sub-criteria. The sub-criteria of timely delivery were defined as the percentage of the orders delivered at the due time or before that (Wanga et al., 2004).

Table 1: The main indicators measuring and explaining the general performance of chain are the key performance indicator (KPI)

performance description	definition of Function Description	level Indicators	
Timely delivery The rate of filling the demand deficit from inventory Delivery time of order	-Supply Chain Performance in Delivery -- correct product - correct place - Right time - correct Conditions and packaging - correct value - correct documents - correct customer delivery	Reliability of the supply chain	Customer related
Complete order fulfillment	The speed at which the supply chain is supposed to deliver to the customer	accountability	
- Supply Chain accountability - Flexibility of production	The agility of the supply chain in response to market changes To achieve or maintain a competitive advantage	flexibility	
- The cost of provided goods and services The cost of supply chain management Value added of each employee Guarantee cost as a percentage of income	Costs associated with supply chain operations	cost	organization related
Total available days for supply Time to cycle the fund to the fund Capital turnover rate	Organizational effectiveness in asset management for support Satisfaction in requests. Which includes managing all fixed and turnover assets .	Asset Management	

The performance idefinitions of SCOR model at the first level Based on the complicated features of supply chain, the method proposed in this study used an oriented process of SCOR model for identifying the stable performance and KPIs.

In this range, the measurement system included five levels of measurement:

Resources, output and efficiency, flexibility, innovation, and information (Brimson, 1991; Costantino, et al., 2015).

Table 1 presented some examples of measurement in specific classifications identified and selected as the main KPIs used in this study for more analysis.

Table 2: presented some examples of measurement in specific classifications identified and selected as the main KPIs used in this study for more analysis

	Level 1 Standards	class (type)
Management fee information (Brimson, 1991) Employee Value Added (Chan& Qi, 2003) Guarantee of expenses (Brimson, 1991) Return on investment (or the net income of a comprehensive capitalized profit) (Mohamadi janaki et al., 2018)	Total Supply Chain Management Costs (Brimson, 1991) Distribution costs (Costantino et al., 2015) Storage costs (Costantino et al., 2015) Construction costs (Beamon, 1999) Comprehensive transaction costs (Shphard& Gunter, 2006)	resources
Delivered on time (Brimson, 1991)	Sales (or profits) (Brimson, 1991)	output

Completing the order(Shphard& Gunter, 2006) Customer satisfaction (Beamon, 1999)Customer Complaint Rates (Shphard& Gunter, 2006) The process cycle process (Gunasekaran & Patel,2004) Reception cycle time (Brimson, 1991)	Return on inventory rates (sales losses) (Brimson, 1991) Accumulation rate (achievement rate of accumulation goal, average accumulated item rate) Order completion time delay (Brimson, 1991)	
Delivery flexibility (Chan& Qi, 2003) Flexibility of new products (Beamon, 1999) Information System Flexibility (Identified)	The supply chain of reaction Flexible manufacturing / manufacturing (Chan& Qi, 2003) Flexibility (Identified) Providing flexibility (identified)	flexibility
Supply Chain Reliability (Identified) Process improvement (identified)	Sales prices of new products (identified) Number of new products sent (identified)	innovation
Availability of information (Vander Vorst ,2001) Information sharing(Costantino et al., 2015)	Information accuracy (Vander Vorst ,2001) Timely information (Vander Vorst ,2001)	information

Most KPIs in a dependent supply chain had the complexity of cause and effect mutual effect (Beamon, 1999; Kleijnen, 2003). These concepts were due to high dependency and interactivity process in KPI implementation. In implementing a KPI, the limitation of resources is normal due to extra cost or attempt for implementing other KPIs due to having different reasons such as incomplete information. To show these relationships, coordinating the KPIs with high correlation should be identified.

In this method, a decision support system can use an optimized algorithm to find the KPI prioritized collections and identify the improvement patterns. Decision makers can select a critical KPI pattern balancing their supply chain strategies. For example, if a supply chain focuses on operational efficiency, it should include some KPI for adapting to the system. If the supply chain focuses on fast or fast/flexible reaction, adapting the pattern may provide the KPIs dependent on reaction or flexibility. Based on improving the patterns, the performance of goals and strategies of feasible KPIs implementation can be adjusted and used based on the current methods.

The reference process for a VO creation consists of seven steps (Figure 2) (Camarinha-Matos et al., 2005). Adopting a performance measurement approach, in (Kleijnen, 2003) partners' search and selection step is extended introducing key performance indicators (KPI) as a first task to be made to filter IPs. This paper follows the same approach, adapting it to LPs and restricting the model to the suggestion stage. This is a complex task because LPs will work collaboratively in a VO and their selection should consider particular aspects of a VO and VBE, such as:

- LPs can only be identified after knowing the particular CO in details;
- A repeated CO will be rarely composed of the same set of VBE members;
- VO's LPs and IPs not necessarily will have worked together in previous COs;

- COs are usually unique or one-of-a-kind;
- KPI and/or their weights vary from one CO to another;
- LPs usually have different information system, semantics and performance measures;
- The final handshake among IPs and LPs should be carried out as fast as possible;
- Each VBE has its particular governance model.

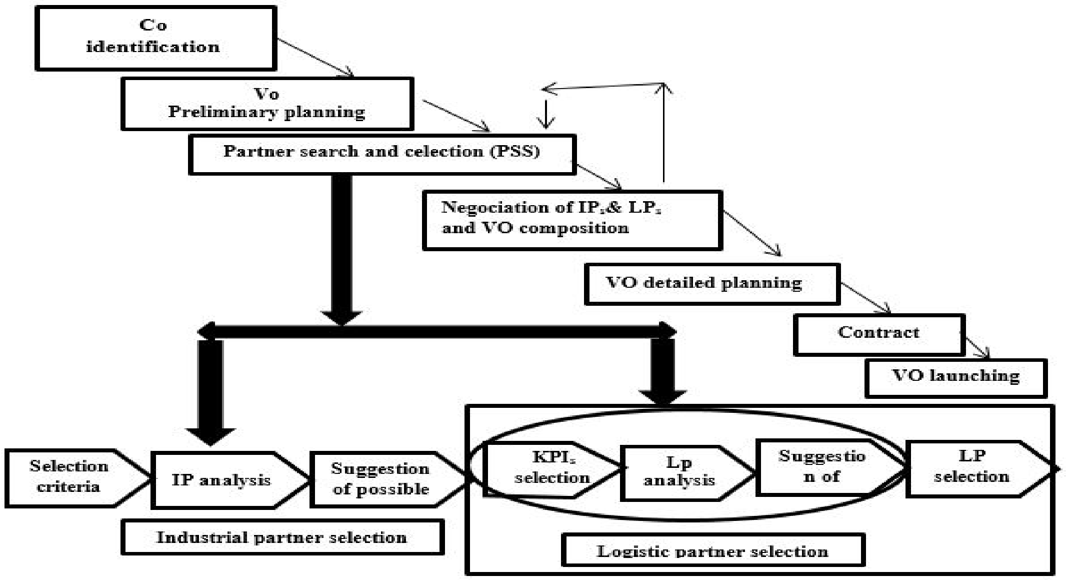

Figure 2. Extended framework for the VO creation

- *CO Identification*

In this first methodology stage the CO is verified in order to identify the logistics itineraries that have to be carried out. A CO, besides other information, is composed of logistics-related data showed on section 4. This set of information was based on a VO information reference model (Oliveira et al., 2007; Baldo et al., 2008) and extended for this work.

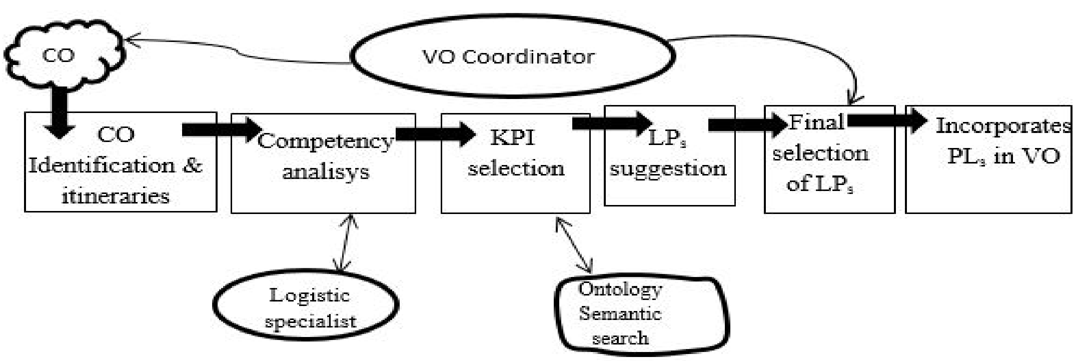

Figure 3. LP selection steps

- *LP competency skills analysis*

In a first round of analysis the methodology checks the technical LP's competences against to every single CO itinerary. If a given LP is pre-selected then it is moved to a suggested list for further VO coordinator decision. After an analysis on the logistics discipline (Gunasekaran et al., 2001), seven attributes were elicited to represent LP competences showed on section 4. The formal competency skills analysis is performed using the set theory. Two sets are considered: *R* and *M*. *R* represents the whole set of specific CO requirements *(R={1,…,r})*. *M* represents the set of LP's competencies *(M={1,..,m})*. The problem is to find a match between *R* and *M*, which will then define the preselected PLs for the given CO. This is provided by the function *G(i,j)*, which represents the intersection of *R* and *M* sets:

$$G(i,j) = \left|R_i \cap M_j\right|, \forall_i \in R \wedge \forall_j \in M \quad (1)$$

Where: i=number of PLs; j=number of COs.

KPI model

A crucial element in the methodology is the KPI model. Regarding this, two general requirements were necessary to cope with. Firstly, the set of KPIs should consider both intra and inter organizational perspectives. Secondly, they should also consider indicators at strategic level. After a literature review, several KPI models were found out (e.g. (26 , Seifert & Wiesner, 2008) However, none of them were neither comprehensive enough to cope with those requirements nor were devoted to logistics in dynamic alliances (e.g.VOs). The devised KPI model has considered some existing models (e.g. SCOR (Supply, 2013) and complemented with a literature overview. It is composed of fifteen KPIs:

- ROE (return-on-equity): The amount of net income returned as a percentage of shareholders' equity;
- Cash flow: focusing on the cash being generated related to how much is being generated and the safety net it provides to the LP;
- Cost Control: controls the cost reduction of LPs;
- Customer satisfaction: measures the customer perception related to delivered services;
- Susceptibility: the elapsed time between customer purchase order and product(s) delivery;
- Commitment: measures the level of commitment between the LPs;
- Collaboration: measures the LPs level of collaboration;
- IT maturity: measures if the LP's IT objectives are aligned to its business strategies;
- Governance: measures how is the code of conduct and cultural issues of each LPs;
- Flexibility: measures the LP flexibility to adapt to changes along VO operation;
- Environmental performance: measures how the LP copes with environmental practices;
- Availability: measures the level of LP availability;
- Effectiveness: measures if resources (e.g. labor) are properly allocated;
- Trust: measures the level of trust between the LPs;
- Communication: measure the level of effective communication among LPs' members.

Each KPI is seen as a strategic dimension, which is divided into a subset of individual and operational/lower level performance indicators (PIs). When computed as a whole, they provide the value of the KPI itself. For example, KPI Cost Control is calculated considering the PIs cost of warehousing, reverse cost and labor cos

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- ***Assign values to KPIs***

As the model works also based on historical data, the VBE database should be updated with the applied KPIs values after the VO dissolution. This is done by all the involved VO's companies via electronic questionnaires. Likert scale (Linacre, 2002) is used to normalize KPI values, defining values from zero to five. These values are calculated from the set of tactical performance indicators that composes each (strategic) KPI

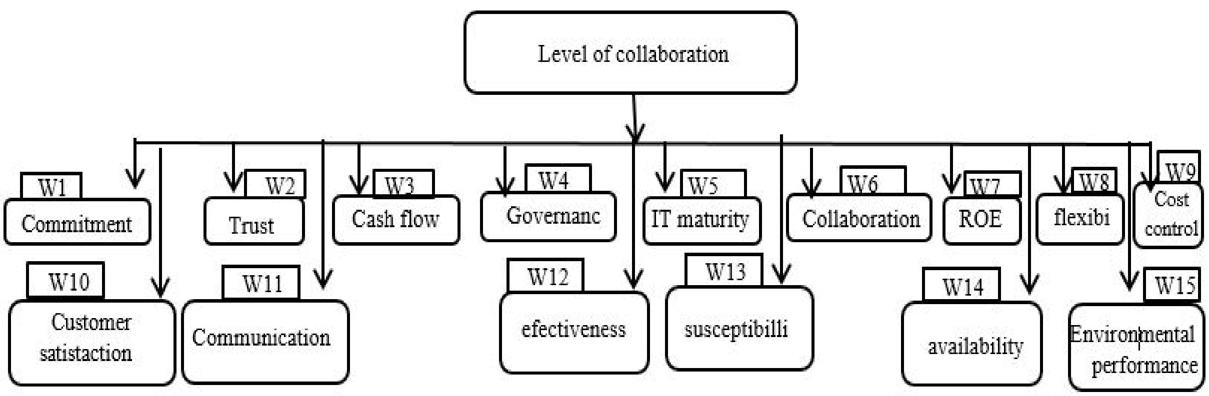
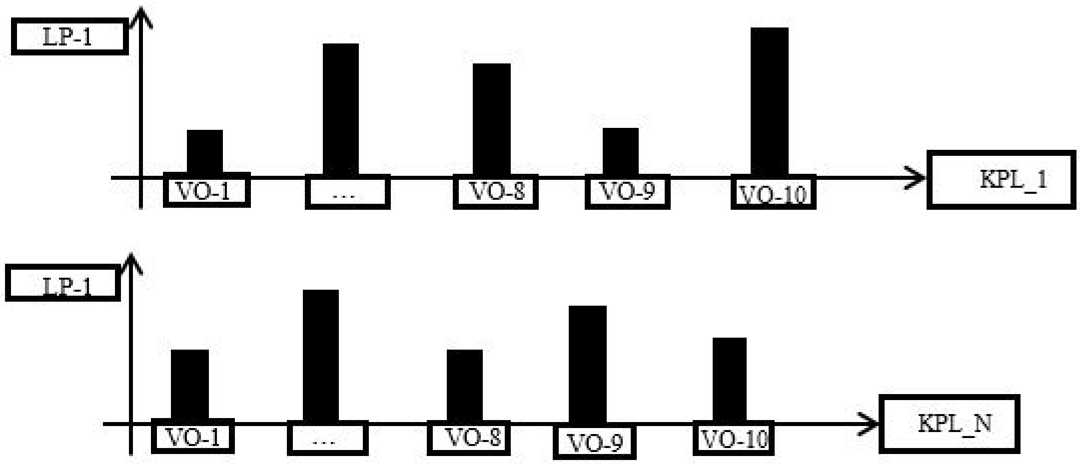


Figure 4. Using AHP with the KPIs

- ***Level of collaboration (LC)***

The final decision about which LPs will compose a VO is determined by a last filter, which is LC. LC is a value calculated for each LP that was selected by the competence analysis. It is represented by a vector of collaboration (VC), which is formed by the historical collaboration of each pre-selected LP in past VOs (Figure)



Vector_ Cllab_LP1=

$$= V[(AA + KPI_1 - S1) * W.kpi1, (AA_{KPI_2} - S2) * W.kpi2, \dots, (AA_{KPI_N} - SN) * W.kpin] \quad (2)$$

AA_{KPI_1} = represents the aritmetic average of the last N values of $KPI_1 W.kpin$
= represents the weight of each KPI assigned by the method AHP sn
= represents the standard deviation of KPIn for PL1

$$Level\_Collaboration\_LP\_1 = LC\_LP1$$
$$LC\_LP1 = ((AA\_KPI\_1.S1) * W.kpi1 + (AA\_KPI\_2.S2) * W.kpi2 + \dots + (AA\_KPI\_N.SN) * W.kpin) \quad (3)$$

Figure 5. Value of KPIs and level of collaboration formula

The formula for VC and LC calculation is given by:

$$VC(i,j,k) = \big(AA\_KPI(i,j,k) - S(i,j,k)\big) * W(i,j,k) \quad (4)$$

i = amount of KPIs;
j = number of LPs per activity;
k = number of activities within a CO;
AA_KPI = arithmetic average of historical values of the KPI i, referring to PL j, which is associated with the activity k;
W (i, j, k) = weight assigned to KPI by AHP;

$$LC(j,k) = \sum_{1}^{15} VC(i,j,k) \quad (5)$$

Where:
I = number of KPIs;
J = number of LPs by activity;
K = number of activities of the OC;
VC (i,j,k) = vector of collaboration from KPI i to partner j, related to activity k;
LC (j, k) = level of collaboration of the PL j to activity k;

or Max (LC_a (j, k))] $LC(k) = [Max(LC(j,k))$ (6)

where:
LC(k): represents the greatest value for the LC or for the LC with the highest coefficient regression to itinerary k.

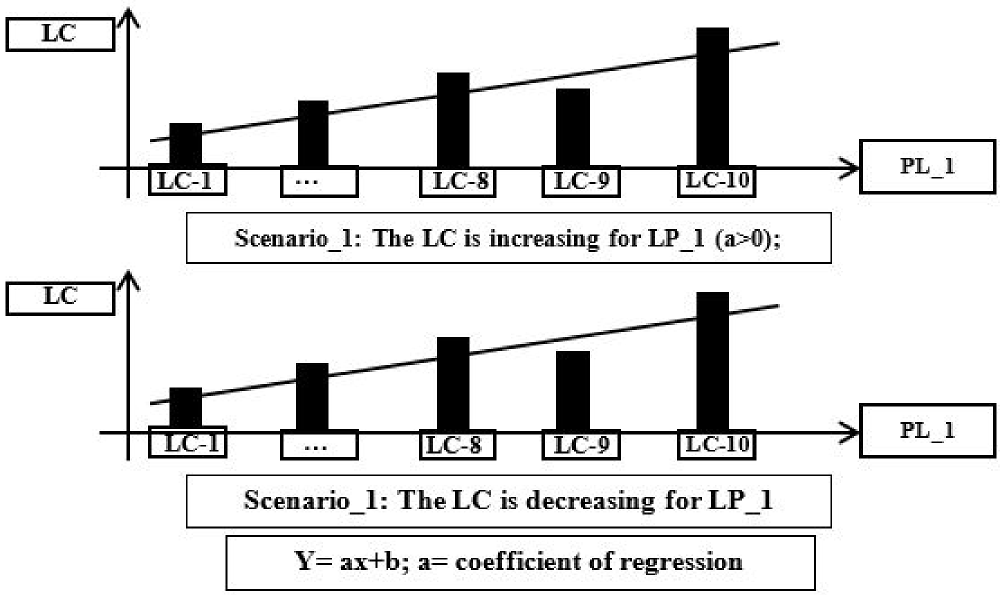


Figure 6. Linear regression analysis for LC

CONCLUSION

Supply chain configuration is a constructive part in SCOR project implementation. Recently, the curve figure configuration describes the work manually implemented a supply chain. In order to automatize this stage, a computer configuration tool was promoted while the configuration tools can be adapted only to the manufacturing factory of a company. The level of information technology capabilities of the industry in order to share appropriate information to the environmental and technological changes; appropriate planning in order to identify and identify the key needs of customers and eliminate them; and finally, increase the incentive of the members of the chain, taking into account their benefits took important steps to improve the coordination and cooperation among the existing supply chain and increase the profitability of the total supply chain. In an analytical model, KPI analysis calculates the cost of each performance management strategy (a set of KPIs) as well as the collaboration of each KPI implementation. For each periodic strategy, it compares the cost with its effect and the associated risk probability. By analyzing each strategy, managers can take the time to review the entire strategy and prevent hasty decision-making livelihoods. In practice, all forms of the supply chain are not easy to obtain and predict.
In general, identifying interconnected relationships between KPIs is an essential part of information that can help supply chain managers to better capture the main forms of supply chain performance and provide metrics for increasing supply chain performance.

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