“LUCIAN BLAGA” UNIVERSITY OF SIBIU
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PHD THESIS

CONTRIBUTIONS REGARDING THE PERFORMANCE EVALUATION OF THE SUPPLY CHAIN MANAGEMENT SYSTEM

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Abstract

The need to create value for their customers is of a higher importance for companies nowadays and the paradigm shift from a logistics management, which is represented mainly by the planning framework that seeks to create a single plan for the flow of products and information through a business with a sole purpose of satisfying its customers, has now evolved to the concept of supply chain management (SCM) which goes beyond this framework and seeks to achieve coordination and linkages between the processes of other entities in the pipeline with the objective of creating a competitive advantage for the organization.

As companies continue to evolve and develop as they reach global level, there is an increase need for them to pass on their success stories in the home country. As the world borders continue to fade in the favour of companies seeking low-cost and highly trained workforce, the need for a structured and well defined supply chain management process is required as to harness the full potential of the available competitive advantage.

Taking these into consideration first arguments sustaining the **necessity of approaching this research subject** are outlined. To obtain the desired level of supply chain performance requires an organization to constantly monitor and control its operations, develop a clear strategy and objectives, ensure their processes exist and function at optimal desired levels, develop an own knowledge database that distinguishes themselves from others, create and follow a clear plan that secures the timely deliverability of each milestone of each project and to efficiently and effectively display all their information to empower management to make smart decisions based on the collected information.

The **central objective** of the thesis is to bring new contributions regarding the performance evaluation of the supply chain management system, with a positive effect on improving the companies' supply chain management performance. This will have a high positive impact also in improving the standardization of the processes in cause, by developing the performance evaluation methods within the supply chain management, by selecting the most relevant supply chain management KPIs, linking them to specific problems and elaborating an own SCM performance evaluation tool.

As **general objectives** of the research we can distinguish the following:

- The analysis of the actual state of the scientific knowledge in the field of supply chain management and to ascertain the eventual gaps of knowledge in this area, identifying potential unexplored research directions;
- The analysis of the supply chain management system and the determination of certain KPIs that influence its performance evaluation;
- The need to select the most relevant KPIs for every specified subsystem of the supply chain management and to study the influence between the identified KPIs and every subsystem.

With the purpose of increasing the veracity of the research results, diversified research methods will be used. Besides the bibliographical research from secondary sources, the interview guide method as a selective qualitative research method, the univariate and

bivariate analysis method and the data mining technique, based on a machine learning algorithm will be used.

The first part is a bibliographic study which is conducted from secondary sources that facilitate the knowledge of the approached field, of the specific terminology, which is necessary for the identification of future research elements. Therefore, specific problems, different points of view, diverse approaches are identified. We can determine the main problem, the poor evaluation of the performance within the supply chain management system, aspect which leads to the incapacity of performance measurement and thus to a decreased productivity and efficiency. Certain gaps regarding the specialty literature in the field concerned are also highlighted.

In order to develop the specialised literature and to approach new research directions in the field, analysed in the second part of the doctoral thesis are specific subsystems and influence factors of the supply chain management, specific influences between certain KPIs and supply chain subsystems and the influence between these KPIs and the supply chain management performance. In this part certain aspects, namely the transformation process, the subsystems, the influence factors of the system, the resources and the specific key performance indicators in order to evaluate the performance of each subsystem and of the entire supply chain management system are treated.

In order to determine the functionality of the supply chain management system, different approaches from various authors concerning the elements and influence factors of the SCM system have been consulted. With a purpose of capturing all elements involved in the supply chain management and all its influence factors and to capture the entire flow of goods from the supplier to the end consumer, a new approach of the supply chain management as a system has been developed. Based on this an own model of analysis of the supply chain management system has been elaborated.

All functions that influence this system have been identified, such as purchasing, R&D, quality, logistics, production, performance management, marketing, human resources, finance, IT, project management and ESH. Also different subsystems have been highlighted, such as demand management, supplier management, contract management, product development, purchasing, warehouse management, production management, distribution and sales management. Twenty-five of the most relevant KPIs for each of the nine categories presented in the own model of Supply Chain Management subsystems and influence factors have been identified.

The third part of the doctoral thesis is based on a selective research based on the interview guide method, where twenty-five respondents from different international automotive companies are interviewed. The interviews also validate the main research hypotheses. The top five most relevant KPIs for every supply chain management subsystem are selected and problems are identified for every subsystem's concerning KPIs. The data is analysed by means of the univariate and bivariate analysis using the SPSS statistical program. This part is based also on the performance evaluation of the supply chain management by means of a dashboard. With the aid of the dashboard, every company can evaluate the performance of their supply chain management subsystems based on the top relevant KPIs. It includes the validation of the proposed model presented in the second part of the doctoral thesis, by means of the data mining technique. Using the multilayer perceptron neural

network, specific influences of certain KPIs on every subsystem's performance and on specific problems are pointed out and validated. Using this algorithm one can predict what KPIs should be used based on the specific identified problems. The hypothesis through which the overall supply chain management performance increases with the increase in performance of the involved subsystems is validated, with a high importance of the top most relevant KPIs for each supply chain management subsystem.

The fourth part of the thesis includes the general synthesis of the conclusions, the own opinions, original contributions and future research directions. We can say that the assumptions pointed out at the beginning of the research have been confirmed, so we can state that there is a certain most relevant number of KPIs for every supply chain management subsystem, KPIs that are linked to specific supply chain management problems, with an effect on the overall supply chain management performance.

As a result of this research, various original contributions in the field concerned have been found relevant, of which we mention:

- Formulating personal opinions on certain gaps identified in the literature, defining concepts and explaining the functioning of the supply chain management and consequently formulating opinions and recommendations on completing the definitions of certain concepts, such as supply chain, supply chain management, procurement management, outsourcing management, performance management;
- Applying cause-effect analysis in explaining the causes and effects of identified problems regarding the actual state of knowledge within the studied field and identifying the objectives and means to solve them;
- Formulating recommendations on the specialty literature development by developing supply chain management studies with a direct focus on performance evaluation and influences between relevant KPIs of the SCM subsystems-problems within SCM subsystems- entire SCM performance evaluation;
- Formulation of personal opinions regarding the impact of certain performance management evaluation methods on the organisations' performance and specific measures that can be taken;
- Formulation of recommendations regarding the implementation of certain performance management evaluation methods;
- Identification of the problems surprised in the analysis of the supply chain management system from various bibliographical sources;
- Elaboration of an own model of supply chain management, surprising all subsystems and influence factors;
- Identification of the 25 most relevant KPIs for each of the nine categories presented in the own model of Supply Chain Management subsystems and influence factors, namely demand management, supplier management, contract management, product development, procurement / purchasing, warehouse / inventory management, production management and distribution management;
- Formulation of recommendations regarding the KPIs objectives;
- Formulation of personal opinions regarding on how KPIs should be outlined;

- Identification of the top five most relevant KPIs of every supply chain management;
- Formulation of personal opinions regarding the influence of certain KPIs on the performance of the supply chain management subsystems;
- Identification of the most important problems identified within every supply chain management subsystem;
- Identification of the root causes of the identified problems;
- Formulation of recommendations regarding certain measures and objectives that can be formulated in order to solve and prevent the identified problems;
- Elaboration of a dashboard as a performance evaluation method of the supply chain management, which includes all top five most relevant KPIs of every SCM subsystem;
- Formulation of recommendations regarding certain KPIs that should be linked to certain identified problems;
- Elaboration of a mathematical model based on the multiplayer perceptron artificial intelligence algorithm of data mining that validates and demonstrates the relations and influences between certain relevant KPIs and problems within each identified SCM subsystem. This algorithm predicts what KPI have to be used concerning the identified problems within the organisation.

The research results of the thesis stand as the basis for the elaboration of certain scientific paper, published in various specialised journals, volumes or conference proceedings and presented in prestigious conferences. Out of the below listed papers, it is noted that out of a total of six papers elaborated in the field of doctoral thesis, one is classified as ISI ESCI, one article is ISI Proceedings, two are indexed in international databases (BDI) and another two are published in various other volumes of national and international conferences. Also, during the research period, the author was implicated in a national research project in collaboration with the "Lucian Blaga" University of Sibiu, within "Planul Național de Cercetare-Dezvoltare și Inovare pentru perioada 2015 – 2020 (PNCDI III)" (National Plan for Research, Development and Innovation for the period 2015 – 2020) with the name: "Optimizarea tehnologiilor ICT pentru evaluarea și valorificarea Capitalului intelectual în centrele de Cercetare&Dezvoltare ale Continental Automotive Systems prin procesare Big Data" (Optimizing ITC technologies for evaluation of the Intellectual capital in the R&D centers at Continental Automotive Systems by Big Data processing).

Taking into consideration the arguments presented, the targeted objectives, the methodological aspects and the validated hypotheses, we can affirm that addressing the field of study contributes to the overall development of the supply chain management performance specialty literature, has a high impact on improving the supply chain management performance, but also impacts the overall efficiency and efficacy of the supply chain management.

Key words: supply chain management, performance evaluation, supply chain management performance, KPI, data mining, dashboard