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A Critical Review of Supply Chain Performance Evaluation

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***Abstract*— There is a simple rule set that you cannot manage what you cannot measure. For the business world, the real power is the power of knowledge as it gives the organization management a efficient explanation to many vogue areas and enables decision makers to deal with unsatisfied performance outputs. Performance evaluation started to be one of the most interested global research area and Top management focus. Performance evaluation has been studied since the middle of 1950s'. Since that time, many proposed framework introduce to assess the organization performance according to many aspects and organization type whether it was service or manufacturing one. One of most crucial strategic management functions is monitoring and controlling of organization performance. This mission is not as easy task as its real effect upon all the organization decisions or its future long sight concern. Many researchers have been reviewed in this search to preview the efforts of the researchers.**

Keywords—Component; SCM, performance evaluation, KPI, BSC, performance measurement, framework

I. INTRODUCTION

In a global economy, competitive and dynamic environment, Supply Chain Management (SCM) is a key strategic factor for increasing organizational effectiveness. All organizations around the world are realizing the importance of supply chains and the impact of their performance on the business. SCM operations are becoming more important in the global business economy. According to Brewer & Speh (2000) a successful supply chain will effectively coordinate their processes, focus on delivering customer value, minimizing costs in key functional areas, and create performance measurement systems that monitor whether the supply chain is achieving the strategic goals. Organization managers are finding that improvements of the supply chain are becoming a necessity to remain competitive in the marketplace. An effective supply chain can improve its competitive performance and help organization to achieve the strategic goals which will translate into the only acceptable language $ for the stakeholders. Therefore, for many reasons, improving supply chain's effectiveness and efficiency becomes a critical factor to remain competitive in a marketplace that is more and more global, and where competition is tougher.

Performance evaluation enable the organization management to monitor and control the way of business activities are going through the whole organization supply chain, pointing out the required improvement initiatives. "Brewer & Speh [1]" created a framework which relates the goals of SCM to customer satisfaction and Organization performance. This framework, shown in Fig.1 demonstrates how supply chain goals are related to the end customer and the financial benefits that can be gained through proper supply chain management.

Despite of finding many conceptual frameworks supply chain performance evaluation that has been investigated in the literature; the supply chain assessment implementation results and case studies was found insufficient. Supply chain performance metrics and measurements have been reviewed in this search. The article starts with a definition of supply chains, with a second section reviews and summarize the researches considering the estimation of supply chain performance. The third section applies an initial analytical table to identify characteristic criteria, while highlighting the summary review of different models used in supply chain evaluations. Finally, the conclusions of all those reviews will be demonstrated in the last section.

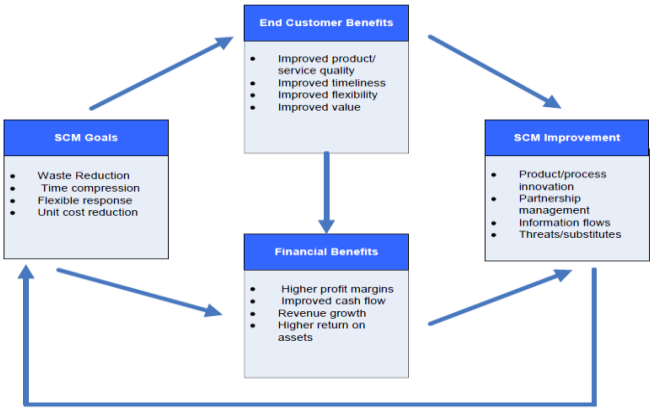

Fig.1. Supply chain management framework [1].

II. SUPPLY CHAIN PERFORMANCE EVALUATION FRAMEWORK REVIEW

Supply chain (SC) performance evaluation problems cover a wide range from evaluating the performance of independent organizations among supply chains to evaluating the performance of a whole supply chain system. The Supply chain performance evaluation problem is one of the most comprehensive strategic decision problems that need to be considered for long-term efficient operation of the whole supply chain traditionally, marketing, distribution, planning, manufacturing and purchasing organizations among the supply chain operated independently. Correspondingly, performance evaluation of supply chain means evaluating the performance of marketing, distribution, planning, manufacturing and purchasing organizations independently.

Some researchers directed their search scope to evaluate the performance of the independent organizations among supply chains such as distribution centers (DC) performance evaluation [2], purchasing performance evaluation [3], vendor performance evaluation [4], etc. However, these independent organizations among supply chains have their own objectives and these objectives are often conflicting. Hence, another growing need for a performance evaluation framework has been aroused which the integration of these independent organizations and what we consider in this review. As the independent organizations among a supply chain has been considered a system and the performance of a whole supply chain has been.

"Neely et al.[5]" defined the performance assessment as the quantifying process of past actions effectiveness and efficiency. Effectiveness has been declared as the extent to which customers' requirements are met and efficiency measured how economically a firm's resources are utilized when providing a pre-specified level of customer satisfaction. Also, they pointed out that a performance measurement system should have a feedback mechanism enable organization to decide the suitable future actions related to improve its performance.

That scope made an evolution of the supply chain performance evaluation and leaded to a numerous valuable frameworks. At the beginning, performance assessment was refereeing to financial performance evaluation of organization. But with the continuity of search and awareness of organization management and stakeholders, it turns to be insufficient way of performance evaluation. Also, not empower the competitive edge of any organization.

All of that growing needs motivated [6] to develop the most globally accepted the balanced scorecard (BSC), as a strategic tool to evaluate the organization performance from four different dimensions: the financial, the internal business process, the customer, and the learning and growth. Their BSC is designed to complement ''financial measures of past performance with their measures of the drivers of future performance''. The name of their concept reflects intent to keep score of a set of items that maintain a balance between short term and long term objectives, between financial and non-financial measures, between lagging and leading indicators, and between internal and external performance perspectives.

"Gunasekaran et al.,[7]" clarified the importance of SCM performance measurement and metrics through the presented model. The proposed framework had been established by get the best use of the available literature and empirical study results of British companies. Organizational performance assessment and metrics had received much attention from academic and business community. As it had direct effect to the success of an organization through its direct relationships with strategic, tactical and operational planning and control. With that clear understanding of Performance measurement and metrics role and effects, there was no drought that it had an important role in determining targets, performance assessment, and designing future courses of actions.

"Bhagwat and Sharma,[8]" developed a balanced scorecard for supply chain management (SCM) that assessed and evaluated day-to-day business operations from the well-known four perspectives: finance, customer, internal business process, and learning and growth. BSC has been established with the aid of accurate review of literature on SCM performance measures and three case studies, each illustrating ways how BSC was developed and applied in small and medium sized enterprises (SMEs) in India. They also try to prove that a balanced SCM scorecard can be the foundation for a strategic SCM system. The BSC developed in this paper provides a useful guidance for the practical managers in evaluation and measuring of SCM in a balanced way and proposes a balanced performance measurement system to map and analyze supply chains. This helps managers to evaluate SCM performance in a much-balanced way from all angles of business.

"Raman et al.[9]" demonstrated a model evaluate the manufacturing enterprise layout in three different aspects, based on which they can make decision towards productivity improvement. That search focused on the measurement of the closeness gap as it was necessary to have assessment model to determine the facilities layout's effectiveness by considering all significant factors. The proposed layout assessment model based upon three layout effectiveness factors: facilities layout flexibility (FLF), productive area utilization (PAU) and closeness gap (CG). The main target of CG indicator was bringing the highly interactive facilities/ departments close to each other . The CG had positive effects to other related layout activities specially that include not value added motion of material handling equipment and also consider the flow of information, equipment, and manpower.

One of the valuable and growing global interests is Environmental performance measurements. It turned to be one of important component in strategies for achieving ecologically sustainable development. However, environmental supply chain performance evaluation frameworks have been initiated and developed for business organization and may not be directly applicable to public organizations. As [10] assessed the state of EPE practice in the Portuguese defense sector, as a particular part of public services. The study has been based upon questionnaire survey involving all Portuguese military units that had a responsible person of environmental issues. The designed questionnaire assessed certain indicators as: the EPE drivers and its importance; knowledge and implementation of ISO 14031; the knowledge and use of environmental indicators; the indicators optimal set; and the positive effect and limitations of using environmental indicators.

And [11]developed a framework for environmental performance measurement tools for public sector organizations. The study was based on the Swedish Rail Administration as a case study. Data collection was mainly depended on focus group interviews. The presented framework investigated crucial features of an environmental performance assessment for the public sector and was illustrated by results from the case organization. The framework was established based on the causal-chain framework pressure-state-response (PSR) and the management system management-by-objectives (MBO). Both approaches have been used through the presented framework to measure and manage performance in accordance with strategic and operational objectives. An environmental management system serves as a toolbox, encompassing and coordinating the environmental objectives and the tools for performance measurement.

"Xu et al.,[12]" investigated the performance evaluation of supply chain of a furniture industry in the southwest of China. Through that search, the main uncertainty factors affecting evaluation process have been detected, then modeled and analyzed by using the rough data envelopment analysis (RDEA) models. Rough DEA have been generated by integrating classical DEA and rough set theory. The supply chain network operation efficiency has been assessed by the aid of rough DEA solution approach through the furniture manufacture industry performance evaluation. Then a practical example has proved the efficiency of the rough DEA model. Also, the decision-making process has been improved by the guidance of the rough DEA model provided.

"Yu and Hu,[13]"evaluated the performance of multiple manufacturing plants in a fuzzy environment through a MCDM approach that combined the voting method and the fuzzy TOPSIS method. Fuzzy TOPSIS enable decision-makers carry out analysis and comparisons in ranking their preference of the alternatives with vague or imprecise data. The criteria weights have been determined by the voting method as it directly affected the performance evaluation results. The evaluation process was consisted of the following steps: (1) elect the evaluation criteria and indicators; (2) assess each criterion weight by the voting method; (3) the assessments for lower-level criteria of each indicator has been aggregated ; (4) determined each criterion performance assessment by fuzzy numbers; (5) Rank the performance of multiple plants by using TOPSIS . One of the main advantages of that approach was the easy implementation than the traditional paired comparison used to weight the criteria in AHP. Also, it enabled the managers to examine the priority weights calculated from their initial responses through the voting process. Finally, the fuzzy TOPSIS approach with its powerful nature in dealing with vague data environment reflected the performance difference among plants.

"Tuncel and Alpan ,[14]" introduced model to analyze a supply chain (SC) network which was subjected to various risks by using a timed Petri nets framework. That approach has been demonstrated by an industrial case study. The SC disruption factors have been analyzed by the failure mode, effects and criticality analysis (FMECA) technique. In that search the risk management procedures and design, planning, and performance evaluation process of supply chain networks has been integrated through Petri net (PN) based simulation. One of the main characteristics of that developed PN model that it provided an efficient environment for defining uncertainties in the system and evaluating the added value of the risk mitigation actions. One of the main findings after the implementation of that proposed model that the risk management actions could improve system performance. Also, the mitigation scenarios can improve and reduce the overall system costs.

"Wang et al.,[15]" developed a model for assessing the high tech firms performance based upon the interaction of BSC indicators financial, customers, internal business process and learning and growth perspective. The developed HBSC structure has been integrated with non-additive fuzzy integral to evaluate the performance of high technology firms. That integrated approaches had ability to overcome interaction among the various perspectives. The execution, validation and implementation of the model have been displayed through sixteen samples from eight high tech firms.

"Belmansour and Nourelfath,[16]" evaluated the throughput (or production rate) of tandem homogenous production lines by using an analytical aggregation method. Differing from existing aggregation methods, each machine could have more than one failure modes. The processed parts flow was assumed as a continuous flow of material. Simulation and numerical experiments have been deployed to measure the approach accuracy. That study contains a comparison between the proposed method and existing aggregation techniques that consider only one failure mode. It was proved that by applying the different failure modes that assume lead to more accurate throughput evaluation.

"Sun,[17]"developed a fuzzy AHP and fuzzy TOPSIS an evaluation model to evaluate different notebook computer ODM companies. The performance evaluation of notebook computer ODM organizations was based upon certain criteria as the capability of manufacturing, financial, innovation, supply chain, human resource, and service quality. Those evaluation criteria have been ranked for priority among these notebook computer ODM companies of the proposed model. The importance weights of the evaluating criteria have been determined by experts and the fuzzy concept in fuzzy environment solve the issues related to uncertainty of human decision-making. After the implementation of the proposed approaches, fuzzy AHP and fuzzy TOPSIS, they found the first two important evaluating criteria for notebook computer ODM companies are supply chain capability and manufacturing capability. The proposed method enabled decision analysts to better understand the complete assessment process and provide a more accurate, effective, and systematic decision support tool.

"Tsai et al.,[18]" proposed an effective model for evaluating national park websites. The proposed model started with applying the Decision-Making Trial and Evaluation Laboratory (DEMATEL) to deal with the evaluation criteria interdependencies. Then, the Analytic Network Process (ANP) has been used to compute weights for each criterion. Finally, the (VIKOR) has been employed to rank Taiwanese national park websites. Overall, the results pointed out the real need for improvement of each national park to become a high quality website. Furthermore, the weight-variance analysis suggests managerial actions based on two-dimensional maps for improving website quality. That search has provided a comprehensive approach that quantitatively assessed a

websites overall performance. Also, that proposed approach has been transformed to practical implementations in terms of providing valuable recommendations for building an ideal website.

"Wu et al.,[19]" developed a multiple criteria decision making (MCDM) performance assessment indicators mainly based on balanced scorecard (BSC) for evaluating extension education centers in universities. These developed indicators have been elected from literature reviews and practical experiences of experts in extension education. Then the elected indicators have been utilized by the decision making trial and evaluation laboratory (DEMATEL) and analytic network process (ANP). The main function of the selected approaches was the identification of the causality between the four BSC perspectives and evaluating the relative weights of indicators. There were valuable findings that ‘‘Learning and growth’’ was the significant influential factor and it had significant effect on the other three BSC dimensions. The crucial three key performance indicators were ‘‘After-sales service’’, ‘‘Turnover volume’’, and ‘‘Net income’ income’’. The presented evaluation model could be considered as a reference for universities extension education centers as it can prioritize the key performance indices improvements with the aid of VIKOR analyses.

"Cao et al.,[20]" proposed an analytical method for the performance evaluation of rework systems with unreliable machines and finite buffers. That introduced model was first presented to characterize the rework flow in the system, a new 3M1B (three-machine and one-buffer) Markov. It differs from the other models, as it was capable of representing multiple rework loops. Also, it can estimate the rework fraction of each loop based on the quality of material flow in the system. The proposed 3M1B model has been developed to deal with the multistage rework systems using as one of the building blocks. The experimental results proved that the decomposition method lead to accurate estimates of performance measures such as throughput and Work-In-Process (WIP). That method had been applied to several problems in that search, such as the optimal inspection location determination and the bottleneck identification machines in rework systems.

"El-Baz,[21]" introduced a fuzzy supply chain performance measurement model. Through, performance measurement of manufacturing environment, different quantitative and qualitative factors has been detected. These factors had a variable importance effect on each other's. The quantitative factors had different dimensions such as time, money, percentage, ratio, and counts. Thus, the presented performance measurement approach that has been developed based on fuzzy set theory and the pair-wise comparison of Analytical Hierarchy Process (AHP). The weight of each of the manufacturing activity in the departmental organization will be determined by the selected approaches. The proposed model contained various input factors treated as a linear membership function of fuzzy type. The model has been tested on a numerical example. The approach provides an effective decision tool for the performance measurement of a supply chain in manufacturing environment.

"Rostamzadeh and Sofian,[22]" presented a fuzzy decision-making approach for prioritizing effective 7Ms to improve production systems performance. A systematic approach has been used for organization and production system inputs which named as 7Ms (Management, Manpower, Marketing, Method, Machine, Material, and Money). Linguistic values are used to assess the ratings and weights for 7Ms. The estimated linguistic ratings had been expressed in trapezoidal or triangular fuzzy numbers. Then, a hierarchy multiple criteria decision making (MCDM) model applied depended upon fuzzy-sets theory including FAHP and FTOPSIS. A comparison of the results of AHP, FAHP; FTOPSIS has been developed. That search has been demonstrated on a manufacturing plant however the results can also be deployed for other organizations types that had been in a competitive environment.

A new evaluation model of faculty based upon the MCDM has been proposed by [23]. The presented model defined the academic activities and has been applied within all scientific areas, taking their specificities into consideration. The presented model had hierarchal additive structure consisted of top level evaluation areas specified by second level evaluation criteria. It contained another bottom non-additive third level assigned for academic activity the quantitative and qualitative dimensions of related to each evaluation criterion. That faculty evaluation model able to

1. Compared the academic staff performance with performance targets assessed the strategy of university management;

2. determine the multicriteria value profile of each faculty member at the top level evaluation areas;

3. measured the overall faculty member value score for each one , with the aid of optimization process that utilized a flexible system of weights and

4. Assigned faculty members to rating categories.

"Grigoroudis et al.,[24]" investigated the evolution of evaluation of public health care organizations performance based on BSC methodology. The presented approach investigated the different characteristics of the aforementioned sector (e.g. lack of competition, social character of organizations, etc.). The proposed assessment system contained financial and non-financial performance indicators with the same importance that were capable of assessing Key Performance Indicators (KPIs). Those KPI were provided services quality, internal and external customers' satisfaction, the self- improvement system of the organization and the organization ability to adapt and change. That assessment model was a MCDA approach, where the UTASTAR method has been used in order to aggregate the marginal performance of KPIs. That approach enabled the organization management to investigate its actual performance compared them to the management strategic objectives. The main finding of the proposed approach referred to the assessment scores of the main dimensions of the BSC methodology (i.e. financial, customer, internal business process, and innovation-learning). Those results enabled the organization to assess and modify the applied strategy. Also it enabled the organization management to implement modern management approaches in every day practice.

"Garcia et al.,[25]" introduced a logistics benchmarking framework for the wine industry. A benchmarking study has been demonstrated considering several wineries from Mendoza (Argentina), in order to investigate the validity of the proposed framework. The researchers introduced a

descriptive model of the WSC including all activities and actors who work to bring the product to the final consumer. They also identified the WSC material and information flow. The proposed framework composed of KPI for measuring logistics performance in added to KPI formulae, description and explanation of different scenarios for the framework implementation during the study.

In the service sector [26] developed service supply chain performance evaluation framework. The metrics that has been review related to the service supply chain based on the strategic, tactical and operational level performance. The SC service performance indicators that have been investigated were demand, customer relationship, supplier relationship, capacity and resource management, service performance, information and technology management and service supply chain finance. Also fuzzy analytic hierarchy process has been used to rank service supply chain performance measurement indicators to improve service supply chain performance. The proposed framework of service supply chain performance measurement has been implemented to the hotel supply chain. The findings of that search were valuable for practitioners in the service supply chain and to researchers in the field.

"Kumar and Singh,[27]" evaluated the performance of global third party logistics service providers for effective supply chain management provided use utilizing integrated approach of fuzzy analytical hierarchy process (fuzzy AHP) and TOPSIS in. Thus, 3PL evaluation and selection plays a crucial role in supply chain management. The various global factors for 3PL evaluation have been explored through literature review. There are many factors of high importance such as geographical coverage, compatibility with user, total revenue, and range of service provided must be considered in selection process. The logistics cost and service quality turned to be the most important criteria for performance rating of 3PLs. the variability in decision fuzzy extended AHP proved that it was very useful tool as it enable decision makers to get over the complexity of determining relative importance of various criteria for 3PLs evaluation. Also, using TOPSIS has been used in raking of alternatives was founded.

"Fan et al.,[28]" discussed and evaluated the existing performance indicator systems and methods. Through that search many SC PE and nature-inspired algorithms have been reviewed. The proposed model consisted of 5 Dimensional Balanced Scorecard (5DBSC) and LMBP (Levenberg–Marquardt Back Propagation) neural network for SC PE. The implement of the proposed model depended on the 14 indicators values of 5DBSC of a given previous period with the aid of a Matlab. That model used to evaluate, predict and optimize the SC performance . the implementation results of a case study of a company had been analyzed and pointed that the presented model was effective, reliable, and valid. The convergence speed is faster than that in the previous Work.

"Vaidya and Hudnurkar,[29]" Understanding the significance of supply chain, demands need of multiple criteria for its performance evaluation. The aim of that is that search was to introduce a supply chain performance evaluating approach based on multiple criteria. Taking into consideration supply chain, demands need of multiple criteria for its performance evaluation. The aim of this paper is to propose an approach to evaluate the performance of supply chain using multiple criteria. The proposed methodology was computing the value of SCPN. The value of SCPN lies between 0 and 1:1 indicating complete compliance with the set benchmark and 0 indicating the worst possible performance of the supply chain. Thus, this number helps the evaluator to assess the present status of the supply chain based on the agreed benchmark. One can realize that the proposed methodology is based on performance evaluation of supply links, which eventually translates into the performance analysis of the supply chain. This approach creates scope for identifying the strongest and the weakest link. Making a suitable decision/strategy for overall improvement of the supply link and hence the supply chain becomes possible. The methodology is also flexible as it permits any addition/deletion of criteria to any of the links in the supply chain.

"Bruna Jr et al.,[30]"develop a performance evaluation model for the operations of the supply chain of an organization of the refrigeration equipment sector. The tool must aid the decision maker in the performance improvement and creation of competitive advantages. They also resided in the proposal of solutions for fulfilling gaps identified within the supply chain performance evaluation area and in the application of the MCDA-C to a practical case. The researchers aimed at developing a supply chain performance evaluation model that was customized to the values and preferences of the Vice-President of Operations for a company in the refrigeration sector. Given the supply chain's complex, conflicting and uncertain environment, the MCDA-C methodology was chosen as the intervention instrument. After discussing the theoretical framework of supply chain performance evaluation and the MCDA-C, the paper presented the results of the case study. In keeping with the applied methodology, the case study was divided into three stages: structuring, evaluation and recommendations.

III. ANALYSIS OF DIFFERENT MODELS

To present differences and similarities between the various evaluation models based on a number of criteria that we considered crucial to any such comparison. We have suggested eight levels of analysis that are clearly interdependent and enable an identification of each model's characteristics. There have been a huge variety of measurement systems, starting with the best known ones such as the Balanced Scorecard [31]or the EFQM Excellence Model [32].Mainly geared towards measuring autonomous entities (companies, sub-diaries, business units, etc.), these models did not take the complexity of value-creating company chains into account.

A number of measurement models was then defined in the 2000s and helped to analyze supply chains in terms of some or all of their components (collaboration, human resource management, sustainability, etc.). Supply chain performance measurement models developed in recent years include Supply Chain Operation (SCOR) [33], Global Supply Chain Forum (GSF) [34], and Efficient Consumer Response (ECR)[35] . The 16 well-known supply chain performance measurement models and their particularities have been defined in appendix.1.

"Estampe et al.,[36]" analyzed various supply chains performance evaluation models by pointing out their specific characteristics and applicability in different contexts. That analysis had been displayed in analytical grid breaking SC PE

models down into seven layers as shown in Table.1. With that grid analysis organization management has been assisted in deciding the model that more suitable for their needs. We have chosen to develop essential characteristics that are useful in summarizing and analyzing the literature review of the SC PE frameworks as (1) Area of application, (2) Key contribution, (3) Framework dimensions& Established indicators, (4) Applied approaches, and (5) Lines of research. We display our analysis and summarize our review of the previous valuable researchers' work in SCPE in Table.2 .This table illustrates how hard it can be to understand different supply chain performance evaluation models' roles and uses.

Table.1. The analysis of SC PE frameworks[35]

	FLR	GSCF	SASC	WCL	ASLOG	EVALOG	AFNOR	SCM/ SME	BSC	SPM	ABC	SCOR	SCALE	APICS	ECR	EFQM
Decision level																
Strategic	●	●	●	●			●	●	●	●		●	●	●	●	●
Tactical	●	●	●	●	●	●	●	●			●	●	●	●	●	●
Operational	●	●			●	●					●			●		
Type of flows																
Physical		●	●	●	●	●	●	●					●	●	●	●
Informational	●	●	●	●	●	●	●	●	●				●	●	●	●
Financial				●			●		●	●	●	●	●			
Level of supply chain maturity																
Intra-organizational	●	●	●	●	●	●		●	●	●	●	●	●	●		●
Inter-organizational		●	●	●	●	●		●		●	●	●			●	
Extended inter-organizational										●		●	●		●	
Multi-chain							●			●		●				
Societal								●	●			●	●			●
Type of bench-marking																
Internal	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●
External				●		●				●		●	●		●	
Contextualization																
SME								●								
Retailer															●	
Industry						●								●	●	
Industry																
Service																
All sectors	●	●	●	●	●		●		●	●	●	●	●			●
Quality factors				●			●					●				●
Human capital				●					●			●				●
Sustainability							●	●	●			●		●		●

Table.2. The analysis of review of SC PE frameworks

Author/s	Area of application	Key contribution	Framework dimensions& Established indicators	Applied approach(es)	Lines of research
Bhagwat and Sharma,(2007)	Production sector	This paper develops a BSC for SCM that measures and evaluates day-to-day business operations. This helps managers to evaluate SCM performance in a much-balanced way from all angles of business.	Finance, customer, internal business process, and learning and growth.	BSC	SC PE
Ramos et al., (2009)	public services, Defence sector	The results provided important support for the future development of EPE practices, including, in particular, performance indicators within the defence sector. By assessing the state of EPE for this sector, it will be easier to address the sector's particular sensitivities and implement the most appropriate EPE framework	the importance of EPE; drivers of EPE; ISO 14031 knowledge and implementation; knowledge and use of environmental indicators; the optimal format for indicators; and the advantages and drawbacks/limitations of using environmental indicators	questionnaire survey	Environmental performance evaluation
Raman et al.(2009)	Production sector	As the proposed model gives the user an index value for the performance of a layout, it might not be sufficient to utilize directly in certain decision making process like planning.	layout effectiveness factors: Facilities layout flexibility(FLF), productive area utilization(PAU)& closeness gap (CG)	Math calculations	Facilities layout evaluation
Lundberg et al.,(2010)	Public sector, Swedish Rail Administration.	the proposed framework differs from earlier EPM/ EPE initiatives in the public sector in that it does not focus solely on the strategic objectives but also includes measurements toward the secondary objectives at an operational level of the organization.	ISO 14031	PSR framework Management-by-objectives (MBO)	Environmental performance measurements
Xu et al.,(2009)	Furniture manufacture industry	This model can be used to evaluate the performance of supply chain network. The RDEA model has been applied to a real SC	Cost(Direct costs, Operation costs,& Transaction expenses), Time(Order lead time), HR(Total volume of employees), Flexibility(Product flexibility &delivery	RDEA models DEA and rough set theory	SC PE

		performance evaluating problem to illustrate efficacy and efficiency of the RDEA model and acquired some valuable management information and lead managers to improve the operation efficiency of the supply chain network.	flexibility), Financial(Sales volume& Net profit), Service(Order fulfillment rate & Percentage of on-time delivery)		
Yu and Hu, (2010)	Manufacturing plants	proposes a new integrated Fuzzy TOPSIS framework for the manufacturing performance evaluation in a multiple plants setting.	Productivity, Production Amount, Production Cost, Inventory Amount,& Quality Cost	Voting method Fuzzy TOPSIS	SC PE
Tuncel and Alpan ,(2010)	Industrial sector	Can assist the evaluation of various operational strategies. The methodology presented here can be applied for designing, analyzing, specification, and evaluation of SC	total revenue, customer order fill rate, total revenue, customer order fill rate, total revenue, customer order fill rate.	Petri net (PN) FMECA to the supply chain process	Performance evaluation
Wang et al.,(2010)	High technology firm	This study identifies the performance-grade setting depending on expert consensus opinions from experts working in high tech industry. Furthermore, this study also constructed the HBSC system capable of providing a reference point and focus for the entire organization. The application of the non-additive measurement model to evaluate the performance of various high tech firms demonstrates that the effects of multi aspects on performance can be aggregated into a global perceived performance score.	BSC dimensions	Non-additive fuzzy integral	SC PE
Belmansour and Nourelfath,(2010)	Production sector	The main characteristic of the proposed method is its ability to evaluate quickly the production rate of	reliability parameters of the failure modes	Aggregation Method	Homogenous Production Line Evaluation

		a line in which machines can have multiple failure modes			
Sun,(2010)	Notebook computer ODM companies	The proposed method enables decision analysts to better understand the complete evaluation process and provide a more accurate, effective, and systematic decision support tool	Manufacturing Capability, Supply Chain Capability, Innovation Capability, Financial Capability, Human Resource Capability,& Service Quality Capability	Fuzzy AHP Fuzzy TOPSIS	Performance evaluation
Tsai et al.,(2010)	Service sector	offering not only a practical tool for evaluating website quality from experts' point of view, but also a heuristic decisional guide for organizing limited resources for managerial actions. the proposed model can also be applied and extended to other organizations to handle any evaluation Problem with interdependent factors.	Navigability, Speed, Links, Relevancy, Richness, Currency ,Attractiveness	DEMATEL, ANP, The modified VIKOR,& WVA	Website evaluation
Wu et al., (2011)	Extension Education Centers	Considered as a reference for extension education centers in universities to prioritize their improvements on the key performance indices after performing VIKOR analyses.	BSC	DEMATEL ANP VIKOR	Performance Evaluation
Cao et al.,(2011)	Manufacturing systems	It is capable of representing multiple rework loops, and the rework fraction of each loop is calculated based on the quality of material flow in the system. It had been applied to several problems, such as the determination of the optimal inspection location and the identification of bottleneck machines in rework systems.	Quality of material flow, The average inventory in the buffer, The production rate,	Markov models	Performance Evaluation
El-Baz,(2011)	Manufacturing companies	Provided an effective decision tool for the performance	Engineering (New Product design, Process design) Planning(Distributed cost,Inventory cost,	Fuzzy AHP	SC PE

		measurement of a supply chain in manufacturing environment.	Customer response time,Lead time ,On-time delivery, Fill rate, Stock out,Plans quality) Production(Manufacturing cost, Utilization, Efficiency ,Accuracy,Labour, Manufacturing flexibility, Product quality) Customer service(Customer dissatisfaction)		
Rostamzadeh and Sofian,(2011)	production sector	The presented framework for prioritizing 7Ms in a fuzzy environment can be easily extended to the analysis of other management decision problems as supplier selection in supply chain with a slight modification	7Ms (Management, Manpower, Marketing, Method, Machine, Material, and Money)	FAHP & FTOPSIS	Production system assessment
Bana e Costa and Oliveira,(2012)	Higher education sector	The model allows (a) the comparison of the performance of academic staff with performance targets reflecting the strategic policy concerns of university management; (b) the definition of the multicriteria value profile of each faculty member at the top level of the evaluation areas; (c) the computation of an overall value score for each faculty member, through an optimisation procedure that makes use of a flexible system of weights and (d) the assignment of faculty members to rating categories.	Teaching, research, knowledge transfer, university Management	Multiple criteria value measurement MACBETH	Faculty evaluation
Grigoroudis et al.,(2012)	Public Healthcare organization	The presented framework able to help the organization to evaluate and revise its strategy, and generally to adopt modern management approaches in every day practice	BSC	UTASTAR method	Strategic performance measurements
Garcia et al.,(2012)	The wine industry	The contributions of this research include the definition and representation of a model for the WSC, and a	Quality(Supplier performance index, Right quality grapes percentage,Production performance index, Inventory performance index, Warehousing	Benchmarking	SC PE

		framework of KPI for measuring logistics performance along the wine supply chain. With this model and the proposed framework, companies in the wine industry can have a better understanding of the relations and the complex dynamics present in the WSC. This could help them to focus on processes to improve, on new strategies or goals, on supply chain and resources optimization to increment final consumer's satisfaction level, and to lower costs and delivery times.	performance index, Customer satisfaction index, Perfect order percentage) Timeliness(Order Processing Cycle Time, Purchase Order Cycle Time, Bottling Cycle Time, Delivery Cycle Time (partially)) Resources Utilization Percentage(Capacity Utilization Bottling Machines, Warehouse Utilization Percentage, Cellar Utilization Capacity) Productivity&capacity Resources Logistics costs		
Cho et al.,(2012)	Service sector	framework is developed with a new perspective of how service supply chain processes could be measured. We apply the developed service SCPE to the hotel supply chain. research provides practitioners with Its greatest value that it can help service supply chain managers to view and assess the design and management of service supply chain processes in a different way as opposed to the traditional management of service level agreements.	SC Operation (Responsiveness, Flexibility,Reliability) Customer service (Tangibles,Assurance, Empathy) Corporate Management(Profitability, cost, assets, resource utilization)	Fuzzy-AHP	SC PE
Kumar and Singh,(2012)	Production sector	The proposed framework for selection of 3PL is very effective to analyze the criteria with their importance and to rank the alternatives. It may help researchers and practitioners as a selection framework at larger scale.	(1)logistics cost (percentage of total sale); (2) service quality (percentage of accuracy in delivery); (3) compatibility (average of traditions, cultural, and linguistic compatibility in percentage); (4) consignment tracking capability (rated on five-point scale); (5) on-time delivery (percentage of total delivery); (6) information systems (rated on five-point scale); (7) total revenue ($bn);	FuzzyAHP TOPSIS	Evaluation of Logistics Service providers.

			(8) geographical coverage, i.e. number of operating countries (rated on five-point rating scale); and (9) range of service provided (rated on five-point scale).		
Fan et al. (2013)	Industrial sector	This model can be used to evaluate, predict and optimize the performance of a SC. The analysis results of a case study of a company show that the proposed model is valid, reliable and effective. To apply the proposed model to optimize SC performances and hence guide companies to improve their SCM, cost model should be built as a conditional function to make sure any changes in SCM are cost effective.	Accounting: Profitability,capital turnover rate,cash turnover cycle Customer: Customer satisfaction, market share Innovation&development: Profit increment rate, information sharing,time of new product R&D Business processes: Response time,stock cycle time,waste rate,capacity utilization Supplier: On-time delivery,flexibility	LMBP neural network 5DBSC	SC PE
Vaidya and Hudnurkar, (2013)	Chemical industry	This paper presents a unique approach for SCPE considering multiple criteria, with a flexibility to modify and analyze using the available data sets.	The value of SCPN. Flexible Indicators	AHP	SC PE
Bruna Jr et al.,(2014)	Refrigeration equipment company	Identification, organization, ordinal and cardinal measurement and integration of the aspects of the context judged as relevant by the decision maker. In addition, it can be highlighted the current situation diagnosis and elaboration of improvement actions related to lean philosophy and advanced planning systems	Fulfill the shareholders' Expectations, Operating profit, Conversion cost, Working capital, Finished goods inventories, WIP, Inventories, RM inventories, Quality in the field, Customer service level, Production speed	MCDA-C	SC PE

4. CONCLUSION

SCM has been known as a tool to pursue continuous improvement by many firms in the competitive market. One of the main reasons of SC success to develop the performance evaluation framework and metrics needed to fully integrate their supply chain to maximize effectiveness and efficiency. Performance Evaluation studies and models should be created so that organizational goals and achievement of those goals can be measured, thus allowing the effectiveness of the strategy or techniques employed to be accessed. The recent research might provide satisfactory analysis in terms of the particular performance level that a given company was seeking within its own particular context. It has been

suggested a table displaying various performance evaluation models comparison has incorporated criteria such as the level of decision-making, the specific flows in question, the relationship between performance and supply chain maturity levels, interest in the quality dimension, human competency and sustainability.

In this search, we introduce another review and summarize the reviewed searches in a table focusing on Area of application, Key contribution, Framework dimensions& Established indicators, applied approaches, and Lines of research. This will help mangers to understand the nature of performance evaluation framework to decide if it is suitable with organization nature and goals. Also, it is helpful for researchers to direct their future work and research questions to revolt the existing framework or overcome any gab in the existing searches.

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Appendix 1.

Appendix 1 summarize the 16 well-known supply chain performance measurement models and their particularities

ABC: Activity Based Costing has been created in the1980s. It aims to analyze costs and margin, but goes beyond the simple calculation of return costs. It necessitates deep knowledge of the company. It groups activities by their process logic and interweaves accounting data into this concept.

FLR: Framework for Logistics Research: it has been developed inthe1990s. It describes dependency between the level of performance achieved, logistics organization and competitive strategy. It can be applied at organizational and strategic level. It structures logistics function into several dimension (centralization, formalization, integration and areas of control).

BSC: Balanced Score Card hasbeendevelopedinthe1990s. It seeks balanced measures to but tress company strategy. This principle proposes four analytical axes: customers, finance, internal business, and learning growth. Growth and it incorporates a human dimension for the performance measurement. It is specifically geared towards general management and can be applied from the strategic through the organizational level

SCOR: Supply Chain Operation Reference model has been developed in 1996 by the Supply Chain Council (SCC).It aims to analyze four dimensions: reliability of commercial performance, flexibility/responsiveness, and cost of supply chain and turnover of committed capital. It can be applied to all industrial and service sector companies, at tactical and operational level for an implementation of decisions relating to the company's strategic planning.

GSCF framework: it has been created by Ohio State University in 1994. It describes three levels (strategic, tactical, and operational) and highlights links between supply chain process and structure. It focuses on seven processes: customer relationship management, customer service management, demand management, order fulfillment, manufacturing flow management, supplier relationship management, product development and commercialization, and returns management.

ASLOG audit: it has been created in 1997 by ASLOG, based on models used in the automobile sector. It assesses logistics procedures by analyzing strength sand weaknesses. It is a transversal tool, which aims to implement good practice dedicated to companies with low or medium levels of maturity. It analyses the following areas: management, strategy and planning, design and projects, sourcing, production, transportation, stocks, sales, returns and after sales, piloting and permanent progress indicator.

SASC: Strategic Audit Supply Chain has been developed in 1999. It analyzes supply chain in terms of processes, information technologies and organization at an organizational level.Its principle is to break logistics chain down into six competencies: customer orientation, distribution, sales planning, lean production, supplier partnerships and integrated management of chain and to link competencies to information technology and organization of chain.

Global EVALOG (Global MMOG/LE): It has been created in 1999 with Odette International Limited and Automobile Industry Action Group. It assesses partner site processes and performance, pursues continuous improvement approach. Although it has been developed for an automobile industry, it can be used for associated sectors (metal works, chemicals). It is structured in to six areas: strategy and improvement, work organization, production planning, customer interface, process control and supplier interface.

WCL: World Class Logistics mode has been developed by Michigan State University in the1990s. It evaluates the company's performance in terms of its ability to account for inter-organizational relationships through a model comprised of 68 questions. It can be applied at strategic and organizational level. It revolves around four areas of competency: positioning, integration, agility and performance measurement.

AFNOR FDX50-605: it has been developed in 2008. It offers general framework for strategic reflection and defines different logistics processes. It identifies performance levers associated with each process. Its model feature six area: identification of needs and setting of objectives, logistics system design and logistics system design and development, production, sales and distribution, logistics support and control over global logistics process.

SCM/SME: it has been developed in 2007 within an SME context. It is composed by a questionnaire featuring 25 modules: corporate strategy, organization and logistic competencies development, performance processes and measurements, information system. Its targets are mainly industrial SMEs in fast moving consumer goods sector. It is structured around demand management, distribution, import/export flows, stocks, production, sourcing, returns, after-sales support and traceability.

APICS: Association for Operations Management has been developed by professional association APICS in 2000. It analyzes innovation and customer service management, efficiency drivers, agility, risk control and sustainability. It mainly applies to industrial firms. Its processes are structured via model that is mainly geared towards production planning.

ECR: Efficient Customer Response has been created in 1994 by an ECR Association of manufacturers and retailers. It evaluates good inter-organizational practices and uses maturity-based evaluation tool: global mapping. It focuses on collaboration between industrialists and distributors in fast moving consumer goods sector. It establishes common language based on joint evaluation of performance by actors in the chain. It is based on 45 criteria structured into four areas: consumer demand management, supply chain management, technological plat forms and integration.

EFQM: Excellence model has been introduced in 1992. It starts by a questionnaire with 50 questions; respondents positioned along the scale of excellence. It covers areas relating to process efficiency, continuous improvement in products and services, personnel management and progression. It is suitable for all types of companies. It is based on eight principles: customer focus, leadership, definition of objectives, process-based management, staff involvement, continuous innovation process, development of partnerships and civic responsibility.

SCALE: Supply Chain Advisor Level Evaluation has been created in the early 2000s by the Institute for Supply Chain Excellence (ISLI) for all sectors of activity. It revolves around questionnaire that assesses strategic and tactical dimensions, elements of value creation. It is based on 58 processes classified in to seven categories of activities: definition of strategic objectives, establishment of procedures, needs planning, coordination of phases, performance evaluation and monitoring and supply chain optimization.

SPM: Strategic Profit Model has been created in 2002, derived from the DuPont model. It displays existing interactions between strategic and operational levels by means of financial ratios. It proposes strategic and financial implementation based on cost drivers using returns on asset or returns on net value measurement.