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SUPPLY CHAIN PERFORMANCE EVALUATION MODELS: A LITERATURE REVIEW

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Abstract: Our structured literature review reveals the current state-of-the-art supply chain performance evaluation models (SCPEMs) from the last 21 years of research. Seventy related papers from the 2000 to 2021 time period were found to contribute by using ISI and SCOPUS databases. This paper has classified SCPEMs in terms of focus area and the perspective considered (financial and non-financial). With the analysis, these models' applicability in today's business environment pinpointed the most usable models and their current shortcomings. Findings disclose current SCPEMs limitations and misalignments with the emerging disruptive technologies observed in today's supply chains. Given the findings, this study has highlighted the lack of overall supply chain performance evaluation and the failure to underline the underperforming decision criteria in the SC network. Therefore, to tackle these gaps, the authors have suggested visibility, leagility, collaboration, digitalization, sustainability, and integration as SCM characteristics to be considered in the future when developing a novel SCPEM. Finally, this study can be used as guidance for future studies.

1 Introduction

Due to the constantly increasing competition in global logistics and globalization, a new level of pressure is being applied to logistics service providers, originating from stakeholder groups, variations in customer demand patterns, and new legislation in sustainability-related requirements [1,2]. Given the recent developments in globalization, digitalization, and customers' knowledge base, supply chain management (SCM) has become an even more challenging task to excel in than it was just a few years ago [3,4]. Therefore, practitioners have been frantically seeking solutions to managerial issues and have been able to find them, at least in part, from the emergence of disruptive innovations such as digitalization and industry 4.0, which have significantly impacted current SC processes [5-7]. This challenge has led academics and practitioners to recognize the need for real-time level measuring, tracking, and optimization of supply chain performance to help firms cope with continuous pressures and achieve strategic goals while providing long-term value to ecosystems [8-10]. For companies, SC excellence is a key focus as it is their competitive advantage and business performance core element [11,12]. Correspondingly, performance measures, data, and metrics are required to reflect business objectives, assess current performance levels, and enhance the overall supply chain (SC) through efficiency and effectiveness, and more recently, sustainability [13]. Appropriate performance measures allow decision-makers to embrace a sustainable perspective and allocate firm resources toward the most efficient improvement activities [14]. On the other hand, inadequate key performance indicators fail to reflect an organization's crucial state [15,16]. Becoming a fundamental management tool, performance evaluation models are designed to assist SC managers in real-time measuring the impact of strategic, tactical, and operational decisions on the SC performance [9,17-19]. In addition, an effective SC performance evaluation model (SCPEM) requires suitable metrics adoption for SC process essence and enhancement point capturing needs [20,21].

There are several performance evaluation models, including Balanced Scorecard (BSC), Activity-based Costing, Economic Value Added (EVA), Supply Chain Operations Reference Model (SCOR), and Global Supply Chain Forum (GSCF). Each of these models could be used to evaluate SC performance depending on the organization's status and strategies [16,22]. Furthermore, the performance measurement outcomes reflect the effect of strategies and possible opportunities in SCM [23,24]. There are several purposes for developing performance evaluation models in SC, such as maximizing corporate performance, including profit and internal process effectiveness by cutting operating costs and increasing service quality, identifying customer needs fulfillment, having a comprehensive overview of business processes, ensuring and tracking progress, identifying bottlenecks waste, problems, and improvement opportunities, plus different SC new idea innovation and novel solution development requirements [7,11,25,26]. Accordingly, considering the overall SC is essential in developing a SCPEM.

Many literature reviews and papers on SC performance evaluation systems have been done in the last couple of decades. For example, Gunasekeran et al. [27] have provided an overview of different performance measures and metrics across SCs and have categorized them into strategic, tactical, and operational levels. Chan et al. [23] have classified performance measures into quantitative and qualitative criteria, and they have captured the key issues in SC. In other work, Akyuz and Erkan [28] have reviewed the papers in the field of SC, information technology, and performance measurement to establish a broad perspective covering different aspects, including people, technology, and processes. Subsequently, Hasan Balfaqih et al. [18] and Reddy et al. [10] have categorized the articles based on the approaches and techniques in the context of SC. To provide a clear definition of SCPMS, Maestrini et al. [17] and Guersola et al. [9] have conducted a systematic literature review in this field. They have, however, classified the literature by journal and discipline. Similarly, Elgazzar et al. [14] have conducted a literature review to provide a comprehensive overview of SCPMS development between 1995 and 2015. The authors have proposed a conceptual framework for the design and implementation of an SCPMS. More recently, Khan et al. [29] have reviewed the existing SCPMS in today's business environment. They have used a qualitative review methodology to determine whether existing SCPMSs are consistent with the current emerging supply chain performance management and measurement trends.

Although the issue of supply chain performance evaluation has been broadly debated in the literature during the last few decades, further research still needs to give more awareness to the functions and shortcomings of existing SCPEMs. Through a structured overview of the previous literature, SCPEMs are significant because they are the core managerial mechanisms for effective and efficient SCM. They are looked at as an appropriate way to improve SC governance by making it more timely, conscious, and more valuable decisions [30,31].

The proposed paper aims to conduct a literature survey to provide a comprehensive overview and better understand existing supply chain performance evaluation models (SCPEMs) applicability in today's business environment, highlighting several SCPEMs drawbacks and suggesting new characteristics of the supply chain management to be considered in the performance measures. Moreover, this work is relevant to academics and practitioners in the area of supply chain management as it enriches the knowledge of current overall supply chain performance evaluation. The following research questions have been established for this study:

RQ1. What are the existing supply chain performance evaluation models (SCPEMs)?

RQ2. What are the SCPEMs' drawbacks and the gap between existing SCPEMs and the current trend of SCM?

Our contribution to SC performance literature is as follows:

1. Determine existing SCPEMs and their functions
2. Identify the knowledge gap in existing SCPEMs
3. Propose new SCM trends to consider when designing a SCPEM in the future.

The remainder of this paper is structured as follows. Section 2 goes into the methodology employed to carry out this study. Section 3 includes a literature review on existing SC performance evaluation models. This section seeks to provide a response to the first research question. The discussion and findings are presented in Section 4. This section responds to the second research question. Finally, the summarized conclusion is discussed in Section 5.

2 Research methodology

The scope of the paper is limited to existing supply chain performance evaluation models (SCPEMs) applicability, functions, and drawbacks. A structured literature survey has been undertaken using ISI Web of Knowledge and Scopus online databases to select the relevant articles to cover this scope. These two databases are the most extensive and widely used search tools in academia [9]. The search focused on studies that investigated SCPE systems, models, or frameworks between 2000 and 2021, as the majority of the research was done over this period. The search was restricted to peer-reviewed journal papers in English within the areas of industrial and manufacturing engineering, accounting, business management, and decision sciences. Supply chain performance, supply chain evaluation, supply chain performance evaluation, supply chain performance evaluation systems, supply chain performance measurement, performance measurement, and performance measurement systems were all utilized as keywords in the study. The selection was made based on the articles' titles, abstracts, and keywords.

From databases, a total of 281 articles (122 in Scopus and 159 in ISI Web of Knowledge) were identified. All abstracts were analyzed to exclude works not relevant to the research. By excluding duplicate papers, The final review resulted in a total of 70 articles for inclusion in the main analysis.

Figure 1 shows the literature search process, which is quite similar to the one conducted by Balfaqih et al. [18]. Other information, such as the distribution of articles regarding journals, is presented in Table 1.

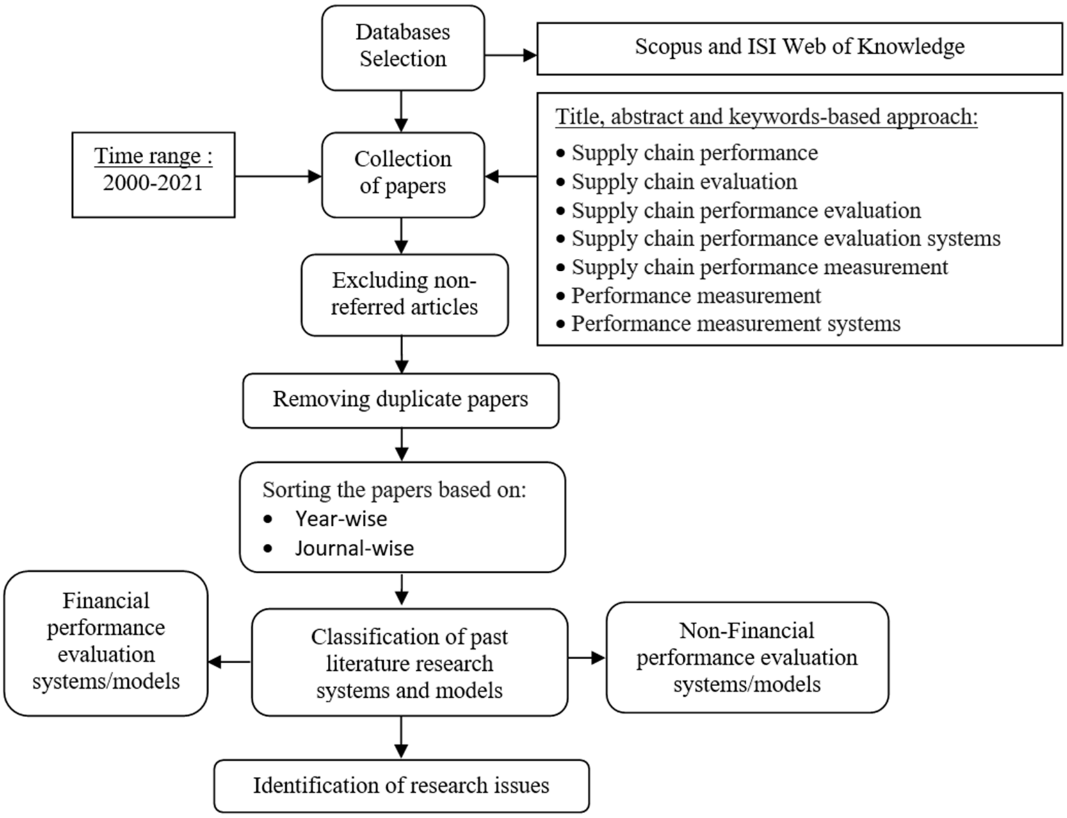

Figure 1 Research methodology

Table 1 Amount of publications per main journals

Academic Journal	Publications
International Journal of Production Economics	9
International Journal of Productivity and Performance Management	8
Production and planning control	7
Benchmarking	6
Journal of Cleaner Production	6
International Journal of Production Research	5
International Journal of Logistics Systems and Management	4
Computers and Industrial Engineering	4
Annals of Operations Research	4
Supply Chain Management: An International Journal	3
Sustainability	3
Computer in Industry	3
Uncertain Supply Chain Management	3
International Journal of Supply Chain Management	3
International Journal of Mechanical and Production Engineering Research and Development	1
International Journal of Industrial and Systems Engineering	1
Total	70

3 Literature review

In recent years, performance evaluation has become essential for any supply chain [32,33]. As global manufacturing has expanded, today's competition centers on supply chains rather than companies [33,34]. In other words, evaluating supply chain performance is critical to establishing and maintaining a competitive advantage in the marketplace [35,36]. According to Neely et al. [37], performance evaluation is a process, metric, or set of metrics aimed at quantifying activities' efficiency and efficacy. This shows how well-desired supply chain goals are achieved, including quality, time, cost, etc. [31,32]. Moreover, it helps decision-makers identify areas for improvement [35,38,40]. Additionally, a system for performance valuations can be defined as a system that merges information from multiple measures for efficiency and effectiveness qualification [23,37]. As it is clear, supply chain performance evaluation is essential for efficient SCM at both inter-organizational and cross-border processes [31]. Therefore, many researchers have tried to consider SCPEMs from different perspectives in the last couple of decades. Initially, works focused on developing an integrated framework, categorizing measures along with decision-making levels, and based on their nature (financial, non-financial) using Balanced Scorecard (BSC). Following that, attention has switched to other areas, most notably the identification of KPIs, adopting measures and metrics for SC resilience, green SC, and, more recently, considering digitalization aspects in SCP [18,39-42].

Based on the selected papers, this section has answered the first research question by presenting existing supply chain performance evaluation models.

3.1 Existing supply chain performance evaluation models

The significant amount of research and extensive published literature on SC performance emphasized the relevance of SCPEMs in the context of overall organizations' performance. Scholars and practitioners have discussed supply chain performance evaluation systems from several perspectives, including cost and non-cost perspectives, business process perspectives, strategic, tactical, and operational perspectives, and financial perspectives [28,43]. Executive management requires financial measures for management-level decisions, but bottom management needs operational standards for day-to-day operations [9,14]. This shows the importance of considering financial and operational measures to assess overall SC performance. Therefore, the authors have classified SCPEMs into two groups: financial and non-financial, and eleven sub-categories of non-financial categories, as shown in Table 2.

3.1.1 Financial Performance Evaluation Systems (FPES)

Although previous studies have widely considered supply chain performance evaluation [8,18,19,29], only a few research studies on supply chain financial performance evaluation have been undertaken [32,44]. Financial performance evaluation systems (FPES) have been defined as classical accounting methods for assessing SC performance. However, they have only focused on financial-based metrics and have been regarded as inadequate. They have failed to include vital strategic non-financial measures that affected its overall performance [29,32,43]. FPES are no longer useful for providing critical information to firms in today's dynamic market [44]. This is because the classical approach which emphasizes financial indicators lacks to adjust to competitive advancements and technology, resulting in internal financial data that is usually erroneous and misleading. Several papers have categorized FPES into various categories [29,43]. Nevertheless, the authors have considered ABC and EVA as the most well-known financial performance evaluation systems.

Table 2 Supply Chain Performance Evaluation models Classification

Financial Performance Evaluation Systems/Models	Activity-Based Costing (ABC)
	Economic Value Added (EVA)
Non-Financial Performance Evaluation Systems/Models	Supply Chain Operations Reference Model (SCOR)
	Supply Chain Balanced Scorecard (SCBSC)
	Global Supply Chain Forum (GSCF)
	Interface-Based Performance Evaluation system (IBPMS)
	Perspective-Based Performance Evaluation system (PBMS)
	Efficiency-Based Performance Evaluation System (EBPMS)
	Hierarchical-Based Performance Evaluation Systems (HBMS)
	Dimension-Based Performance Evaluation System (DBPMS)
	Process-Based Performance Evaluation System (PBPMS)
	Knowledge-Based Performance Evaluation system (KBPMS)
	Performance pyramid and prism-based model

3.1.1.1 Activity-Based Costing (ABC)

In an attempt to join operational performance and financial measures, Harvard Business School introduced Activity-based Costing in 1987. It constitutes estimating the resources regarding cost while the activities are being broken down into single tasks and cost drivers. The model is widely utilized for margin analysis and cost. ABC is implemented in five phases [45-47]: i) Identifying the firm's operations and various products to map processes. ii) Assignment of workloads and working hours to the various operations. iii) Development of a performance indicators system for assessing the output of cost-generating activities. iv) Identifying the number of resources utilized per product and, as a result, the related expenses. v)

Determining the product cost detailed by activity. The ABC method enables an accurate assessment of supply chain processes productivity and costs [29,45-47].

3.1.1.2 Economic Value Added (EVA)

The Economic Value Added approach was built by Stern in 1995 with the purpose of predicting the return on capital (ROC) of firms in terms of value-added and thus correcting the shortcoming in classical accounting methods, which focus solely on short-term financial outcomes that are unable to provide long-term value-added to companies and their shareholders [48,49]. This approach was founded on the principle that when a firm earns more than its cost of capital, the shareholder value increases. EVA seeks to measure an organization's value, focusing on operating profits over capital employed (through debt and equity). Therefore, it is beneficial in determining long-term shareholder value and high-level executive contributions [29,48,49].

3.1.2 Non-Financial Performance Evaluation Systems (NFPES)

The non-financial performance measures have been introduced to provide extra information which the conventional approach could not offer [9,14]. Although financial indicators are the most used in top-level management where strategic decisions are made, they are not relevant in daily operations because they are only available after SC operations have been completed. This shows the importance of non-financial measures in organizational performance since they assist low-level management with day-to-day operations. Non-financial SCPEMs have been developed so far upon reviewing the literature in the field of SCPM [8,18,22,29,43,50,51]. The authors have classified NFPES into eleven sub-categories.

Following is the description of NFPMS:

3.1.2.1 Supply Chain Operations Reference Model (SCOR Model)

The SC Council formed the first version of the SCOR model in 1996. This model was developed to describe the management process related to all phases involved in meeting customer demand. Therefore, it allows companies to boost both the efficiency and effectiveness of their SC [9,18,22,52,53]. The SCOR model has two dimensions: SCOR processes (plan, source, make, deliver, return, and enable) and performance criteria (reliability, responsiveness, agility, cost, asset management efficiency). Thus, it is arranged in a 5x6 matrix [54]. The SCOR model has been regarded as a supply chain assessment framework, as it defines and categorizes the processes that construct the chain, allocates metrics to such processes, and reviews similar benchmarks [18,28,53,55]. The latest version of the SCOR model (SCOR 12.0) was released by ASCM in 2017 and is currently used in many manufacturing industries [53,54,56]. Nowadays, there are over 250 SCOR metrics in the framework drawn from board members' experience and contributions [54,56].

3.1.2.2 Balanced Scorecard Model (BSC Model)

The BSC model has been recognized as a leading tool to evaluate long-term corporate performance from multi perspectives, including financial perspective, internal business process, learning and growth perspective, and customer perspective [15,36,57]. The BSC concept was coined by Kaplan and Norton in 1992 to better reflect the real performance of the company and select and combine performance metrics from a balanced view. The BSC model includes traditional financial measures reflecting past performance and operational (non-financial) representing future performance drivers. It also helps decision-makers rapidly improve their activities and operations and aims to enhance internal and external corporate functions [15,18,36,51]. Metrics within the BSC perspectives are chosen based on the firm's strategic objectives. As a result, decision-makers can convert strategies into a set of metrics that can be used to track a strategy's overall effect on the business [15,36,57].

3.1.2.3 Global Supply Chain Forum (GSCF)

The GSCF framework was established by Ohio State University in 1994. The primary purpose was to describe the standards of supply chain processes at different decision-making levels [22,58,59]. This model has focused on the SC network structure, SCM components, and SCM processes. The Global Supply Chain Forum has identified eight key processes that construct the core of SCM, namely, customer service management, customer relationship management, demand management, managing manufacturing flows, order fulfillment, product development and marketing, supplier relationship management, and returns management [22,58,59].

3.1.2.4 Interface-Based Performance Evaluation System (IBPMS)

IBMS was introduced by Ohio State University in 2001. In this framework, the performance of each phase is related to the SC network [29,43,50]. It aimed to keep track of how customer relationship management (CRM) and supplier relationship management (SRM) systems interacted at each stage of the supply chain [29]. The IBMS framework aimed to develop supply chain metrics that translate performance into shareholder value to maximize shareholders' value for the overall SC along with each company [29,43].

3.1.2.5 Perspective-Based Performance Evaluation System (PBPMS)

PBPMS was conceptualized by Otto and Kotzab (2003) as an inter-functional measurement system [60]. It looks at SC all potential perspectives and provide measures and metrics to assess each perspective. They have defined perspective as a unique vision of what SCM is about

[18,29,60]. These perspectives are system dynamics, logistics, operations research/IT, marketing, organization, and strategy. However, some of the proposed metrics are not used in business practice. Furthermore, a trade-off between one perspective measure and another perspective measure may exist. Previous studies have classified it into two sub-categories, the BSC and SCOR models [18,29,61].

3.1.2.6 Efficiency-Based Performance Evaluation System (EBPMS)

EBPMS are systems that quantify SCP in terms of efficiency [29,43]. Several approaches and frameworks have been developed in this context (Negi et al. [11], Sharma and Bhagwa [62], Rodríguez et al. [61], Izadikhah et al. [63], and Hahn et al. [64]). These systems are able to measure and evaluate the various units' SC efficiency linked to each other but not beside the target value or benchmarking [29]. Most of these approaches are based on data envelopment analysis (DEA), measuring internal SCP related to efficiency [29,63].

3.1.2.7 Hierarchical-Based Performance Evaluation System (HBPMS)

In 2004, HBPMS was developed by Gunasekaran et al. [31]. It has been used in three aspects: metrics, criteria, and processes. Metrics have been categorized at strategic, tactical, and operational levels, which mirror the relevant amount of management authority, control, and influence for the performance [30,33,65]. These metrics have also been divided into financial and non-financial [18,29,43]. The purpose of the model was to make fast and fitting decisions. Generally, This model links the performance measures with firms' objectives [30,43,66]. Many hierarchical frameworks have been developed. For example, Bhagwat and Sharma [62] have classified the metrics related to the three hierarchical levels. Moreover, they focus on metrics in the global competitive environment so that managers can make suitable decisions. Luthra et al. [66] have suggested an integrated framework to select and assess sustainable suppliers using AHP (Analytical Hierarchy Process). In other work, Venkatesh et al. [67] have developed a framework based on fuzzy AHP-TOPSIS (Technique for Order Performance by Similarity to Ideal Solution) to solve partner selection problems.

3.1.2.8 Dimension-Based Performance Evaluation System (DBPMS)

DBPMS concept is founded on the principle that any SCP can be evaluated in terms of dimensions [29,50]. Beamon has identified three criteria to assess SCP, namely, flexibility, resources, and output [29,43,68]. These measures are needed in SCPE. In other words, supply chain performance evaluation systems must take these measures into account as they are key success factors for the overall supply chain performance [14,29,69]. Examples of resource performance measures include manufacturing cost, inventory cost, and return on investment (ROI). Output measures comprise total sales, fill rate, and on-time deliveries, whereas flexibility parameters measure in terms of volume changes and new product introduction. Otherwise, various works have suggested other dimensions to evaluate SCP. For example, Ferreira and Silva [70] have integrated sustainability metrics In SCPMS. Similarly, Kafa et al. [13] have suggested green supply chain performance measurement metrics. More recently, Neri et al. [71] have proposed a set of metrics based on BSC dimensions and TBL (Triple Bottom Line) criteria (Social and Environmental). Their framework addressed different decision-making levels. In another work, Zekhnini et al. [72] have suggested a model for supply chain performance based on metrics related to digitalization and sustainability. Rasool et al. [73] have addressed the digital supply chain, suggesting metrics based on BSC dimensions.

3.1.2.9 Process-Based Performance Evaluation System (PBPMS)

SCM refers to processes and activities integration from supplier to end customer. Due to this fact, it is vital to understand key SC processes and activities to develop an efficient performance measurement and evaluation system [14,18,74,75]. Many researchers have used PBPMS to evaluate SCP. For example, Lin and Li [76] and Charkha and Jaju [77] have used six-sigma metrics to assess the overall supply chain performance. In another paper, Chan and Qi [75] have studied the feasibility of SCPMS based on process-based metrics. They have considered five processes (supplying, inbound logistics, core manufacturing, outbound logistics, and marketing and sales). Gunasekaran et al. [31] have considered four supply chain processes (plan, source, make, and deliver) in their framework using a process-based approach. Persson and Olhager [78] have defined the SC as a set of processes to evaluate SC entities. Their case study was conducted in the mobile communication industry. Lima-Junior and Carpinetti [79] have used SCOR metrics to predict supply chain performance. Their framework is based on Artificial neural networks (ANN) as they allow a suitable adaptation to the dynamic environment by employing historical performance data. Ikatrinasari et al. [53] have conducted a framework based on SCOR metrics to improve supply chain performance. Their research has focused on printing services companies. Hence, they have recommended four performance criteria to consider; namely, Reliability metric: Perfect Order Fulfillment (POF), Responsiveness metric: Order Fulfillment Cycle Time (OFCT), cost metric: Cost of Goods Sold (COGS), and assets metric: Cash to Cash Cycle Time (CTCCT).

3.1.2.10 Knowledge-Based Performance Evaluation System (KBPMS)

Recently, knowledge has become one of the key factors in providing competitive advantage and continued development and success for supply chain partners [35,38].

Every decision is vital for SC performance and impacts directly and indirectly on overall supply chain performance. Therefore, the knowledge of decision-makers is needed in assessing supply chain performance [29]. KBPMS have been developed due to digitalization and Industry 4.0 requirements and have been considered smart SCPMS [29,35]. Previous works have focused on using knowledge to evaluate overall supply chain performance. For example, Khan et al. [35] did produce a knowledge-based system (KBS), which gave them the possibility to establish the relationship between short-term and long timeframe based decisions and the decision criteria performance of related supply chain, as well as incorporate knowledge between SC partners for accurate overall supply chain performance evaluation. They have used fuzzy AHP to implement their framework. In another work, Khurshid Khan and Wibisono [80] have considered five SCP perspectives: a business perspective, customer perspective, manufacturing competitive priorities perspective, internal process perspective and resource, and method availability perspective using KBPMS based on AHP. As a result, their model has looked suitable to assist decision-makers using PMS and offers relevant and thorough prioritized outcomes for actions and improvement.

3.1.2.11 Performance pyramid and prism-based model

As a top-down approach, the performance pyramid integrates corporate strategy with its operations by converting upper objectives (based on consumer priorities) and underside metrics. [22,29,81]. However, this model fails to provide an instrument to identify key performance indicators [29,81].

The performance prism is a framework for five performance measures evaluation (stakeholder satisfaction, strategies, processes, capabilities, and stakeholder contributions). The performance prism provides a far more full view of various stakeholders (e.g., investors, consumers, workers, regulators, and suppliers) than other frameworks. However, although the performance prism extends further than classical performance evaluation, it provides little about how the performance measures will be achieved [29,81].

4 Result and discussion

Based on the found and mapped foregoing body of knowledge in academics, it is argued that numerous models and frameworks for monitoring and analyzing supply chain performance have been established. Both qualitative and quantitative metrics of financial and non-financial nature have been included in performance evaluation models across the supply chain. However, due to the competitive environment and the emergence of disruptive technologies such as digitalization and industry 4.0, and new legislation in sustainability-related requirements, the reviewed existing models and frameworks of SCP evaluation still face utilization drawbacks and practical applicability limitations. Below, Table 3 highlights several limitations of existing models and frameworks of SCP evaluation and their focus area.

Table 3 SC performance evaluation systems/models: focus area and limitations

SCPEM	Sub-categories	Focus area	Limitations	Reference
Financial Performance Evaluation Systems/Models	Activity-Based Costing (ABC)	Cost and margin analysis	- Focusing solely on financial measures and metrics. - Time-consuming and costly to sustain. - Difficult to implement in small companies.	[29,45,46,82]
	Economic Value Added (EVA)	Financial indicator: Return on capital	- Focusing solely on financial measures and metrics. - Inadequacy of EVA for small companies and certain industries such as the technology sector. - difficult to determine the exact cost of equity.	[29,43,48]
Non-Financial Performance Evaluation Systems/Models	Supply Chain Operations Reference Model (SCOR Model)	Address, improve and communicate SCM decisions among SC partners	- Heavy focus on flows of information without including all related SC activities. - The lack of a learning technique allows quantification of cause-effect relationships among metrics in a specific application environment. - Overall performance evaluation is rather complex. - Not flexible if there is a change in the assessment. - Corporate sustainability issues are not included within the scope of SCOR. - There are over 250 SCOR metrics, so selecting and monitoring all these metrics is time-consuming. - It does not take into account the global perspectives on market uncertainty.	[18,22,43,52,53, 55,79]
	Balanced Scorecard Model (BSC Model)	Evaluate long-term corporate performance from multi perspectives, including financial	- It cannot evaluate the overall performance and highlight the under-performed KPI criteria. - Lack of coordination along with the SC network. - The relationship between short-term and long-term decisions and SC performance measures (short-term	[15,36,43,51,57, 61,83]

		perspective, internal business process, learning and growth perspective, and customer perspective.	and long-term) for accurate overall SC performance evaluation is lacking. - BSC is designed as a control tool rather than an improvement tool that emphasizes guidance at the strategic level rather than the functional or operational level. - It does not enable quick decision-making, highlights under-performed criteria, and fails to assess overall SC performance. - It doesn't cover sustainability and digitalization perspectives.	
	Global Supply Chain Forum (GSCF)	Describe supply chain process standards at different decision levels.	- How the processes are carried out and handled is unclear. - It does not cover all SC functions. - It does not consider financial flow. - External benchmarking is missing. - It does not include sustainability issues and quality impacts.	[22,58,59]
	Interface-Based Performance Evaluation System (IBPMS)	Linked performance of each SC network member.	- Requiring complete transparency and information openness in all stages can be a challenge to implement.	[29,43,50]
	Perspective-Based Performance Evaluation System (PBMS)	Evaluate SC performance in terms of six main perspectives: system dynamics, operations research, logistics, marketing, organization, and strategy.	- A trade-off between one perspective measure and another perspective measure is possible.	[18,29,43]
	Efficiency-Based Performance Evaluation System (EBPMS)	Evaluate SC performance in terms of efficiency.	- It does not provide any link between supply chain functions. - Requirement of accurate measurement for both the inputs and outputs. - Most EBPMS are solely based on the DEA technique and ignore the other MCDM tools. - Uncertainty is produced in the decision-making process.	[9,35,43,64]
	Hierarchical-Based Performance Evaluation System (HBPMS)	Assess SC performance at various stages of decision-making (strategic, tactical, and operational).	- There are no specific guidelines for reducing different levels of conflict throughout the whole SC network.	[18,29,43,62]
	Dimension-Based Performance Evaluation System (DBPMS)	Assess SC performance with regards to dimensions.	- It is not considered physical flow. - It only focused on strategic measures. - It cannot highlight the under-performed KPI criteria at any decision-making level in the whole SC network.	[22,35,43,51]
	Process-Based Performance Evaluation System (PBPMS)	Evaluate SCP considering the key operational process of SC.	- Time-consuming when integrating all processes and activities within the PMS. - It is difficult to decide which process should be improved to achieve a specific performance goal. - Not flexible if there is a change in the assessment.	[14,18,75]

	Knowledge-Based Performance Evaluation System (KBPMS)	Evaluate SCP based on the decision-makers' knowledge.	- A survey of various firms should be conducted to verify the required short-term and long-term criteria to be included in the KBS. - A KBPMS conducted by Khan et al. is only implemented in the automotive sector and should be carried out in other sectors. -The suggested KBPMS by Khan et al. is not executed by establishing links between distinct SC functions.	[29,35,38]

Subsequently, the authors have discussed the current trends in monitoring and managing SC and highlighted the impact of technological advancements in business performance. Based on the literature analysis, it is argued that traditional SCPEMs fail to deal with the complexity of SC. Therefore, the authors have identified some gaps in existing supply chain performance evaluation models, which are as follows:

- Existing SC performance evaluation systems have a poor financial and non-financial measurement balance.
- Previous SCPE frameworks have not captured both the digitalization and sustainability aspects.
- Lacking in assessing overall supply chain performance.
- Fuzzy information and data are used in assessing overall supply chain performance.
- Existing SCPEMs are unable to integrate short-term and long-term decisions and decision criteria.
- Lack of underlining of underperforming decision criteria in the SC network.

Based on the gaps mentioned above in current SCPEMs, it is stated that to make fast decisions for monitoring SCP effectively and efficiently and achieve a high degree of satisfaction for decision-makers, SCPEMs must keep up with new trends in SCM.

Below, the authors have summarized the anticipated trends in need of efficient supply chain performance evaluation:

➢ **Visibility**

Supply chain visibility helps to improve inventory levels, decrease uncertainty, risk, and bottlenecks, and optimize SC operations. Meanwhile, the visibility aspect is a major challenge in traditional SC operations because when problems occur in SC functions, they can worsen and further propagate down the chain. Therefore, it is challenging to manage and track these issues due to the complexity of the supply chain. This shows the importance of visibility in SC, and companies must be transparent in their order processing and provide ongoing feedback and order status to their consumers. Correspondingly, the emergence of disruptive technologies has increased the transparency of the overall value creation process [5]. This leads the decision-making process more collaborative and efficient. To cope with this trend, it is required to implement a SCPEM that will deal with the following challenging trends in SCM.

➢ **Leagility**

Supply chain leagility is a blend of agility (fast reaction and service) and leanness (total cost optimization) within the whole SC strategy [7]. Previously, lean and agile were thought to be two distinct types of supply chain operations [84]. These two terms have a high impact on efficiency, cost, service, and speed. Generally, leagility is more suitable in supply chains where end-customer demand is volatile and unexpected, but ultimate customers are also price-sensitive. Despite the importance of this trend in SCM, it is revealed that supply chain performance evaluation models also need to use the Internet, IoT, and cloud computing to timely identify, monitor, track, and analyze the changes in all supply chain links [7]. By implementing leagility in the whole SC network, the service quality will be assured, as well as low inventory cost downstream, the stability and efficiency of upstream manufacturing and operations [7].

➢ **Collaboration**

Collaboration and proper trust between various SC functions are needed to improve supply chain performance [85]. Therefore, decision-makers need to collaborate to understand their needs, expectations, and each other's responsibilities. This will help eliminate repetitive tasks and improve each function's performance and the quality and efficiency of customer deliveries [29,38]. The reviewed existing supply chain performance evaluation models lack strong collaboration among SC functions and lack suitable methods to improve overall supply chain performance. As a result, SCPEMs need to collaborate with different SC functions and boost overall SC performance.

➢ **Digitalization**

Digitalization helps companies create transparency, improve the quality and efficiency of supply chain processes, modernize business models as well as track and monitor all activities, assets, and operations electronically [86]. This will provide decision-makers with a holistic view of the whole supply chain and help them make fast decisions related to SC functions [5,42]. Unfortunately, the reviewed SCPEMs are not suitable for capitalizing on the benefits of digitalization measures and improving overall supply chain performance. To cope with this trend, it is required to design supply chain performance evaluation systems that include digitalization measures and enhance overall SC performance.

- **Sustainability**

Unlike classical SCM, sustainable SCM helps companies increase profitability and, at the same time, it helps to minimize negative environmental effects and increase social welfare [87]. On the other hand, sustainable SCM requires companies to take financial feasibility into account when considering the sustainable part of their SCs [88]. This highlights the importance of changing the focus of supply chain performance management from operational excellence to social and environmental responsibility [9,69]. Therefore, integrating the issue of sustainability into supply chains will improve the environmental, social, and financial performance of supply chains [71]. Meanwhile, this will give decision-makers a comprehensive view of the overall supply chain based on triple bottom line factors (environmental, social, and economic) and help them make accurate and rapid decisions related to SC functions. The reviewed SCPEMs lack the introduction of measures and metrics to evaluate the sustainability performance of supply chains, given the complexity of the decision-making processes. To deal with the sustainability trend, it is required to design supply chain performance evaluation models that consider the sustainability performance and track the indicators that support decision-making and improve the whole SC performance.

- **Integrated SC**

An integrated supply chain is an association of customers and suppliers that collaborate to improve their collective performance in creating, distributing, and supporting a final product utilizing management approaches. Integration among SC functions has become vital for efficient SC [29,89]. Therefore, it reduces bullwhip effects and enhances overall SC performance. Each SC process and its related measuring criteria impact the whole SC performance. Integration within SC is also important to provide relationships between long-term (strategic and tactical) and short-time (operational) decisions and decision measures [29,38]. This will help decision-makers make suitable decisions and understand their impact on overall supply chain performance. To align existing SCPEMs with this trend, an integrated supply chain performance evaluation system that encompasses all SC activities, provides relationships between decisions and decision measures, and assesses overall SC performance is required.

5 Conclusion

The value of the study is connected to the comprehensive review of existing supply chain performance evaluation models over a time span of 21 years (2000-2021) by reviewing academic research published in relevant peer-reviewed journals using ISI and SCOPUS databases. This study was focused on answering two set research questions:

RQ1. What are the existing supply chain performance evaluation models (SCPEMs)?
Before answering the RQ1, the authors have provided background knowledge on previous works and studies related to supply chain performance evaluation. Therefore, they have emphasized the development of this field over the past two decades. The review indicates that a substantial number of papers have been contributed to the field of supply chain performance.

In response to RQ1, the authors have conducted a literature survey based on 70 selected articles. They have classified SCPEMs in terms of focus area and the perspective considered (financial and non-financial) and found out their applicability in today's business environment. The review revealed that the SCOR model and BSC are the most widely applied supply chain performance evaluation frameworks. Meanwhile, they have several limitations, as mentioned in table 4.

RQ2.What are the SCPEMs' drawbacks and the gap between existing SCPEMs and the current trend of SCM?
To answer the RQ2, the proposed work discusses various limitations and drawbacks of each SCPEM in Section 4. This leads to identifying the knowledge gap in existing SCPEMs, as indicated in Section 4. Findings reveal that existing supply chain performance evaluation models are not aligned with the emergence of disruptive technologies observed in SCM. Therefore, the authors have recommended some SCM trends to be considered in the future when designing a SCPEM. For example, integration between each SC function will help improve productivity, quality, and customer satisfaction effectively and efficiently because disruptive technologies have made SCM complicated nowadays. This shows the importance of designing an integrated model that enables the traceability and transparency of all supply chain activities, incorporates all SC functions, and provides relationships between long-term (strategic and tactical) and short-time (operational) decisions and decision measures and evaluates overall SC performance. Moreover, given the competitive environment and the emergence of disruptive technologies such as digitalization and industry 4.0, and the importance of environmental and social criteria as key elements for business success, developing supply chain performance evaluation systems that include digitalization, sustainability measures and sustainability reporting capabilities [90] to improve overall SC performance are recommended as future research. This work illustrates the main characteristics that should be considered when designing and developing a SCPEM in a new business environment. Therefore, the suggested study is a solid basis for both academics and decision-makers in the field of supply chain management.

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