

Article

A Proposed Performance-Measurement System for Enabling Supply-Chain Strategies

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Abstract: Existing performance-measurement systems in the supply-chain literature have been designed for specific supply chains. Without a business-appropriate performance-measurement system, practitioners devise strategies that are neither scientific nor supported by data. The objective of this paper was to propose a performance-measurement system to support the enabling of supply-chain strategies. The proposed performance-measurement system (PMS), combining the Plan–Do–Check–Act cycle (PDCA) with the evidence-based management (EBM) concept, served as the basis for developing a procedural framework. The PMS was validated using the case logistics service providers (LSPs). The PDCA methodology was used to develop a structural framework for fourth-party logistics (4PL). In the Plan step, the research team identified the business problems of fourth-party logistics (4PL). In the Do step, the LSP literature was reviewed, to identify five performance dimensions (‘Service Quality’; ‘Social and Environmental’; ‘Inter-organizational Relationship’; ‘Financial’; and ‘Efficiency and Effectiveness’), and key performance indicators (KPIs). The 4PL management team participated in the finalization of the five performance dimensions and the 53 KPIs, which were used to propose a preliminary version of the structural framework for the 4PL. In the Check step, the data collected from 478 subcontractors of the 4PL were analyzed, using confirmatory factor analysis and structural equation modeling, and were used to validate the proposed structural framework for the 4PL. The validated structural framework was further presented at an academic conference, and to the 4PL for feedback, and was used to formulate supply-chain strategies through brainstorming. The findings include a validated structural framework containing five performance dimensions and 32 KPIs. The research revealed that input performance (‘Service Quality’, ‘Social and Environmental’, and ‘Inter-organizational Relationship’) positively affected output performance (‘Financial’ and ‘Efficiency and Effectiveness’). Supply-chain strategies were further suggested to the 4PL. The validating case in this study demonstrated that the employed procedural framework (PDCA and EBM) was applicable, and could be used to derive a structural framework and supply-chain strategies for the 4PL. This study contributes to the literature, by proposing a PMS for supply-chain strategy development. The paper’s illustrative case provides a practical application of how to develop a performance-measurement system.

Keywords: performance-measurement system; the PDCA cycle; evidence-based management; logistics service providers



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1. Introduction

Modern-day competition is no longer between companies but between supply chains [1]. Supply-chain management, therefore, requires the development of supply-chain strategies. The development of supply-chain strategies requires that all parties within the supply chains understand their respective baseline performances (‘As-Is’), and have a clear understanding with regards to their future directions (‘To-Be’) [2]. In the literature, many performance-measurement systems can lead to strategy development, but these are designed for specific supply chains [3,4], and raise a practical problem when applied

in another context [5]. Without a business-appropriate performance-measurement system, practitioners devise strategies that are neither scientific nor supported by data [1,6]. This underlines the need to develop a performance-measurement system that can guide practitioners in formulating supply-chain strategies based on scientific evidence. From a management perspective, performance-measurement systems should be developed using an approach that is logical, systematic, and communicable [5,7].

The objective of this paper was to propose a performance-measurement system to support the enabling of supply-chain strategies. The proposed performance-measurement system combined the Plan–Do–Check–Act (PDCA) cycle with the evidence-based management (EBM) concept. The case of logistics service providers (LSPs) providing last-mile transportation was used, to validate the proposed performance-measurement system. This study contributes to the literature, by proposing a performance-measurement system that can be used in enabling supply-chain strategies. The paper’s illustrative case provides a practical application of the proposed performance-measurement system.

The structure of the paper is as follows. The next section provides an overview of the literature on performance-measurement systems for supply-chain management. It is followed by an introduction to the PDCA and EBM concepts and their applications in the context of performance-measurement systems. In Section 3, the context of LSPs is presented. The research methodology is explained next, and shows how the PDCA and EBM concepts were adapted within the context of measuring LSPs’ performance. The findings are reported in Section 4. Section 5 begins with theoretical discussions regarding the use of the PDCA cycle and EBM in the development of a performance-measurement system, and then moves on to managerial implications. The contribution and limitations of the study are summarized in Section 6, along with suggestions for future research.

2. Literature Review

This section includes a review of the literature on performance-measurement systems for supply-chain management, and a review of the PDCA and EBM concepts.

2.1. Supply-Chain Strategies

Supply-chain strategies are supply-chain management objectives and ways to operationalize these objectives, to achieve improved performance; whereas operations strategies are plans for utilizing a company’s resources [8,9]. Consequently, supply-chain strategies transcend operations strategies, which are established within the boundaries of a single organization. This emphasizes the importance of supply-chain strategies in defining operations strategies, and organizations should consider both supply-chain and operations strategies when constructing effective and efficient supply networks that benefit all parties involved [10]. Developing supply-chain and operations strategies necessitates a performance-measuring framework that enables practitioners to comprehend their baseline performances [2].

2.2. Performance-Measurement Systems

The performance-measurement literature divides performance-measurement frameworks into two types: structural and procedural. Structural performance-measurement (hereafter structural frameworks) specifies performance-measurement typologies, without prescribing the process used to develop them. Procedural performance-measurement (hereafter procedural frameworks) gives a step-by-step process for developing performance measurement [7]. The performance-measurement literature has provided lists of the most-used structural and procedural frameworks [7,11,12]. Folan and Browne [7] further emphasized that structural and procedural frameworks are developed independently. Structural frameworks provide typologies for performance measurement, but lack a procedural element. In contrast, procedural frameworks offer a systematic approach to performance measurement, but lack performance typologies.

When structural and procedural frameworks are combined, the combination is known as a performance-measurement system. There is a limited list of performance-measurement systems in the literature [7,13,14]. Among them, the Balanced Scorecard (BSC) [15] has been the most widely studied and implemented in the performance-measurement literature [11]. In the supply-chain-management literature, several performance-measurement systems have been proposed [16–19]. The Supply-Chain Operations Reference (SCOR) model [20] and the BSC have been recognized as the most prevalent performance-measurement systems used for improving supply chains [21,22].

The BSC is a method that facilitates the development of a firm's strategy [15]. The BSC's structural framework includes four dimensions: financial, customer, internal business process, and learning and growth perspectives [15]. The latter three dimensions focus on non-financial and operational aspects complementary to the financial dimension. The BSC's procedural framework consists of translating vision, communicating and linking, business planning, and feedback and learning [15]. The BSC is the most well-recognized management control system [23] that helps reduce issues related to insufficient information, inconsistent incentives, and coordination [24]. There are applications of the BSC in supply-chain-management literature [25–27].

The SCOR model enables organizational strategies that can enhance supply chains. The initial level of the SCOR model includes five dimensions: supply-chain dependability, flexibility, responsiveness, cost, and assets. The second level includes metrics employed to indicate the causes of performance gaps identified at the first level. The third level contains metrics used to analyze the causes identified at the second level. There are five steps in the procedural framework: plan; source; make; deliver; and return. Researchers have employed the SCOR model for enhancing supply-chain processes [28,29].

There are, however, criticisms of the SCOR model and the BSC, when they are used to develop performance-measurement systems for supply-chain improvement. The SCOR model focuses on operational measures and process-improvement, but does not support supply-chain strategy development [30–33]. Axelsson and Frankel [32] have also criticized the SCOR model for having a pre-defined list of performance measures, that needs to be tailored to the organizational context. Similarly, the BSC comes with predetermined performance dimensions, and is somewhat generic, requiring considerable adjustments to match the objectives and operations of the organization [33,34]. Other criticisms of the BSC include the exclusion of important stakeholders, competitive business environments, and the social aspects of the industry [3,35,36].

All of the above-mentioned limitations underline the need for a performance-measurement system for supply-chain management. Such a system should permit adaptability to the business context, reflect a company's day-to-day operations, and enable the formulation of supply-chain strategies. The following is a description of the PDCA cycle, and an explanation of why it can be used to solve the limitations identified by the literature: inability to support supply-chain strategy development; having a predetermined list of performance measures; having difficulty in adjusting to the organizational context; and neglecting relevant stakeholders, competitive business environments, and social aspects of the industry.

2.3. Plan-Do-Check-Act and Evidence-Based Management

The PDCA cycle was proposed by Shewhart [37], and popularized by Deming [38], for use as a problem-solving technique within the context of quality management. It consists of Plan (planning), Do (implementing the plan), Check (evaluating the implementations), and Act (processing the outcomes). Currently, the PDCA cycle is recognized as a scientific methodology with a standardized procedure that allows for continual improvement [39–42].

In the supply-chain management literature, few studies have utilized the PDCA cycle, with the majority focusing on green supply chains [43–45]. In contrast, the performance-measurement literature contains several examples of researchers applying the PDCA cycle in various circumstances, such as manufacturing [40], education [45], and employee devel-

opment [46]. There are also many applications of PDCA-type cycles in the benchmarking literature [40], which is not surprising, given that the researchers in this field appear to be inspired by the PDCA cycle [47]. Developing performance-measurement systems and strategies for continuous improvement is one of the main purposes of the use of the PDCA cycle in benchmarking research [40,47]. According to Bhutta and Huq [48] and Pham Evans et al. [49]: the Plan step entails identifying a problem; the Do step includes carrying out the Plan; the Check step involves analysis of data; the Act step consists of activities to close the gaps and evaluations of the outcomes of these actions.

In conclusion, the literature suggests that the PDCA cycle is a methodology that should enable us to develop a performance-assessment system that satisfies a company's goal and its desire for continuous improvement. The methodology also allows for adaptation to the organization context and its day-to-day operations, and should lead to formulating supply-chain strategies.

In addition, Kulikowski [50] has proposed using Evidence-Based Management (EBM) in the PDCA cycle, to increase the scientific robustness of the PDCA methodology. EBM was introduced into the management field to decrease biases in human decision-making, and to promote the objectivity of decisions and judgments [51]. This objectivity can be derived from four primary sources: (1) scientific research; (2) information from organizations; (3) the judgments and opinions of managers, practitioners, and specialists participating in organizations; (4) the opinions of stakeholders [52]. Kulikowski [50] proposed a six-step critical-thinking process of EBM in the PDCA cycle, and believed that this should stimulate critical thinking: 'Ask', in evidence-based planning, indicates that researchers must translate practical problems into answerable inquiries; in evidence-based doing, there are two steps—'Acquire' refers to systematically searching for and gathering evidence, and 'Appraise' refers to critically assessing the reliability and significance of the evidence; 'Aggregate', in evidence-based checking, is the process of weighing and pulling evidence together; the last two steps, in this six-step critical-thinking process of EBM, entail evidence-based acting—'Apply' refers to incorporating the evidence in the decision-making process, and 'Assess' refers to analyzing the outcome of the decision made. The integration of EBM's six-step critical-thinking process in the PDCA cycle has not, to the best of our knowledge, been empirically validated.

The following section introduces the case used in this study, and describes how the PDCA cycle and EBM were adapted to propose a performance-measurement system. The proposed performance-measurement system was further employed to derive a performance-measurement system for the case under investigation.

3. Methodology

3.1. The Context of the Validating Case

Logistics service businesses in Thailand have been criticized for lacking competitiveness [53], as compared to most European Union member states and OECD members [54]. Due to globalization, many local logistics service businesses in Thailand must compete with multinational corporations such as Kerry, DHL, and Maersk. This creates challenges for both small-size local logistics service businesses and large local logistics service firms.

The corporation under investigation (hereafter 'FIRM') is a large local logistics service business operating in the context of last-mile transportation services. It offers consolidation services through its central distribution center, based in a location with connections to all regions in Thailand. FIRM has also extended its services to parcel-delivery services. FIRM offers different types of services, which include business-to-business, business-to-consumer, and consumer-to-consumer.

FIRM is a large fourth-party logistics (4PL) that offers logistics services through its subcontractors, who are operators of pick-up trucks or trucks with loads less than 1.5 tons. In its day-to-day operation, FIRM receives customer orders, and then assigns its subcontractors to perform delivery services to FIRM's customers. The data used to validate the proposed measurement system in this study were the performances of these subcontractors.

This study selected FIRM and its subcontractors for two reasons: firstly, the increase in e-commerce trade has rendered last-mile delivery critical, and the performance of such last-mile delivery parties is key to the success or failure of e-commerce businesses [55]; secondly, our research team could access FIRM and its subcontractors' data.

3.2. Development of Performance-Measurement System

Figure 1 illustrates the PDCA methodology employed in this study, and the result of each step of PDCA.

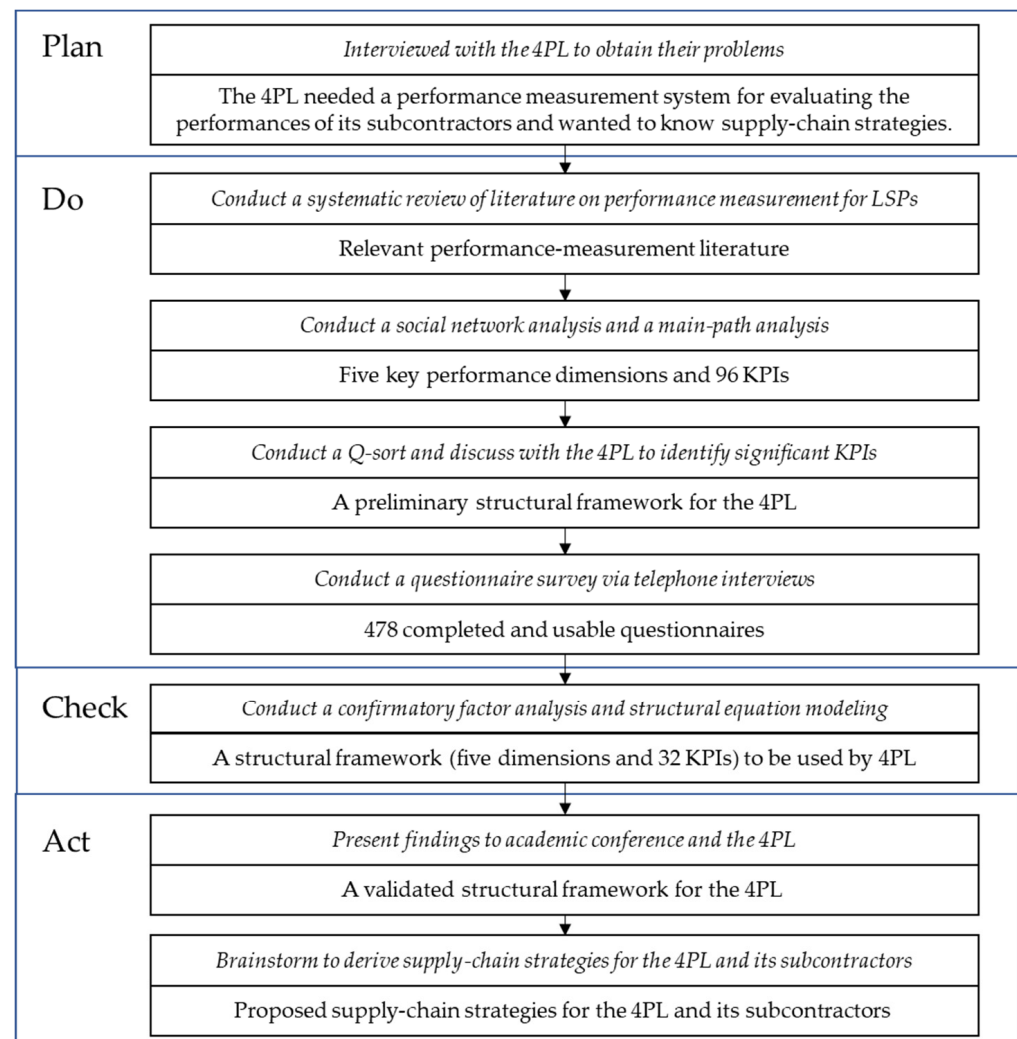


Figure 1. Research methodology.

Table 1 explains the process for developing the performance-measurement system for the LSPs under study. The concepts of the PDCA cycle and EBM served as the foundation for establishing the proposed procedural framework (i.e., the six-step critical-thinking process that was adapted for the development of a performance-measurement system). Each step of the proposed procedural framework was operationalized, using the research instruments listed in Table 1, to develop a structural framework for FIRM. The following is a summary of the research undertaken.

Table 1. Process for developing the performance-measurement system for the LSPs under study.

PDCA	EBM	Proposed Procedural Framework	Research Instruments Used in the Study
Plan: identifying a problem.	Ask: translate practical problems into answerable inquiries.	Obtain requirements from FIRM.	Interview with the management team of FIRM.
Do: carrying out the Plan.	Acquire: systematically search for and retrieve the evidence.	Search and review relevant performance-measurement literature.	Conduct a systematic review of literature on performance-measurement for LSPs.
		Identify performance dimensions and key performance indicators (KPIs).	Conduct a social network analysis, to reveal key performance dimensions and a main-path analysis to identify relevant KPIs.
		Develop preliminary-version performance of the structural-measurement framework for FIRM and its subcontractors under study.	Choose the system model as a theoretical foundation for a preliminary framework, using the Q-sort technique to sort the key performance dimensions and KPIs into a preliminary framework.
	Appraise: critically assess the reliability and significance of the evidence.	Validate the preliminary framework with FIRM under study.	Interview and discuss with FIRM, to refine the preliminary framework to fit with the FIRM context.
		Carry out data collection.	Collect data from FIRM's subcontractors, using a questionnaire survey via telephone interviews.
Check: analysis of data.	Aggregate: weigh and pull evidence together.	Validate the measurement model and the structural model.	Analyze the obtained data, using confirmatory factor analysis and structural equation modeling.
Act: activities to close the gaps and evaluations of the outcomes of these actions.	Apply: incorporate the evidence in the decision-making process.	Conduct model correction.	Present findings to academic conference, and to the management team of FIRM.
	Assess: analyze the outcome of the decision made.	Analyze the results of the developed structural framework to propose supply-chain strategies.	Brainstorm between the authors, to derive supply-chain strategies for FIRM.

In the Plan step, to obtain FIRM's needs, an interview [56] was conducted with the management team of FIRM, to determine general concerns and issues associated with the current competition in the LSP industry. The management included the managing director and two logistics managers. The interviews were carried out two times, lasted for four hours in total, and were noted in memos.

In the Do step, to acquire evidence, a systematic review of literature [57] on performance measurement for LSPs was carried out in 2019, via Scopus and ProQuest, which identified a total of 209 articles. Details of the systematic literature review can be found in Varadejsatitwong et al. [58]. Screening for the relevancy and trustworthiness of each identified article, using Ramos's [59] criteria, resulted in 93 articles. Using Pajek Software 4.01, social network analysis (SNA) [60] was employed to link the relevant citations identified in the 93 articles, and reveal key performance dimensions. For each performance dimension,

seminal papers were identified, using main-path analysis [61], and were reviewed by the research team, to extract key performance indicators (KPIs).

The systems model [62] served as the theoretical foundation for developing a preliminary-version performance of the structural-measurement framework for FIRM. The model posits that a company uses inputs to produce outputs (i.e., products and services) that satisfy customer needs [62]. The model has been implemented in numerous service industries [63,64], including transportation-service performance [65]. Similar to prior research on performance measurement for supply-chain management (e.g., [66]), the Q-sort technique [67] was employed to categorize the key performance dimensions into either the input or output side of the system model. The systems model and the key performance dimensions were introduced to 12 experts who attended an international conference, and they were then requested to do the sorting task. The agreements between the experts were evaluated, using an internal reliability assessment, and were acceptable, with a score of 70% [68]. The extracted KPIs were derived from their relevant performance dimension (i.e., significant articles in each performance dimension provided relevant KPIs); the Q-sort technique was employed to establish the relevance of the KPIs to their performance dimensions. The same group of experts was asked to sort the identified KPIs by performance dimension. A preliminary-version performance of the structural-measurement framework for FIRM was thus derived.

The management team of FIRM was interviewed, to assess the preliminary version's applicability, and to tailor it to the contexts of FIRM and its subcontractors. Finally, the structural framework to be used by FIRM was proposed. Next, a survey [69] was administered, between July 2019 and February 2021. A questionnaire, containing key performance dimensions and KPIs pertinent to each dimension, was prepared (Appendix A). The importance of each KPI to its performance dimension was determined, using a Likert scale ranging from 1 (less important) to 5 (most important). The data were acquired from FIRM's subcontractors, using the questionnaire and telephone interviews [56]. FIRM provided an accurate and up-to-date list of subcontractors; the authors called each subcontractor on the list, and asked them to participate in the survey. Each interview lasted around 30 min, to cover all questionnaire items. There was a total of 503 responses, of which 478 were complete and usable, which was sufficient for a test using confirmatory factor analysis (CFA) and structural equation modeling (SEM) [70].

In the Check step, the proposed structural framework was empirically validated, using the collected data. Following Srivastava and Singh's [71] recommendation, CFA was used to validate the measurement model, and to evaluate inter-relationships between KPIs in each performance dimension. KPIs with standardized factor loadings below a score of 0.60 were excluded [70,72]. Construct reliability was tested by observing Cronbach alpha values [70]. The results of the CFA analysis were then used to develop an operational model that described the relationship between input and output performance. The operational model was validated by SEM testing, using AMOS version 23. Given the results of SEM, a structural framework for FIRM was established.

In the Act step, to conduct a model correction, the structural framework was presented at an academic conference, and subsequently presented to the management team for feedback collection. Next, the research team expanded the output of the model correction, to create supply-chain strategies. Through brainstorming [73], the authors analyzed the structural framework, to propose supply-chain strategies for FIRM and its subcontractors. The following section reports the findings of the study.

4. Findings

Table 2 reports the findings from implementing the proposed procedural framework. The information presented below corresponds to the six-step critical-thinking process.

Table 2. Findings from the case of LSPs under study.

PDCA	EBM	Proposed Procedural Framework	Evidence-Based Findings
Plan	Ask	Obtain requirements from FIRM.	- FIRM required a performance-measurement system for evaluating its subcontractors, and strategies for improving the subcontractors' performances.
		Search and review relevant performance-measurement literature.	- The results of the systematic literature review.
Do	Acquire	Identify performance dimensions and key performance indicators (KPIs).	- Five key performance dimensions: 'Service Quality'; 'Social and Environmental'; 'Inter-organizational Relationship', 'Financial'; and 'Efficiency and Effectiveness'. - Ninety-six KPIs relevant for all key performance dimensions.
		Develop preliminary-version performance of the structural-measurement framework for FIRM and its subcontractors under study.	- The sorting result of key performance dimensions. - The sorting result of the KPIs. - The preliminary-version performance of the structural-measurement framework for FIRM (five key performance dimensions and 96 KPIs)
	Appraise	Validate the preliminary framework with FIRM under study.	- The proposed structural framework for FIRM (five key performance dimensions and 53 KPIs).
		Carry out data collection.	- A questionnaire (Appendix A). - Completed and usable questionnaires (N = 503; n = 478).
Check	Aggregate	Validate the measurement model and the structural model.	- The results of confirmatory factor analysis and structural equation modeling. - The structural framework to be used by FIRM (five key performance dimensions and 32 KPIs).
	Apply	Conduct model correction.	- Feedback collected from academics and FIRM.
Act	Assess	Analyze the results of the developed structural framework to propose supply-chain strategies	- Proposed supply-chain strategies for FIRM and its subcontractors.

In the Ask step, a conversation with FIRM revealed that FIRM needed a performance-measurement system for evaluating the performance of its subcontractors. Due to the limitations of the current performance-measurement system provided in the literature (Section 2), FIRM could not develop its performance-measurement system, and lacked knowledge of the framework's components. In addition, FIRM wanted to know how to formulate supply-chain strategies, to improve its subcontractors' performances and its overall supply chain.

In the Acquire step, social network analysis was used to process 93 articles identified from the systematic review of the literature; the social network analysis indicated five groups of articles: 21 articles related to service quality; 5 articles related to social and environmental aspects; 16 articles related to inter-organizational relationship, 4 articles related to financial aspects; and 47 articles related to efficiency and effectiveness. The results of the systematic literature review can be found in Varadejsatitwong et al. [58]. The citation networks of these articles are depicted in Appendix B, along with the titles of the five key performance dimensions: 'Service Quality', 'Social and Environmental', 'Inter-organizational Relationship', 'Financial', and 'Efficiency and Effectiveness'. The main-path analyses found 96 KPIs collected from the seminal studies that the 93 articles cited;

these KPIs included 22 indicators for the ‘Service Quality’ dimension, 27 for the ‘Social and Environmental’ dimension, 16 for the inter-organizational relationship dimension, 16 for the ‘Financial’ dimension, and 15 for the ‘Efficiency and Effectiveness’ dimension.

The Q-sort technique done by the experts revealed that the input performance was comprised of two performance dimensions: the ‘Financial’ dimension and the ‘Efficiency and Effectiveness’ dimension. The output performance included the remaining performance dimensions, namely, ‘Service Quality’, ‘Social and Environmental’, and ‘Inter-organizational Relationship’. Therefore, the preliminary-version performance of the structural-measurement framework for FIRM was developed. In addition, the Q-sort technique applied to the 96 KPIs yielded results similar to the literature.

In the Appraise step, the management team of FIRM appraised the preliminary framework, and suggested modifications. In conclusion, 51 out of 96 KPIs were chosen, as they were suitable for FIRM and its subcontractors. Two additional KPIs were added to the ‘Efficiency and Effectiveness’ dimension: the number of transportation accidents and the number of fatal transportation accidents. Accordingly, the preliminary framework comprised 53 KPIs (Appendix C), and was ready for empirical testing.

In the Check step, the Cronbach alpha values indicated that all key performance dimensions had scores greater than 0.90, and that all average variance extracted values exceeded 0.50. Each factor loading score was over 0.60. This supported the convergent and discriminant validity. According to the results of CFA, only 32 KPIs were included in the measurement model (Figures 2 and 3). Figure 4 shows that the SEM results suggested that the input–output performance relationship described in the operational model was validated, based on fit indices proposed by academics [74–77]. Thus, the structural framework to be used by FIRM was established (Table 3).

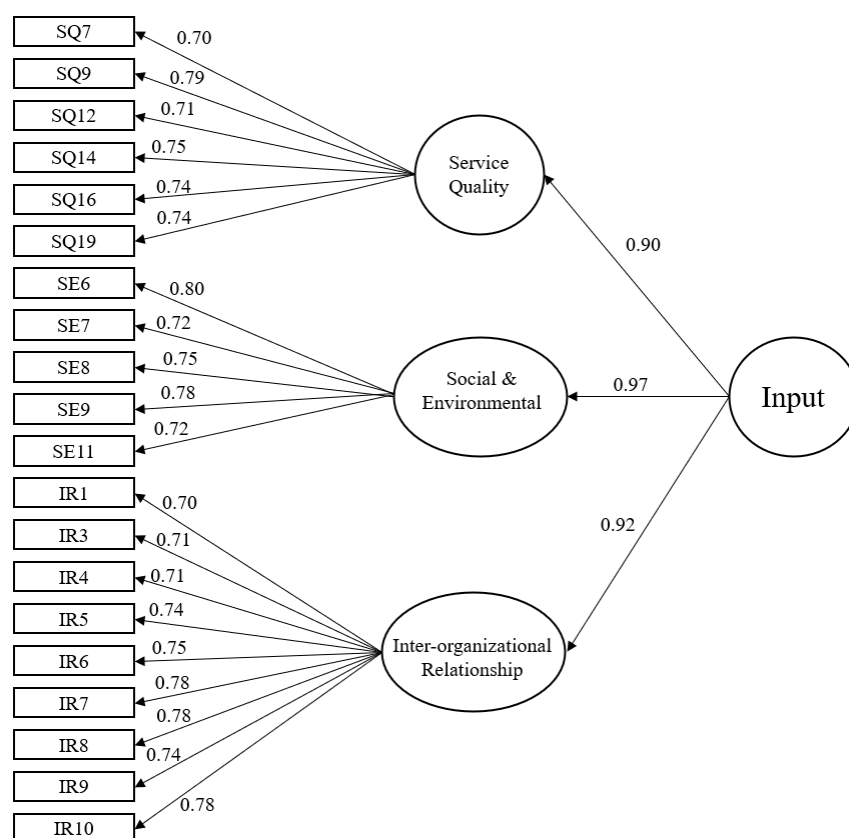


Figure 2. Input performance. Adapted from Varadejsatitwong et al. [58].

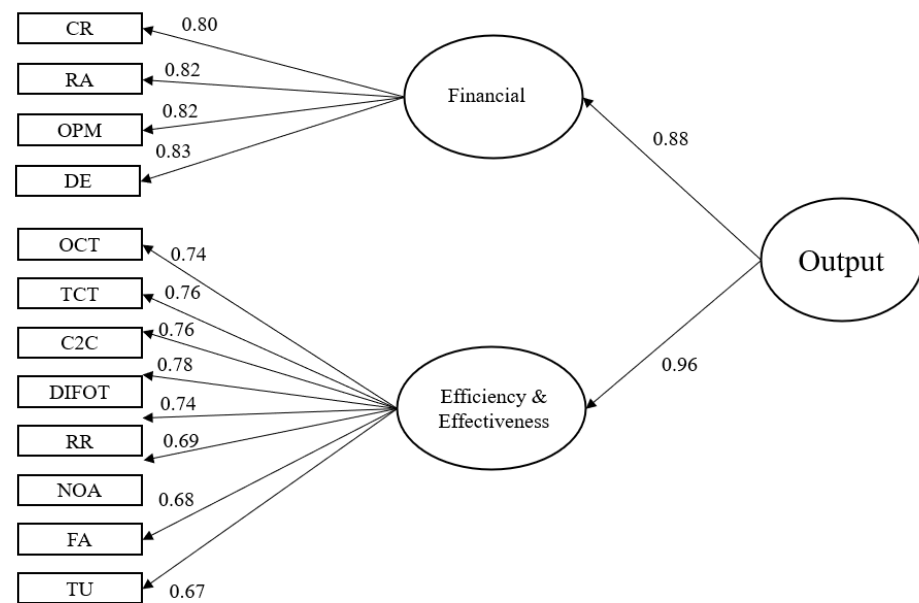


Figure 3. Output performance. Adapted from Varadejsatitwong et al. [58].

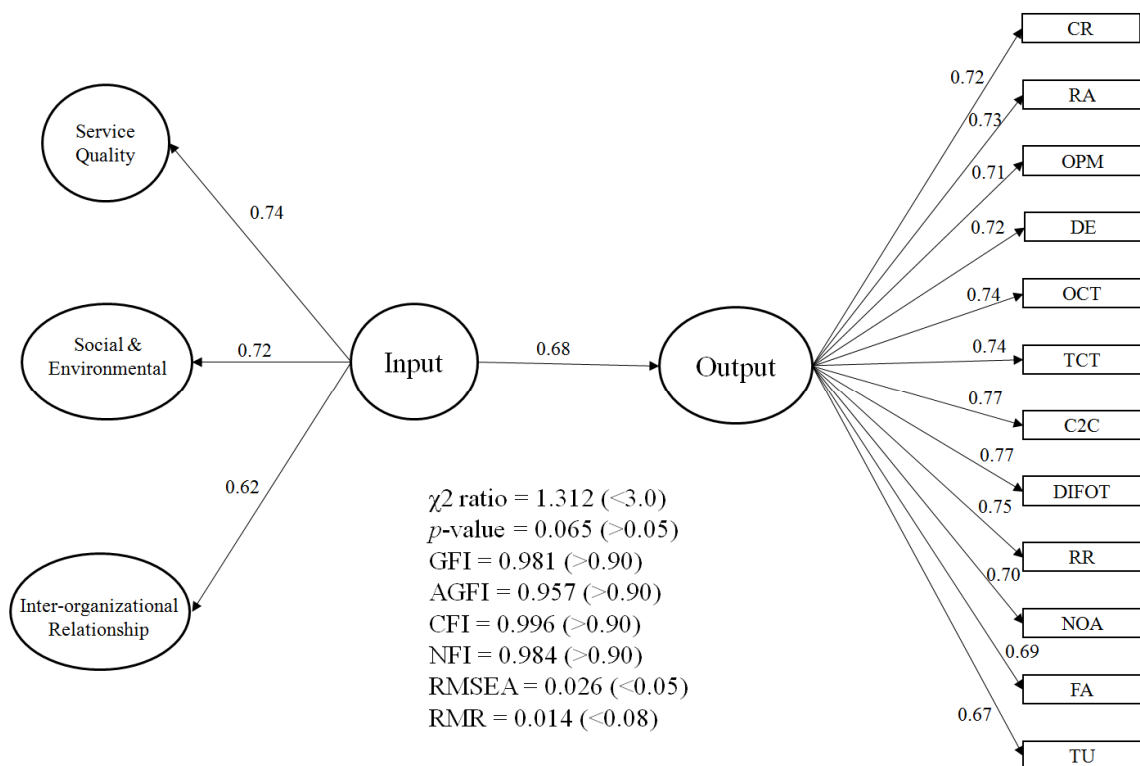


Figure 4. Results of structural equation modeling. Adapted from Varadejsatitwong et al. [58].

Table 3. A structural framework for FIRM.

Dimension	Input Performance			Output Performance	
	Service Quality	Social and Environmental	Inter-Organizational Relationship	Financial	Efficiency and Effectiveness
KPI			(1) There is cooperation within the organization through joint learning processes/activities.		
		(1) There have been any strikes in the last 2 years.	(2) Management level is involved in activities to create engagement at all levels.		
	(1) Consistency of the service.	(2) The company pays a basic salary that is equal or higher than the legal local minimum wage.	(3) There is a delegation of the power to make decisions on actions to the personnel of various parties.	(1) Current Ratio.	(1) Order cycle time.
	(2) Provide enough information to customers.	(3) The company provides all workers with legally required social security and benefits.	(4) There are opportunities for personnel to participate in the development of the organization.	(2) Return on Asset.	(2) Transport cycle time.
	(3) Respond quickly to customer claims.	(4) The company have an Environmental Management System.	(5) Trustworthiness among partners.	(3) Operating profit margin.	(3) Cash-Conversion Cycle.
	(4) Clear policy on warranty, security.	(5) Any environmental training has been provided for the company personnel during the previous three years.	(6) There is an exchange of information with each other, such as co-planning work and joint decisions.	(4) Debt to Equity ratio.	(4) Delivery in full and on time.
	(5) Staff knowledge and expertise.		(7) Knowledge and technology transfer.		(5) Return rate.
	(6) Care for customers' needs and interests.		(8) Risk-sharing.		(6) Number of accidents.
			(9) There is a written contract agreement.		(7) Fatal accident.
					(8) Truck utilization.

In the Apply step, the academics and the management team of FIRM made comments on the structural framework. The academics agreed with the research instruments used, the analysis methods, and the conclusions of the investigation, and recommended that the findings might be applied to all subcontractors. Regarding the management team of FIRM, they concurred with the selection of 32 indicators, and stressed their inexperience with the input–output relationship and its components. In the past, FIRM evaluated subcontractors by mainly using financial, efficiency-related, and effectiveness-related indicators. These indicators were also interpreted independently: for instance, return-on-asset (ROA) was merely used to determine the strategic actions implemented to increase the efficiency of machinery use and reduce operating expenses. Therefore, the structural framework had increased their knowledge of performance dimensions and KPIs. FIRM was now aware of alternative strategies for improving financial performance, such as enhancing service quality and cultivating customer relationships. Additionally, FIRM intended to use the developed performance-measurement system to enable benchmarking of its subcontractors' performances.

In the Assess step, the results of brainstorming suggested the supply-chain strategies for FIRM and its subcontractors (Table 4). These strategies were offered to enhance the input side of the systems model: 'Service Quality'; 'Social and Environmental'; and 'Inter-organizational Relationship'. As the input performance affected the output performance, implementing the proposed strategies should affect the input side of the systems model—specifically, the 'Financial' dimension and the 'Efficiency and Effectiveness' dimension. In addition, Table 4 contains only the strategies designed to improve the most important KPIs in each dimension. As implementing the strategies was an early step for FIRM and its subcontractors, it was more realistic to focus primarily on improving the most important KPIs. Table 4 contains supply-chain and operational strategies, because the two are inter-related, and companies should consider both when establishing supply chains that benefit all parties [78]. Following this section are theoretical and managerial discussions based on the findings.

Table 4. Proposed strategies for the LSPs under study.

Dimension	Indicator	Examples of Supply-Chain Strategies	Examples of Operations Strategies
'Service Quality'	Provide enough information to FIRM (SQ9).	Improve the effectiveness of the information-sharing system between FIRM and subcontractors, in terms of day-to-day operational information.	- Secure shared information [79,80]. - Increase information accuracy [78,81]. - Increase the level of information readiness [79,82].
	Encounter any employee strike in the past two years (SE6).	Increase collaboration between FIRM and subcontractors, to develop collaborative workforce management.	- Improve labor relations to increase employee retention rates [83,84]. - Motivate executives, with direct/indirect incentives to initiate programs enhancing employee welfare [85].
'Social and Environmental'	Adopt an Environmental Management System (EMS) (SE9).	Promote sustainable resources management between FIRM and subcontractors.	- Reduce environmental impact, through services, processes, and corporate policies [86–88]. - Reduce CO₂ emissions, by optimizing the last-mile-transportation truck routing [89].

Table 4. Cont.

Dimension	Indicator	Examples of Supply-Chain Strategies	Examples of Operations Strategies
'Inter-organizational Relationship'	Exchange information with each other, such as co-planning work, and joint decisions (IR7).	Improve the effectiveness of the information-sharing system between FIRM and subcontractors, in terms of joint decision making, planning, and research and development programs.	- Secure shared information [90,91]. - Increase information accuracy [92,93]. - Increase the level of information-readiness [90,94].
	Implement knowledge and technology transfer (IR8).	Initiate knowledge- and technology- sharing orientation between FIRM and subcontractors.	- Provide support from top management [95]. - Develop trust between firms [95].
	Have a written contract agreement (IR10).	Adopt efficient legal enforcing contracts and agreements.	- Enforce written contracts, to bind the exchanging partners to follow the rules [93,94].

5. Discussions

This section begins with our reflections on the application of the PDCA cycle and EBM in the study, and is followed by our proposal for a performance-measurement system and its managerial implications.

5.1. Theoretical Implications

5.1.1. Reflections on the Use of the PDCA Cycle and EBM

It has been suggested that the PDCA cycle is a standard methodology for developing, monitoring, and evaluating frameworks [96]. The PDCA cycle was adapted for the context of performance-measurement systems in this study. The PDCA cycle provided a process flow (i.e., from P to D to C to A) that could be used as a checklist, to ensure that the researchers did not overlook any crucial step in developing a performance-measurement system. As the PDCA cycle is an approach to continuous improvement [41,50], FIRM could re-examine and improve the structural framework whenever the business environment changed.

EBM has enhanced the PDCA cycle by providing granularity in each step. In this study, applying EBM helped to increase the scientific evidence supporting the development of a performance-measurement system. Researchers and managers were constantly required to provide scientific evidence to back their decisions at each stage of the development process. Combining EBM with the PDCA cycle strengthened the scientific robustness of the PDCA technique, and the robustness of the proposed performance-measurement system, as suggested by Kulikowski [50].

5.1.2. Proposed Performance-Measurement System

Figure 5 depicts the proposed performance-measurement system for supply-chain strategy development. The proposed performance-measurement system incorporates both procedural and structural frameworks, as suggested by Folan and Browne [7]. The proposed performance-measurement system provides a procedure for further developing a structural framework. It is more adaptable than existing performance-measurement systems, such as BSC and the SCOR model, which have predetermined performance dimensions. By using the proposed performance-measurement system, any practitioner, including the LSPs under study, should be able to create structural frameworks that reflect their company's daily operations and supply chain structures. Consequently, performance dimensions and KPIs in a structural framework will correspond with the organization's objectives. The proposed performance-measurement system can also facilitate the formulation of supply-

chain strategies. Such strategies are derived from the performance dimensions and KPIs unique to the organization's supply chain structure.

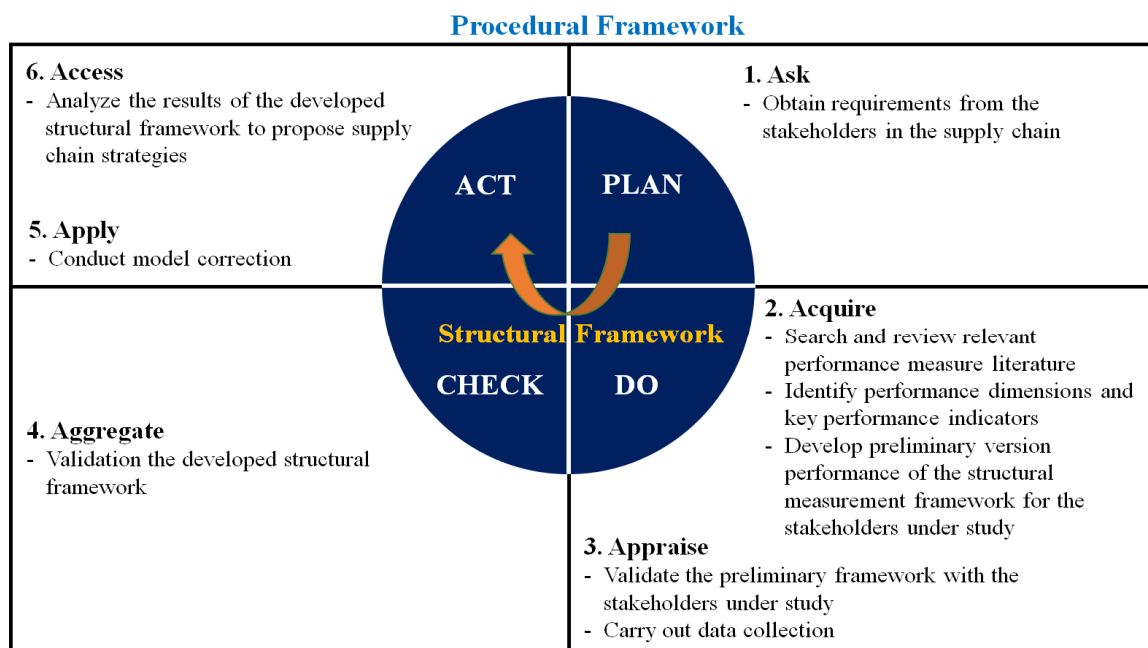


Figure 5. Proposed Performance-Measurement System.

The PDCA cycle and EBM integrated into the procedural framework provide a scientific methodological procedure and enhance the robustness of any developed structural framework. This implies that supply-chain strategies have been developed from scientific evidence rather than non-scientific opinions. In addition, as the PDCA cycle is a continuous improvement process, the proposed performance-measurement system permits regular revision of the structural framework. Practitioners would be recommended to update their structural frameworks if the business environment changed (e.g., as new supply-chain parties were added) or if there was a significant shift in the literature (e.g., as new knowledge emerged). As a result of these evolutions, the number of performance dimensions and KPIs could increase or decrease.

5.2. Managerial Implications

The proposed performance-measurement system would be made available to organizations seeking to develop their performance-measurement systems. This study provides a case study of LSPs, to illustrate the implementation of the proposed performance-measurement system. Companies' supply-chain managers can use this paper as a guide, in developing a performance assessment system.

Regarding supply-chain strategies, it can be seen from the illustrated case that only some KPIs were employed to determine supply-chain strategies. Ideally, FIRM would use all identified significant KPIs to formulate supply-chain and operational strategies, and to implement improvements. From a practical standpoint, however, doing so would have consumed FIRM's resources, and would have placed an excessive load on subcontractors. It was therefore recommended that FIRM should prioritize certain KPIs. By establishing these priorities, FIRM's supply chain managers were capable of focusing on addressing specific supply-chain issues. Subcontractors also had a lesser load, and were more readily motivated to collaborate with FIRM to implement the strategy. At this early stage, supply chain collaboration was then formed, and provided a foundation for further development and implementation of supply-chain strategies.

6. Conclusions

This paper proposes a performance-measurement system to support the enabling of supply-chain strategies. The case of LSPs in Thailand was employed, to validate and demonstrate an application of the proposed performance-measurement system.

This paper contributes to the supply-chain literature, by proposing a performance-measurement system. In other words, it offers an alternative way of developing a structural framework, by applying the procedural framework in the proposed performance-measurement system, which allows for adaptation to the business context and environment. As the proposed procedural framework was developed from the Plan-Do-Check-Act (PDCA) cycle and the concept of evidence-based management (EBM), this increased the scientific rigor of the structural framework and the derived supply-chain strategies. Furthermore, to our knowledge, this is the first study to empirically validate the combined PDCA and EBM methodology.

The paper contributes to practice, by demonstrating how to implement the proposed performance-measurement system via a validating case. Practitioners and academics are strongly encouraged to adopt the proposed system, when establishing a framework for performance measurement, and initiating supply-chain strategies. In addition, a list of the performance dimensions and KPIs outlined in this study may serve as a reference. LSPs may also utilize the list of KPIs to establish monitoring procedures for their day-to-day operations. The firm and LSPs under study can utilize the developed performance-measurement system and strategies to improve their supply-chain performance.

This study is nonetheless subject to limitations. In this study, the application of the proposed performance-measurement system was based on a dyadic relationship (i.e., FIRM and its subcontractors). However, this should not preclude future implementations of the proposed performance-measurement system in a non-dyadic relationship and various organizations (e.g., government and not-for-profit organizations). We encourage future studies to employ the proposed performance-measurement system with other supply-chain parties or more than two parties. When there are more than two parties, complications may occur, offering a challenge for future research.

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Institutional Review Board Statement: Not applicable. Ethical review and approval were waived for this study, due to the study was not involving humans. According to the American Association for Public Opinion Research (2022), the data in this study were not obtained from humans, the authors did not use any intervention or interaction with humans to gather data, and the study did not contain individuals' private data. Thus, this study did not meet the definition of 'human subjects'.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Performance Measurement Questionnaire for LSPs

1. Financial evaluation

- (1) Please indicates the current assets of your firm for last year: ... THB
- (2) Please indicates the current liability of your firm for last year: ... THB
- (3) Please indicates the EBIT of your firm for last year: ... THB
- (4) Please indicates the total asset of your firm for last year: ... THB

- (5) Please indicates the operating earnings of your firm for last year: THB
 (6) Please indicates the total revenue of your firm for last year: THB
 (7) Please indicates the total debts of your firm for last year: THB
 (8) Please indicates the total equity of your firm for last year: THB

2. Efficiency and effectiveness evaluation

Lead time

1. What is the average lead-time from the moment your company gets the order to the delivery of your service (for export/import, please use lead-time to/from main port/airport): _____ days
2. What is your average lead-time when transporting products to your main customer (for export/import, please use lead time to/from main port/airport): _____h/days
3. What is the average number of days between customer order delivery to receipt of customer payment: _____ days
4. What was the average number of days between supplier order receipt to order payment by your firm: _____ days

Reliability

5. What is the percentage of shipments per month that arrives on time to your main customer?: _____%
6. What is the percentages of shipments per month that arrives in full to your main customer?: _____%
7. What is the percentage of shipments per month that arrived wrong, arrived damaged and substitute items to your main customer?: _____%

Transportation efficiency

8. In recent years, there is a proportion of all accidents that occur during the transportation. Accounted for _____% of all transportation trips
9. In recent years, there is a proportion of fatal accidents that occur during the transportation. Accounted for _____% of all transportation trips
10. On average, the usage of the space in the transport vehicles accounted for _____% of the total space in the vehicle used for transportation

3. Service quality evaluation

Factors	Strongly Disagree —> Strongly Agree
(1) Modern equipment	
(2) Physical facilities are visually appealing	
(3) Employees always look neat	
(4) Appearance of the physical facilities are consistent with the type of service industry	
(5) Accuracy of documents	
(6) Short transit time	
(7) Consistency of the service	
(8) Fast responses to customers' requests	
(9) Provide enough information to customers	
(10) Good care of the customers	
(11) Fast and easy order and document processing	
(12) Quick respond to customer claims	
(13) Staff's willingness to provide service	
(14) Clear policy on warranty, security	
(15) No damage goods while in transit	

Factors	Strongly Disagree → Strongly Agree
(16) Staff's knowledge and expertise	
(17) High standard service	
(18) Keep customers' information confidentially	
(19) Care for customers' needs and interests	
(20) Assess customers' future needs	

4. Social and environmental evaluation

Factors	Strongly Disagree → Strongly Agree
Social responsibility	
(1) There is a current Health and Safety Action Plan for the company	
(2) The company keeps any statistics on lost time accidents, lost workdays resulting from incidents or total staff hours worked	
(3) Any health and safety training have been provided for company personnel during the previous 2 years	
(4) The company employs any personnel under the age of 18	
(5) There is any labor exacted under force, or not performed voluntarily by the workers	
(6) There have been any strikes in the last 2 years	
(7) The company pays a basic salary that is equal or higher than the legal local minimum wage	
(8) The company provides all workers with legally required social security and benefits e.g., health insurance, pension, maternity leave, etc.	
Environment concern	
(9) The company have an Environmental Management System (EMS)	
(10) The company have an environmental action plan outlining key actions and targets for the current year	
(11) Any environmental training has been provided for company personnel during the previous three years	

5. Inter-organizational relationship evaluation

Factors	Strongly Disagree → Strongly Agree
(1) There is a cooperation within the company through joint learning processes/activities	
(2) There have incentives to be able to achieve their goals	
(3) There is the involvement of management in activities to create engagement at all levels	
(4) There is a delegation of the power to make decisions on the actions in all departments	
(5) There are opportunities to participate in the development of the company	
(6) There is a trustworthiness among partners	
(7) There is an information sharing among partners	
(8) There is knowledge and technology transfer among partners	
(9) There is a risk sharing among partners	
(10) There is a written contract agreement between partners	

Appendix B

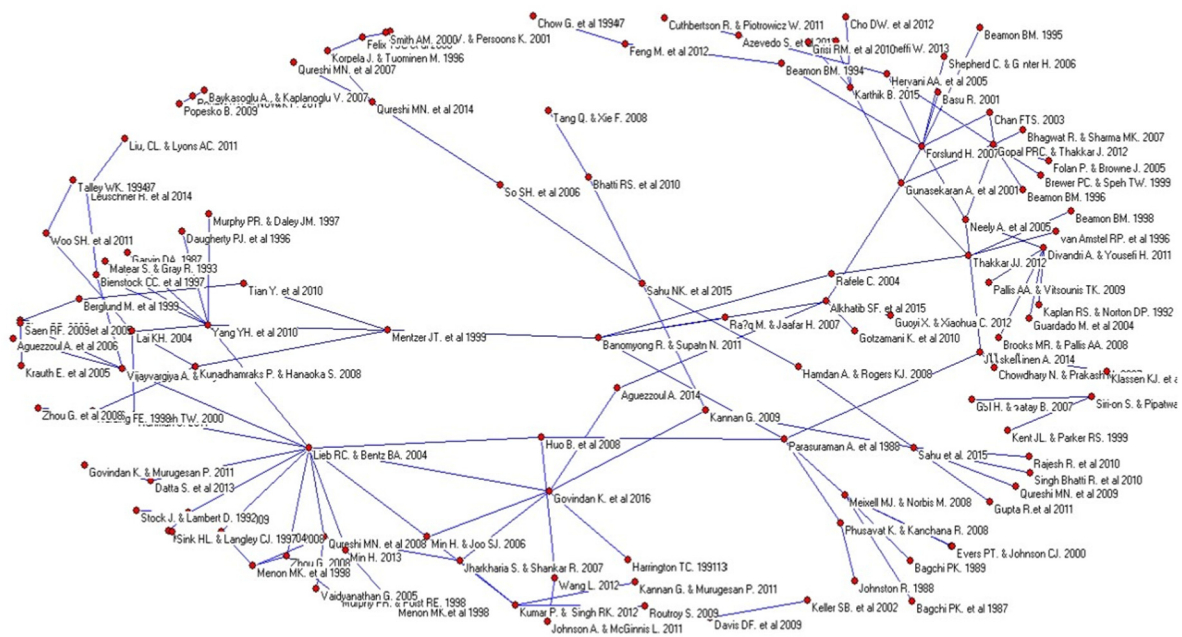


Figure A1. The citation network entitled ‘Efficiency and Effectiveness’.

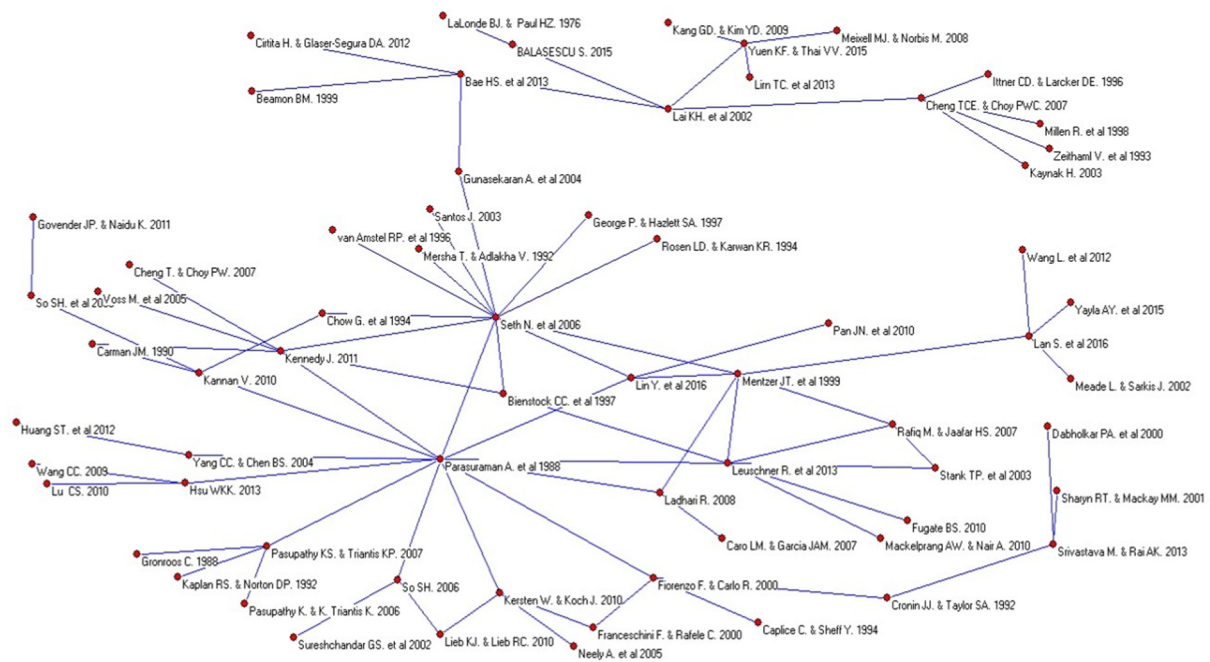


Figure A2. The citation network entitled ‘Service Quality’.

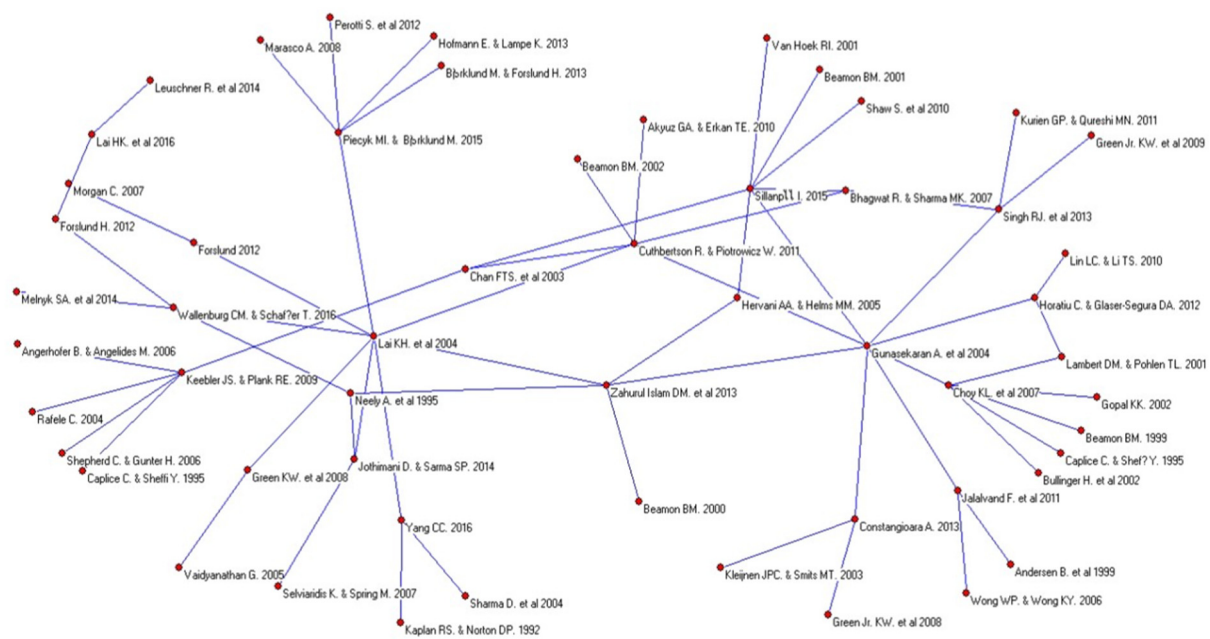


Figure A3. The citation network entitled 'Inter-organizational Relationship'.

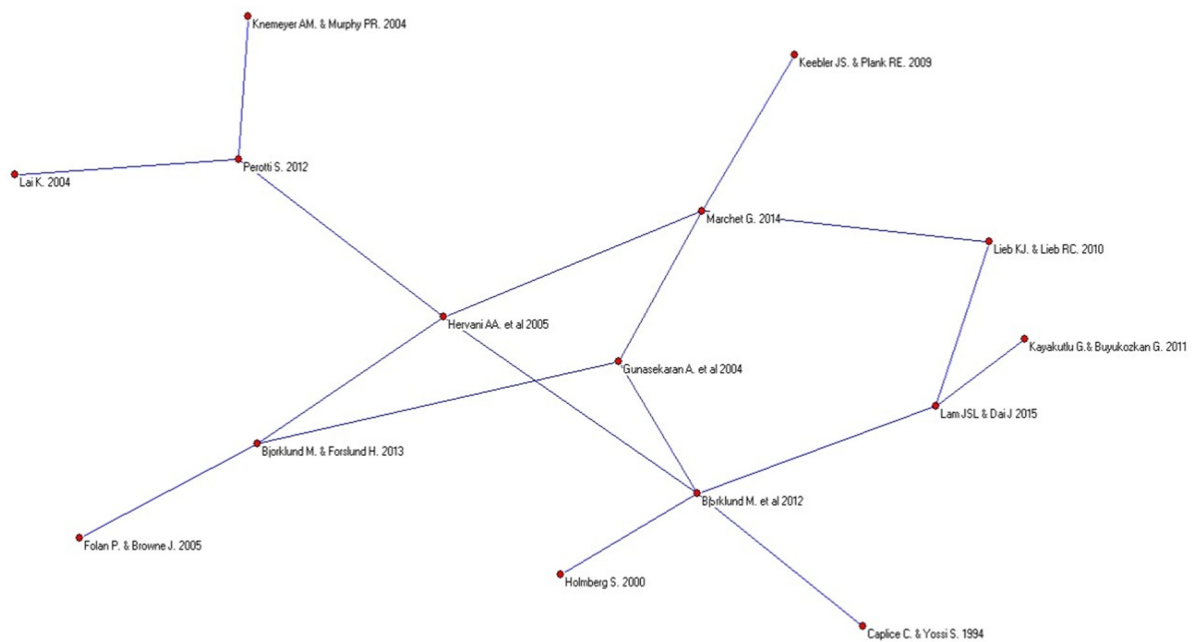


Figure A4. The citation network entitled 'Social and Environmental'.

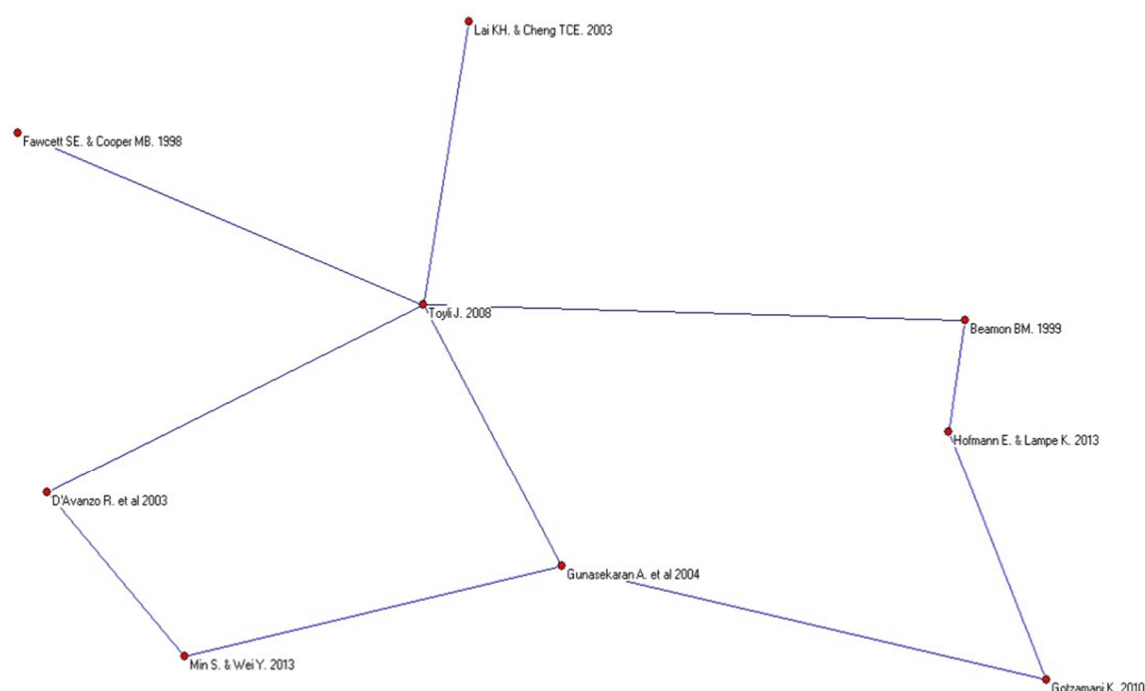


Figure A5. The citation network entitled 'Financial'.

Appendix C

Table A1. List of input performance indicators.

Indicator	Description	Standardized Regression Weights
SQ1	Modern equipment	0.535
SQ2	Physical facilities are visually appealing	0.518
SQ3	Employees always look neat	0.497
SQ4	Appearance of the physical facilities are consistent with the type of service industry	0.526
SQ5	Accuracy of documents	0.431
SQ6	Short transit time	0.558
SQ7	Consistency of the service	0.701
SQ8	Fast responses to customers' requests	0.462
SQ9	Provide enough information to customers	0.789
SQ10	Good care of the customers	0.558
SQ11	Fast and easy order and document processing	0.423
SQ12	Quick respond to customer claims	0.707
SQ13	Staff's willingness to provide service	0.389
SQ14	Clear policy on warranty, security	0.748
SQ15	No damage goods while in transit	0.542
SQ16	Staff's knowledge and expertise	0.743
SQ17	High standard service	0.414
SQ18	Keep customer's information confidentially	0.579
SQ19	Care for customer's need and interest	0.742
SQ20	Assess customer's future need	0.394

Table A1. Cont.

Indicator	Description	Standardized Regression Weights
SE1	There is a current health and safety action plan for the company	0.556
SE2	The company keeps any statistics on lost time accidents, lost workdays resulting from incidents or total staff hours worked	0.469
SE3	Any health and safety training have been provided for company personnel during the previous 2 years	0.471
SE4	The company employs any personnel under the age of 18	0.568
SE5	There is any labor exacted under force, or not performed voluntarily by the workers	0.511
SE6	There have been any strikes in the last 2 years	0.802
SE7	The company pays a basic salary that is equal or higher than the legal local minimum wage	0.717
SE8	The company provides all workers with legally required social security and benefits e.g., health insurance, pension, maternity leave, etc.	0.752
SE9	The company have an Environmental Management System (EMS)	0.783
SE10	The company have an environmental action plan outlining key actions and targets for the current year	0.498
SE11	Any environmental training has been provided for company personnel during the previous three years	0.734
IR1	There is a cooperation within the organization through joint learning processes/activities	0.703
IR2	There is incentives for personnel to be able to achieve their goals	0.464
IR3	Management level is involved in activities to create engagement at all levels	0.714
IR4	There is a delegation of the power to make decisions on the actions to the personnel of various parties	0.706
IR5	There are opportunities for personnel to participate in the development of the organization	0.741
IR6	Trustworthiness among partners	0.746
IR7	There is an exchange of information with each other such as co-planning work and joint decisions	0.778
IR8	Knowledge and technology transfer	0.751
IR9	Risk sharing	0.739
IR10	There is a written contract agreement	0.775

Table A2. List of output performance indicators.

Indicator	Description	Standardized Regression Weights
FN1	Current Ratio (times)	0.805
FN2	Return on Asset (%)	0.815
FN3	Operating profit margin (%)	0.818
FN4	Debt-to-equity ratio (times)	0.828
EE1	Order cycle time (days)	0.744
EE2	Transportation cycle time (days)	0.749
EE3	Cash conversion cycle (days)	0.763
EE4	Delivery in-full and on-time (%)	0.777

Table A2. Cont.

Indicator	Description	Standardized Regression Weights
EE5	Return rate (%)	0.743
EE6	Number of accidents (%)	0.689
EE7	Fatal accident (%)	0.683
EE8	Truck utilization (%)	0.674

References

1. Christopher, M. *Logistics & Supply Chain Management*, 4th ed.; Pearson: London, UK, 2011.
2. Xia, L.X.X. Supply chain modelling and improvement in telecom industry: A case study. In Proceedings of the 2006 4th IEEE International Conference on Industrial Informatics, Singapore, 16–18 August 2006.
3. Farokhi, S.; Roghanian, E.; Samimi, Y. Quantitative target setting in balanced scorecard method using simultaneous equations system and goal programming. *Int. J. Product. Perform. Manag.* **2019**, *69*, 2089–2118. [\[CrossRef\]](#)
4. Lima-Junior, F.R.; Carpinetti, L.C.R. Predicting supply chain performance based on SCOR® metrics and multilayer perceptron neural networks. *Int. J. Prod. Econ.* **2019**, *212*, 19–38. [\[CrossRef\]](#)
5. Tahir, A.C.; Darton, R.C. The process analysis method of selecting indicators to quantify the sustainability performance of a business operation. *J. Clean. Prod.* **2010**, *18*, 1598–1607. [\[CrossRef\]](#)
6. Shapiro, M.J.; Morey, J.C.; Small, S.D.; Langford, V.; Kaylor, C.J.; Jagminas, L.; Suner, S.; Salisbury, M.L.; Simon, R.; Jay, G.D. Simulation based teamwork training for emergency department staff: Does it improve clinical team performance when added to an existing didactic teamwork curriculum? *BMJ Qual Saf.* **2004**, *13*, 417–421. [\[CrossRef\]](#)
7. Folan, P.; Browne, J. A review of performance measurement: Towards performance management. *Comput. Ind.* **2005**, *56*, 663–680. [\[CrossRef\]](#)
8. Qi, Y.; Huo, B.; Wang, Z.; Yeung, H.Y.J. The impact of operations and supply chain strategies on integration and performance. *Int. J. Prod. Econ.* **2017**, *185*, 162–174. [\[CrossRef\]](#)
9. Schnetzler, M.J.; Sennheiser, A.; Schönsleben, P. A decomposition-based approach for the development of a supply chain strategy. *Int. J. Prod. Econ.* **2007**, *105*, 21–42. [\[CrossRef\]](#)
10. Jacobs, F.R.; Chase, R.B. *Operations and Supply Management*, 13th ed.; McGraw-Hill/Irwin: New York, NY, USA, 2011.
11. Liu, W.B.; Meng, I.W.; Mingers, J.; Tang, N.; Wang, W. Developing a performance management system using soft systems methodology: A Chinese case study. *Eur. J. Oper. Res.* **2012**, *223*, 529–540. [\[CrossRef\]](#)
12. Heikkilä, M.; Bouwman, H.; Heikkilä, J.; Solaimani, S.; Janssen, W. Business model metrics: An open repository. *Inf. Syst. E-Bus. Manag.* **2016**, *14*, 337–366. [\[CrossRef\]](#)
13. Kumru, M. A balanced scorecard-based composite measuring approach to assessing the performance of a media outlet. *Serv. Ind. J.* **2012**, *32*, 821–843. [\[CrossRef\]](#)
14. Hradílek, J. Cat Model for Complex Evaluation of Organisational Maturity in Small and Medium Enterprises. *Cent. Eur. Bus. Rev.* **2020**, *9*, 1. [\[CrossRef\]](#)
15. Kaplan, R.; Norton, D. The Balanced Scorecard—Measures That Drive Performance. *Harv. Bus. Rev.* **2005**, *83*, 172.
16. Van Hoek, R. Measuring the unmeasurable—Measuring and improving performance in the supply chain. *Int. J. Supply Chain. Manag.* **1998**, *3*, 187–192.
17. Beamon, B. Measuring supply chain performance. *Int. J. Oper. Prod. Manag.* **1999**, *19*, 275–292.
18. Holmberg, S. A systems perspective on supply chain measurements. *Int. J. Phys. Distrib. Logist. Manag.* **2000**, *30*, 847–868. [\[CrossRef\]](#)
19. Gunasekaran, A.; Patel, C.; Tirtiroglu, E. Performance measures and metrics in a supply chain environment. *Int. J. Oper. Prod. Manag.* **2001**, *21*, 71–87. [\[CrossRef\]](#)
20. APICS. *Supply Chain Operations Reference Model*; APICS Supply Chain Council: Chicago, IL, USA, 2019; available online: <http://www.apics.org/apics-for-business/frameworks/scor> (accessed on 12 July 2022).
21. Chorfi, Z.; Benabbou, L.; Berrado, A. An integrated performance measurement framework for enhancing public health care supply chains. *Supply Chain Forum.* **2018**, *19*, 191–203. [\[CrossRef\]](#)
22. Reddy, J.M.; Rao, N.; Krishnanand, L. A review on supply chain performance measurement systems. *Procedia Manuf.* **2019**, *30*, 40–47.
23. Zizlavsky, O. The Balanced Scorecard: Innovative Performance Measurement and Management Control System. *J. Technol. Manag. Innov.* **2014**, *9*, 210–222.
24. Van Veen-Dirks, P.M.G. Complementary choices and management control: Field research in a flexible production environment. *Manag. Account. Res.* **2006**, *17*, 72–105. [\[CrossRef\]](#)
25. Bhagwat, R.; Sharma, M. Performance measurement of supply chain management: A balanced scorecard approach. *Comput. Ind. Eng.* **2007**, *53*, 43–62. [\[CrossRef\]](#)

26. Reefke, H.; Trocchi, M. Balanced scorecard for sustainable supply chains: Design and development guidelines. *Int. J. Product. Perform. Manag.* **2013**, *62*, 805–826. [\[CrossRef\]](#)
27. Nouri, F.A.; Nikabadi, M.S.; Olfat, L. Developing the framework of sustainable service supply chain balanced scorecard (SSSC BSC). *Int. J. Product. Perform. Manag.* **2019**, *68*, 148–170. [\[CrossRef\]](#)
28. Li, L.; Su, Q.; Chen, X. Ensuring supply chain quality performance through applying the SCOR model. *Int. J. Prod. Res.* **2011**, *49*, 33–57. [\[CrossRef\]](#)
29. Sellitto, M.A.; Pereira, G.M.; Borchardt, M.; Da Silva, R.I.; Viegas, C.V. A SCOR-based model for supply chain performance measurement: Application in the footwear industry. *Int. J. Prod. Res.* **2015**, *53*, 4917–4926. [\[CrossRef\]](#)
30. Tang, L.C.; Goh, T.N.; Lam, S.W.; Zhang, C.W. Fortification of Six Sigma: Expanding the DMAIC toolset. *Qual. Reliab. Eng. Int.* **2007**, *23*, 3–18. [\[CrossRef\]](#)
31. Lepori, E.; Damand, D.; Barth, B. Benefits and limitations of the SCOR model in warehousing. *IFAC Proc. Vol.* **2013**, *46*, 424–429. [\[CrossRef\]](#)
32. Axelsson, P.; Frankel, J. *Performance Measurement System for Warehouse Activities Based on the SCOR®Model*; Department of Industrial Management and Logistics, Lund University: Lund, Sweden, 2014.
33. Rillo, M. Limitations of balanced scorecard. In Proceedings of the 2nd Scientific and Educational Conference, Business Administration: Business in a Globalizing Economy, Parnu, Estonia, 16 July 2004.
34. Thompson, K.R.; Mathys, N.J. It's time to add the employee dimension to the balanced scorecard. *Organ. Dyn.* **2013**, *2*, 135–144. [\[CrossRef\]](#)
35. Neely, A. The evolution of performance measurement research: Developments in the last decade and a research agenda for the next. *Int. J. Oper. Prod. Manag.* **2005**, *25*, 1264–1277. [\[CrossRef\]](#)
36. Barber, E. How to measure the “value” in value chains. *Int. J. Phys. Distrib. Logist. Manag.* **2008**, *38*, 685–698. [\[CrossRef\]](#)
37. Shewhart, W.A. *Economic Control of Quality of Manufactured Product*; Macmillan And Co., Ltd.: New York, NY, USA, 1931.
38. Deming, W.E. *The New Economics, for Industry, Government, Education*, 2nd ed.; MIT Press: Cambridge, MA, USA, 2000.
39. Ribeiro, L.M.M.; Cabral, S.J.A. A benchmarking methodology for metalcasting industry. *Benchmarking* **2006**, *13*, 23–35. [\[CrossRef\]](#)
40. Du, Q.L.; Cao, S.M.; Ba, L.L.; Cheng, J.M. Application of PDCA cycle in the performance management system. In Proceedings of the 2008 4th International Conference on Wireless Communications, Networking and Mobile Computing, Dalian, China, 12–14 October 2008; pp. 1–4.
41. Realyvásquez-Vargas, A.; Arredondo-Soto, K.C.; Carrillo-Gutiérrez, T.; Ravelo, G. Applying the Plan-Do-Check-Act (PDCA) cycle to reduce the defects in the manufacturing industry. A case study. *Appl. Sci.* **2018**, *8*, 2181. [\[CrossRef\]](#)
42. Hervani, A.M.; Helms, M.; Sarkis, J. Performance measurement for green supply chain management. *Benchmarking* **2005**, *12*, 330–353. [\[CrossRef\]](#)
43. Pesonen, V. Development and Analysis of Performance Measurement Indicators Utilized by Third Party Logistics Service Providers. Master's Thesis, Industrial Management, School of Technology and Innovations, University of Vaasa, Vaasa, Finland, 2021.
44. Ghosh, S.; Mandal, M.C.; Ray, A. A PDCA based approach to evaluate green supply chain management performance under fuzzy environment. *Int. J. Sci. Manag. Eng.* **2022**, 1–15. [\[CrossRef\]](#)
45. Sangpikul, A. Implementing academic service learning and the PDCA cycle in a marketing course: Contributions to three beneficiaries. *J. Hosp. Leis. Sports Tour. Educ.* **2017**, *21*, 83–87. [\[CrossRef\]](#)
46. Matsuo, M.; Nakahara, J. The effects of the PDCA cycle and OJT on workplace learning. *Int. J. Hum. Resour. Manag.* **2013**, *24*, 195–207. [\[CrossRef\]](#)
47. Sarkis, J. Benchmarking for agility. *Benchmarking* **2001**, *8*, 88–107. [\[CrossRef\]](#)
48. Bhutta, K.S.; Huq, F. Benchmarking—Best practices: An integrated approach. *Benchmarking* **1999**, *6*, 254–268. [\[CrossRef\]](#)
49. Pham Evans, M.T.; Tisak, D.J.; Williamson, D.F. Twenty-first century benchmarking: Searching for the next generation. *Benchmarking* **2012**, *19*, 760–780. [\[CrossRef\]](#)
50. Kulikowski, K. The model of evidence-based benchmarking: A more robust approach to benchmarking. *Benchmarking* **2021**, *28*, 721–736. [\[CrossRef\]](#)
51. Barends, E.; Rousseau, D.M. *Evidence-Based Management: How to Use Evidence to Make Better Organizational Decisions*; Kogan Page Publishers: New York, NY, USA, 2018.
52. Briner, R.B.; Denyer, D.; Rousseau, D.M. Evidence-based management: Concept cleanup time? *Acad. Manag. Perspect.* **2009**, *23*, 19–32. [\[CrossRef\]](#)
53. Banomyong, R.; Cook, P.; Kent, P. Formulating regional logistics development policy: The case of ASEAN. *Int. J. Logist. Res. Appl.* **2008**, *11*, 359–379. [\[CrossRef\]](#)
54. Rezaei, J.; van Roekel, W.S.; Tavasszy, L. Measuring the relative importance of the logistics performance index indicators using Best Worst Method. *Transp. Policy* **2018**, *68*, 158–169. [\[CrossRef\]](#)
55. Mangiaracina, R.; Perego, A.; Seghezzi, A.; Tumino, A. Innovative solutions to increase last-mile delivery efficiency in B2C e-commerce: A literature review. *Int. J. Phys. Distrib. Logist. Manag.* **2019**, *49*, 901–920. [\[CrossRef\]](#)
56. Gubrium, J.F.; Holstein, J.A. *Handbook of Interview Research: Context and Method*; Sage Publications: Thousand Oaks, CA, USA, 2001.
57. Hemingway, P.; Brereton, N. What Is a Systematic Review? *Hayward Med. Commun.* **2009**, *2*, 1–8.

58. Varadejsatitwong, P.; Banomyong, R.; Julagaasigorn, P. Developing a Performance Measurement Framework for Logistics Service Providers. In Proceedings of the 2021 Conference: The International Conference on Industrial Engineering and Operations Management (IEOM), Monterrey, Mexico, 3–5 November 2021; pp. 994–1005.
59. Ramos, T.B. Development of regional sustainability indicators and the role of academia in this process: The Portuguese practice. *J. Clean. Prod.* **2009**, *17*, 1101–1115. [\[CrossRef\]](#)
60. De Nooy, W.; Mrvar, A.; Batagelj, V. *Exploratory Social Network Analysis with Pajek*; Cambridge University Press: Cambridge, UK, 2005.
61. Hummon, N.P.; Dereian, P. Connectivity in a citation network: The development of DNA theory. *Soc. Netw.* **1989**, *11*, 39–63. [\[CrossRef\]](#)
62. Kemp, P.A. Researching housing management performance. *Urban. Stud.* **1995**, *32*, 779–790. [\[CrossRef\]](#)
63. Southern, G. A systems approach to performance measurement in hospitality. *Int. J. Contemp. Hosp.* **1999**, *11*, 366–376. [\[CrossRef\]](#)
64. Straub, A.; Koopman, M.; van Mossel, H.J. Systems approach and performance measurement by social enterprises. *Facilities* **2010**, *28*, 321–331. [\[CrossRef\]](#)
65. Sulek, J.M.; Lind, M.R. A systems model for evaluating transit performance. *J. Public Trans.* **2000**, *3*, 2. [\[CrossRef\]](#)
66. Banomyong, R.; Julagasigorn, P.; Varadejsatitwong, P.; Piboonrungrroj, P. The humanitarian supply chain assessment tool (HumSCAT). *J. Humanit. Logist. Supply Chain Manag.* **2019**, *9*, 221–249. [\[CrossRef\]](#)
67. Brown, S.R. A primer on Q methodology. *Operant. Subj.* **1993**, *6*, 91–138.
68. Hinkin, T.R.; Tracey, J.B.; Enz, C.A. Scale construction: Developing reliable and valid measurement instruments. *J. Hosp. Tour. Res.* **1997**, *21*, 100–120. [\[CrossRef\]](#)
69. Oppenheim, A.N. *Questionnaire Design, Interviewing and Attitude Measurement*; Bloomsbury Publishing: London, UK, 2000.
70. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E. *Multivariate Data Analysis*, 8th ed.; Cengage Learning EMEA: London, UK, 2019.
71. Srivastava, S.; Singh, R.K. Exploring integrated supply chain performance in healthcare: A service provider perspective. *Benchmarking* **2021**, *28*, 106–130. [\[CrossRef\]](#)
72. George, D.; Mallery, P. *SPSS for Windows Step by Step: A Simple Guide and Reference 11.0 Update*, 4th ed.; Allyn & Bacon: Boston, MA, USA, 2003.
73. Osborn, A.F. Principles and Procedures of Creative Thinking. In *Applied Imagination*; Scribners: Hunter, NY, USA, 1953.
74. Byrne, B.M. *Structural Equation Modeling with LISREL, PRELIS, and SIMPLIS: Basic Concepts, Applications, and Programming*; Lawrence Erlbaum Associates: Mahwah, NJ, USA, 1998.
75. De Jong, G. Causal loops in long-term supply relationships: Theory and evidence from the United States, Japan, and Europe. Ph.D. Thesis, SOM, University of Groningen, Groningen, The Netherlands, 1999.
76. Bagozzi, R.P.; Yi, Y. On the evaluation of structural equation models. *J. Acad. Mark. Sci.* **1988**, *16*, 74–94. [\[CrossRef\]](#)
77. Browne, M.W.; Cudeck, R. Alternative ways of assessing model fit. *Sociol. Methods Res.* **1992**, *21*, 230–258. [\[CrossRef\]](#)
78. Fu, X.; Dong, M.; Liu, S.; Han, G. Trust based decisions in supply chains with an agent. *Decis. Support Syst.* **2016**, *82*, 35–46. [\[CrossRef\]](#)
79. Panahifar, F.; Byrne, P.J.; Heavey, C. A hybrid approach to the study of CPFR implementation enablers. *Prod. Plan. Control* **2015**, *26*, 1090–1109. [\[CrossRef\]](#)
80. Lorenzo Ochoa, O.; Claes, B.; Koryak, O.; Diaz, A. Integration through orchestration: The interplay between enterprise systems and inventory management capabilities. *J. Enterp. Inf. Manag.* **2017**, *30*, 555–582. [\[CrossRef\]](#)
81. Tang, O.; Musa, S.N. Identifying risk issues and research advancements in supply chain risk management. *Int. J. Prod. Econ.* **2011**, *133*, 25–34. [\[CrossRef\]](#)
82. Lyu, J.; Ding, J.H.; Chen, P.S. Coordinating replenishment mechanisms in supply chain: From the collaborative supplier and store-level retailer perspective. *Int. J. Prod. Econ.* **2010**, *123*, 221–234. [\[CrossRef\]](#)
83. Greening, D.W.; Turban, D.B. Corporate social performance as a competitive advantage in attracting a quality workforce. *Bus. Soc.* **2000**, *39*, 254–280. [\[CrossRef\]](#)
84. Ting, I.W.K.; Azizan, N.A.; Bhaskaran, R.K.; Sukumaran, S.K. Corporate social performance and firm performance: Comparative study among developed and emerging market firms. *Sustainability* **2019**, *12*, 26. [\[CrossRef\]](#)
85. Hong, B.; Li, Z.; Minor, D. Corporate governance and executive compensation for corporate social responsibility. *J. Bus. Ethics* **2016**, *136*, 199–213. [\[CrossRef\]](#)
86. Bansal, P.; Roth, K. Why companies go green: A model of ecological responsiveness. *Acad. Manag. J.* **2000**, *43*, 717–736.
87. Journeault, M. The influence of the eco-control package on environmental and economic performance: A natural resource-based approach. *Manag. Account. Res.* **2016**, *28*, 149–178. [\[CrossRef\]](#)
88. Ormazabal, M.; Rich, E.; Sarriegi, J.M.; Viles, E. Environmental Management Evolution Framework. *Organ Environ.* **2017**, *30*, 27–50. [\[CrossRef\]](#)
89. Szymczyka, K.; Kadłubek, M. Challenges in general cargo distribution strategy in urban logistics—Comparative analysis of the biggest logistics operators in EU. *Transp. Res. Proc.* **2019**, *39*, 525–533. [\[CrossRef\]](#)
90. Islam, M.Z.; Jasimuddin, S.M.; Hasan, I. Organizational culture, structure, technology infrastructure and knowledge sharing: Empirical evidence from MNCs based in Malaysia. *VINE J. Inf. Knowl. Manag. Syst.* **2015**, *45*, 67–88. [\[CrossRef\]](#)
91. Rosendaal, B.; Frankema, K.B. Knowledge sharing within teams: Enabling and constraining factors. *Knowl. Manag. Res. Pract.* **2013**, *13*, 235–247. [\[CrossRef\]](#)

92. Rutten, W.; Blaas-Franken, J.; Martin, H. The impact of (low) trust on knowledge sharing. *J. Knowl. Manag.* **2016**, *20*, 199–214. [[CrossRef](#)]
93. Wang, C.L.; Siu, N.Y.M.; Barnes, B.R. The significance of trust and renqing in the long-term orientation of Chinese business-to-business relationships. *Ind. Mark. Manag.* **2008**, *37*, 819–824. [[CrossRef](#)]
94. Wang, C.L.; Shi, Y.; Barnes, B.R. The role of satisfaction, trust and contractual obligation on long-term orientation among Chinese and Western managers. *J. Bus. Res.* **2015**, *68*, 473–479. [[CrossRef](#)]
95. Vij, S.; Farooq, R. Multi-group moderation analysis for relationship between knowledge sharing orientation and business performance. *J. Knowl. Manag.* **2014**, *10*, 36–53. [[CrossRef](#)]
96. Baba, M.D.; Sha'ri, M.Y.; Azhari, M.S. A benchmarking implementation framework for automotive manufacturing SMEs. *Benchmarking* **2006**, *13*, 396–430. [[CrossRef](#)]