

## A review of financial and non-financial measures of supply chain performance

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### Abstract:

This study ascertains the pertinent measures and metrics of supply chain performance through an extensive literature review. A total of 53 international peer-reviewed journal articles published between 2012-2021 were retrieved from Scopus, Emerald insight, Elsevier and Springer databases for review. The articles reviewed were selected and categorised based on the approach, scope and contribution in assessing and ascertaining the measures and metrics of supply chain performance. Limited to the review of literature, this study provides a benchmark and approaches for ascertaining the level of supply chain performance from financial and non-financial perspectives. Throughout the review, the study found inventory turnover ratio, supply chain and logistics costs and cash flows reflected in terms of ROI, ROE, ROA, profit margin, working capital and assets as the prime financial measures of supply chain performance. Moreover, the study found customer satisfaction, delivery performance, quality services, enhanced relationships and competitive advantages as the key non-financial measures of supply chain performance. The study concludes and recommends the financial and non-financial measures as the appropriate approaches for ascertaining the level of supply chain performance. In order to appropriately ascertain the level of supply chain performance, performance measurement should be accounted for by all actors at each node of the supply chain, using the same approach, measures and metrics. Additionally, further studies are required to address the benefits and issues that impede supply chain performance and measurements across different sectors of the economy.

### Key words:

Supply chain performance, performance measurement, supply chain performance measures, supply chain key performance indicator, financial measures, non-financial measures.

## 1. Introduction

Dynamic market forces, globalisation, technological advancement and intensive competition between supply chains have exerted pressures on business firms to plan, strategize and adopt the best practices along the supply chain to enhance their operational and financial performance. The key drivers toward sustainable supply chain performance are the excellence and supply chain actors' ability in adopting the best supply chain practices. Studies by [Benzidia and Makaoui \(2020\)](#), [Bhattacharya and](#)

[Kumar \(2020\)](#) and [Malviya \(2019\)](#) spotted green supply chain, just-in-time (JIT), collaboration among the supply chain actors, total quality management (TQM), elimination of non-value-adding activities through lean-Kaizen practices, the ability to respond quickly to everchanging market forces (agility) and adoption of computer-based supply chain systems such as enterprises resources planning (ERP), e-procurement systems, e-commerce and electronic data interchange (EDI) as the best supply chain practices that significantly influence supply chain performance. Assessment of the performance of

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supply chain management and its related activities is centred on two supply chain goals. These are the substance goals and the relationship goals. These goals form a benchmark for measuring and evaluating the level of supply chain performance. These include the desire to meet the market requirements in terms of cost-effectiveness, timely delivery, customers satisfaction, enhanced long-term relationships among the supply chain actors, quality standards and financial sustainability (Tigga et al., 2021; Kailash and Goyal, 2021; Mishra et al., 2018).

Measuring and ascertaining the level of supply chain performance requires accurate indicators and data because the outputs have a significant impact on the organisation's strategic, tactical and operational decision-making and goal-setting. According to Chand et al. (2020), Gawankar et al. (2019) and Moreira and Tjahjono (2016) the future directions, targets and allocation of resources depend on the current status of supply chain performance metrics or indicators being revealed. Appropriate measures of supply chain performance enable managers and other practitioners along the supply chain to be able to identify the weaknesses in a particular business firm and employ resources, adopt the best supply chain practices and strategies toward the most efficient and effective supply chain performance. Conversely, inadequate measurement and evaluation result in the ultimate failure of a supply chain in the realisation of its goals. In order to enhance improved supply chain performance, the supply chain performance measures, control and evaluation systems should involve comparing the actual or the current level of supply chain performance against pre-set targets and objectives (Ramezankhani et al., 2018; Karamouz et al., 2020; Matsoso and Benedict, 2017). The supply chain performance indicators should be measurable, either qualitatively or quantitatively to ascertain the level at which the supply chain has achieved its strategic, tactical and operational objectives.

Despite the set of targets, goals and objectives in place, measuring and evaluating the success of supply chain performance have remained a common challenging task in some business firms and organisations. Frederico et al. (2021) and Menhat and Yusuf (2018) highlighted the lack of a common supply chain measurement approach, measures, benchmarks and metrics as the major issues that impede effective assessment of supply chain performance. Managers and scholars eagerly seek and strive toward enforcing the best approaches for measuring and evaluating supply chain performance so as to help business firms

cope-up with dynamic market forces and achieve the desired goals along the supply chain. Sustainable and excellent supply chain performance requires the establishment of common measures and metrics for ascertaining and tracking whether the set of supply chain goals have been attained at each node of the supply chain. Several models have been put in place by scholars and supply chain managers as important tools for measuring, evaluating and ascertaining the success of supply chain activities. These include the balanced scorecard (BSC) tool, the supply operations reference model (SCOR), the economic value added (EVA), the activity-based costing model (ABC) and the global supply chain forum (GSCF) (Ramezankhani et al., 2018; Karamouz et al., 2020). Moreover, financial and non-financial performance approach has also gained momentum. Each model or approach has unique features and is used depending on the nature, activity and status of a particular organisation or supply chain.

There exists vast literature that addresses and discusses the approaches and tools for measuring and ascertaining the level of supply chain performance across different firms, organisations and sectors of the economy. However, a discussion on the prime approach and strategy for measuring and assessing the performance of the supply chain has yet been concluded. No common approach and strategy for measuring and ascertaining the level of supply chain performance has been established. Reviewed studies have approached this topic from a single perspective of supply chain performance measurement, stemming from quantitative and qualitative perspectives (Tigga et al., 2021; Mishra et al., 2018; Junior and Carpinetti, 2017), financial measures (Jin et al., 2017; Galankashi and Rafiei, 2021) and non-financial measures (Matsoso and Benedict, 2014). However, there exist limited literature that jointly reviews and integrates the measures and metrics of supply chain performance. This study is a review of literature that summarises the findings from previous studies on the measures and metrics of supply chain performance from financial and non-financial perspectives. The pertinent questions under this study are: how do business firms measure and evaluate their performance along their chain? what are the appropriate measures for ascertaining the level of supply chain performance? From this base, this study reviews the literature and establishes whether financial and non-financial approaches are the appropriate measures for assessing and ascertaining the level of supply chain performance.

## **2. Supply chain performance measurements**

Supply chain performance measurement is the process which is aimed at quantifying and qualifying the efficacy and success of supply chain activities and goals using a set of standards and metrics (Kamble and Gunasekaran, 2019; Junior and Carpinetti, 2017). On the other hand, supply chain performance measures refer to an approach used by supply chain managers and other practitioners to assess and judge the success of supply chain system using a set of established performance metrics and indicators (Elgazzar et al., 2019; Laihonon and Pekkola, 2016). The metrics which are used in assessing the success of supply chain activities are ascertained depending on the approach, the objectives and the measure set forth by the supply chain managers. The performance metrics essentially mean key performance criteria which are set and derived from the target goals and objectives of the supply chain. From the reviewed literature, we discovered different measures and approaches for assessing the success of supply chain activities (supply chain performance). Some studies used quantitative and qualitative measures (Junior and Carpinetti, 2017; Mishra et al., 2018) while others used financial and non-financial perspectives (Galankashi and Rafiei, 2021; Jin et al., 2017; Matsoso and Benedict, 2017). Each measure is employed depending on the specific objectives of supply chain management, the firm's operational activities, and the nature of performance metrics which are sought to be generated along the supply chain.

Qualitative measures are non-numeric measures that describe the traits and characteristics of supply chain performance. It ascertains, evaluates or measures the success of the supply chain by assessing the quality of services and goods offered, the competitiveness position of a business firm or organisation, customer satisfaction and enhanced supply chain relationships among supply chain actors (Baumann and Genoulaz, 2014; Dhaigude and Kapoor, 2017; Bai et al., 2012). However, some literature regards the qualitative measures and metrics of supply chain performance from a non-financial perspective. The measures like customer satisfaction, quality of the products and supply chain relationships are qualitative and non-financial in nature since they cannot be quantified in numeric and have no direct financial implications

(Tigga et al., 2021; Piotrowicz and Cuthbertson, 2015). The quantitative measures use performance metrics that can be quantified and expressed in numeric form. It includes the performance measures and metrics like order processing and manufacturing lead time, customers order fill rate, inventory turnover ratio, profit margin, sales and returns (Matsoso and Benedict, 2017; Piotrowicz and Cuthbertson, 2015; Kamble and Gunasekaran, 2019). Deepening further into the literature, we found that quantitative measures and metrics of supply chain performance can be viewed from financial and non-financial perspectives. For example, delivery performance such as on-time delivery, lead time and cycle time are perceived as both quantitative and non-financial measures of supply chain performance. Meanwhile, cash flows such as profits margin, ROI, ROA, ROE and supply chain-related costs are quantitative and financial in nature. The financial and non-financial measures and metrics overlap the quantitative and qualitative measures and approaches for ascertaining the level of supply chain performance. On the other hand, the prime objective of any business firm along the supply chain is to achieve financial sustainability through profit maximization, cost minimisation and customer satisfaction (Govindan et al., 2017; Israel, 2022c; Frederico et al., 2021). From this base, this study regards financial and non-financial as the appropriate measures and metrics for ascertaining the level and success of supply chain activities. Nevertheless, non-financial measures and metrics of supply chain performance which include customer satisfaction, quality performance and delivery performance have indirect financial implications for a business firm. Keeping customers satisfied for example through timely delivery, better relationships and quality services attract and retains more customers, which in turn results in high sales, revenue and profit margin (Bjorklund et al., 2012; Israel, 2022a; Kamble and Gunasekaran, 2019). From the reviewed articles, the study managed to extract nine (9) constructs for supply chain performance measures (see Table 1). These are customer satisfaction, supply chain relationships, quality performance, firm's competitive advantages, delivery performance, supply chain costs, inventory turnover ratio, cash flow and lead time. The detailed measures and key performance indicators (metrics) for each category of supply chain performance are presented in tables 3 and 4, and are discussed in the results section of this study.

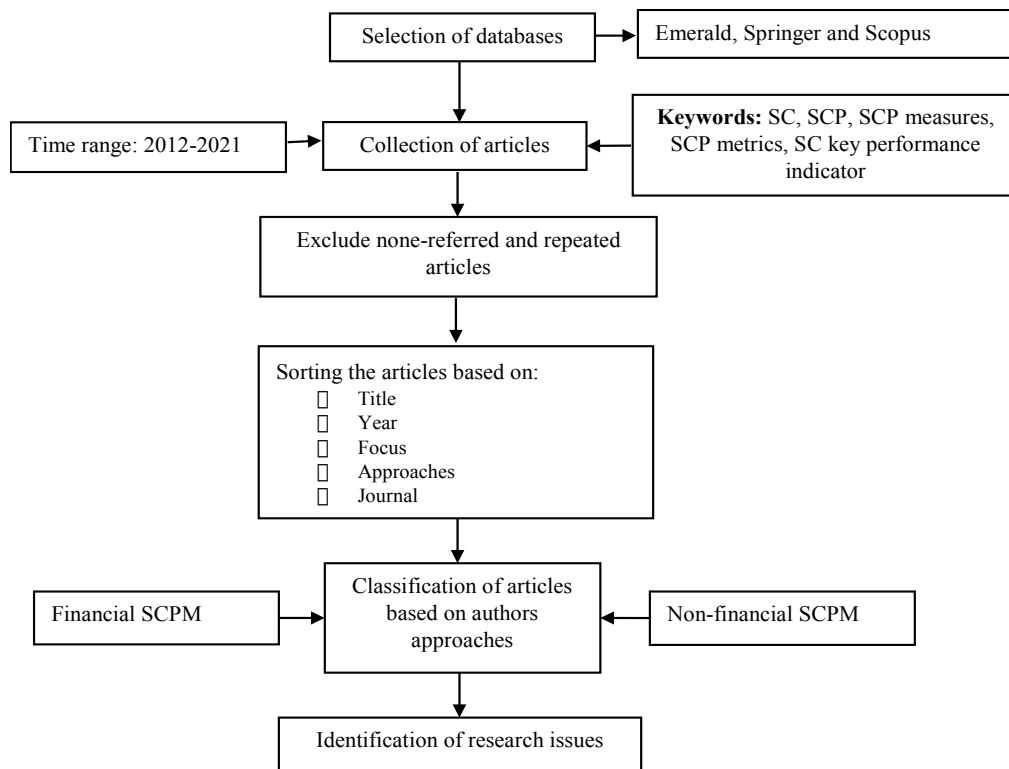
**Table 1.** Overview of the empirical literature on SC performance measures.

SC Performance measures	Descriptions	Supporting reference
Customers satisfaction	Measures how happy customers are with the firm's products and services and how quickly SC is flexible and responsive in responding to customers' problems.	Tigga et al. (2021), Charkha and Jaju, (2019), Jain and Verma (2021)
Quality performance	The extent to which SC meets agreed products and service specifications, minimizes defect rate, customer complaints and rejection rate.	Karamouz et al. (2020), Patil et al. (2021), Laihonon and Pekkola (2016)
Supply chain relationships	Measures of enhanced cooperations and strategic partnerships, alliances, coordination and collaboration among supply chain actors.	Ramezankhani et al. (2018), Anand and Grover (2015), Benzidia and Makaoui (2020)
Competitive advantages	Measures of SC's ability in meeting quality standards, cost, time, certifications, financial resources and commercialization of unique products and services.	Moreira and Tjahjono (2016), Israel (2022b), Piotrowicz and Cuthbertson (2015)
Delivery performance	The measure of the ability of SC to consistently deliver the requirements at the agreed quality and quantities within a due time and place from reliable suppliers to ensure continuous availability of supplies.	Charkha and Jaju (2019), Jain and Verma (2021), Hsu et al. (2013), Samaranayake and Laosirihongthong (2016)
Supply chain cost	Cost-effectiveness of SC, undertaking SC activities at a reasonable low cost and within the preestimated SC, budget quantified in the total SC and logistics costs.	Elrod et al. (2013), Zaman and Ahsan (2014), Kailash and Goyal (2021), Sillanpaa (2015)
Inventory turnover ratio	Measure how well the business firms along the supply chain use their inventory, or how frequent inventories are purchased, used and replaced within the organization to enhance their operations.	Katiyar et al. (2015), Karamouz et al. (2020), Piotrowicz and Cuthbertson (2015), Ramezankhani et al. (2018)
Cash flow	Measures SC performance in the context of financial sustainability such as profit margin, revenues, ROA and ROI.	Santarelli et al. (2015), Schaltegger and Burritt (2014), Junior and Carpinetti (2017)
Lead time	The measure of SC performance in terms of the time required in performing and completing a certain task or process of SC.	Hsu et al. (2013), Bjorklund et al. (2012), Piotrowicz and Cuthbertson (2015)

### 3. Methodology

The literature that addresses the strategies for sustainable supply chain performance across different sectors and firms is quite vast. However, the reviews that establish how supply chain performance is quantified and qualified are quite inadequate. In this paper, we reviewed the existing literature with a focus on supply chain performance and establish the measures and metrics of supply chain performance. We reviewed the financial and non-financial measures and metrics for ascertaining the level of supply chain performance. The relevant articles under review were extracted from Elsevier, Springer, Francis and Taylor and Emerald insight online databases. These are the

most reputable and extensive research databases. To have the latest set of data on the measures and metrics of supply chain performance, the scope of the study was limited to articles published between 2012-2021. Only articles published in the English language with a focus on supply chain performance during a specified time span were retrieved for analysis. Figure 1 explicitly presents the methodology employed in reviewing and retrieving the literature for analysis adopted from Gopal and Thakkar (2011) and Galankashi and Rafiei (2021). Moreover, the analysis was made to determine the dominant research strategies used in the reviewed articles. The study found that the previous researchers have adopted different research strategies in examining the supply chain performance measurement, ranging from conceptual papers, empirical studies, reviews,



**Figure 1.** Review process: Adopted from [Gopal and Thakkar \(2011\)](#), [Galankashi and Rafiei \(2021\)](#).

case studies and exploratory studies (see [Table 2](#)). No common research methods have been employed in the reviewed articles. [Table 2](#) further shows that surveys, interviews and focus group discussions were the most research methods used, while systematic literature review and review of literature were the least used methods.

The Boolean operator’s search strategy, with search keywords: “supply chain”, “supply chain

performance”, “supply chain performance measures”, “supply chain performance metrics” and “supply chain key performance indicator” in the title, the keywords and in the abstract of the article were employed. Each article from the databases was scrutinised based on the financial and non-financial perspectives for measuring and ascertaining the level of supply chain performance. Relevant articles were retained while duplicates and grey literature were excluded. It is from the specified search criteria

**Table 2.** Approaches used in the selected articles.

Research strategy	Methods	Count
Conceptual	Survey and interview	5
	Interview and focus group discussion	7
	Review of literature	2
Empirical	Survey and interview	9
	Interview and observation	4
Review	Literature review	4
	Systematic literature review	2
Case study	Focus group discussion and interview	4
	Interview	3
	Interview and observation	5
Exploratory	Interview and observation	2
	Interview	3
	Interview and focus group discussion	3

and strategy, we managed to retrieve 53 articles for inclusion and further analysis. The distribution with respect to journals in which the articles were published is presented in Figure 2. As shown in Figure 2, Benchmarking: an international journal and the international journal of productivity and performance management are the most famously known publishers of this area followed by the journal of computers and industrial engineering. Figure 3 shows the number of publications from 2012-2021. The trend revealed a remarkably high number of publications in 2015 (8 articles) followed by 2021 and 2011 with 7 articles. The year 2012 and 2016 had the least quantity of articles on supply chain performance measurement, with a total of 3 research articles each.

## 4. Results and discussion

Tables 3 and 4 summarise the results of non-financial and financial measures and metrics of supply chain performance with respect to a review conducted. From the literature, the study reviewed and summarised seven (7) constructs of non-financial measures and their respective metrics of supply chain performance (see Table 3). Moreover, scrutinizing the literature, the study managed to ascertain three (3) constructs for financial supply chain performance measures with their respective metrics (see Table 4). The following sections present a detailed discussion of the measures and metrics for assessing the non-financial as well as the financial performance of the supply chain performance.

### 4.1. Non-financial measures and metrics of supply chain performance

#### 4.1.1. Customer satisfaction

In a world-class business operation, customer satisfaction is one of the most important measures of firm and supply chain performance (Huang et al., 2013; Jain and Verma, 2021). Besides, customer satisfaction is a central objective of supply chain management and its outcomes are measured in the aspect of how happy customers are when interacting with a firm’s products and services, or the extent to which the product and services offered by a firm exceed customers’ expectations. From the literature perspectives, studies assert that the prime indicators of customer satisfaction along the supply chain are ascertained in the level of customers’ perceived value of products and services and how quickly supply chain actors are flexible and responsive in handling customers’ requests in time and at cost-effective (Charkha and Jaju, 2019; Schaltegger and Burritt, 2014; Lakri et al., 2015). Without satisfied customers, supply chain performance cannot be deemed effective. Therefore, measuring supply chain performance must regard the extent to which customers are satisfied with the firm’s products or services.

#### 4.1.2. Quality performance

Quality performance is a non-financial measure of supply chain performance which is assessed through

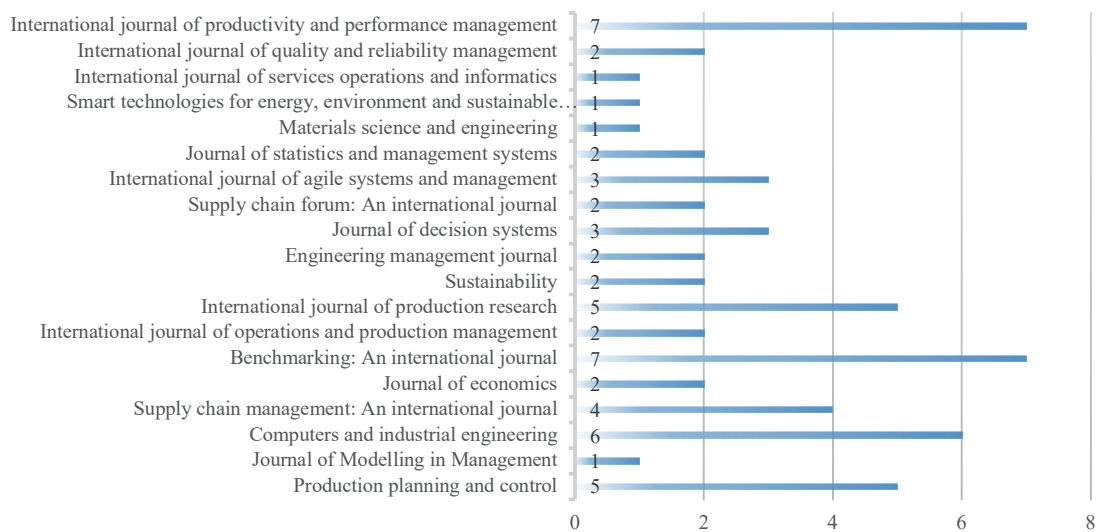


Figure 2. Distribution of publication amongst journals.

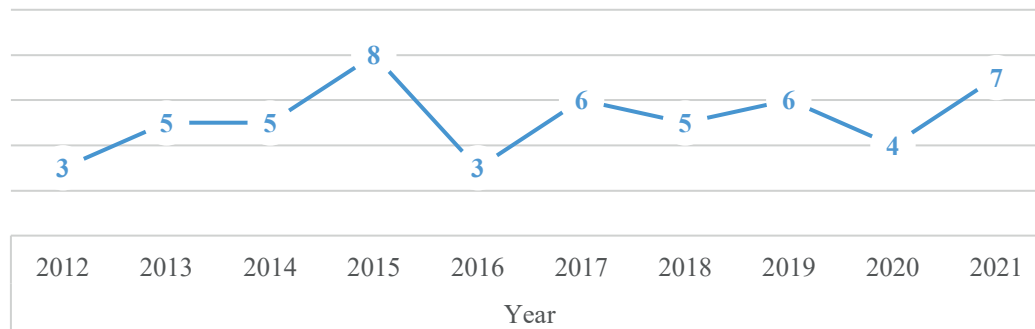


Figure 3. Distribution of publications per year (2012 – 2021, n = 53).

firms’ physical products, processes and services. It is centred on assessing the quality of supply chain services, products and services. The important metrics of quality performance along the supply chain encompass the ability of firms or organisations to deliver the products and services as per the agreed specifications, low defect rate for products, minimised numbers of complaints on the quality of delivered goods and the effectiveness of supply chain processes and practices (Karamouz et al., 2020; Junior and Cesar,

2019; Charkha and Jaju, 2019). Moreover, studies by Gawankar (2019) and Chand et al. (2020) mentioned the rate of rejection resulting from the delivery of poor-quality goods and services as one of the prime indicators of supply chain quality performance. Quality performance enhances the reputation as well as the competitive advantages of business firms, eliminates non-value-adding activities and attracts and retains customers and firms’ profits.

Table 3. Non-financial measures and metrics of supply chain performance.

References	SC Performance measures	SC performance metrics (KPIs)
Sillanpaa (2015), Gawankar et al. (2019), Junior and Cesar (2019)	Customer satisfaction	<ul style="list-style-type: none"> <li>• Customers perceived value of products and services</li> <li>• Customer query time</li> <li>• Flexibility</li> <li>• Responsiveness</li> <li>• Customer’s order fill rate</li> </ul>
Karamouz et al. (2020), Lakri et al. (2015), Moreira and Tjahjono (2016)	Quality performance	<ul style="list-style-type: none"> <li>• Meeting agreed products and service specifications</li> <li>• Number of complaints</li> <li>• Defect rate and rejection rate</li> </ul>
Elrod et al. (2013), Anand and Grover (2015)	Supply chain relationships	<ul style="list-style-type: none"> <li>• Arm-length relationships</li> <li>• Collaboration, strategic partnerships and alliances</li> <li>• Fewer disputes</li> <li>• Joint problem solving</li> <li>• Trustworthy</li> </ul>
Govindan et al. (2017), Huang et al. (2013), Benzidia and Makaoui (2020)	Competitive advantages	<ul style="list-style-type: none"> <li>• Meeting market requirements: cost, quality, standards, and time; credibility, financial and human resources capability</li> <li>• Supply chain innovations</li> </ul>
Zaman and Ahsan (2014), Hsu et al. (2013)	Lead time	<ul style="list-style-type: none"> <li>• Order processing time</li> <li>• Production lead time</li> </ul>
Karamouz et al. (2020), Samaranayake and Laosirihongthong (2016), Hsu et al. (2013)	Delivery performance	<ul style="list-style-type: none"> <li>• Total cycle time</li> <li>• Delivery at the right place</li> <li>• Suppliers’ reliability</li> <li>• On-time delivery</li> <li>• Quality of delivered goods</li> </ul>
Moazzam et al. (2018), Ramezankhani et al. (2018)	Continuous availability of supplies	<ul style="list-style-type: none"> <li>• Average number of days in which supplies are available for customers or internal use</li> <li>• The rate of stock-out</li> </ul>

**Table 4.** Financial measures and metrics of supply chain performance.

References	SC Performance measures	SC performance metrics (KPIs)
Baumann and Genoulaz (2014), Malviya (2019), Moazzam et al. (2018)	Supply chain costs	<ul style="list-style-type: none"> <li>• Logistics cost</li> <li>• Cost for raw materials</li> <li>• Manufacturing cost</li> <li>• Transport cost</li> <li>• Materials return costs</li> <li>• Inventory holding costs and</li> <li>• Risk costs-obsolescence, loss, damages and scraps</li> </ul>
Galankashi and Rafiei (2021), Ali (2015)	Inventory turnover	<ul style="list-style-type: none"> <li>• Inventory turnover ratio</li> </ul>
Schaltegger and Burritt (2014), Agrell and Marbini (2013), Han et al. (2017)	Cash flows	<ul style="list-style-type: none"> <li>• Gross sales/revenue</li> <li>• Working capital</li> <li>• ROA</li> <li>• Assents and operational equipment</li> <li>• Assets turnover ratio</li> <li>• ROI</li> <li>• Gross profit margin</li> <li>• ROE</li> </ul>

#### 4.1.3. Supply chain relationships

Enhanced supply chain relationships measure the extent to which the relationship goal of a supply chain is achieved. It is categorised in this study as the non-financial measures of supply chain performance which is assessed through cooperative and strategic partnerships, alliances, coordination and collaboration between business firms in the upstream and downstream supply chain. Enhanced supply chain relationships in terms of long-term association, joint problem-solving and information sharing, mutual planning and fewer disputes among the supply chain actors are the prime indicators improve supply chain performance (Sillanpaa, 2015; Benzidia and Makaoui, 2020; Tigga et al., 2021). Enhanced supply chain relationship among the supply chain actors is importantly created to enhance financial and operational performance, by attracting and retaining customers and suppliers and minimising materials handling costs, acquisition costs and supply chain risks.

#### 4.1.4. Lead time

Lead time is a non-financial and quantitative measure of supply chain performance defined and measured as the average time required in performing and completing a certain supply chain task or process. Bhattacharya and Kumar (2020) and Laihonen and Pekkola (2016) noted that the measure for supply chain performance in the context of lead time is assessed in terms of total cycle time. The prime metrics

of lead time are the time interval in undertaking and fulfilling supply chain activities. It stems from order processing time, production and distribution lead time. A shorter lead time implies better and improved supply chain performance since enhances the timely delivery of requirements and ultimate customer satisfaction. Long order processing time results in delays in delivery of requirements, which may result in stock-out thus keeping customers unsatisfied. Measuring lead time is an important aspect since drives other supply chain performance metrics such as customer satisfaction and supply chain costs (Jin et al., 2017; Bjorklund et al., 2012).

#### 4.1.5. Competitive advantages

Supply chain competitive advantage is a non-financial and qualitative measure of firms and supply chain performance. It is measured or expressed as the ability of supply chain and business firms to meet market requirements than the competitors. These include the ability in meeting cost and financial requirements, quality standards and certifications, the ability to commercialise unique products or services, and the ability to meet time requirements and market demand (Moreira and Tjahjono, 2016; Govindan et al., 2017). An organisation or business firm which is capable of delivering and meeting the aforementioned market requirements is regarded with better supply chain performance. Competitive advantages enhance the sustainability of the supply chain and the performance of business firms. Moreover, competitive advantages enhance firms'



ability along the supply chain in accessing market and trade opportunities for sustainable growth and development (Israel, 2022b; Huang et al., 2013).

#### *4.1.6. Delivery performance*

Delivery performance is another important quantitative and non-financial measure which ascertains the efficacy of the supply chain. It measures and ascertains how effectively and efficiently procurement requirements are processed and delivered to the ultimate customers within a specified time. Delivery performance can be assessed through timely delivery of requirements (that is on-time delivery), delivery of requirements at the specified right place, completeness of the order, delivery of the right quality of goods and reliability of suppliers (Charkha and Jaju, 2019; Jain and Verma, 2021; Piotrowicz and Cuthbertson, 2015; Najmi and Makui, 2012). These measures and metrics satisfy the express objectives of supply chain management which emphasizes on delivery of the right quality and quantities of requirements at a specified place and time. On-time delivery enhances the continuous availability of supplies for internal and external customers, thus avoiding the risk of stock-out whilst keeping customers satisfied (Israel et al., 2019; Karamouz et al. 2020).

## **4.2. Financial measures and metrics of supply chain performance**

### *4.2.1. Supply chain costs*

Supply chain management aims at executing supply chain activities and delivering goods and services to the customers at the possible least cost. Literature reveals that the cost-effectiveness along the supply chain is measured by quantifying and assessing how different costs incurred in the course of undertaking supply chain activities are kept at an optimum. It constitutes the manufacturing cost, cost of raw materials, acquisition and operational costs, warehousing costs, transport and distribution cost, service costs and risk costs (Kailash and Goyal, 2021; Yu, 2015; Zaman and Ahsan, 2014). The primary objective of supply chain management is to operate while keeping supply chain costs at the best optimum. Undertaking supply chain activities within the pre-estimated budget imply cost-effectiveness and sustainable financial performance. Moreover, the adoption of sustainable supply chain practices such as JIT, VMI and EDI can help the supply chain

achieve cost-effectiveness and sustainable supply chain financial performance (Galankashi and Rafiei, 2021; Tigga et al., 2021; Lakri et al., 2015).

### *4.2.2. Inventory turnover*

The literature further revealed that one of the measures of supply chain performance in the aspect of financial performance is the rate of inventory turnover (Mastos et al., 2021; Ali, 2015). This metric measures how well the business firms along the supply chain use their inventory, or how frequently inventories are purchased, used and replaced within the organisation. It is determined and measured as the ratio between the cost of goods sold to the average annual inventory. A higher value of inventory turnover ratio implies better and strong sales performance, revenue and profit margins. A lower value of inventory turnover ratio implies weak sales or decreasing demand, revenue and profits for goods and services (Malviya, 2019; Ali, 2015; Mwenda et al., 2021).

### *4.2.3. Cash flows*

Cash flows measure and ascertains the efficacy of the supply chain in the context of financial sustainability. It is a financial and quantitative measure in nature. From the reviewed literature, authors mentioned sales revenue, the ROE, profit margin, ROA, ROI, efficiency assents management and operational equipment as the important metrics of sustainable financial cash flows and supply chain financial performance (Jin et al., 2017; Matsoso and Benedict, 2017; Mwenda and Pastory, 2021). High ROA, ROE and ROI imply financial growth of a business firm and sustainable supply chain financial performance. Moreover, the net profit margin is primarily a key metric and determinant of supply chain financial performance, which is computed as the total revenues minus total expenses incurred (Lehyani et al., 2021; Matsoso and Benedict, 2014).

## **5. Limitations, contributions and future direction**

The findings presented and discussed in this study are confined to a literature review of the journal articles that were published in the last ten (10) years (2012-2021). The current and contemporary issues pertaining to supply chain performance measurement (financial and non-financial) that would have been ascertained by using the field

approaches were not accounted for. Therefore, the measures and metrics for financial and non-financial performance highlighted in this study are based on the reviewed literature within a specified time span. The novel contribution of this review is that it enriches and updates the existing literature on supply chain performance measures and metrics from financial and non-financial perspectives. The present literature measures and evaluates supply chain performance based on a single perspective from the four broad approaches (quantitative, qualitative, financial and non-financial). This study reviewed and summarises the measures of supply chain performance into two perspectives: the financial and non-financial perspectives which have been inadequately researched and reviewed. Since there is no common approach that has been put in place as the appropriate measure of supply chain performance, this study enriches scholars and policymakers with financial and non-financial measures and metrics for ascertaining the level of supply chain performance.

The issues that impede the effective measurement of supply chain performance at different nodes of the supply chain and across different sectors of the economy have not been systematically researched and documented. Most of the previous studies mainly focus on supply chain performance measurements, with no focus on the performance and measurements impending issues. Therefore, the study recommends that further studies be carried out on the issues that impede supply chain performance and supply chain performance measurements across different sectors of the economy. Moreover, there is limited literature that addresses the benefits of supply chain performance to business firms. Thus, future studies should also address the benefits of supply chain performance measurement to business firms. This will enhance a wider understanding among scholars and policymakers regarding the measures of supply chain performance, the benefits of supply chain performance measurements and the issues that impede supply chain performance measurement.

## **6. Conclusion and managerial implications**

The study extensively reviewed previous literature to identify and ascertain the appropriate measures and metrics of supply chain performance. About 53 peer-reviewed journal articles published between

2012-2021 in international reputable journals with a focus on supply chain performance measurements were included for review and analysis. The study categorised the identified supply chain performance measures into two perspectives, the financial and non-financial measures. The study found and concludes that the non-financial and financial measures and metrics are the appropriate approaches for ascertaining the level of supply chain performance since they overlap other (qualitative and quantitative) measurement approaches. The study found that the financial measures of supply chain performance are inventory turnover ratio, supply chain and logistics costs (manufacturing costs, transportation and distribution costs, costs for raw materials, inventory holding costs and risk costs such as the rate of materials obsolescence, loss, damages and scraps) and cash flows which are reflected in terms of ROI, ROE, ROA, profit margin, working capital and assets. The non-financial measures are customer satisfaction, firms' competitive advantages, delivery performance, quality of services, enhanced relationship among supply chain actors and total cycle time. The financial measures and metrics are the proxies for ascertaining firms' financial and operational performance. Good financial positions in terms of ROA, ROE, ROI and profit margins imply better performance and financial sustainability of firms. On other hand, the non-financial measure and metrics of supply chain performance have indirect financial implications to a business firm. For example, keeping customers satisfied with timely delivery, cost-effectiveness and quality services attract and retain more customers which in turn results in increased sales revenue and profits.

Based on the study's findings, the authors recommend the followings. To supply chain managers and multi-tier supply chain actors, the authors recommend financial and non-financial measures as the appropriate approaches for measuring and ascertaining the level of supply chain performance. As stated earlier, these are the proxies for assessing and evaluating the operational and financial performance and sustainability of a business firm. In order to appropriately ascertain the level of supply chain performance, the authors recommend that the measurement of supply chain performance be accounted for by all actors at each node of the supply chain. This can be enhanced by using the same approach, measures, metrics or performance indicators. Moreover, the assessment and evaluation of supply chain performance should

be measured against specific goals and targets. It is therefore necessary that firms along the supply chain have common goals and targets that will be assessed and evaluated against the actual performance. This

will help firms along the supply chain be able to assess their current status, make decisions, allocate resources and determine the future direction.

## References

- Agrell, J., & Marbini, A. (2013). Frontier-based performance analysis models for supply chain management: State of the art and research directions. *Computers and industrial engineering*, 66(3), 567-583. <https://doi.org/10.1016/j.cie.2013.02.014>
- Ali, R. (2015). Exploring antecedents of extended supply chain performance measures. *Benchmarking: An international journal*, 22(5), 752-772. <https://doi.org/10.1108/BIJ-04-2013-0040>
- Anand, N., & Grover, N. (2015). Measuring retail supply chain performance: Theoretical model using key performance indicators (KPIs). *Benchmarking: An international journal*, 22(1), 1-16. <https://doi.org/10.1108/BIJ-05-2012-0034>
- Bai, C., Sarkis, J., Wei, X., & Koh, L. (2012). Evaluating ecological sustainable performance measures for supply chain management. *Supply chain management: An international journal*, 17(1), 78-92. <https://doi.org/10.1108/13598541211212221>
- Baumann, E., & Genoulaz, V. (2014). A framework for sustainable performance assessment of supply chain management practices. *Computers and industrial engineering*, 76, 138-147. <https://doi.org/10.1016/j.cie.2014.07.029>
- Benzidia, S., & Makaoui, N. (2020). Improving SMEs performance through supply chain flexibility and market agility: IT orchestration perspective. *Supply chain forum: An international journal*, 21(3), 173-184. <https://doi.org/10.1080/16258312.2020.1801108>
- Bhattacharya, K., & Kumar, S. (2020). A robust two-layer green supply chain modelling under performance based fuzzy game theoretic approach. *Computers and industrial engineering*, 152, 107005. <https://doi.org/10.1016/j.cie.2020.107005>
- Bjorklund, M., Martinsen, U., & Abrahamsson, M. (2012). Performance measurements in the greening of supply chains. *Supply chain management: An international journal*, 17(1), 29-39. <https://doi.org/10.1108/13598541211212186>
- Burritt, S. (2014). Measuring and managing sustainability performance of supply chains. *Supply chain management: An international journal*, 19(3), 232-241. <https://doi.org/10.1108/SCM-02-2014-0061>
- Chand, P., Thakkar, J., & Ghosh, K. (2020). Analysis of supply chain performance metrics for Indian mining & earthmoving equipment manufacturing companies using hybrid MCDM model. *Resources Policy*, 68, 101742. <https://doi.org/10.1016/j.resourpol.2020.101742>
- Charkha, P., & Jaju, S. (2019). Identification of performance measures for supply chain performance measurement in textile enterprise. In: Kolhe, M., Labhassetwar, P., Suryawanshi, H. (eds) *Smart Technologies for Energy, Environment and Sustainable Development*. Lecture Notes on Multidisciplinary Industrial Engineering. Springer, Singapore, pp. 607-617. [https://doi.org/10.1007/978-981-13-6148-7\\_58](https://doi.org/10.1007/978-981-13-6148-7_58)
- Dhaigude, A., & Kapoor, R. (2017). The mediation role of supply chain agility on supply chain orientation-supply chain performance link. *Journal of decision systems*, 26(3), 275-293. <https://doi.org/10.1080/12460125.2017.1351862>
- Elgazzar, S., Tipi, N., & Jones, G. (2019). Key characteristics for designing a supply chain performance measurement system. *International journal of productivity and performance management*, 68(2), 296-318. <https://doi.org/10.1108/IJPPM-04-2018-0147>
- Elrod, C., Murray, S., & Bande, S. (2013). A review of performance metrics for supply chain Management. *Engineering Management Journal*, 25(3), 39-50. <https://doi.org/10.1080/10429247.2013.11431981>
- Frederico, G., Garza-Reyes, J., Kumar, A., & Kumar, V. (2021). Performance measurement for supply chains in the Industry 4.0 era: a balanced scorecard approach. *International journal of productivity and performance management*, 70(4), 789-807. <https://doi.org/10.1108/IJPPM-08-2019-0400>
- Galankashi, M., & Rafiei, F. (2021). Financial performance measurement of supply chains: A review. *International journal of productivity and performance management*, 71(5), 1674-1707. <https://doi.org/10.1108/IJPPM-11-2019-0533>
- Gawankar, S., Gunasekaran, A., & Kamble, S. (2019). A study on investments in the big data-driven supply chain, performance measures and organisational performance in Indian retail 4.0 context. *International journal of production research*, 58(5), 1574-1593. <https://doi.org/10.1080/00207543.2019.1668070>
- Gopal, P., & Thakkar, J. (2012). A review on supply chain performance measures and metrics: 2000-2011. *International journal of productivity and performance management*, 61(5), 518-547. <https://doi.org/10.1108/17410401211232957>

- Govindan, K., Mangla, S., & Luthra, S. (2017). Prioritising indicators in improving supply chain performance using fuzzy AHP: insights from the case example of four Indian manufacturing companies. *Production planning and control*, 28(6), 552-573. <https://doi.org/10.1080/09537287.2017.1309716>
- Han, W., Huang, Y., & Macbeth, D. (2017). Performance measurement of cross-culture supply chain partnership: a case study in the Chinese automotive industry. *International journal of production research*, 56(7), 2437-2451. <https://doi.org/10.1080/00207543.2017.1377357>
- Huang, C., Su, C., & Chen, P. K. (2013). An empirical study of the impact of knowledge creation and sharing on supply chain practice with competitive performance. *Journal of statistics and management systems*, 13(5), 921-936. <https://doi.org/10.1080/09720510.2010.10701511>
- Huatuco, L., Torres, J., & Calinescu, N. (2013). Performance measurement of sustainable supply chains. *International journal of productivity and performance management*, 62(8), <https://doi.org/10.1108/IJPPM-07-2013-0131>
- Hsu, B., Hsu, L., & Shu, M. (2013). Evaluation of supply chain performance using delivery-time performance analysis chart approach. *Journal of statistics and management systems*, 16(1), 73-87. <https://doi.org/10.1080/09720510.2013.777568>
- Israel, B., Kazungu, I., & Mchopa, A. (2019). Centralised medical supplies procurement and health service delivery in Arusha and Kilimanjaro regions Tanzania. *East African Journal of Social and Applied Sciences*, 1(1), 70-79.
- Israel, B. (2022a). Enhancing customer retention in manufacturing SMEs through supply chain innovative practices. *Management dynamics in the knowledge economy*, 10(3), 272-286.
- Israel, B. (2022b). Joint ventures for SMEs competitiveness and inclusive growth: A comparative analysis of SMEs in Mbeya, Tanzania. *E-Journal of Humanities, Arts and Social Sciences*, 3(8), 337-353. <https://doi.org/10.38159/ejass.2022385>
- Israel, B. (2022c). The role of co-operative societies in supply chain of agricultural products: a review of literature. *Journal of international trade, logistics and law*, 8(2), 69-77.
- Jain, R., & Verma, M. (2021). Block chain: a pathway to improve performance measures of supply chain. *International journal of services operations and informatics*, 11(2), 300-314. <https://doi.org/10.1504/IJSOI.2021.117258>
- Jin, H., Jeong, S., & Kim, S. (2017). A Linkage model of supply chain operation and financial performance for economic sustainability of firm. *Sustainability*, 9(1), 139. <https://doi.org/10.3390/su9010139>
- Junior, F. Carpinetti, L. (2017). Quantitative models for supply chain performance evaluation: a literature review. *Computers and industrial engineering*, 113, 333-346. <https://doi.org/10.1016/j.cie.2017.09.022>
- Junior, F., & Cesar, L. (2019). An adaptive network-based fuzzy inference system to supply chain performance evaluation based on SCOR® metrics. *Computers and industrial engineering*, 139, 106191. <https://doi.org/10.1016/j.cie.2019.106191>
- Kailash, R., & Goyal, S. (2021). Weighted interpretive structural modelling approach for exploration of performance measures of benchmarking of internal supply chain management. *International journal of agile systems and management*, 14(1), 119-139. <https://doi.org/10.1504/IJASM.2021.114911>
- Kamble, S., & Gunasekaran, A. (2019). Big data-driven supply chain performance measurement system: a review and framework for implementation. *International journal of production research*, 58(1), 65-86. <https://doi.org/10.1080/00207543.2019.1630770>
- Karamouz, S., Ahmadi, R., & Ghafournia, M. (2020). Supply chain quality management performance measurement: Systematic review. *International journal of quality and reliability management*, 38(2), 484-504. <https://doi.org/10.1108/IJQRM-03-2019-0073>
- Katiyar, R., Barua, M., & Meena, P. (2015). Modelling the measures of supply chain performance in the Indian automotive industry. *Benchmarking: An international journal*, 22(4), 665-696. <https://doi.org/10.1108/BIJ-09-2014-0091>
- Laihonen, H., & Pekkola, S. (2016). Impacts of using a performance measurement system in supply chain management: a case study. *International journal of production research*, 54(18), 5607-5617. <https://doi.org/10.1080/00207543.2016.1181810>
- Lakri, S., Dallery, Y., & Jemai, Z. (2015). Measurement and management of supply chain performance: Practices in today's large companies. *Supply chain forum: An international journal*, 16(4), 16-30. <https://doi.org/10.1080/16258312.2015.11728691>
- Lehyani, F., Zouari, A., Ghorbel, A., & Tollenaere, M. (2021). Defining and Measuring Supply Chain Performance: A Systematic Literature Review. *Engineering management journal*, 33(4), 283-313. <https://doi.org/10.1080/10429247.2020.1834309>
- Maestrini, V., Luzzini, D., Caniato, F., Maccarrone, P., & Ronchi, S. (2018). Measuring supply chain performance: A lifecycle framework and a case study. *International journal of operations and production management*, 38(4), 934-956. <https://doi.org/10.1108/IJOPM-07-2015-0455>

- Malviya, R. (2019). Developing integrated framework to measure performance of green supply chain management: A comparative case analysis. *Benchmarking: An International Journal*, 27(2), 634-665. <https://doi.org/10.1108/BIJ-01-2019-0016>
- Mastos, T., Gotzamani, K., & Kafetzopoulos, D. (2021). Development and validation of a measurement instrument for sustainability in food supply chains. *Sustainability*, 14(9), 5203. <https://doi.org/10.3390/su14095203>
- Matsoso, M., & Benedict, O. (2014). Non-financial performance measures in small medium enterprises' supply chain management. *Journal of economics*, 5(3), 247-257. <https://doi.org/10.1080/09765239.2014.11885001>
- Matsoso, M., & Benedict, O. (2017). Financial Performance Measures of Small Medium Enterprises in the 21st Century. *Journal of economics*, 7(2-3), 144-160. <https://doi.org/10.1080/09765239.2016.11907829>
- Menhat, M., & Yusuf, Y. (2018). Factors influencing the choice of performance measures for the oil and gas supply chain – exploratory study.. In *IOP Conference Series: Materials Science and Engineering*, 342(1), 012091. IOP Publishing. <https://doi.org/10.1088/1757-899X/342/1/012091>
- Mishra, D., Gunasekaran, A., Papadopoulos, T., Dubey, R. (2018). Supply chain performance measures and metrics: a bibliometric study. *Benchmarking: An international journal*, 25(3), 932-967, <https://doi.org/10.1108/BIJ-08-2017-0224>
- Moazzam, M., Akhtar, P., Garnevska, E., & Marr, N. (2018). Measuring agri-food supply chain performance and risk through a new analytical framework: a case study of New Zealand dairy. *Production planning and control*, 29(15), 1258-1274. <https://doi.org/10.1080/09537287.2018.1522847>
- Moreira, M., & Tjahjono, B. (2016). Applying performance measures to support decision-making in supply chain operations: A case of beverage industry. *International journal of production research*, 54(8), 2345-2365. <https://doi.org/10.1080/00207543.2015.1076944>
- Mwenda, B., & Pastory, D. (2021). Financial Performance of Firms Before and After Listing on Dar es Salaam Stock Exchange, Tanzania. The Second Business and Economic Development Conference (BEDC, 2021), Held on 16<sup>th</sup> -17<sup>th</sup> November, 2021 in Dodoma, Tanzania.
- Mwenda, B., Ndiege, B., & Pastory, D. (2021). Non-financial information disclosure and performance of firms listed at Dar es salaam Stock Exchange, Tanzania: is there a link? *Journal of Co-operative and Business Studies*, 6(2), 47-58. [https://doi.org/10.1007/978-3-030-68836-3\\_25](https://doi.org/10.1007/978-3-030-68836-3_25)
- Najmi, A., & Makui, A. (2012). A conceptual model for measuring supply chain's performance, *Production planning and control*, 23(9), 694-706. <https://doi.org/10.1080/09537287.2011.586004>
- Patil, A., Shardeo, V., & Madaan, J. (2021). Modelling performance measurement barriers of humanitarian supply chain. *International journal of productivity and performance management*, 70(8), 1972-2000. <https://doi.org/10.1108/IJPPM-01-2020-0031>
- Piotrowicz, W., & Cuthbertson, R. (2015). Performance measurement and metrics in supply chains: an exploratory study. *International journal of productivity and performance management*, 64(8), 1068-109. <https://doi.org/10.1108/IJPPM-04-2014-0064>
- Ramezankhani, M., Torabi, S.A., & Vahidi, F. (2018). Supply chain performance measurement and evaluation: A mixed sustainability and resilience approach. *Computers and industrial engineering*, 126, 531-548. <https://doi.org/10.1016/j.cie.2018.09.054>
- Samaranayake, P., & Laosirihongthong, T. (2016). Configuration of supply chain integration and delivery performance: Unitary structure model and fuzzy approach. *Journal of modelling in management*, 11(1), 43-74. <https://doi.org/10.1108/JM2-01-2014-0005>
- Santarelli, G., Abidi, H., Klumpp, M., & Regattieri, A. (2015). Humanitarian supply chains and performance measurement schemes in practice. *International journal of productivity and performance management*, 64(6), 784-810. <https://doi.org/10.1108/IJPPM-11-2013-0185>
- Schaltegger, S., & Burritt, R. (2014). Measuring and managing sustainability performance of supply chains. *Supply Chain Management: An international journal*, 19(3). <https://doi.org/10.1108/SCM-02-2014-0083>
- Sillanpaa, I. (2015). Empirical study of measuring supply chain performance. *Benchmarking: An International Journal*, 22(2), 290-308, <https://doi.org/10.1108/BIJ-01-2013-0009>
- Tigga, A., Kannabiran, G., & Arumugam, V. (2021). Exploring relationships among IT advancement, IT assimilation, supply chain capabilities and supply chain performance. *Journal of decision systems*, 30(4), 414-438. <https://doi.org/10.1080/12460125.2021.1873022>
- Yu, W. (2015). The effect of IT-enabled supply chain integration on performance. *Production planning and control*, 26(12), 945-957. <https://doi.org/10.1080/09537287.2014.1002021>
- Zaman, K., & Ahsan, A. (2014). Lean supply chain performance measurement. *International journal of productivity and performance management*, 63(5), 588-612. <https://doi.org/10.1108/IJPPM-05-2013-0092>