Analysis of Indicators Used for Measuring Sustainability in Supply Chains: A Systematic Review

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Abstract. *The purpose of this paper is to analyze indicators used for measuring sustainability in supply chains. A systematic review was conducted to explore indicator-based frameworks and identify the associated gaps within published peer-reviewed articles that are relevant to sustainability performance measurement of supply chains. A total of 628 indicators were analyzed: 202 for economic, 208 for environmental and 218 for social dimensions of sustainability. The majority of the indicators were used only once, which indicates a lack of consistency and consensus on how sustainability should be measured in supply chains. Four indicators, product quality, energy consumption, occupational health and safety, and employment/job opportunity, were found to be the most frequently and consistently used indicators. Multi-criteria decision analysis (MCDA) techniques are the most widely applied research methods for analyzing the indicators. Case studies were mostly conducted in the automotive and food industries compared to other industrial sectors. The majority of previous research focused on linear multi-echelon supply chain than closed-loop supply chain. The indicator-based frameworks proposed by the previous research did not consider context-based sustainability. Unlike previous long-lists of indicators in the literature, this paper analyzed the most consistent and frequently used indicators for measuring sustainability in supply chains. Moreover, it provides a comprehensive view of indicators by including all the three dimensions of sustainability. This paper presents an in-depth analysis of the use of indicators in sustainability measurement of supply chains. It proposes a preliminary research agenda by highlighting gaps in the existing research and this will provide a strong basis for future academic and practitioner work.*

Keywords: *Indicator, Performance measurement, Sustainability, Supply chain*

1. Introduction

Sustainability has received substantial attention both in academia and practitioners' world in recent years [21, 57]. Due to growing concerns of environmental and social impacts, governments' regulations, customers, employees, shareholders, community activists, and non-governmental organizations have put pressure on companies and their supply chains to adopt sustainability practices [15, 20, 21, 36]. Sustainability practices are also adopted for gaining competitive advantage [27, 30, 34]. The adoption of sustainability in the context of supply chain has gained considerable attention [48], and it is viewed as an essential strategy to deliver long-term profitability [61]. Supply chains are vital to the global economy and provide many business opportunities [46], and they are driving forces behind business competitive advantages [44]. However, they can also lead to unintended social and environmental impacts [46]. To alleviate the impacts, sustainability performance management of the supply chains is vital [44, 46]. Companies are encouraged to revise their major processes of supply chain management by adopting sustainability practices since environmental and social impacts affect their image and competitiveness [50]. With the increasing pressure from various stakeholders for more transparency of sustainability practices, there is a trend in research and practice towards developing tools for sustainability measurement of supply chains [17, 40]. Sustainability of supply chain cannot be appropriately managed if it is not measured effectively [43]. Measuring sustainability performance of a company and its supply chain has become essential for setting goals and determining future courses of action [48].

Sustainability measurement in the supply chain is widely addressed by three interrelated dimensions of sustainability – economic, environmental, and social [10, 12, 26, 29] which are described as triple bottom line (TBL) [10, 12, 26]. Sustainability measurement of supply chains consists of managing economic, environmental and social aspects [7, 30]. The TBL approach is a central concept that helps

organizations to operationalize sustainability while diverse interpretations of sustainability exist [24]. TBL is the most widely used comprehensive approach for implementing sustainability practices in the company and supply chain. The use of multidimensional indicators, based on TBL, is crucial for easy and comparable sustainability performance measurement [8]. TBL indicators are increasingly recognized as a powerful tool providing information on sustainability performance in areas of economy, environment and society [40]. The development and application of sustainability indicators depend on the purpose for which they will be applied (i.e., the context of the business) [13]. It is important to employ context-based indicators to express an organization's sustainability as a function of its impacts on economy, environment and social relative to norms, standards or thresholds of being sustainable [35].

This paper aimed at analyzing indicators used for measuring sustainability in supply chains and highlighting the associated gaps in the existing research. To achieve this objective, a systematic literature review was conducted to find peer-reviewed articles relevant to sustainability performance measurement of supply chains. Analysis of the selected papers was conducted, and the results were discussed briefly. Finally, concluding remarks with future research agenda were forwarded.

2. Methodology

A systematic literature review was conducted to identify peer-reviewed articles that focus on sustainability measurement of supply chains. For this purpose, Scopus and Web of Science (WoS) were selected as a search database since they provide extensive coverage of peer-reviewed journal articles in the scientific, technical, and social sciences [3]. Two sets of keywords were used for the search in the databases: ("sustainable supply chain*" or "sustainable supply chain management" or "supply chain* sustainability") in the first set and ("indicator*" or "metric*" or "measure*") in the second set.

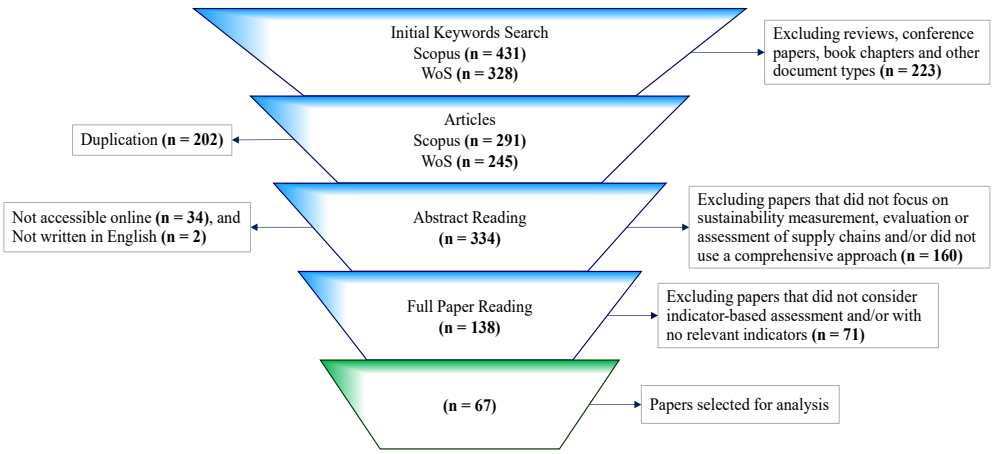

Fig. 1. Approach of the systematic literature review

As seen in Fig. 1, a total of 759 papers were initially found using the keywords search in the Scopus and WoS published until 2020. The search considered peer-reviewed articles published in the English language. All fields as well as all subject areas available in the Scopus and WoS databases were taken. By excluding reviews, conference papers, book chapters and other document types (in other words, focusing only on articles since they are thoroughly peer-reviewed), 536 articles were identified from both Scopus and WoS. Out of which, 202 papers were found duplicated. It was not possible to access 34 papers through an online search, and 2 papers were not written in the English language. After abstract reading, 160 were excluded since they did not focus sustainability performance measurement, evaluation or assessment of supply chains, and were not based on a comprehensive approach (i.e., TBL approach). In addition, 71 papers, because they did not propose indicators that are relevant to the purpose of this study, were excluded through full paper reading. Finally, 67 papers were identified and selected for general analysis, and 41 papers, since they are supported with empirical analysis, out of the 67 were used for the analysis of indicators.

3. Results and discussion

In this section, the results of the analysis are presented with a brief discussion. Section 3.1 and section 3.2 present an overview on the distribution of the papers by journal type and research methods applied by the previous research respectively. Section 3.3 briefly discusses the results of indicators analysis by their frequency of use. The associated gaps are briefly described in section 3.4.

3.1.Distribution of papers by journal type

Fig. 2 shows the distribution of the selected papers by journal type. It is seen that about 50 % of the papers are from six journals (i.e. Journal of Cleaner Production, Sustainability (Switzerland), Benchmarking, Computers and Operations Research, International Journal of Productivity and Performance Management, and British Food Journal). The Journal of Cleaner Production is the leading contributor to the papers.

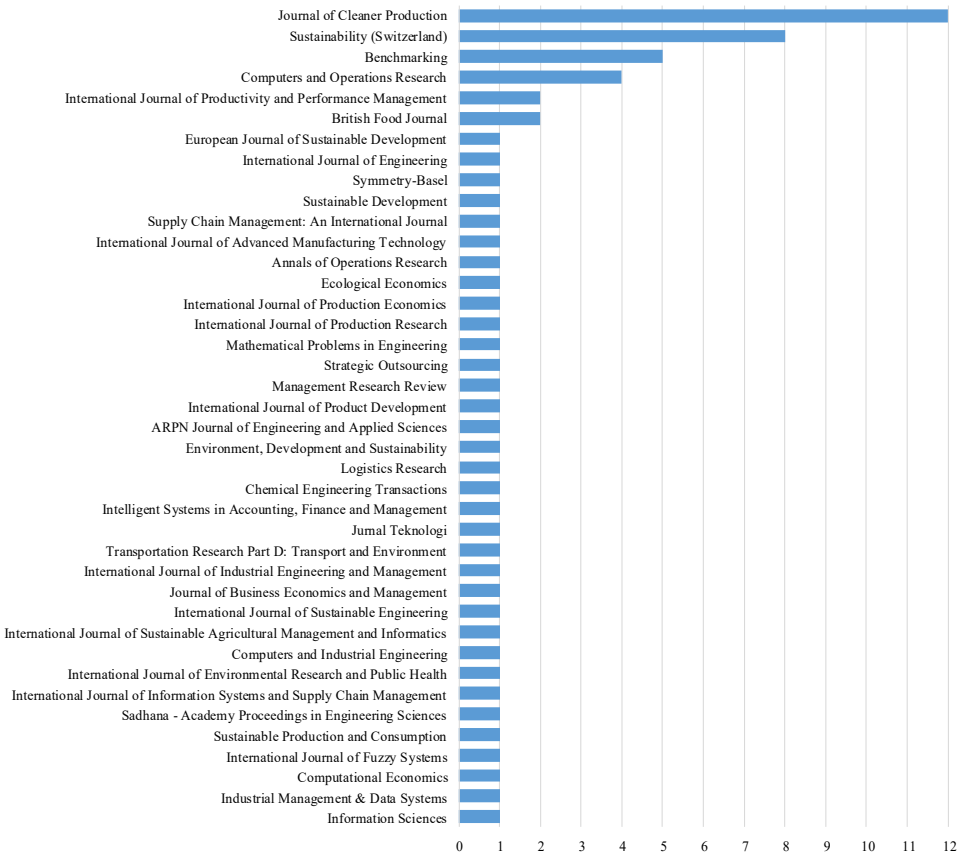

Fig. 2. Distribution of papers by journal type.

3.2.Research methods applied

Figure 3 presents research methods which are used by three or more papers for data analysis.

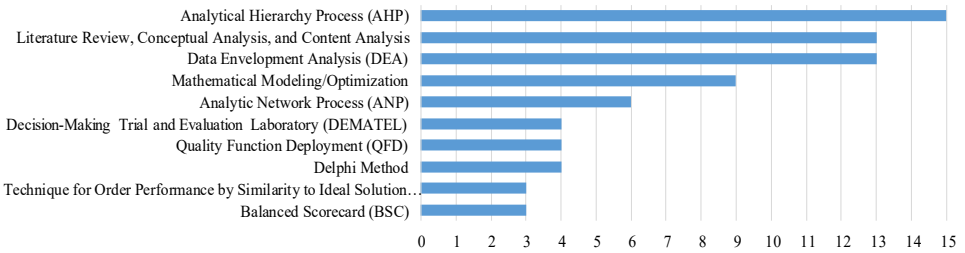

Fig. 3. Research methods applied by the previous research.

Multi-criteria decision analysis (MCDA) techniques including AHP, ANP, DEMATEL, and TOPSIS were widely applied to analyze sustainability dimensions and indicators. AHP was used to determine the weight of indicators by incorporating experts' opinions without considering interrelationship/ interdependence among indicators. ANP was also used to determine the weight of indicators by defining interrelationship among them. DEMATEL was applied to identify the influential indicators from a recommended list by considering interrelationship among indicators. TOPSIS was employed to rank and select the best alternatives such as best suppliers based on sustainability criteria. Data envelopment analysis (DEA) was also used to evaluate sustainability of supply chains in terms of efficiency scores by defining decision making units. Fuzzy logic is applied to MCDA techniques and DEA to address the vagueness of experts' opinions.

The previous research carried-out case studies in various industrial sectors to illustrate and validate their work. As seen in Table 1, more case studies were conducted in automotive and food industries than in other industrial sectors.

Table 1. Some of the industrial sectors for the case study.

Industrial Sector	Papers (#)	Authors
Automotive	4	[32], [30], [50], [19]
Food	4	[5], [23], [4], [58]
Plastic	3	[60], [38], [57]
Cement	2	[31], [56]
Electronics	2	[28], [53]
Sugar	2	[11], [1]
Aircraft	1	[45]
Apparel	1	[25]
Chemical	1	[6]
Oil and Gas	1	[55]
Soft Drink	1	[13]

3.3.Analysis of indicators

As shown in Table 2, a total of 628 indicators (202 for economic, 208 for environmental and 218 for social dimensions) were identified in the literature by analyzing selected papers that carried out empirical research. A wide-range of the indicators (about 87%) were found to be used once, and this shows a lack of consistency and consensus on how sustainability should be measured in supply chains [3] and the effect of industry context differences on the use of the indicators. Thirty-three (33) indicators were used 4 times and above. It is revealed that about 92% of the indicators were used less than 4 times. Four

indicators (product quality, energy consumption, occupational health and safety, and employment/job opportunity), which accounts for 0.6% of the total indicators, were used 10 times and above.

Table 2. Identified indicators by frequency of use.

Frequency of Use	Identified Indicators (#)
1	546
2	33
3	16
4	14
5	5
6	5
7	2
8	2
9	1
10	1
11	1
12	1
13	1
Total	**628**

The overwhelming majority of the indicators focused on the measurement of absolute or relative sustainability performance. They are either absolute or relative indicators. Absolute indicators express sustainability performance in terms of what overall levels of performance are in specific areas of interest (e.g., water consumption) for an organization as a whole [35]. While relative indicators express sustainability performance in terms of how performance in one area (e.g., water consumption) correlates to performance in another area (e.g., total production) of an organization [35]. On the other hand, the systematic review reveals that there is a lack of context-based indicators for measuring sustainability in supply chains. Context-based indicators express an organization's sustainability performance as a function of its impact on the economy, environment and social with respect to norms, standards or thresholds of being sustainable (e.g., water consumed per employee compared with a fair or equitable allocation of available renewable water supplies) [35]. Global Reporting Initiative (GRI) indicators were used by some papers. GRI promotes sustainability context. However, it does not explicitly state the context with respect to norms, standards or thresholds of being sustainable.

Table 3. Frequently used indicators for economic dimension.

Indicators	Frequency of Use	Authors
Product quality	11	[31], [39], [47], [13], [61], [45], [5], [56], [16], [34], [57]
Delivery time	8	[31], [39], [47], [61], [41], [56], [16], [25]
Flexibility	8	[39], [47], [61], [45], [16], [34], [57], [25]
Product price	7	[31], [47], [41], [5], [16], [6], [25]
Investment	5	[18], [54], [33], [22], [15]
Revenue	4	[55], [11], [45], [19]
Productivity	4	[18], [11], [32], [58]
Profit	4	[9], [40], [33], [45]

Table 3 shows that product quality, delivery time, flexibility, product price, investment, revenue, productivity, and profit were revealed to be the frequently used indicators for measuring economic dimension of sustainability in supply chains. Table 3 also reveals that all the indicators were not equally

considered in the reviewed literature. Product quality was found to be the topmost commonly used indicator in indicator-based sustainability measurement frameworks of the previous research.

Table 4. Frequently used indicators for environment dimension.

Indicators	Frequency of Use	Authors
Energy consumption	13	[18], [55], [11], [14], [31], [13], [33], [54], [49], [57], [25], [58], [15]
Water consumption	9	[18], [55], [13], [45], [17], [49], [53], [58], [15]
GHG emissions	7	[18], [11], [45], [22], [17], [49], [25]
Waste minimization	6	[1], [14], [16], [34], [53], [15]
Waste management	5	[9], [39], [54], [2], [57]
Recyclable waste	5	[1], [13], [43], [16], [57]
Reverse logistics	5	[2], [16], [30], [34], [15]
Material consumption	4	[13], [45], [41], [30]
Recycled material use	4	[49], [19], [25], [15]
Renewable energy use	4	[56], [17], [49], [15]
Air emissions	4	[1], [22], [49], [19]
Solid waste	4	[11], [39], [13], [49]
Pollution control	4	[31], [39], [61], [50]

Table 4 reveals the commonly used indicators for measuring environmental dimension of sustainability in supply chains. Of these indicators, energy consumption is the topmost considered indicator by the previous research.

Table 5. Frequently used indicators for social dimension.

Indicators	Frequency of Use	Authors
Occupational health and safety	12	[9], [14], [31], [47], [40], [45], [28], [22], [2], [16], [57], [19]
Employment/Job opportunity	10	[31], [40], [45], [28], [43], [56], [57], [4], [37], [58]
Customer satisfaction	6	[61], [43], [32], [17], [19], [53]
Working conditions	6	[1], [59], [41], [56], [30], [57]
Corruption	6	[45], [28], [56], [17], [49], [19]
Employee training	6	[1], [39], [54], [17], [22], [49]
Workplace accidents	5	[55], [39], [5], [17], [15]
Wage	4	[55], [17], [49], [58]
Child labor	4	[28], [49], [17], [19]
Human rights	4	[9], [47], [32], [2]
Freedom of association	4	[28], [56], [17], [49]
Discrimination	4	[28], [56], [17], [49]

The indicators in Table 5 were found to be consistent and frequently used indicators for measuring social dimension of sustainability in supply chains. Among which, occupational health and safety, and employment/job opportunity are the uppermost considered indicators.

3.4.Gaps and research opportunities

The previous research considered different supply chains in their indicator-based framework. They addressed linear/forward multi-echelon supply chain, single-echelon (supplier), and closed-loop supply chain. Linear multi-echelon supply chain mainly consisted of supply, production, distribution, and customer. Vivas et al. [55] developed a methodology to assist a decision-maker in evaluating and choosing the best sustainable options for an oil and gas supply chain. Demartini et al. [13] analyzed the current state of soft drink supply chains with respect to sustainability issues. Tsolakis et al. [54] introduced a qualitative sustainability performance assessment framework for food supply networks. Single-echelon mainly addressed supplier sustainability measurement. Giannakis et al. [18] developed a sustainability performance measurement framework for supplier evaluation and selection using analytic network process. Zhou et al. [61] proposed a novel criteria system for evaluating sustainable suppliers. There is a concern of environmental and social impacts that resulted from the growing amount of end-of-life (EOL) products [52]. Closed-loop supply chain (CLSC) can substantially help for managing the EOL products and improving sustainability by reusing, remanufacturing, recycling [42, 51, 52]. Pourjavad et al. [42] developed a fuzzy multi-objective mixed-integer linear programming to optimize a sustainable CLSC network. Taleizadeh et al. [52] proposed a comprehensive model to measures social and environmental effects of closed-loop supply chain. Most previous research considered linear/forward multi-echelon supply chain. Whereas, closed-loop supply chain has been less studied by the previous research. This shows that research on sustainability measurement of CLSC is lacking.

In context-based sustainability (CBS), it is necessary to define a context. According to McElory and van Engelen [35] an organization's sustainability performance is a function of its impacts on the economy, environment and social (numerator) relative to norms, standards or thresholds of being sustainable (denominator). Taleizadeh et al. [52] used GRI indicators in their model to measure social and environmental effects. Azevedo et al. [7] also used GRI indicators in their framework for assessing sustainability of individual companies and their corresponding upstream supply chain. However, the overwhelming majority of the previous research did not consider context-based sustainability/ sustainability context. There is limited research on context-based sustainability. The gaps reveal that there is a need for research that focuses on closed-loop supply chains and context-based sustainability.

4. Conclusion

This paper presents the analysis of indicators published in the literature on sustainability measurement of supply chains. A systematic literature review was conducted to search the relevant peer-reviewed articles in this area. The analysis of indicators is conducted on selected empirical research papers. The results showed that from the total 628 indicators which were addressed in the literature, the majority (87%) of them were used only once in the literature, and this shows a lack of consistency in the use of indicators for measuring sustainability in supply chains. Product quality, energy consumption, occupational health and safety, and employment/job opportunity were found to be the most consistent and frequently used indicators for measuring sustainability in supply chains. The results also revealed that multi-criteria decision analysis (MCDA) techniques are the most widely applied research methods which have been used for the analysis of the indicators. Compared to other industrial sectors, automotive and food industries are more considered for conducting the case studies. The indicator-based frameworks by the previous research mostly considered linear/forward multi-echelon supply chains than closed-loop supply chains. Research on sustainability measurement in a closed-loop supply chain context is lacking. Measurement of sustainability uses absolute, relative and context-based indicators to get a sense of whether supply chains are truly sustainable or not. It is revealed that unlike absolute and relative indicators, there is a lack of context-based indicators for measuring sustainability in supply chains. This paper provides a research agenda by exploring the research gaps in the existing research. It highlights research opportunities on consistent and applicable indicators, context-based sustainability, and sustainability measurement in closed-loop supply chains. Hence, it recommends future research to focus on context-based sustainability measurement in closed-loop supply chains using consistent and applicable indicators.

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References

[1] Abdel-Basset M, Mohamed R, Zaied AENH, Smarandache F. A hybrid plithogenic decision-making approach with quality function deployment for selecting supply chain sustainability metrics. Symmetry, 2019. 11: 903. DOI: 10.3390/sym11070903.

[2] Abidi N, Bandyopadhayay A, Gupta V. Sustainable Supply Chain Management: A Three Dimensional Framework and Performance Metric for Indian IT Product Companies. International Journal of Information Systems and Supply Chain Management, 2017. 10(1): 29-52. DOI: 10.4018/ijisscm.2017010103.

[3] Ahi P, Searcy C. An analysis of metrics used to measure performance in green and sustainable supply chains. Journal of Cleaner Production, 2015. 86: 360-377. DOI: 10.1016/j.jclepro.2014.08.005.

[4] Aidonis D, Folinas D, Achillas C, Triantafyllou D, Malindretos G. Multi-criteria evaluation of sustainable supply chains in the agrifood sector. International Journal of Sustainable Agricultural Management and Informatics, 2015. 1: 106-119. DOI: 10.1504/IJSAMI.2015.070747.

[5] Allaoui H, Guo Y, Choudhary A, Bloemhof J. Sustainable agro-food supply chain design using two-stage hybrid multi-objective decision-making approach. Computers and Operations Research, 2018. 89: 369-384. DOI: 10.1016/j.cor.2016.10.012.

[6] Azadi M, Jafarian M, Saen RF, Mirhedayatian SM. A new fuzzy DEA model for evaluation of efficiency and effectiveness of suppliers in sustainable supply chain management context. Computers and Operations Research, 2015. 54: 274-285. DOI. 10.1016/j.cor.2014.03.002.

[7] Azevedo SG, Carvalho H, Ferreira LM, Matias JCO. A proposed framework to assess upstream supply chain sustainability. Environment, Development and Sustainability, 2017. 19: 2253–2273. DOI: 10.1007/s10668-016-9853-0.

[8] Bai C, Sarkis J. Determining and applying sustainable supplier key performance indicators. Supply Chain Management, 2014. 19: 275-291. DOI: 10.1108/SCM-12-2013-0441

[9] Bappy MM, Ali SM, Kabir G, Paul SK. Supply chain sustainability assessment with Dempster-Shafer evidence theory: Implications in cleaner production. Journal of Cleaner Production, 2019. 237: 117771. DOI: 10.1016/j.jclepro.2019.117771.

[10] Chardine-Baumann E, Botta-Genoulaz V. A framework for sustainable performance assessment of supply chain management practices. Computers & Industrial Engineering, 2014. 76: 138-147. DOI: 10.1016/j.cie.2014.07.029.

[11] Dania WAP, Xing K, Amer Y. Collaboration quality assessment for sustainable supply chains: benchmarking. Benchmarking, 2019. 26: 1469-1498. DOI: 10.1108/BIJ-03-2018-0070.

[12] de Brito MP, Rezaei J, Tavasszy LA. An integrative framework for sustainable supply chain management practices in the oil and gas industry AU - Ahmad, Nurul K. Wan. Journal of Environmental Planning and Management, 2017. 60(4): 577-601. DOI: 10.1080/09640568.2016.1178105.

[13] Demartini M, Pinna C, Aliakbarian B, Tonelli F, Terzi S. Soft drink supply chain sustainability: A case based approach to identify and explain best practices and key performance indicators. Sustainability (Switzerland), 2018. 10: 3549. DOI: 10.3390/su10103540.

[14] Dey PK, Yang GL, Malesios C, De D, Evangelinos K. Performance Management of Supply Chain Sustainability in Small and Medium-Sized Enterprises Using a Combined Structural Equation Modelling and Data Envelopment Analysis. Computational Economics, 2019. 58: 573–613. DOI. 10.1007/s10614-019-09948-1

[15] Erol I, Sencer S, Sari R. A new fuzzy multi-criteria framework for measuring sustainability performance of a supply chain. Ecological Economics, 2011. 70: 1088-1100. DOI: 10.1016/j.ecolecon.2011.01.001.

[16] Faisal MN, Al-Esmael B, Sharif KJ. Supplier selection for a sustainable supply chain Triple bottom line (3BL) and analytic network process approach. Benchmarking-an International Journal, 2017. 24(7): 1956-1976. DOI: 10.1108/bij-03-2016-0042.
[17] Fritz MMC, Schöggl JP, Baumgartner RJ. Selected sustainability aspects for supply chain data exchange: Towards a supply chain-wide sustainability assessment. Journal of Cleaner Production, 2017. 141: 587–607. DOI:10.1016/j.jclepro.2016.09.080.
[18] Giannakis M, Dubey R, Vlachos I, Ju Y. Supplier sustainability performance evaluation using the analytic network process. Journal of Cleaner Production, 2020. 247:119439. DOI:10.1016/j.jclepro.2019.119439
[19] Gopal PRC, Thakkar J. Development of composite sustainable supply chain performance index for the automobile industry. International Journal of Sustainable Engineering, 2015. 8: 366-385. DOI: 10.1080/19397038.2014.947392.
[20] Kusi-Sarpong S., Gupta H, Sarkis J. A supply chain sustainability innovation framework and evaluation methodology. International Journal of Production Research, 2019. 57: 1990–2008. DOI: 10.1080/00207543.2018.1518607.
[21] Hassini E, Surti C, Searcy C. A literature review and a case study of sustainable supply chains with a focus on metrics. International Journal of Production Economics, 2012. 140: 69-82. DOI: 10.1016/j.ijpe.2012.01.042.
[22] Husgafvel R, Poikela K, Honkatukia J, Dahl O. Development and piloting of sustainability assessment metrics for arctic process industry in Finland-The biorefinery investment and slag processing service cases. Sustainability (Switzerland), 2017. 9: 1693. DOI: 10.3390/su9101693.
[23] Izadikhah M, Saen RF. Assessing sustainability of supply chains by chance-constrained two-stage DEA model in the presence of undesirable factors. Computers and Operations Research, 2018. 100: 343-367. DOI: 10.1016/j.cor.2017.10.002.
[24] Izadikhah M, Saen RF, Roostaee R. How to assess sustainability of suppliers in the presence of volume discount and negative data in data envelopment analysis? Annals of Operations Research, 2018. 269: 241–267. DOI: 10.1007/s10479-018-2790-6.
[25] Jakhar SK. Performance evaluation and a flow allocation decision model for a sustainable supply chain of an apparel industry. Journal of Cleaner Production, 2015. 87: 391-413. DOI: 10.1016/j.jclepro.2014.09.089.
[26] Johnson MP, Schaltegger S, Beske-Janssen P. 20 years of performance measurement in sustainable supply chain management – what has been achieved? Supply Chain Management: An International Journal, 2015. 20: 664-680. DOI: 10.1108/SCM-06-2015-0216.
[27] Karthik B, Raut RD, Kamble SS, Kharat MG, Kamble SJ. Decision support system framework for performance based evaluation and ranking system of carry and forward agents. Strategic Outsourcing, 2015. 8: 23-52. DOI: 10.1108/SO-02-2015-0008.
[28] Kolotzek C, Helbig C, Thorenz A, Reller A, Tuma A. A company-oriented model for the assessment of raw material supply risks, environmental impact and social implications. Journal of Cleaner Production, 2018. 176: 566-580. DOI: 10.1016/j.jclepro.2017.12.162.
[29] Kumar A, Anbanandam R. Development of social sustainability index for freight transportation system. Journal of Cleaner Production, 2019. 210: 77-92. DOI: 10.1016/j.jclepro.2018.10.353.
[30] Kumar D, Garg CP. Evaluating sustainable supply chain indicators using fuzzy AHP: Case of Indian automotive industry. Benchmarking, 2017. 24: 1742-1766. DOI: 10.1108/BIJ-11-2015-0111.
[31] Laosirihongthong T, Samaranayake P, Nagalingam S. A holistic approach to supplier evaluation and order allocation towards sustainable procurement. Benchmarking, 2019. 26: 2543-2573. DOI: 10.1108/BIJ-11-2018-0360.
[32] Li Y, Mathiyazhagan K. Application of DEMATEL approach to identify the influential indicators towards sustainable supply chain adoption in the auto components manufacturing sector. Journal of Cleaner Production, 2018. 172: 2931-2941. DOI: 10.1016/j.jclepro.2017.11.120.
[33] Liang XD, Zhao XL, Wang M, Li Z. Small and Medium-Sized Enterprises Sustainable Supply Chain Financing Decision Based on Triple Bottom Line Theory. Sustainability, 2018. 10. DOI: 10.3390/su10114242.
[34] Lim MK, Tseng ML, Tan KH, Bui TD. Knowledge management in sustainable supply chain management: Improving performance through an interpretive structural modelling approach. Journal of Cleaner Production, 2017. 162: 806-816. DOI: 10.1016/j.jclepro.2017.06.056.

[35] McElroy MW, van Engelen J. Corporate Sustainability Management: The Art and Science of Managing Non-financial Performance. Earthscan; 2012.
[36] Morali O, Searcy C. A Review of Sustainable Supply Chain Management Practices in Canada. Journal of Business Ethics, 2013. 117: 635–658. DOI: 10.1007/s10551-012-1539-4.
[37] Morana J, Gonzalez-Feliu J. A sustainable urban logistics dashboard from the perspective of a group of operational managers. Management Research Review, 2015. 38: 1068-1085. DOI: 10.1108/mrr-11-2014-0260.
[38] Motevali Haghighi S, Torabi SA, Ghasemi R. An integrated approach for performance evaluation in sustainable supply chain networks (with a case study). Journal of Cleaner Production, 2016. 137: 579-597. DOI: 10.1016/j.jclepro.2016.07.119.
[39] Narimissa O, Kangarani-Farahani A, Molla-Alizadeh-Zavardehi S. Evaluation of sustainable supply chain management performance: Indicators. Sustainable Development, 2019. 28: 118-131. DOI:10.1002/sd.1976.
[40] Ngan SL, Promentille MAB, Yatim P, Lam HL, Er AC. Developing sustainability index for Malaysian palm oil industry with fuzzy analytic network process. Chemical Engineering Transactions, 2018. 70. DOI: 10.3303/CET1870039.
[41] Osiro L, Lima FR, Carpinetti LCR. A group decision model based on quality function deployment and hesitant fuzzy for selecting supply chain sustainability metrics. Journal of Cleaner Production, 2018. 183: 964-978. DOI: 10.1016/j.jclepro.2018.02.197.
[42] Pourjavad E, Mayorga RV. Multi-objective Fuzzy Programming of Closed-Loop Supply Chain Considering Sustainable Measures. International Journal of Fuzzy Systems, 2019. 21: 655-673. DOI: 10.1007/s40815-018-0551-y.
[43] Pourjavad E, Shahin A. Hybrid performance evaluation of sustainable service and manufacturing supply chain management: An integrated approach of fuzzy dematel and fuzzy inference system. Intelligent Systems in Accounting, Finance and Management, 2018. 25: 134-147. DOI: 10.1002/isaf.1431.
[44] Qorri A, Mujkić Z, Kraslawski A. A conceptual framework for measuring sustainability performance of supply chains. Journal of Cleaner Production, 2018. 189: 570-584. DOI: 10.1016/j.jclepro.2018.04.073.
[45] Raj A, Srivastava SK. Sustainability performance assessment of an aircraft manufacturing firm. Benchmarking, 2018. 25: 1500-1527. DOI: 10.1108/BIJ-01-2017-0001.
[46] Reefke H, Trocchi M. Balanced scorecard for sustainable supply chains: Design and development guidelines. International Journal of Productivity and Performance Management, 2013. 62: 805-826. DOI: 10.1108/IJPPM-02-2013-0029.
[47] Resat HG, Unsal B. A novel multi-objective optimization approach for sustainable supply chain: A case study in packaging industry. Sustainable Production and Consumption, 2019. 20: 29-39. DOI: 10.1016/j.spc.2019.04.008.
[48] Saeed MA, Kersten W. Supply chain sustainability performance indicators - A content analysis based on published standards and guidelines. Logistics Research, 2017. 10: 1-19. DOI: 10.23773/2017_12.
[49] Schöggl JP, Fritz MMC, Baumgartner RJ. Sustainability assessment in automotive and electronics supply chains-A set of indicators defined in a multi-stakeholder approach. Sustainability (Switzerland), 2016. 8: 1185. DOI: 10.3390/su8111185.
[50] Shahryari Nia A, Olfat L, Esmaeili A, Rostamzadeh R, Antucheviciene J. Using fuzzy Choquet Integral operator for supplier selection with environmental considerations. Journal of Business Economics and Management, 2016. 17: 503-526. DOI: 10.3846/16111699.2016.1194315.
[51] Stindt D. A generic planning approach for sustainable supply chain management - How to integrate concepts and methods to address the issues of sustainability? Journal of Cleaner Production, 2017. 153: 146-163. DOI: 10.1016/j.jclepro.2017.03.126.
[52] Taleizadeh AA, Haghighi F, Niaki STA. Modeling and solving a sustainable closed loop supply chain problem with pricing decisions and discounts on returned products. Journal of Cleaner Production, 2019. 207: 163-181. DOI: 10.1016/j.jclepro.2018.09.198.
[53] Tseng M, Lim M, Wong WP. Sustainable supply chain management: A closed-loop network hierarchical approach. Industrial Management and Data Systems, 2015. 115: 436-461. DOI:10.1108/IMDS-10-2014-0319.

[54] Tsolakis N, Anastasiadis F, Srai JS. Sustainability performance in food supply networks: Insights from the UK industry. Sustainability (Switzerland), 2018. 10: 3148. DOI: 10.3390/su10093148.
[55] Vivas RDC, Sant'Anna AMO, Esquerre KPSO, Freires FGM. Integrated method combining analytical and mathematical models for the evaluation and optimization of sustainable supply chains: A Brazilian case study. Computers and Industrial Engineering, 2020. 139: 105670. DOI: 10.1016/j.cie.2019.01.044.
[56] Wu Z, Zhai S, Hong J, Zhang Y, Shi K. Building sustainable supply chains for organizations based on QFD: A case study. International Journal of Environmental Research and Public Health, 2018. 15: 2834. DOI: 10.3390/ijerph15122834.
[57] Xu J, Jiang X, Wu Z. A Sustainable Performance Assessment Framework for Plastic Film Supply Chain Management from a Chinese Perspective. Sustainability (Switzerland), 2016. 8: 1042. DOI: 10.3390/su8101042.
[58] Yakovleva N, Sarkis J, Sloan T. Sustainable benchmarking of supply chains: The case of the food industry. International Journal of Production Research, 2012. 50: 1297-1317. DOI: 10.1080/00207543.2011.571926
[59] Yazdani M, Chatterjee P, Montero-Simo MJ, Araque-Padilla RA. An Integrated Multi-Attribute Model for Evaluation of Sustainable Mobile Phone. Sustainability (Switzerland), 2019. 11: 3704. DOI: 10.3390/su11133704.
[60] Zarbakhshnia N, Jaghdani TJ. Sustainable supplier evaluation and selection with a novel two-stage DEA model in the presence of uncontrollable inputs and undesirable outputs: a plastic case study. International Journal of Advanced Manufacturing Technology, 2018. 97: 2933–2945. DOI: 10.1007/s00170-018-2138-z.
[61] Zhou X, Xu Z. An integrated sustainable supplier selection approach based on hybrid information aggregation. Sustainability (Switzerland), 2018. 10: 2543. DOI: 10.3390/su10072543.