LogForum

> Scientific Journal of Logistics <

2023, 19 (4), 655-667

http://doi.org/10.17270/J.LOG.2023.872

http://www.logforum.net p-ISSN 1895-2038 e-ISSN 1734-459X

ORIGINAL PAPER

SUPPLIER ENVIRONMENTAL EVALUATION – THE RATIONALE FOR THE PRACTICAL APPLICATION

Piotr Cezary Sosnowski

Department of Logistics, Faculty of Management, University of Łodź, **Poland**

ABSTRACT. Background: Reducing negative environmental impacts is becoming more and more significant in many areas of management. It is related not only to introducing the concept of circular economy, but also to building and integrating closed-loop supply chains. It includes different aspects of buyer-supplier relationships, such as supplier selection and evaluation. The aim of this article is to determine the scope of use of supplier environmental evaluation and the possibilities for the development of this concept.

Methods: The focal study has an exploratory character. The research methods used are the review of the literature and a survey conducted using the computer-aided telephone interview (CATI) technique. The reviewed literature is related to the areas of supplier environmental evaluation and supplier assessment. The empirical study focusses on different areas of supplier environmental evaluation and supplier assessment environmental criteria using a novel approach not found in the literature.

Results: The results refer to the possibilities of practical application of the supplier environmental evaluation. One of these possibilities is to link different areas of supplier environmental evaluation with specific environmental criteria of supplier assessment.

Conclusions: The main implication for business is to focus activities related to reducing negative environmental impacts mainly on the compliance of the supplier with the buyer's needs and requirements related to the environmental performance and limiting environmental impacts. The originality of this article lies in the approach focussing on differentiation between the environmental assessment and the environmental evaluation of suppliers and determining the possibility of a practical application of SEE.

Keywords: supplier environmental evaluation, supplier assessment, buyer-supplier relationships, buyer-supplier cooperation

INTRODUCTION

Supplier evaluation is an increasingly complex management problem. Companies face numerous problems regarding cooperation with their suppliers, including turbulent economic environment, supply chain disruptions resulting from the COVID-19 pandemic, and political shifts, e.g., resulting from the Russian invasion of Ukraine. Another significant factor is the increasing role of limiting negative environmental impacts, which is related to raising awareness of climate change, sustainable development, corporate social responsibility, and ESG reporting.

The aim of this article is to determine the scope of use of supplier environmental evaluation (SEE) and the possibilities for the development of this concept. Determining the value of environmental activities and supplier results could be crucial for achieving ESG goals [Whitelock, 2015] and building circular (or closed-loop) supply chains [Chen and Tan, 2021; González-Sánchez et al., 2020].

The paper is structured as follows. First, the introduction including the theoretical background is presented. Second, the materials and methods used in the conducted study are characterised. The results and discussion are then outlined. Finally, the conclusion including

Citation: *Sosnowski P. C., 2023. Supplier environmental evaluation – the rationale for the practical application. LogForum 19 (4), 655-667,* http://doi.org/10.17270/J.LOG.2023.872

Received: 29.07.2023, Accepted: 22.08.2023, on-line: 10.12.2023

limitation, implications, and recommendations for future research are described.

The originality of this article lies in the approach that focusses on the differentiation between environmental assessment and SEE, and the determining possibility of the practical application of SEE.

SUPPLIER EVALUATION VS. SUPPLIER ASSESSMENT

Various scholars describe supplier evaluation differently, but they mostly define it in relation to assessment. Most of the definitions outlined in Table 1 link the supplier evaluation to their assessment.

Particular researchers consider the concept of evaluation more broadly than the assessment itself [Johnson et al., 2011; Monczka et al., 2016; Urbaniak, 2010; Zeydan et al., 2011]. Some of them consider supplier assessment as a measurement of supplier performance intended to provide a baseline for supplier evaluation and development [Monczka et al., 2016]. Others associate the supplier assessment with their evaluation [Park et al., 2010].

Table 1. Overview of definitions of supplier evaluation

Authors (year)	Definitions of the supplier evaluation
[Timmerman, 1986]	Assessment of supplier performance
[Purdy and Safayeni, 2000]	Assessment of supplier processes on the basis of given criteria
[Park et al., 2010]	Evaluation of the supplier's value by measuring its capacity and performance
[Urbaniak, 2010]	Periodic assessment and the assessment of the impact of the cooperation with the supplier on the recipient company and on the supply chain
[Johnson et al., 2011]	A set of formal and informal activities that aim to choose a supplier or assess its performance and effectiveness
[Hald and Ellegaard, 2011]	Process of quantifying supplier performance
[Zeydan et al., 2011]	A decision-making problem related to the selection or assessment of a supplier, with the aim of minimising risk and maximising added value for the recipient company
[Osiro et al., 2014]	Identify the importance of the supplier's performance in relation to the expectations placed on it in order to improve its capabilities and the effectiveness of its operations
[Monczka et al., 2016]	A set of activities that aims to select a supplier or assess its performance and effectiveness
[Sosnowski, 2022]	A set of systematic and objective activities designed to assess the performance, capability, and effectiveness of the supplier, including initial assessment, periodic assessment, and the impact assessment of the cooperation with the supplier on the recipient company and the supply chain

Source: own elaboration.

As shown in Table 1, supplier evaluation is based on their assessment. Therefore, the concept of evaluation, in addition to the initial and periodic supplier assessment, also refers to an assessment of the supplier's performance in relation to the results obtained and the impact of buyer-supplier cooperation on the buyer's company and on the focal supply chain. Furthermore, both supplier evaluation and supplier assessment are examples of multi criteria decision making (MCDM) problems [Gupta et al., 2019; Sumrit and Srisawad, 2022].

The main objective of supplier evaluation is to determine the value of supplier activities in relation to performance [Park et al., 2010]. However, the purpose of supplier evaluation is

described as a decision to begin, continue, or discontinue a cooperation with a supplier [Johnson et al., 2011] and determine supplier development activities [Weele, van, 2014]. Supplier evaluation is also recognised as an important part of supply chain management. It plays a key role in improving company competitiveness and influences the efficiency of supply chain operations [Dachyar and Maharani, 2019].

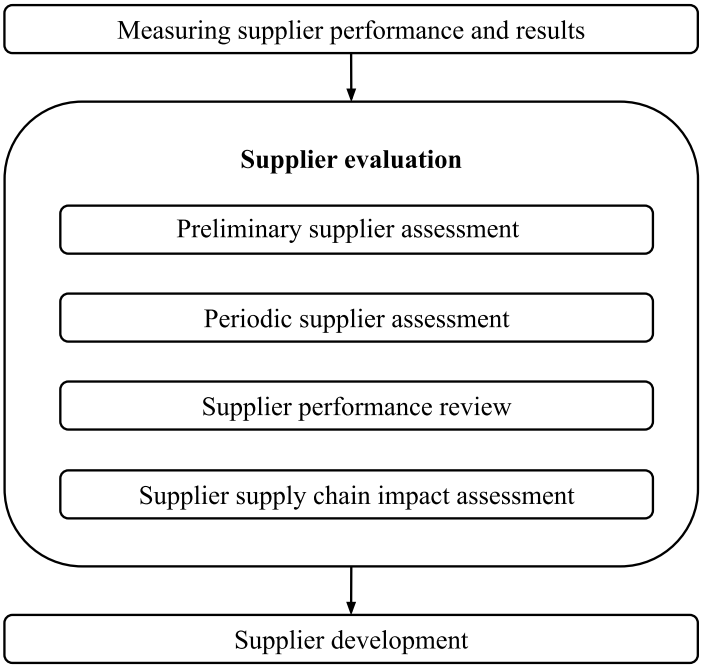

Fig. 1. Relationship between activity and performance measurement, assessment, evaluation, and supplier development
Source: own elaboration based on Monczka et al., 2016; Urbaniak, 2010; Weele, van, 2014

Supplier evaluation can be carried out during the duration of supplier cooperation or after it has ended. The start of cooperation with a supplier is determined by a positive result of the initial assessment – supplier selection [Urbaniak, 2010]. Some sources extend supplier evaluation to pre-cooperation activities [Hashemi et al., 2015].

INTRODUCING SUPPLIER ENVIRONMENTAL EVALUATION

According to J. Sarkis, the fundamental importance of environmental evaluation in the buyer-supplier relationships and in the context of other areas of evaluation is primarily due to the lack of control of the company over this particular area. Measurement as well as assessment and evaluation of suppliers are all concerned with the analysis of data and the identification of phenomena occurring. In this case, the data analysed relatively often comes from outside the company conducting the evaluation. Similarly, the identified phenomena also occur relatively often outside the focal company [Sarkis, 2014].

This leads to the problem of the lack of precise information received from the supplier and the lack of certainty about whether the information obtained from the supplier can be considered reliable [Sahu et al., 2012].

Based on Sosnowski [2022], the SEE can be defined as *'a set of systematic and objective activities designed to evaluate the performance, capability, and effectiveness of the supplier in the area of reducing various negative environmental impacts, including initial assessment, periodic assessment and impact assessment of the cooperation with the supplier in the recipient company and the supply chain.'*

Taking into account the definition given above, the following proposition was formulated:

P1. SEE determines whether to start or continue cooperation with suppliers.

There is a difference between supplier evaluation criteria focused on specific indicators and measures, such as price, delivery time, or number of late deliveries, and evaluation areas that relate to broad business components, such as performance or operational flexibility. This type of approach reflects, among other things, the 'green supplier evaluation index system' outlined by Sahu et al. [2012, 2014].

They assume a breakdown of the elements of the SEE system into three 'indexing levels', representing the levels of detail of the evaluation elements: the target level, the rule level, and the hierarchy level (see: Table 2).

Table 2. Example of green supplier evaluation index

Indexing levels	Indexing elements
Target level	SEE
Rule level	Areas of SEE, e.g., supplier capabilities, scope of cooperation, environmental factors
Hierarchy level	Criteria for assessing suppliers, e.g., delivery delays, level of carbon emissions into the atmosphere, implementation of an ISO 14001-compliant environmental management system

Source: own elaboration based on Sahu et al., 2012, 2014

According to this system, the supplier evaluation represents the target level that the company aims to achieve. The next level, known as the rule level, represents the areas of supplier evaluation. These include areas of supplier performance and buyer-supplier cooperation, such as supplier capabilities, scope of cooperation, or environmental factors. On the other hand, the lowest level, known as the hierarchy level, is represented by the individual assessment criteria assigned to the individual evaluation areas.

As such, the subdivision of the evaluation areas can provide a means of allocating the assessment criteria, where each evaluation area is assigned its associated supplier assessment criteria. The supplier evaluation system proposed by Dachyar and Maharani [2019], among others, is consistent with this approach.

MATERIALS AND METHODS

The focal study has an exploratory character and consisted of the following stages:

1. Review of the literature.
2. Preparation of the CATI (Computer-Assisted Telephone Interview) study;
3. Conducting the CATI study;
4. Analysis of results, including the semi-quantitative analysis of areas of SEE and environmental criteria in supplier management.
5. Formulating conclusions.

The preparation of the CATI study was preceded by a review of the literature on the topics of supplier assessment (including environmental criteria) and SEE. The study was carried out in a group of 101 medium and large companies operating in the following production sectors in Poland: chemical, pharmaceutical, IT and optical equipment, electrical, automotive, and furniture production. The size of the company and the production sectors were used in the quota sampling. The choice of industries was based on the relatively high level of environmental impact they generate. Including only medium and large companies resulted from the approach that the bigger the company, the more complex the management system it has implemented. The size of the company was determined by the number of employees. A medium company employs between 50 and 249 employees, while a large company employs at least 250. To choose the focal companies, the Polish Classification of Economic Activities (pl. *Polska Klasyfikacja Działalności*) was used.

The following research questions were formulated:

1. Do companies use environmental criteria in supplier assessment?
2. Do companies conduct SEE?

To answer these questions, the questionnaire was structured in order to gather the following information on the focal companies.

Q1 The main area of activity of the company.

Q2 The size of the company.

Q3 Conducting a formal initial or periodic supplier assessment.

Q4Using environmental criteria in initial or periodic supplier assessment.

Q5 Conducting SEE.

Q6 Using specific areas of SEE.

Q3 and Q5 are the filter questions. Data collection using the questionnaire is illustrated in Fig. 2.

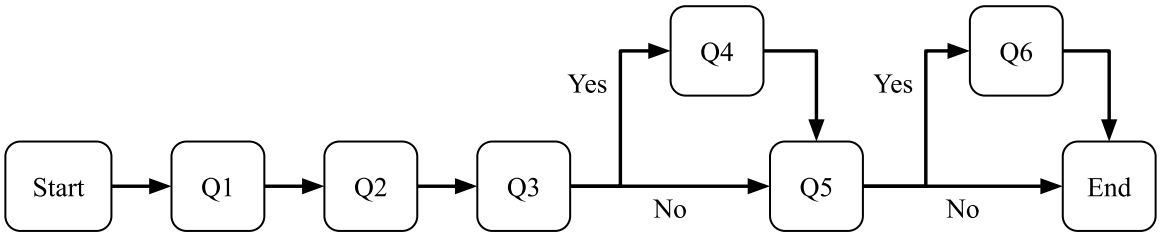

Fig. 2. Order of the questions in the questionnaire
Source: own elaboration.

The questionnaire preparation methodology was based on the assumption that reliable answers for Q4 and Q6 can only be given by respondents working for companies using environmental criteria in supplier assessment and conducting SEE.

RESULTS AND DISCUSSION

The environmental criteria for supplier assessment can be identified as those criteria that have a direct impact on their negative environmental impacts. It is important to note that environmental criteria can be related to both the level of negative environmental impact, e.g., the level of pollutant emissions [Wu and Barnes, 2016], and its reduction, e.g., waste reduction [Agarwal and Vijayvargy, 2012].

To carry out the study, the classification of environmental criteria was developed for supplier evaluation, based on the work of different scholars. It is presented in Table 3.

Table 3. Environmental criteria for supplier assessment

Environmental criteria for supplier assessment	Authors
Location of the supplier's plant	Dai and Blackhurst, 2012; Winter and Lasch, 2016
Having an implemented environmental management system, e.g., ISO 14001 or EMAS	Govindan et al., 2015; Shen et al., 2013; Tundys, 2018; Winter and Lasch, 2016
Use of environmentally friendly materials (e.g., recycled packaging)	Agarwal and Vijayvargy, 2012; Dai and Blackhurst, 2012; Govindan et al., 2015; Shen et al., 2013; Winter and Lasch, 2016
Use of environmentally friendly technologies (e.g., low-waste technologies)	Dai and Blackhurst, 2012; Govindan et al., 2015; Shen et al., 2013; Winter and Lasch, 2016
Reducing the consumption of material resources, energy, and water	Dai and Blackhurst, 2012; Govindan et al., 2015; Shen et al., 2013; Tundys, 2018; Winter and Lasch, 2016
Reducing pollutant emissions (waste, wastewater, atmospheric emissions, and noise)	Agarwal and Vijayvargy, 2012; Dai and Blackhurst, 2012; Govindan et al., 2015; Nielsen et al., 2014; Shen et al., 2013; Winter and Lasch, 2016

Source: own elaboration.

Types of emissions whose levels and reduction are used as criteria for supplier assessment include solid waste, wastewater, atmospheric emissions, odour, and hazardous substances [Nielsen et al., 2014]. Controlling the use of resources, for example, water, energy, and raw materials, is also a criterion of this type [Tundys, 2018]. Other environmental criteria include, for example, the use of pro-environmental raw materials and technologies in production, eco-design [Shen et al., 2013], the use of environmental labels, the use of recycled raw materials and the consumption of semifinished products, and energy and water [Govindan et al., 2015; Winter and Lasch, 2016].

Different scholars provide different classifications of environmental criteria for supplier assessment that overlap each other. For example, Dai and Blackhurst [2012] distinguish the 'minimise waste' criterion, which is directly related to both reducing the consumption of material resources, energy and water and reducing pollutant emissions (waste, wastewater, atmospheric emissions, and noise).

The diverse approaches of researchers to classifying the areas of SEE raise the question: which approach to this classification should be adopted in order to meet its primary objective, which is to assess the supplier's activities, capabilities, and effectiveness in reducing the various types of negative environmental impact [Sosnowski, 2022]? To answer this, it may be helpful to use the evaluation areas for development assistance by the Organisation for Economic Cooperation and Development. These areas are the following: impact, efficiency, effectiveness, relevance, coherence, and sustainability. The OECD uses the term 'criterion' for the evaluation [OECD, 2021, 2022]. However, in the context of this article, this term is restricted for assessment and the term 'area' is used instead.

Previously, there was no coherence area in this classification [OECD, 1991]. However, this new criterion complements the areas of SEE used, among others, by Sosnowski [2022] (see: Table 4).

Table 4. Evaluation areas by the OECD and proposed areas of SEE

Evaluation areas by OECD	Areas of SEE
Impact - the extent to which the intervention has generated or is expected to generate significant positive or negative, intended or unintended, higher-level effects	Supplier environmental impact - the changes that suppliers' activities have had on the environment
Coherence – the compatibility of the intervention with other interventions in a country, sector, or institution	Compliance of supplier environmental performance with the buyer's requirements
Efficiency – the extent to which the intervention delivers or is likely to deliver results in an economic and timely way.	Translating supplier activities into environmental outcomes
Effectiveness – the extent to which the intervention achieved or is expected to achieve, its objectives, and its results, including any differential results across groups.	Achieving by suppliers their environmental goals
Relevance – the extent to which the intervention objectives and design respond to beneficiaries	Compliance of supplier environmental performance with the buyer's needs
Sustainability - the extent to which the net benefits of the intervention continue or are likely to continue.	Sustainability of the supplier's environmental performance
-	Innovativeness of supplier environmental activities

Source: own elaboration based on OECD, 2021, 2022; Sosnowski, 2022.

This use of OECD evaluation areas is supported by the second principle of their use: 'The criteria should be applied thoughtfully and adapted to the context of intervention and evaluation. Although originally developed for use in international development cooperation, the criteria can be applied in any sector and for evaluations of public or private interventions. They can be used to evaluate many different topics and types of interventions, including thematic topics or strategic issues, policies, and projects [OECD, 2021].

Environmental efficiency as an area of environmental evaluation has been proposed by Govindan et al. [2015]. Environmental impact directly translates into reduction of its negative environmental impact, which is the objective of SEE as defined earlier. The sustainability of

supplier environmental performance is consistent with the definition of sustainable development, of which environmental issues are one of the cornerstones [World Commission on Environment and Development, 1987].

The author expanded the classification of SEE areas to include innovativeness, which has been identified as SEE by, among others, Bai and Sarkis [2014], Hashemi et al. [2015], and Kannan et al. [2015].

With areas formulated in this manner, supplier evaluation can use supplier assessment to achieve its objective, depending on the preferences or environmental policy of the focal company. Supplier evaluation can be conducted in terms of, for example, the environmental impact of their activities, the contribution of their activities to reducing negative environmental impacts, or the achievement of their environmental goals.

Based on the proposed evaluation areas, the preferred supplier profile can be defined from an environmental evaluation point of view. It should meet the following requirements [OECD, 2021, 2022]:

1. Compliance of environmental performance with buyer needs;
2. Compliance of environmental performance with buyer requirements;
3. Minimal or no negative impact on the environment;
4. Achieving environmental goals;
5. Willingness to cooperate in reducing negative environmental impacts;
6. Conducting environmental activities that contribute to a sustainable reduction of negative environmental impacts;
7. Implementation of innovative environmental measures.

Fulfilling these requirements would increase the probability of a positive outcome of conducted SEE. The significance of these requirements could be determined by the CATI study. The structure of the survey group is presented in Table 5.

Table 5. Structure of the survey group

The main area of operations*	The main source of capital	Employment volume		Grand Total
		250 and more	From 50 to 249	
AUTO	Domestic	5	17	**22**
	Foreign	6	3	**9**
	Total	11	20	**31**
CHEM	Domestic	10	27	**37**
	Foreign	5	3	**8**
	Total	15	30	**45**
IT	Domestic	3	15	**18**
	Foreign	4	3	**7**
	Total	7	18	**25**
Grand Total		**33**	**68**	**101**

*AUTO – automotive production; CHEM – chemical, pharmaceutical, and plastic production; IT – IT, electronic, and electrical production.
Source: own elaboration

The numbers of companies in the studied sectors are similar to each other. No less than 25% of the companies studied in every sector were large companies that employ 250 or more people. Most of the companies studied conduct a formal initial or periodic supplier assessment, or both types (see Table 6).

Table 6. Conducting a formal initial or periodic supplier assessment

Conducting a formal initial and periodic supplier assessment	Number	Percentage
Initial assessment	17	16.8%
Periodic assessment	4	4.0%
Both	39	38.6%
None	41	40.6%
Total	**101**	**100%**

Source: own elaboration

More than 40% of the companies studied use environmental criteria in supplier selection and supplier assessment. Most of them use this kind of criteria in both supplier selection and supplier assessment (see Table 7).

Table 7. Using environmental criteria in supplier assessment

Using environmental criteria in the initial or periodic supplier assessment	Number	Percentage
Yes, in initial assessment	11	10.9%
Yes, in periodic assessment	3	3.0%
Yes, in both	27	26.7%
No	60	59.4%
Total	**101**	**100%**

Source: own elaboration

The most widely used criterion in both initial and periodic supplier assessment is having an implemented environmental management system. Other significant criteria in the initial supplier assessment are the use of environmentally friendly materials and technologies, while other significant criteria in the periodic supplier assessment are the use of environmentally friendly materials and the location of the supplier's plant(see: Table 8).

25.7% of the respondents indicated conducting SEE (see: Table 9).

Table 8. Using environmental criteria in supplier assessment: breakdown analysis

Using environmental criteria in supplier assessment	Abbreviation	Initial assessment		Periodic assessment	
		Number	Percentage	Number	Percentage
Having an implemented environmental management system, e.g., ISO 14001 or EMAS	C1	20	52.6%	16	51.6%
Use of environmentally friendly materials (e.g., recycled packaging)	C2	20	52.6%	12	38.7%
Use of environmentally friendly technologies (e.g., low-waste technologies)	C3	20	52.6%	11	35.5%
Location of the supplier's plant	C4	13	37.6%	12	38.7%
Reducing the consumption of material resources, energy and water	C5	13	37.6%	9	29.0%
Reducing pollutant emissions (waste, wastewater, atmospheric emissions, noise)	C6	9	24.7%	7	22.6%
Total of environmental criteria in the given type of supplier assessment		**38**	**100%**	**31**	**100%**

Source: own elaboration.

Table 9. Conducting SEE

Conducting SEE	Number	Percentage
Yes	26	25.7%
No	75	74.3%
Total	**101**	**100%**

Source: own elaboration.

Among the companies surveyed, the most frequently used evaluation area is the compliance of supplier environmental performance with the buyer's requirements. The second most frequently used area is the compliance of supplier environmental performance with the buyer's needs. The element of suppliers' activities was also taken into account here. The next areas most frequently used by respondents are the supplier environmental impact, suppliers achieving their environmental goals, and supplier activities translating into environmental outcomes. These evaluation areas determine the importance in a given company of translating supplier activities into results.

The areas indicated least frequently were the innovativeness of supplier environmental activities and the sustainability of the supplier environmental performance. This may be due to the dynamic nature of the supplier environmental performance, which varies over time.

The scope of using SEE areas is illustrated in Table 10.

Table 10. Using areas of SEE

Areas of SEE	Abbreviation	Number	Percentage
Compliance of the supplier's environmental performance with the buyer's requirements	A1	16	61.5%
Compliance of the supplier's environmental performance with the buyer's needs	A2	13	50.0%
Supplier environmental impact - the changes that suppliers' activities have had on the environment	A3	11	42.3%
Achieving by suppliers their environmental goals	A4	8	30.7%
Translating supplier activities into environmental outcomes	A5	7	27.2%
Innovativeness of supplier environmental activities	A6	4	15.4%
Sustainability of the supplier's environmental performance	A7	3	11.5%
Total of using areas of SEE		**26**	**100%**

Source: own elaboration.

The results related to the compliance of the supplier's environmental performance with the buyer's requirements and needs indicate the relevance of the difference between these areas. In contrast to the requirements, the buyer's needs might be difficult to measure. For example, to what extent should the focal company use environmentally friendly materials (C2) to meet the buyer's needs?

To illustrate the relevance of specific environmental criteria in supplier assessment for specific areas of SEE, the cross-tabulation of these two entities was prepared (see: Table 11). This kind of approach was not found in the reviewed literature.

The cross-tabulation data was divided into three ranges:

1. >=10 – most relevant criterion for the SEE area;
2. 10> and >=5 – medium relevant criterion for the SEE area;
3. >5 – less relevant criterion for the SEE area.

Only one area (A1) is in range 1. for any criteria (C1, C2, and C3). This might indicate that these criteria are the most important for this particular area. The same criteria are in range 2. for A2, A3, and A5. Furthermore, the criteria C1, C2, and C3 are used the most frequently, while the areas that are used the most frequently are A1, A2 and A3. Moreover, only areas A1, A2, A3, and A5 are in the range 1. or 2. for more than 3 criteria.

Table 11. Cross-tabulation using areas of SEE and environmental criteria in supplier management

Environmental criteria in supplier assessment ➔ **Areas of SEE ⬇**	C1	C2	C3	C4	C5	C6	**Total of using given area of SEE**
A1	10	12	10	4	7	5	**16**
A2	6	8	8	2	8	4	**13**
A3	7	8	7	3	5	5	**11**
A4	3	5	6	4	4	1	**8**
A5	5	7	5	3	5	2	**7**
A6	2	2	3	2	2	2	**4**
A7	2	2	3	1	3	2	**3**
Total of using a given environmental criterion in ANY type of supplier assessment (initial or periodical)	**25**	**22**	**22**	**17**	**14**	**10**	

Source: own elaboration.

CONCLUSION

The main limitation of this study is that it only focuses on companies operating in Poland. However, the companies that were the main source of capital for both domestic (77) and foreign (24) were taken into account. The number of companies that conduct SEE – 26 out of 101, giving 25.7% of the sampling group – is also a limitation of this study. In the previous similar study conducted under the same conditions with respect to the population [Sosnowski, 2022], the percentage of companies conducting SEE was 63.8% (88 of 138). It gives a difference of more than 38 percentage points. Possible reasons for this difference include conducting the earlier study before the COVID-19 outbreak and before the Russian invasion of Ukraine.

The main implication for business is to focus activities related to reducing negative environmental impacts mainly on the compliance of the supplier with the buyer's needs and requirements related to the environmental performance and limiting environmental impacts. Such activities should primarily include implementing environmental management systems, e.g., ISO 14001 or EMAS, using environmentally friendly materials (e.g., recycled packaging) and using environmentally friendly technologies (e.g., low-waste technologies).

Taking into account the given limitations of the conducted study, the main recommendation for future research is to use ranges for the empirical study related to both using environmental criteria in supplier assessment and conducting SEE. Such ranges could include the Likert scale on the relevance of using specific environmental criteria and/or areas of SEE. Another recommendation for future research is developing supplier segmentation framework that takes into account SEE.

In summary, SEE is related to performing activities designed to assess the performance, capability, and effectiveness of the supplier in reducing various negative environmental impacts. These areas mainly include the compliance of the supplier with the buyer's needs and requirements related to the environmental performance and limiting environmental impacts. The criteria related to these activities should include implementing environmental management system, e.g., ISO 14001 or EMAS, using environmentally friendly materials (e.g., recycled packaging) and using environmentally friendly technologies (e.g., low waste technologies).

Although the scope of SEE use is limited, the future study might determine the relevance of this concept as an applicable, coherent, and standalone tool for decision-making related to supplier selection and evaluation.

ACKNOWLEDGMENTS

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

Agarwal G., Vijayvargy L., 2012, Green supplier assessment in environmentally responsive supply chains through analytical network process, Lecture Notes in Engineering and Computer Science, 2196, 1218–1223.

Bai C., Sarkis J., 2014, Determining and applying sustainable supplier key performance indicators, Supply Chain Management, 19(3), 275–291. https://doi.org/10.1108/SCM-12-2013-0441

Chen Z., Tan A., 2021, Exploring the circular supply chain to reduce plastic waste in Singapore, LogForum, 17(2), 271–286. https://doi.org/10.17270/J.LOG.2021.564

Dachyar M., Maharani A.K., 2019, Supplier Evaluation and Segmentation in Cheese Company Using Best-Worst Method and TOPSIS, Proceedings of the International Conference on Industrial Engineering and Operations Management, 81–89.

Dai J., Blackhurst J., 2012, A four-phase AHP–QFD approach for supplier assessment: a sustainability perspective, International Journal of Production Research, 50(19), 5474–5490. https://doi.org/10.1080/00207543.2011.639396

González-Sánchez R., Settembre-Blundo D., Ferrari A.M., García-Muiña F.E., 2020, Main Dimensions in the Building of the Circular Supply Chain: A Literature Review, Sustainability 2020, Vol. 12, Page 2459, 12(6), 2459. https://doi.org/10.3390/SU12062459

Govindan K., Rajendran S., Sarkis J., Murugesan P., 2015, Multi criteria decision making approaches for green supplier evaluation and selection: A literature review, Journal of Cleaner Production, 98, 66–83. https://doi.org/10.1016/j.jclepro.2013.06.046

Gupta S., Soni U., Kumar G., 2019, Green supplier selection using multi-criterion decision making under fuzzy environment: A case study in automotive industry, Computers and Industrial Engineering, 136, 663–680. https://doi.org/10.1016/J.CIE.2019.07.038

Hald K.S., Ellegaard C., 2011, Supplier evaluation processes: The shaping and reshaping of supplier performance, International Journal of Operations and Production Management, 31(8), 888–910. https://doi.org/10.1108/01443571111153085/FULL/PDF

Hashemi S.H., Karimi A., Tavana M., 2015, An integrated green supplier selection approach with analytic network process and improved Grey relational analysis, International Journal of Production Economics, 159, 178–191. https://doi.org/10.1016/j.ijpe.2014.09.027

Johnson P.F., Leenders M.R., Flynn A.E., 2011, Purchasing and Supply Management (Fourteenth), McGraw-Hill Irwin.

Kannan D., Govindan K., Rajendran S., 2015, Fuzzy axiomatic design approach based green supplier selection: A case study from Singapore, Journal of Cleaner Production, 96(Supplement C), 194–208. https://doi.org/10.1016/j.jclepro.2013.12.076

Monczka R.M., Handfield R.B., Giunipero L.C., Patterson P., 2016, Purchasing and supply chain management, In Purchasing and Supply Management, Cengage Learning. http://ds.libol.fpt.edu.vn/handle/123456789/256

Nielsen I.E., Banaeian N., Golińska P., Mobli H., Omid M., 2014, Green Supplier Selection Criteria: From a Literature Review to a Flexible Framework for Determination of Suitable Criteria, In P. Golinska (Ed.), Logistics Operations, Supply Chain Management and Sustainability (pp. 79–99), Springer International Publishing. https://doi.org/10.1007/978-3-319-07287-6_6

OECD, 1991, PRINCIPLES FOR EVALUATION OF DEVELOPMENT ASSISTANCE.

OECD, 2021, Applying Evaluation Criteria Thoughtfully. https://doi.org/10.1787/543e84ed-en

OECD, 2022, Evaluation Criteria. https://www.oecd.org/dac/evaluation/daccriteriaforevaluatingdevelopmentassistance.htm

Osiro L., Lima-Junior F.R., Carpinetti L.C.R., 2014, A fuzzy logic approach to supplier evaluation for development, International Journal of Production Economics, 153, 95–112. https://doi.org/10.1016/J.IJPE.2014.02.00

Park J.J., Shin K., Chang T., Park J.J., 2010, An integrative framework for supplier relationship management, Industrial Management & Data Systems, 110(4), 495–515. https://doi.org/10.1108/02635571011038990

Purdy L., Safayeni F., 2000, Strategies for supplier evaluation: a framework for potential advantages and limitations, IEEE Transactions on Engineering Management, 47(4), 435–443. https://doi.org/10.1109/17.895339

Sahu N.K., Datta S., Mahapatra S.S., 2014, Green supplier appraisement in fuzzy environment, Benchmarking, 21(3), 412–429. https://doi.org/10.1108/BIJ-06-2012-0042

Sahu N.K., Datta S., Sankar Mahapatra S., 2012, Establishing green supplier appraisement platform using grey concepts, Grey Systems: Theory and Application, 2(3), 395–418. https://doi.org/10.1108/20439371211273276

Sarkis J., 2014, Green Supply Chain Management, ASME. https://doi.org/10.1115/1.860281

Shen L., Olfat L., Govindan K., Khodaverdi R., Diabat A., 2013, A fuzzy multi criteria approach for evaluating green supplier's performance in green supply chain with linguistic preferences, Resources, Conservation and Recycling, 74, 170–179. https://doi.org/10.1016/j.resconrec.2012.09.006

Sosnowski P.C., 2022, Ewaluacja środowiskowa w relacjach z dostawcami, Wydawnictwo Uniwersytetu Łódzkiego.

Sumrit D., Srisawad S., 2022, Fuzzy Failure Mode and Effect Analysis model for operational supply chain risks assessment: an application in canned tuna manufacturer in Thailand, LogForum, 1, 77–96. https://doi.org/10.17270/J.LOG.2022.645

Timmerman E., 1986, An Approach to Vendor Performance Evaluation, Journal of Purchasing and Materials Management, 22(4), 2–8. https://doi.org/10.1111/J.1745-493X.1986.TB00168.X

Tundys B., 2018, Zielony łańcuch dostaw: zarządzanie, pomiar, ocena, CeDeWu.

Urbaniak M., 2010, Kierunki doskonalenia systemów zarządzania jakością, Wydawnictwo Uniwersytetu Łódzkiego.

Weele, van A.J., 2014, Purchasing and supply chain management : analysis, planning and practice, Thomson Learning.

Whitelock V.G., 2015, Relationship between Environmental Social Governance (ESG) Management and Performance - The Role of Collaboration in the Supply Chain, University of Toledo.

Winter S., Lasch R., 2016, Environmental and social criteria in supplier evaluation – Lessons from the fashion and apparel industry, Journal of Cleaner Production, 139(Supplement C), 175–190. https://doi.org/https://doi.org/10.1016/j.jclepro.2016.07.201

World Commission on Environment and Development, 1987, Report of the World Commission on Environment and Development: Our Common Future Towards Sustainable Development .

Wu C., Barnes D., 2016, An integrated model for green partner selection and supply chain construction, Journal of Cleaner Production, 112, 2114–2132. https://doi.org/10.1016/j.jclepro.2015.02.023

Zeydan M., Çolpan C., Çobanoǵlu C., 2011, A combined methodology for supplier selection and performance evaluation, Expert Systems with Applications, 38(3), 2741–2751. https://doi.org/10.1016/J.ESWA.2010.08.064

Piotr Cezary Sosnowski ORCID ID: https://orcid.org/0000-0002-3573-6718
Department of Logistics,
Faculty of Management,
University of Łodź, **Poland**
e-mail: piotr.sosnowski@uni.lodz.pl