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ORIGINAL PAPER

GREEN CONCEPTS IN THE SUPPLY CHAIN

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ABSTRACT. Background: Reducing negative environmental impacts has become a significant managerial issue. It includes also supply chain participants, e.g., by introducing such concepts as green supplier evaluation or green supplier development.
The goal of this paper is to identify concepts aimed at reducing negative environmental impacts in the supply chain (the "green concepts") and to determine their scope of use.
Methods: The research method used in this paper is the review of the existing literature. The reviewed literature is related to the area of reducing negative environmental impacts in supply chain.
Results: The results concern the classification of green concepts in supply chain and determining their scope of use, including green supply chain management, green purchasing and green supplier development.
Conclusion: The main research implication is providing a basis for further research related to reducing negative environmental impacts in supply chain. It includes also identifying relationships between these concepts and observable trends in the global economy, such as sharing economy and circular economy. The results might also contribute to implementing the green concepts in companies interested in reducing negative environmental impacts in their supply chains. The originality of this work lies in taking into consideration various concepts aimed at reducing negative environmental impacts and discussing them in the context of the supply chain.

Keywords: green supply chain management, green purchasing, green supplier development, green concepts, supply chain management, environmental impacts

INTRODUCTION

Reducing negative environmental impacts is becoming increasingly important in management. This also applies to supply chains. The importance of reducing negative environmental impacts in the supply chain was described, among others, by R. Sroufe [2006, p. 12]. Environmental issues relevant to the supply chain include location and method of extraction of raw materials, energy and material capacity of the business, environmental performance, emission level, mode of transport, mode of packaging, reusability, technologies and methods of production and eco-innovations [Rudnicka, 2011, p. 165].

The goal of this paper is to identify concepts aimed at reducing negative environmental impacts in the supply chain (the "green concepts") and to determine their scope of use.

NEGATIVE ENVIRONMENTAL IMPACTS IN SUPPLY CHAIN

Different areas of the supply chain have different environmental impacts. These include emissions of solid waste, wastewater and atmospheric pollutants. During the extraction of non-renewable natural resources, the landscape degrades, and soil, water and air are polluted. During production, material goods and energy are consumed. Furthermore, packaging and hazardous substances are used. In addition, emissions of solid waste, wastewater, gas, vibration and noise emissions occur. Energy is

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also consumed during transport. On the other hand, one of the effects of using a finished product is the production of waste associated with this product, which can contaminate the soil, water or air. The different types of negative environmental impacts, considering the related areas of the supply chain, are presented in Table1.

Table1. Types of negative environmental impacts

Supply chain area	Types of negative environmental impacts in the supply chain
All	Emissions of solid waste; atmospheric emissions (including CO_2)
Extraction of natural resources	Depletion of non-renewable raw materials; energy consumption; water consumption; landscape degradation; reducing biodiversity; soil, water and air pollution (including chemical pollution); eutrophication; vibrations; noise
Transport and distribution	Leaks; energy consumption; vibrations; noise
Production	Manufacturing and use of dangerous substances; resource consumption; energy consumption; water consumption; waste generation; the use of packaging; heat emissions; wastewater emissions; vibrations; noise; use of chemicals in consumables
Use of the finished product	Excessive consumption; emissions associated with improper use of the finished product; lack of (or improper) management of waste; soil, water and air pollution (including chemical pollution); exposure to dangerous substances; returns of finished products
Stage after the end of use	Pollution of soils, water and air (including chemical pollution) by waste

Source: own study based on: Kalinowski et al., 2019, pp. 144–145; Preuss, 2006, pp. 218–221.

Researchers also identify a significant role for environmental management in the supply chain. C. Y. Wong et al. describe the inclusion of environmental management in the supply chain as a way to build a green supply chain [Wong et al., 2015, pp. 59–60]. M. Urbaniak, on the other hand, points to the essential role of environmental management in building a competitive advantage [Urbaniak, 2018, p. 139]. Furthermore, S. Y. Lee and R. D. Klassen described the essential importance of environmental management in building a green supply chain, and stressed the importance of monitoring and collaborating with suppliers for the development of environmental management capabilities among suppliers [Lee and Klassen, 2008, p. 583].

ENVIRONMENTAL MANAGEMENT IN SUPPLY CHAIN

As defined by R. D. Klassen and C. P. McLaughin, environmental management means, in all efforts, to minimise the negative environmental impact of products throughout their life cycle [Klassen and McLaughlin, 1996, p. 1199].

Environmental management is also influenced by the supply chain actors: suppliers, clients, employees and competition. Suppliers have a negative impact on the environment and their clients decide whether and how they will respond to such impacts: whether they apply environmental criteria for assessment or environmental evaluation of suppliers (green supplier evaluation), or take other actions related to environmental cooperation or collaboration with them [Sosnowski, 2019, pp. 333–334].

The motivation for supply chain actors is provided by their clients and their competitors. For clients, this includes, but is not limited to, environmental requirements for products, services and processes related to their production and provision. In the case of competition, this includes, but is not limited to, competing by meeting the environmental requirements of consumers. In turn, employees of supply chain companies are involved in activities that have an impact on reducing negative environmental impacts [Rudnicka, 2016, p. 70]. The impact of supply chain actors on environmental management is described in Table2

Table2. Impact of supply chain actors on environmental management

Supply chain actors	Impact on environmental management
Suppliers	Generation of pollutant emissions and consumption of material goods and energy affecting product life cycle assessment; impacting environmental risk levels
Clients	Placing environmental requirements on products and services and processes related to their production and provision; participating in the life cycle of the product; deciding on the degree of acceptance of implemented eco-innovation
Employees	Participation in actions affecting the reduction of negative environmental impacts
Competition	Meeting the environmental requirements of your audience, which motivates you to take similar action

Source: own study based on: Rudnicka, 2016, p. 70.

Supply chain actors are an intermediate link between their clients and suppliers. In the context of environmental management, this means, on the one hand, meeting the environmental requirements of its clients and, on the other hand, placing environmental requirements on its suppliers. Employees who work to reduce negative environmental impacts in their company and competitors who meet the environmental expectations of their clients are also important. thus provide an incentive for other market actors to compete in this area.

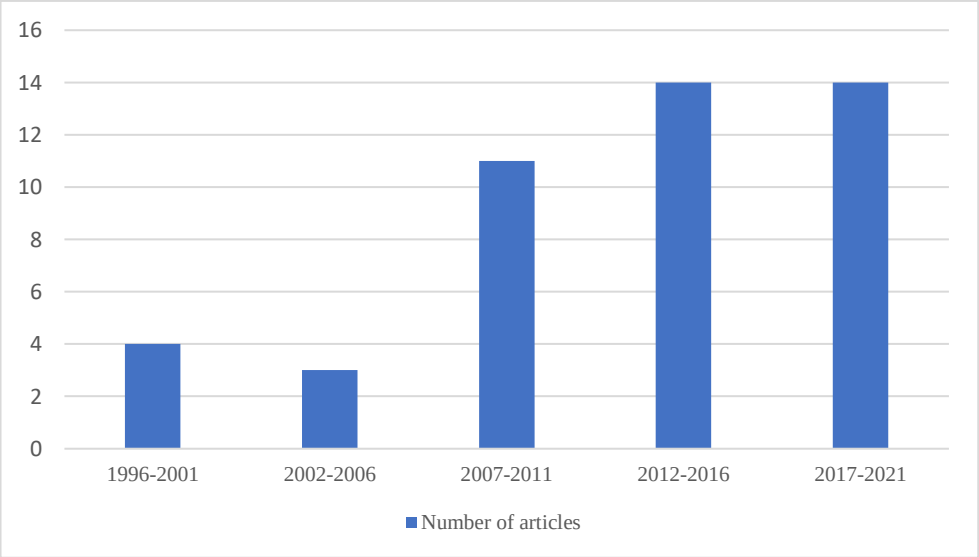

Figure 1. The bibliometric analysis timeline

THE OVERVIEW OF GREEN CONCEPTS IN SUPPLY CHAIN

Green concepts that relate to the supply chain can be distinguished. Some of them relate to elements of supply chain management, such as purchasing process management, supplier relationship management, supplier development or the implementation of environmental innovations in the supply chain [Ocicka, 2014, p. 7276]. These include such concepts as green purchasing [Bai and Sarkis, 2010, p. 1201; Dubey et al., 2013, pp. 188–189], green supplier development [Bai and Sarkis, 2010, p. 1201] and reverse logistics [Rogers and Tibben-Lembke, 2001, p. 130].

The bibliometric analysis timeline is presented in Figure 1.

The literature review was conducted in July and August of 2021. There was no criterion related to the time of publication. Articles taken into account were published between 1996 and 2021. It should be noted that the relative majority of reviewed sources (28 out of 46) were published during the last decade. It points out the increasing significance of the focal topic in management science.

Some green concepts concern the supply chain as a whole. This includes the creation of closed-loop supply chains. Furthermore, a green concept that is particularly important in the context of this dissertation is green supply chain management. It combines environmental management and supply chain management, considering the use of tools such as green supplier evaluation. Other green concepts concern specific elements of supply chain, e.g. green manufacturing [Malek and Desai, 2020, p. 9].

Green concepts in the supply chain can also include concepts related to sustainable development that concern not only environmental issues but also economic and social issues. In this approach, green concepts in the supply chain also include sustainable purchasing, sustainable supplier management, sustainable supplier management and sustainable supply chain management. An overview of green concepts in the supply chain is presented in Table3 It can be observed that the above-presented concepts can provide a link not only with the relevant area of the supply chain but also with sustainable development. This is important because one of the dimensions of sustainability is the environment. In addition, all the above concepts, except for green manufacturing, are directly related to cooperation with suppliers. This demonstrates the indirect link between these concepts and buyer-supplier relationships. It should also be noted that the concepts presented above are not disjointed. Some of them are even treated as elements of other concepts, such as green purchasing, which can be considered both as a separate green concept in the supply chain and as part of the green supply chain management concept.

Other concepts that are more indirectly related to reducing negative environmental impact in supply chain include: sharing economy [Govindan et al., 2020, p. 2], circular business models (circular economy) [Bocken et al., 2019, p. 4].

FINDINGS AND DISCUSSION

There are several green concepts included in the overview. Some of them are related to the concept of sustainability (sustainable supply chain management, sustainable purchasing sustainable supplier development and sustainable supplier management). Hence, these concepts are focused not only on environmental issues but also economic and social issues. In the case of sustainable supply chain management, it includes sustainable aspects of all supply chain actors [Karaosman et al., 2020, pp. 660–661].

Also, three described concepts are related directly both to building relationships in the supply chain (hence, building a supply chain) and reducing negative environmental impacts: green supply chain management, green purchasing and green supplier development.

Table3. Overview of green concepts in supply chain

Concept	Description
Reverse logistics	The process of planning, implementing and controlling the efficient, cost-effective movement of raw materials, stocks, finished products and related information from the place of consumption to the place of origin with a view to recovery or production of value or proper disposal
Closed-loop supply chain management	Design, control and operate the system to maximize value creation throughout the product lifecycle with dynamic value recovery with different types and magnitudes of returns over time
Green supply chain management	Integrating environmental thinking into supply chain management, including product design, sourcing and raw material selection, manufacturing processes, final product delivery to end-users, and post-use product management
Green distribution*	Distribution management including measuring and reducing negative environmental impacts
Green logistics*	Efforts to measure and reduce the negative environmental impact of logistics activities
Green manufacturing*	Production management including measuring and reducing negative environmental impacts
Green purchasing, green procurement, green supply management, environmental purchasing, environmental purchasing and suppliermanagement*	Management of the purchasing process including measuring and reducing negative environmental impact, including the inclusion of environmental criteria in supplier selection and evaluation of suppliers in terms of the results of their environmental activities
Green supplier development*	Supplier development aimed at increasing supplier environmental performance
Sustainable purchasing	Integrating environmental, social, ethical and economic issues into the management of the organisation's external resources in such a way that the supply of all the goods, services, capabilities and knowledge needed to run, maintain and manage the core organisation and support actions provide value not only to the organisation but also to society and the economy
Sustainable supplier development	Supplier-oriented development focused on achieving their environmental and social objectives
Sustainable supplier management	Economic, environmental and socially efficient supplier management
Sustainable supply chain management	Managing the flows of goods, information and capital and working with other actors in the supply chain integrating the three dimensions of sustainable development: economic, environmental and social

* also mentioned as green supply chain management practices

Source: own study based on: Bai and Sarkis, 2010, p. 1201; Dubey et al., 2013, pp. 188–189; Foerstl et al., 2010, p. 118; Guide and Van Wassenhove, 2009, p. 10; Pagell et al., 2010, p. 58; Rogers and Tibben-Lembke, 2001, p. 130; Sancha et al., 2015, p. 95; Seuring, 2013, p. 1514; Sosnowski and Bojanowska, 2018, p. 128; Srivastava, 2007, pp. 54–55; Tate et al., 2012, p. 174; Wilding et al., 2012, p. 489; Zsidisin and Siferd, 2001, p. 69.

GREEN SUPPLY CHAIN MANAGEMENT

The first green supply chain management studies were produced in the last years of the 20th century to characterise environmental management activities in the supply chain [Sarkis, 1998, pp. 162–163]. According to some scholars, e.g. A. Maryniak and S. Laari, green supply chain management combines supply chain management with environmental management [Laari et al., 2017, p. 1304; Maryniak, 2017, p. 13]. In this respect, green supply chain management can be defined as the implementation of environmental management in the supply chain [Srivastava, 2007, pp. 53–54] This is important given the indications that the development of supply chain management is related to green supply chain management [Nelson et al., 2012, p. 33].

To discuss the concept of green supply chain management, it is necessary to establish the meaning of the term 'green supply chain'. According to J. Witkowski and A. Pisarek, the green supply chain distinguishes the traditional supply chain from the traditional one, among others, by its purpose. The traditional supply chain aims to maximise profits and minimize costs throughout the supply chain. The green supply chain, on the other hand, aims to reduce resource consumption and negative environmental impacts throughout the supply chain. In addition, the green supply chain is operating to build a closed-loop supply chain, and all stakeholders of the company are focused on end-users [Witkowski and Pisarek, 2017, p. 18].

The management of the green supply chain should consider not only flows of goods, services, information and capital but also waste [Sarkis, 2012, p. 209]. It is also indicated that the implementation of the green supply chain management concept can be a step towards the implementation of sustainable supply chain management concepts which take into account, in addition to the economic and environmental dimension, the social dimension, in line with the principles of sustainable development [Tundys, 2018, p. 99].

GREEN PURCHASING

The green purchasing concept incorporates the reduction of different types of negative environmental impact in the management of the purchasing process [Dubey et al., 2013, pp. 88–89]. This is an element of green supply chain management that is directly related to the green supplier evaluation [Sarkis, 2014]. The implementation of the green purchasing concept may be motivated by end-user requirements, applicable regulations and expected economic benefits [ElTayeb et al., 2010, p. 224].

Green purchasing practices are an instrument for the implementation of green purchasing practices. These include, but are not limited to, activities related to the green supplier evaluation, such as the environmental audit of suppliers, the environmental certification of suppliers by an independent body, the assessment of the life cycle of the material good purchased, the requirement for the supplier to implement and maintain an environmental management system not necessarily certified by a third party, and the requirement for suppliers to disclose the specific characteristics of the material good purchased, e.g. in the form of environmental labels or declarations [Bowen et al., 2006, p. 159]. Green purchasing practices also include the use of environmental checklists [Chien and Shih, 2007, p. 384] to conduct environmental activities [Bowen et al., 2006, p. 159; Sarkis, 2014, p. 15].

It should be noted that the company's commitment to environmental issues translates into its purchasing opportunities [Large and Gimenez Thomsen, 2011, p. 181] and implementing the concept of green purchasing translates into economic efficiency [Green et al., 2012, p. 299]. In addition, positive links have been demonstrated both between the implementation of green purchasing and the increase in the efficiency of purchasing management understood as a function of the company and between the implementation of green purchasing and the increased purchasing efficiency if the company maintains a partnership with suppliers [González-Benito et al., 2016, p. 319]. Furthermore, there is a positive correlation between taking environmental considerations into account in the purchasing process and increasing the effectiveness of environmental activities and the competitive advantage of the company [Ferri and Pedrini, 2018, p. 886].

GREEN SUPPLIER DEVELOPMENT

Supplier development incorporating environmental activities, referred to as green supplier development or environmental supplier development, means the efforts to increase the effectiveness of the environmental activities of suppliers [Bai and Sarkis, 2010, p. 1201]. This is done primarily by interacting with them, the use of supplier evaluation and taking into account the type of relationship with [Sarkis, 2014, pp. 19–21; Urbaniak et al., 2021, p. 2]. Overall, supplier development is influenced by factors such as effective communication, partnership approach, mutual involvement of the supplier and the client in cooperation and support of top management [Sillanpää et al., 2015, pp. 230–231]. The partnership approach implies the possibility of the importance of the type or duration of the relationship between the supplier and the client in terms of carrying out supplier development activities [Wagner, 2011, p. 281].

Among the areas of green supplier development activities are exchange and communication of knowledge on environmental issues (green knowledge), exchange of resources and management practices [Bai and Sarkis, 2010, p. 1202]. The first area includes knowledge exchange and communication activities aimed at reducing the negative environmental impact of the supplier, such as the training of suppliers in this field and the evaluation of suppliers taking into account environmental criteria. In turn, the exchange of

resources and investments takes into account the sharing of material goods and capital with the supplier for the same purpose. Management and organisational practices, on the other hand, include all other organisational and management activities aimed at reducing the various negative impacts of suppliers on the environment, such as the implementation of green practices, environmental contracting and green supplier development, eligibility criteria for suppliers to implement green supplier development.

CONCLUSION

To summarize, there are several concepts directly related to related directly to building relationships in the supply chain and reducing negative environmental impacts. They are related either to the supply chain as a whole (green supply chain management) or to specific areas of the supply chain. Despite of limiting the scope of use, some of them affect directly more than supply chain link, e.g., green purchasing and green supplier development.

However, results reducing negative environmental impacts by introducing these concepts depend, among alia, on management approach. Possible factors affecting effectiveness of introducing green concepts in supply chain are performance measurement system and cooperation and collaboration with other supply chain actors.

It should be noted that the essential element of both green purchasing and green supplier development is green supplier evaluation, which can provide a basis for environmental cooperation between buyer and supplier. However, the scope of practical implementation of these concepts in a company may vary (see: Implication for business practice).

IMPLICATION FOR FUTURE RESEARCH

All the identified green concepts in the supply chain are related directly or indirectly to reducing the negative environmental impacts. The main recommendation for future research is a study of relationships between these concepts and observable trends in the global economy, such as sharing economy and circular economy.

The results might provide a way of introducing identified green concepts in the context of an economy based on either (or both) shareability and/or circularity.

IMPLICATION FOR BUSINESS PRACTICE

Implementation of concepts described in this paper may result in reducing negative environmental impacts in companies. The profitability of such action depends on the region of operations, targeted market, business sector, and legal regulations related to business processes and products.

Hence, the introduction of such concepts as green purchasing should be preceded by the research of these areas.

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