GREENING ACROSS SUPPLY CHAIN – ANALYSIS OF THE EMPIRICAL STUDIES

Tomasz Wiśniewski* and Blanka Tundys**

Faculty of Management and Economics of Services, University of Szczecin, Szczecin,
Cukrowa 8, 71-004, Szczecin, Poland
* Email: tomasz.wisniewski@wzieu.pl
** Email: blanka.tundys@wzieu.pl

Abstract: The environmental pressures and accompanying market trends require chain managers to reorient their approach to chain construction and management. New business models are gaining popularity, but interesting from a research point of view is whether organizations are aware of the greening of the environment in which pro-environmental aspects are implemented, or whether there is a difference between the assessment of supply chain performance depending on the extent of the environmental aspects being implemented. The results of the research indicate that there is a gap in both research and practical aspects. The difficulty is ignorance of how the chain can be assessed, in terms of its greening, often the awareness of the importance of problems is not used in relation to the environment. It is important to pursue further research in this area and implement solutions to economic practice, since only in this way will environmental aspects really change the supply chain.

Paper type: Research Paper

1. INTRODUCTION

Business activity undergoes constant transformation. Supply chains are becoming more complex and their processes undergo dynamic changes. Of great importance in the design and management chains are global megatrends, including those relating to environmental protection or sustainable development more broadly. The pressure of the environment, requirements of customers and competitors contributes to the introduction of greener rules of management, infrastructure or an organizational change in the chains and supply chains.

By adopting the greening of processes, it is important to point out how this takes place in the supply chains and their individual links. Are new business models being deployed, tools and instruments used to do that, who is the initiator of change, and what effects do they bring to the stakeholders? The reflections focus on verifying the theses and the answers to the research questions, and pointing to the recommendations and possibilities for changing the current state for organizations that do not implement green management of their chain up to this point.

New business models, including, but not limited to, changing customer requirements, but also the benefits that new strategies can bring to organizations and their supply chains, are becoming increasingly popular.

2. AIMS AND RESEARCH PROBLEMS

The research problem of the focus is on the analysis of greening along the supply chain. An important element is to indicate the role that environmental certificates play in the chain, whether it affects the degree of their greening and the implementation of modern chain concepts. The next part is based on whether individual links implement green rules and at what time. The authors attempted to find the answers to the following research questions: Are there differences between the assessment of supply chain performance depending on the scope of environmental aspects being implemented (green logistics, green or sustainable chain). What is the impact on performance in the supply chain (level and organizational aspects)? Are dedicated management instruments used to assess chain efficiency? Is the scientific management methods / instruments used to assess its effectiveness in the supply chain?

The assessment of the supply chain and its individual links, including the extent of its greening, is independent of the scope of environmental innovations being implemented. Regardless of the extent and extent of greening, organizations do not implement dedicated greenhouse assessment instruments. Scientific tools for assessing the environmental performance of a chain do not play a significant role in the assessment of the chain. The degree of greening often depends on factors outside the organization.

3. LITERATURE REVIEW

3.1. Green management

In the traditional sense, management aims to do business so that it can achieve the greatest economic benefits. Environmental and social goals do not play a major role. Today, running a business without paying attention to the elements of sustainable development will not allow you to be competitive and thus gain economic profit. Introducing environmental aspects to an organization's management is a trendy trend. Depending on the nature of the organization and its size range and degree of formalization of the principles of environmental management can be different. As a rule, small and medium-sized enterprises undertake less formal activities, but adapting to requirements often reduces the flexibility of the organization. The implementation of innovative solutions has a decisive influence on the organizational structure. This is related to the adaptation of new technological solutions. Taking this type of action affects the need to own and use a large number of diverse resources. This, in turn, allows for the implementation of advanced environmental practices and activities.

Based on the literature (Banerjee, 2001) 4 themes can be distinguished taking actions related to the implementation of the environmental aspects of the organization (or, more broadly, in the supply chain): (1) regulations; (2) expected competitive advantage; (3) commitment top management; (4) public opinion (reconciliation of the requirements of diverse social groups).

3.2. Green strategy in the supply chain

Introduction a green strategy into the supply chain involves taking appropriate actions that can be defined as: (1) "Green commitment" - occurring when the organization commits itself to reducing its negative impact on the environment; (2) "Green activity" refers to an organization that implements selected methods to reduce negative environmental impacts and meet environmental commitments; (3) „Green system "- is implemented in organizations that have an environmental management system, evaluate, review the system and implement continuous improvement tools as well as implemented standards and environmental standards. (4) „Green culture" – a wide range of activities that involve running a business that works with the environment and the elements of greening become part of the whole culture of the organization. Environmental protection is present in all aspects of the organization, (5) „Green Network" – Extend rules and actions throughout the supply chain, including creating incentives for partners to implement innovative solutions (Green Industry Project, 2014). Graduation of solutions and levels of implementation of green rules is related both to the degree of advancement of the solutions as well as to a better understanding of the nature of greening. It's a good idea to start with the sim-

plest solutions so you can implement more technically advanced, technologically advanced and conceptually advanced solutions in the next steps. Within the individual levels, specific actions need to be taken to fulfill the assumptions and then move on to the next level. These actions can be described as either an environmental orientation or as an environmental strategy. By implementing an environmental strategy you can expect both short and long term effects. The most important elements in strategies include: planning, design, prevention of pollution, properly targeted human resource management, quality, or logistical processes (including sourcing, manufacturing, distribution, storage). Green strategy allows you to gain new areas of competitiveness.

3.3. Green supply chain

Re-configuring the supply chain involves many elements, one of the global trends is the interest in the environmental aspect and the impact of chain activity on the environment. As a rule, logistics processes have a pejorative impact on the environment. Logistic activity itself, its nature and scope is focused on the use of resources and, unfortunately, in most cases the negative effects of this activity. In the new supply chain perspective, logistic paradigms must be complementary to sustainability. Supply chains have impact on environmental performance (Parmigiani et al., 2011). Green supply chain integrated environmental thinking and practises into supply chain (Sarkis et al., 2011) and the environmental dimension of sustainability in a supply chain context (Wu and Pagell, 2011). Also it the complex of mechanisms implemented at the corporate and plant level to assess or improve the environmental performance of a supplier base (Gavronski et al., 2011) during products`s cycle life (H'Mida and Lakhal, 2007) and it use environmental measures to the whole supply chain (Albino et al., 2009). It is important to use ecological thinking in whole of processes. In the productions processes resources should be economical use and optimal steering of the process in view to the elimination of causes of disturbances (Sławińska, 2016). The definitions and scope of activities undertaken within the chain vary depending on the nature of the chain offerings, the chain length, the structure of the capital, the role of the leader or the number of units in the chain. Activities undertaken within the new trend in the chain include not only organizational and marketing but also technical and technological activities, including the implementation of each type of innovation. These include, but are not limited to, the minimization of waste volume and pollution in general, as part of individual logistics processes, including product and after-life packaging management (Srivastava, 2007). Strategic initiatives require long-term and strategic cooperation between the various links in the chain and network stakeholders (Liu et al., 2012) including solutions in every phase of the logistics system including reverse logistics (Rao and Holt, 2005). It is also important to work with suppliers and their selection and evaluation through their greening, as well as incorporating soft elements such as marketing, PR, green distribution or green public procurement (Hervani et al. 2005). Green supply chain is based on following trends: environmental laws and regulations

are increasingly widespread; consumers are becoming receptive to products made from recycled as well as virgin materials; some companies are finding recycling, remanufacturing, and processing of used products, materials, and packaging to be good business that represents additional sources of revenue (Krykavskyy et al., 2014). The main emphasis in the green chain is on the environmental and environmental aspects. Activities and solutions are subordinated to these goals.

3.4. Instruments and methods using in the green supply chain management

By analyzing the tools and methods used in the green chain, you should refer to the drivers and consider them in the categories.

Table 1. Drivers in the Green supply chain; Source: own elaboration on the basis of: (Kamol Kittiwong & Phruksaphanrat, 2011)

Drivers in the Green supply chain		
Characteristic		
external	supplier	Through collaboration, you can achieve ecological effects in systems. Cooperation is about establishing common principles, standards and tools implemented within the chain. It also covers joint planning and product design and packaging.
	regulation	Another important and essential factor in the implementation of the green chain, depending on regulation at the governmental or community level. Creating a Policy of the environmental
	market/consumer	Market factors and consumers influence what happens in the supply chains and how they will be shaped.
	competitors	Green rules can create a competitive advantage. New products and solutions
	social/stakeholder	Environmental pressures and increased public awareness make organizations evaluate their environment and their activities from an environmental point of view. The new strategy works to reach new customers.
internal	supporting from top management	Top management support plays an overriding role in the introduction of the green chain. The vision and mission must be conveyed to employees at various levels to succeed and meet the goals of the entire organization and chain.
	organization strategy	Organizations need to redesign their business strategies in order to maintain their market position and acquire new customers. The direction is a more environmental strategy
	Cost reduction	Better use of resources will have the potential to reduce costs. Not only ecological products, but also resource-efficient and better use of potential leads to a competitive advantage for the organization.
	economic benefit	Lower costs, improved image, increased customer satisfaction, new market opportunities, improved image are contributing to increased economic benefits.
	reverse logistics	Creating added value in feedback processes, not only economic but also environmental benefits.

Drivers can be divided into internal and external– the description and characteristics are presented in Table 1. Both categories play an extremely important role in the creation of the green chain. One of the key elements is the supplier.

Implementing a green chain can take many forms. Starting from organizational, administrative, legal and infrastructure changes. The actions taken use different sets of instruments: management, economic, legal. Regardless of the scope or type of instrumentation used, it is important to point out the common goals of such actions: improving image, increasing economic profitability, changing strategy to more pro-environmental, satisfying clefts.

4. METHODOLOGY AND ANALYSIS

The research methods used for the study include: literature analysis, data collection based on questionnaire surveys. Statistical methods were used to analyze and elaborate the data.

The questionnaire has been prepared based on an in-depth analysis of the literature, interviews with experts and conducted a scientific discussion. On the basis of identified research areas and to the previously formulated hypotheses the survey questions were developed. Answers to the questions are designed in such a way that the respondents answering used the 5 point Likert scale. (1 – never / very rarely, 5 – very often / always). On the basis of randomly selected study sample, examined was 154 companies.

4.1. Data collection

The survey using a questionnaire was conducted throughout of Poland, using the CATI method, in connection with an extensive questionnaire and the need to sacrifice more time to fill it, interviewers performed them for 3 months. The survey was directed to the food industry – conventional, food industry – organic, wearing apparel manufacturing, home appliance manufacturers, sales network of grocery and general merchandise retailer, sales network of home appliances, sales network of retail-clothing. On the basis of randomly selected sample, 159 companies were examined. Other limitations of the study were: the number of employees: 51–99 person and responding to the questionnaire employees – middle to senior levels of management experience, for example supply chain manager, logistics manager, head of logistics or supply chain, procurement and purchasing manager. The number of investigated objects (159) stems from the assumptions of the correct statistical survey.

4.2. Empirical findings

An analysis of independence was made to examine whether there are relationships between companies that implement or intend to implement: green supply chain, sustainable supply chain, green logistics. From the definition of independence analysis, it is based on the assumption that there are no dependencies between the individual variables tested and, moreover, there are no significant differences between the quantities compared. Chi-squared test for independence was used.

Null hypothesis H0 is that there are no differences in the efficiency assessment and supply chain performance (questions 1A-1D, 2, 3) in comparison to companies that implement or intend to implement: green supply chain, sustainable supply chain, green logistics. All calculation was done in Statistica 10.0 software, results are presented in table 2.

Table 2. Chi-square and V-Cramer coefficients

Companies implement or intend to implement	χ^2	p	V Cramer
Green supply chain	4.5170	0.04132	0.37412
Sustainable supply chain	8.3221	0.04211	0.34216
Green logistics	13.4213	0.00813	0.53848

Observing p-value for these parameters it can be seen that hypothesis H0 is rejected. It means that to companies that implement or intend to implement: green supply chain, sustainable supply chain, green logistics have different assessment in the efficiency and supply chain performance.

In addition to estimate how strong is this relationship V-Cramer coefficient was used. When value of this coefficient is less than 0.3 that means there is week relation between analyzed characteristics. Value between 0.3 and 0.5 means that there is moderate relation and more than 0.5 means that there is strong relation between these characteristics. From table 2 one can observe that V-Cramer coefficient says that there is moderate relation. From this it can be observed that the biggest value of this coefficient is in companies that implement or intend to implement green logistics.
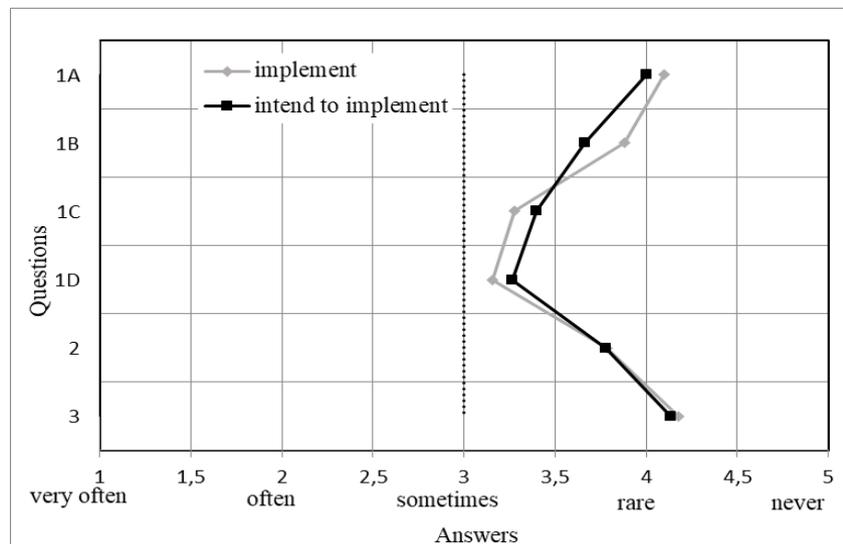
Figures 1A-1C show the semantic differentiations presenting dissimilarities in the efficiency assessment and supply chain performance (questions 1A-1D, 2, 3) in comparison to companies implementing or planning to implement respectively:
- Green supply chain (Figure 1A),
- Sustainable supply chain (Figure 1B),
- Green logistics (Figure 1C).

The respondents responded to the questions listed below on a scale: 1 – very often, 2 – often, 3 sometimes, 4 – rarely, 5 – never.

Questions:

1. In assessing the efficiency and efficiency of the supply chain, environmental aspects are taken into account:
   A) At the chain level
   B) Only in selected areas
   C) Only in selected units
   D) Only to evaluate selected processes
2. Dedicated environmental management instruments are used to assess the efficiency and performance of the supply chain
3. Scientific assessment methods (including ecological efficiency, management methods, modern concepts) shall be used to assess the efficiency and effectiveness of the supply chain.
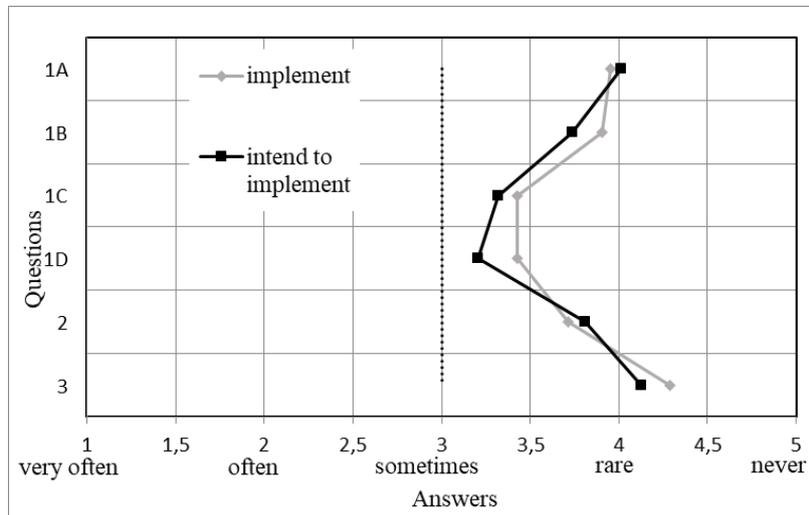

Fig. 1A. Semantic differential presenting dissimilarities in the efficiency assessment and supply chain performance in comparison to companies implementing or planning to implement green supply chain

From Figure 1A that shows semantic differential in companies implementing or planning to implement green supply chain one can observe that the biggest differences are for questions 1B to 1D. In assessing the efficiency and efficiency of the supply chain, environmental aspects are taken into account by companies: only in selected areas (1B), only in selected units (1C) and only to evaluate selected processes(1D). What is important, companies that declare that they implement environmental aspects are doing it more often only in selected units and only to evaluate selected processes. A similar conclusion can be drawn when looking at 1B and 1C, where companies who intend to implement green supply chain more often take

into account environmental aspects. Dissimilarities in questions 2 – dedicated environmental management instruments are used to assess the efficiency and performance of the supply chain and question 3 – scientific assessment methods (including ecological efficiency, management methods, modern concepts) shall be used to assess the efficiency and effectiveness of the supply chain are not so distinct.
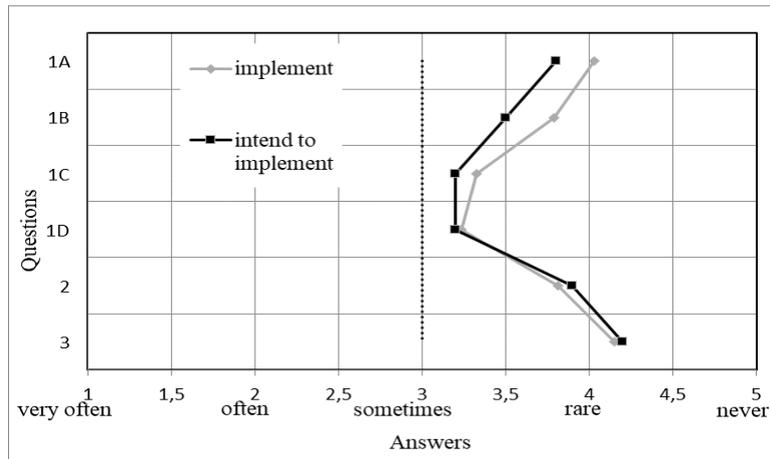

Fig. 1B. Semantic differential presenting dissimilarities in the efficiency assessment and supply chain performance in comparison to companies implementing or planning to implement sustainable supply chain


Fig. 1C. Semantic differential presenting dissimilarities in the efficiency assessment and supply chain performance in comparison to companies implementing or planning to implement green logistics

Certificates analysis was performed by individual groups in the supply chain. Results are presented in Figure 2. Approximately 24% of all 154 companies have a certificate. The highest number of certificates have the manufacturers, but the highest percentage of certificates is held by retailers (almost 40%).
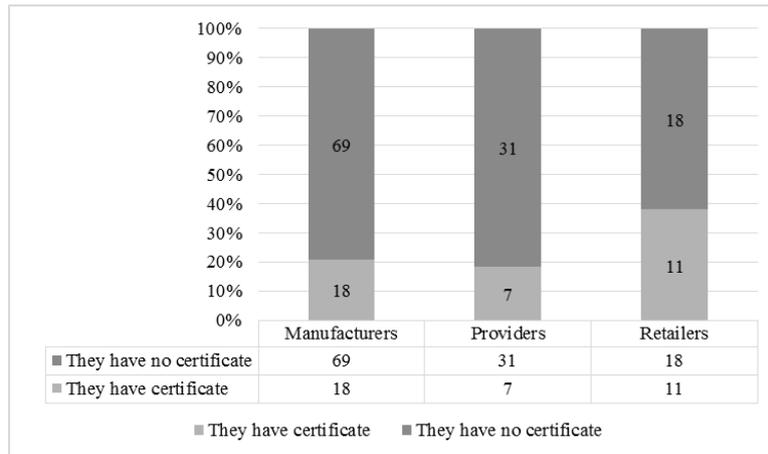

Fig. 2. Number of certificates held by individual groups in the supply chain
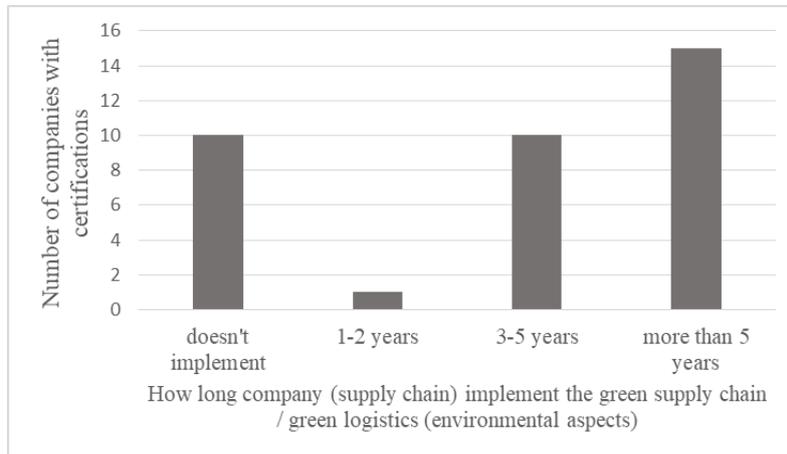
Fig. 3. Number of companies with certifications vs. period of implementing of green supply chain

Figure 3 presents number of companies with certifications in comparison to how long they implement the green supply chain / green logistics (environmental aspects). It can be seen that the number of certificates increases with the implement of the green supply chain. But the important note is that companies that de-

clare that they do not introduce aspects of the green supply chain also have environmental certifications (10 such companies). Furthermore, Figure 4 shows the number of individual types of certificates held. Most companies have ISO 1400x certification, but there are a large number of companies that have certificates other than ISO 1400x or EMAS.
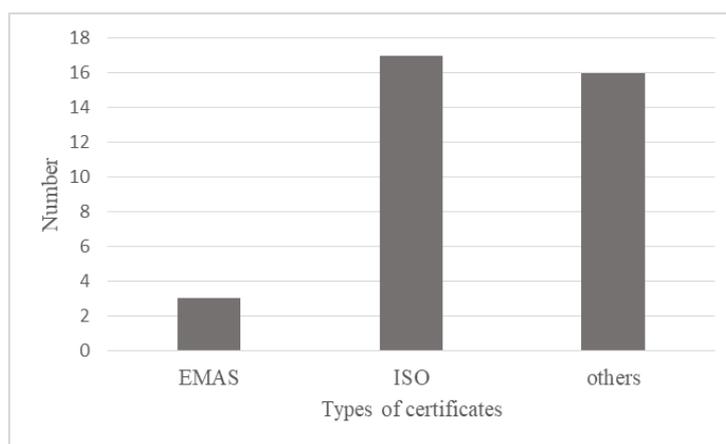
Fig. 4. Number of each types of certificates

Analysis of variance (ANOVA) was used to examine the significance of differences between entrepreneurs who implement and not implement the green supply chain. To this end, we use Fisher's law that the ratio of the squares of variances between groups to squares of variances inside groups is determined according to a certain distribution (Fisher-Snedecor distribution) and it is possible to assess the probability of occurrence of certain values of F.

Analysis of variance (ANOVA) has been used to determine if there are differences for the implementing or non-implementing green supply chain in the context of the following questions/criterions:

1. Is one of the selection criteria (eg supplier, partner) are environmental requirements? Please evaluate how often this criterion is used, using a scale of 1–5.
2. How often does the aspect of the "green" image be taken into account when selecting a supplier / partner? Please assess the grade to be taken into account using the 1-5 scale.

    Answers by key: 1 – very often, 2 – often, 3 – sporadically, 4 – rarely, 5 – never.

The analysis was done by division company into types: (1) Manufacturers, (2) Providers, (3) Retailers. From the results appears that that the only differences between enterprises declaring the implementation of the green supply chain are in criterion 1 – one of the selection criteria (e.g. supplier, partner) are environmental requirements and only in the retailers group (the biggest spread between F_0 from ANOVA than from Snedecor distribution with small p-value at the same time).

Table 3. Analysis of Variance for executed research

Source of Variation		Mean Square	F_0	p-value
Criterion 1 - one of the selection criteria (eg supplier, partner) are environmental requirements	Manufacturers	0.530466	0.87722	0.351618
	Providers	0.725529	1.04368	0.314627
	Retailers	**7.889286**	**13.83610**	**0.000967**
Criterion 2- "green" image is taken into account	Manufacturers	1.510978	2.28102	0.134674
	Providers	1.334921	1.86592	0.182814
	Retailers	0.128571	0.22975	0.635717

This means that although entrepreneurs declare the implementation of the green supply chain, in practice they do not choose suppliers in terms of environmental aspects nor take into account the "green" image.

5. DISCUSSION AND LIMITATION

These reflections should contribute to the discussion on activities related to greening the supply chain, how to evaluate it and how to promote it. The novelty and originality of the work is the assessment of the degree of greening with the use of the indicated statistical methods, on the basis of which the conclusions are drawn, for further analysis. Referring to the results of research and applications, there is a gap in knowledge about the green supply chain, organizations do not use the tools and methods available to support the implementation of the green chain and how to assess it. The study has its limits: the verification of the submitted theses refers only to a selective research sample of three sectors, each of which is predisposed to implement an ecological or sustainable supply chain. And just for the size of the organization. Other statistical methods may be used that may point to other aspects and allow other conclusions to be drawn in the field under examination. Considerations do not differentiate between sectors of the economy, so conclusions are general, limited at the same time. Perhaps if it refer to the specific sectors the result would be different.

6. CONCLUSION

The deliberations were aimed at showing how organizations and supply chains perceive the green supply chain. Are they using dedicated assessment methods and management tools? The results of the research indicate that there is a gap in both research and practical aspects. The hardships do not know how they can assess the

chain, in terms of its being blown up, often aware of the relevance of the problems do not use this knowledge in relations with the environment. It is important to pursue further research in this area and implement solutions to economic practice, since only in this way will environmental aspects really change the supply chain. From the statistics analysis performed, it appears that organizations that declare the implementation of the green supply chain do not use "green" rules. Declarations remain in most cases uncovered. Moreover, analyzes have shown that companies that apply or are planning to apply and even do not apply the green supply chain do not differ in taken into account environmental aspects.

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BIOGRAPHICAL NOTES

Tomasz Wisniewski received his BSc in Management and Production Engineering from Westpomeranian University in Szczecin in 2009 and BSc in Mathematics from the University of Szczecin in 2013, the PhD in Computer Science from Westpomeranian University in Szczecin in 2014. He is currently an Assistant Professor in University of Szczecin. His professional interest include a methodology and practical implementation of simulation, optimization, supply chain modelling and statistical analysis.

Blanka Tundys is an Assistant Professor at the Department of Logistics, at the Faculty of Management and Economics of Services, University of Szczecin, Poland. Her main research areas are: green supply chain management, green logistics, measurement of green supply chain, processes modeling and city logistics. She is an author and co-author of 80 publications and has written one book (City Logistics – in polish language, 2008 I. ed., 2013 II ed.). She was main contractor in 5 international research projects (finance by German Academic Exchange Services and Deutsch-Polnische Wissenschaftsstiftung). She has gotten three times a scholarship of DAAD (German Academic Exchange Services) foundation (2001, 2004-2005, 2011). In 2004-2005 she has gotten a scholarship at the Fachhochschule Osnabrück (Germany), while she was preparing her doctoral dissertation. She has gotten a three scholarship by LLP - Erasmus-Program. Since 2015 she is a reviewer for the Journal of Business and Economics (USA), Editorial Board Member and Committee member of the international conferences.