ZESZYTY NAUKOWE POLITECHNIKI ŁÓDZKIEJ
Nr 1220 ORGANIZACJA I ZARZĄDZANIE, z. 70 2017

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DIFFERENCE AND SIMILARITY IN PERCEPTION BETWEEN GREEN SUPPLY CHAIN MANAGEMENT IN FOOD INDUSTRY AND GREEN SUPPLY CHAIN MANAGEMENT IN GENERALLY IN CROATIAN COMPANIES

1. Introduction

Nowadays, the increase in greenhouse gas (GHG) emissions in the atmosphere is currently one of the most serious environmental treats. Due to GHG emissions we will be witnesses of climate change which will cause damaging impacts in the next few decades [1]. These will primarily affect the natural and human systems [2]. At the same time these emissions are also a limiting factor for the economic growth of some countries, especially those in the transition process [3]. One of the reasons for that is the protocol, adopted in 2012 at Doha 2012 UN Climate Change Conference COP18 CMP8, at which the industrial world agreed to reduce the emissions of greenhouse gases approximately 18% below 1990 levels by 2013-2020 [4]. In the meantime, also due to the climate change and the increase in environmental awareness all over the world, the concept of Green Supply Chain Management appeared. It is often defined as integrating environmental thinking into supply chain management [5].Within that concept many greening elements aimed at the reduction of materials, energy, waste, pollution and emissions, or promoting the usage of recyclable materials and renewable energy sources, are introduced in various segments of supply chains. The proof lies in number of examples from industry, as well as in significant interest of academic community that could be seen through research papers, doctoral thesis and research projects.

There are three main reasons why companies implement the greening process into their corporation [6, 7]:

- Legislation – they have to comply with the environmental regulations,

- Marketing – addressing the environmental concerns of their customers,
- Ecological awareness – mitigate the environmental impact of their production activities.

Today there are many concepts, methods and models which are dealing with ecology, cleaner production, greener supply chains etc. However, mentioned examples and literature is not always fully clear and identical in terms of terminology used, while those various concepts, methods and models are appearing as a topic with practically same ultimate goal – greener processes of supply chain/production.

First part of this paper is an overview of Green Supply Chain Management (GSCM) with Life Cycle Assessment (LCA), Product Lifecycle Management (PLM), Product Life Cycle Management (PLCM) and Life Cycle Management (LCM) terms. Also Green Logistics (GL), Sustainable Logistics (SL), Environmental Logistics (EL), Clean Logistics (CL) and Green Production (GP), Sustainable Production (SP), Environmental Production (EP), Clean Production (CP) are connected to sustainability so they are included into the research.

The research was based on literature survey within two databases (SCOPUS and Science Direct) that contain number of relevant scientific journals, databases of doctoral thesis, and additionally standards and directives related to sustainable development. In addition to the above mentioned concepts, methods and models some standards and directive are also connected with sustainable development. Concepts of sustainable developments are often associated with the following standards and directives:

- ISO 9001 Quality management systems – Requirements,
- ISO 14001 Environmental management systems – Requirements with guidance for use,
- ISO 14040 Environmental management – Life cycle assessment – Principles and framework,
- ISO 14051 Environmental management – Material flow cost accounting – General framework,
- ISO 14062 Environmental management – Integrating environmental aspects into product design and development,
- ISO 14064 Greenhouse gases – part 1, 2, 3,
- ISO 26000 Guidance on social responsibility,
- ISO 50001 Energy management systems – Requirements with guidance for use,
- OHSAS 18001 Occupational health and safety management systems,
- WEEE Waste Electrical and Electronic Equipment Directive,
- RoHs Directive on the restriction of the use of certain Hazardous substances in electrical and electronic equipment,
- IPP Integrated Product Policy,
- EuP Energy using Products directive,

- ELV End of Life Vehicles directive,
- EPA Environmental Protection Act,
- PPW Packaging and Packaging Waste directive,
- EMAS Eco-Management and Audit Scheme directive,
- VOC Volatile Organic Compounds directive,
- ED Eco-design directive.

This is the first part of the research with aims of identifying interrelations among those concepts, methods and models similarities and differences appearing in approaches of various authors, leading to an overall better understanding of broad concept of GSCM. Also in this part of the paper the connection between GSCM and food SCM/GSCM is presented.

Second part of the paper presents the survey which is carried out in Croatia business sector in view of current state and trends, barriers and drivers of sustainability. The results shows differences and similarities between companies which are associated with food SCM/GSCM and those which are associated with SCM/GSCM.

2. Life cycle assessment, product lifecycle management, product life cycle management, life cycle management

The development of LCA methodology has its roots back in the late 1960's and early 1970's when the first studies applying a life cycle perspective on a process system took place in the USA, focusing on environmental impacts from different types of beverage containers [8].

When comparing LCA and PLM/PLCM/LCM, some differences can be found. In ISO 14040 LCA is defined as the "compilation and evaluation of the inputs, outputs and potential environmental impacts of a product system throughout its life cycle". Thus, LCA is a tool for the analysis of the environmental burden of products at all stages in their life cycle – from the extraction of resources, through the production of materials, product parts and the product itself, and the use of the product to the management after it is discarded, either by reuse, recycling or final disposal (in effect, therefore, "from the cradle to the grave") [9].

In industry, PLM is the process of managing the entire lifecycle of a product from its conception, through design and manufacture, to service and disposal, and should be distinguished from PLCM. PLM describes the engineering aspect of a product, from managing descriptions and properties of a product through its development and useful life; whereas, PLCM refers to the commercial management of life of a product in the business market with respect to costs and sales measures [10]. On the other hand LCM is an integrated model to assist in businesses managing the total life cycle of products and services towards more sustainable

consumption and production patterns [11]. Image 1 presents LCA method while image 2 presents PLM model.

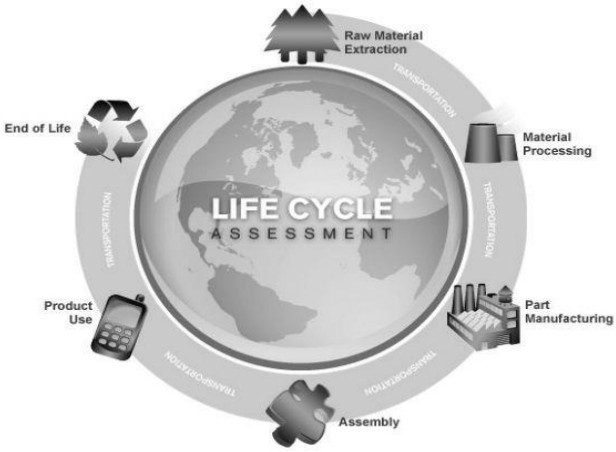

Image 1. LCA method
Source: www.solidworks.com/sustainability

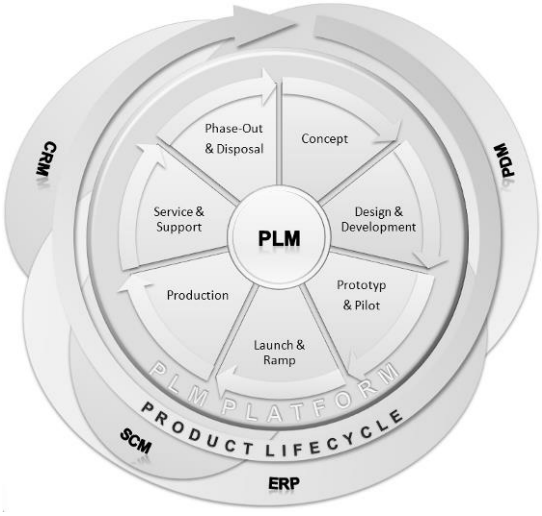

Image 2. PLM model
Source: www.imi.kit.edu/english/209_368.php

3. Green supply chain management

From the definition of Supply Chain management given by the Council of Supply Chain Management Professionals (CSCMP) [12], "Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities." Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers and customers. In essence, supply chain management integrates supply and demand management within and across companies. Making it green, it could be simply illustrated as in image 3.

GSCM is a field of implementation of green thinking in all the segments of companies' activities and with focusing on the definition of SCM and the three basic groups of activities – procurement, operations and logistics. Green supply chain management could be illustrated as in image 4 [7].

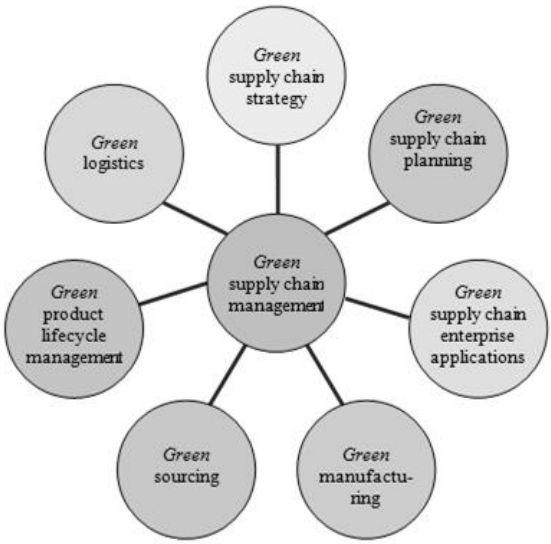

Image 3. Elements of Green supply chain management
Source: [7].

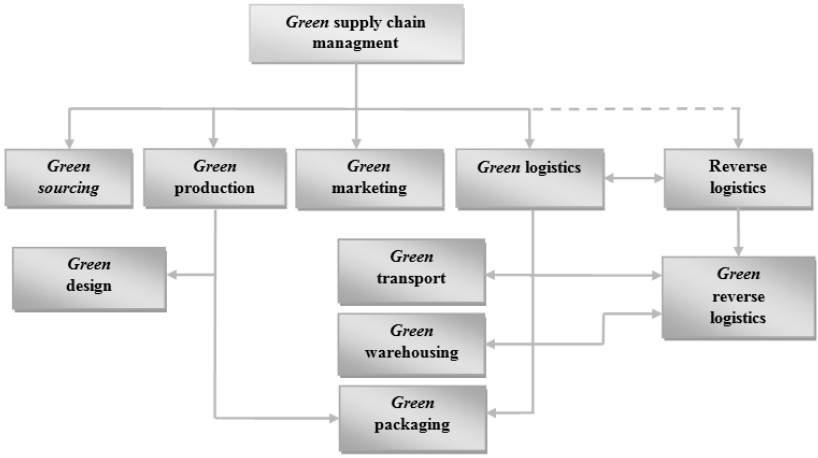

Image 4. Greening diagram
Source: [7].

When we look at the food supply chain management we can see that the main difference is those food products usually have short expiration date. This is then associated with transport, storage, therefore logistics [13]. The quality of the products and regulatory framework are constantly increasing and more and more customers what to buy organic products. All this together, leads to the appearance of GSCM in the food industries which aims to "apply" green thinking into the food SCM.

4. Design of the surveys

The GSCM topic is relatively new in Croatia and state and trends aren't correctly known and that was one of the reasons for this kind of surveys. The survey was carried out in Croatia business sector. The structure of the survey is shown in image 5.

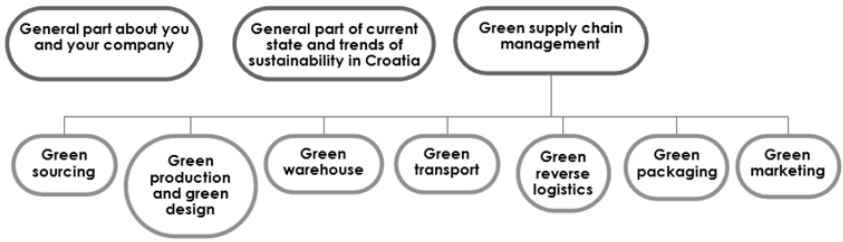

Image 5. Structure of a business sector survey
Source: [7].

The first part of the survey includes general questions about the examinee and company he works. The second part of the survey is designed to give the ripples on how well are they informed about sustainable concepts, methods, models, standards and directives and are some of them implemented or in the stage of implementing into the company. The third part includes questions regarding the drivers, barriers, activates and benefits of implementing the GSCM. Other parts of the survey represent activities within GSCM. Total survey has 57 questions.

5. Results of the survey

The invitation for the survey was send to 3257 big, medium and small companies with different categories of the business. Survey was carried out in three independent parts. Results are show for the first two part of the survey. 102 complete answers (33 related with food SCM) were received for the first part of the survey and 75 (19 related with food SCM) for the second part of the survey. Image below shows following results of the survey:

- Image 6. Level of familiarity with the standards,
- Image 7. Level of implementing of the standards,
- Image 8. Level of familiarity with the directive,
- Image 9. Level of implementing of the directive,
- Image 10. Level of familiarity with the concepts, methods and models,
- Image 11. Level of implementing the concepts, methods and models,
- Image 12. The influence of the drivers for implementing the GSCM,
- Image 13. The influence of the barriers for implementing the GSCM,
- Image 13. cont. The influence of the barriers for implementing the GSCM.

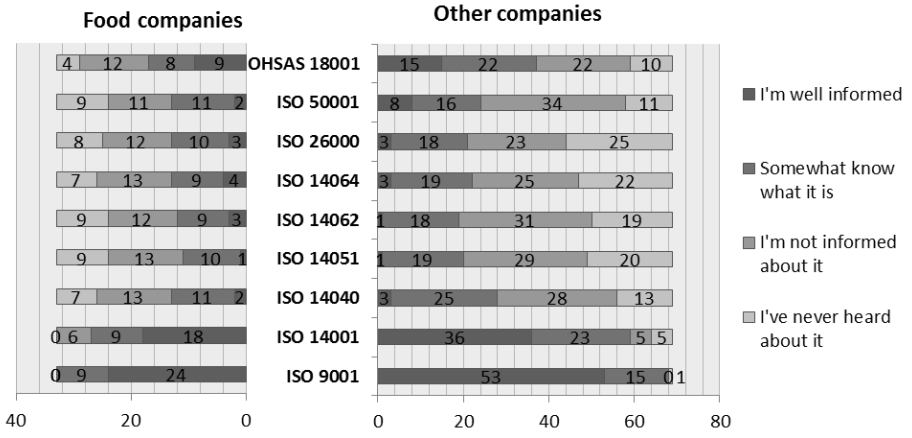

Image 6. Level of familiarity with the standards
Source: own.

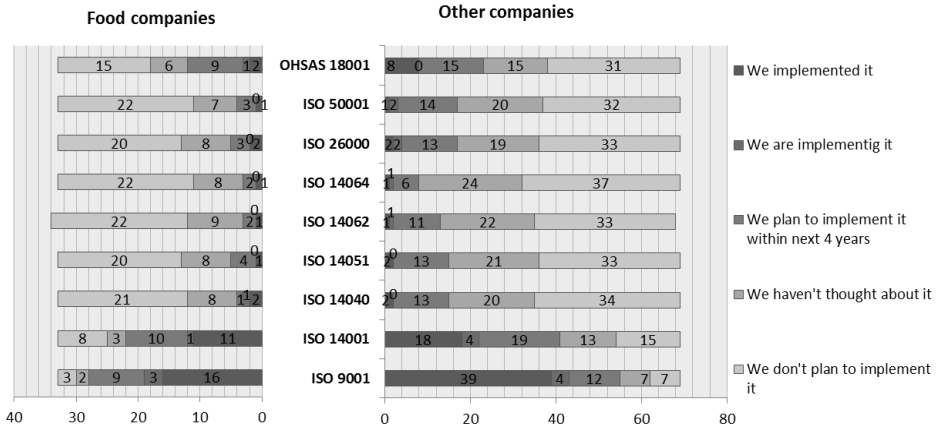

Image 7. Level of implementing of the standards
Source: own.

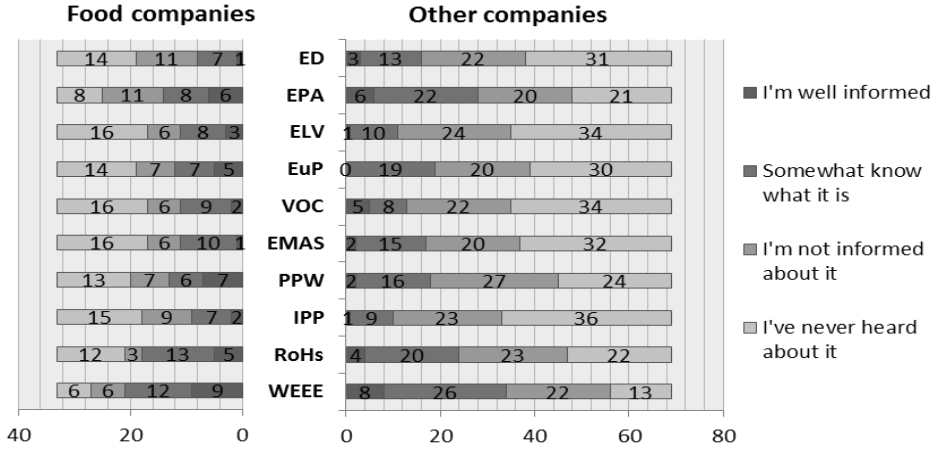

Image 8. Level of familiarity with the directive
Source: own.

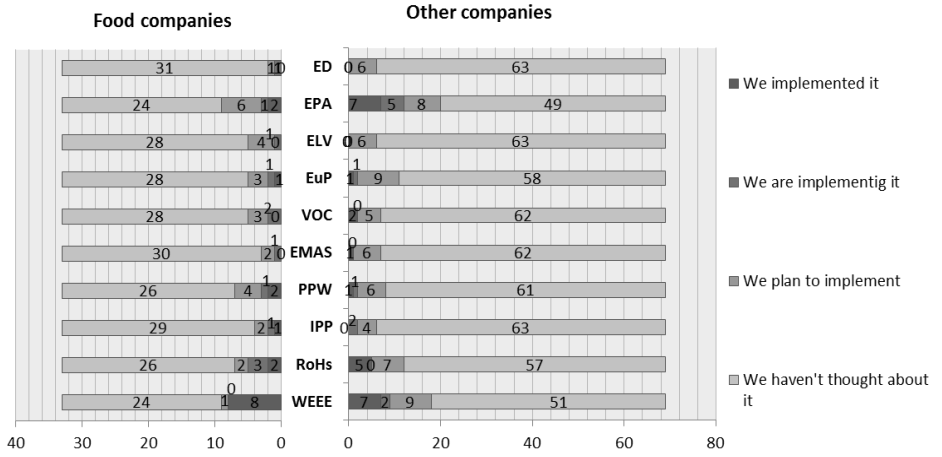

Image 9. Level of implementing of the directive
Source: own.

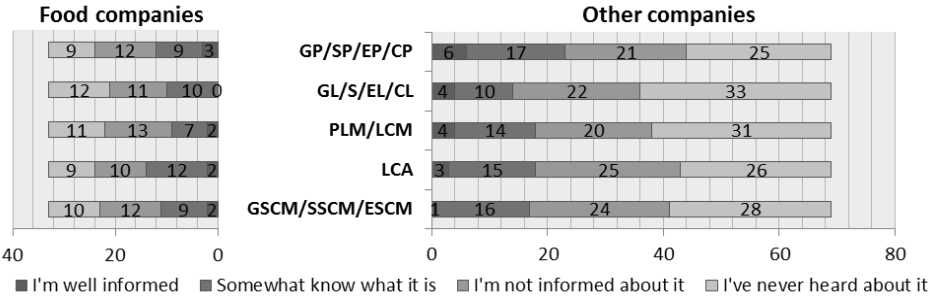

Image 10. Level of familiarity with the concepts, methods and models
Source: own.

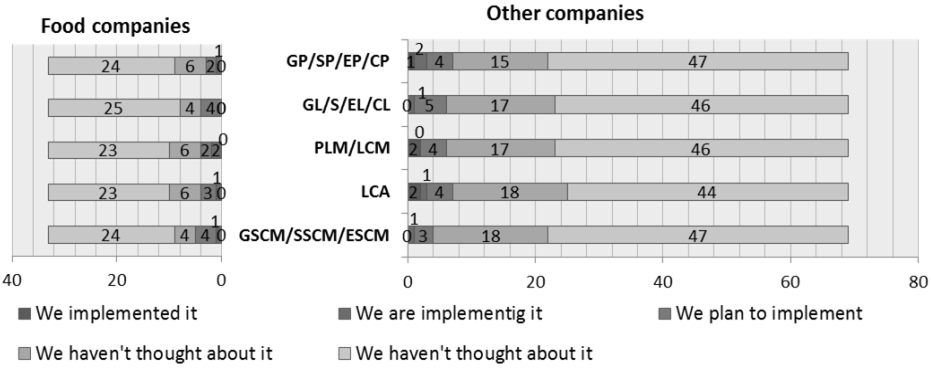

Image 11. Level of implementing the concepts, methods and models
Source: own.

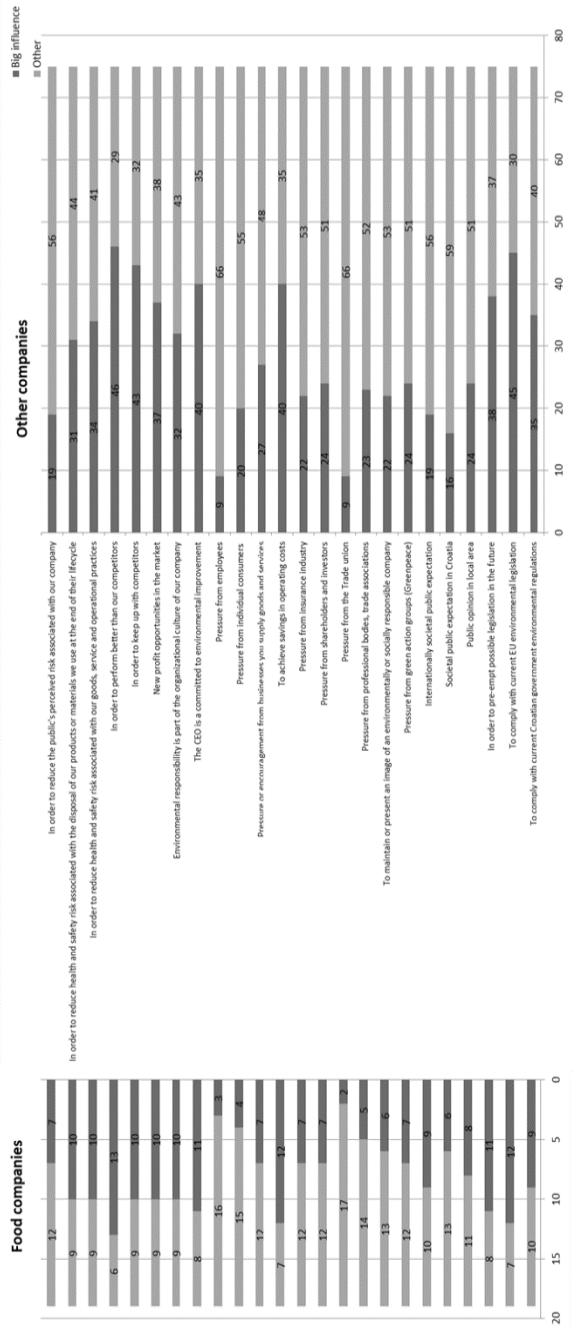

Image 12. The influence of the drivers for implementing the GSCM
Source: own.

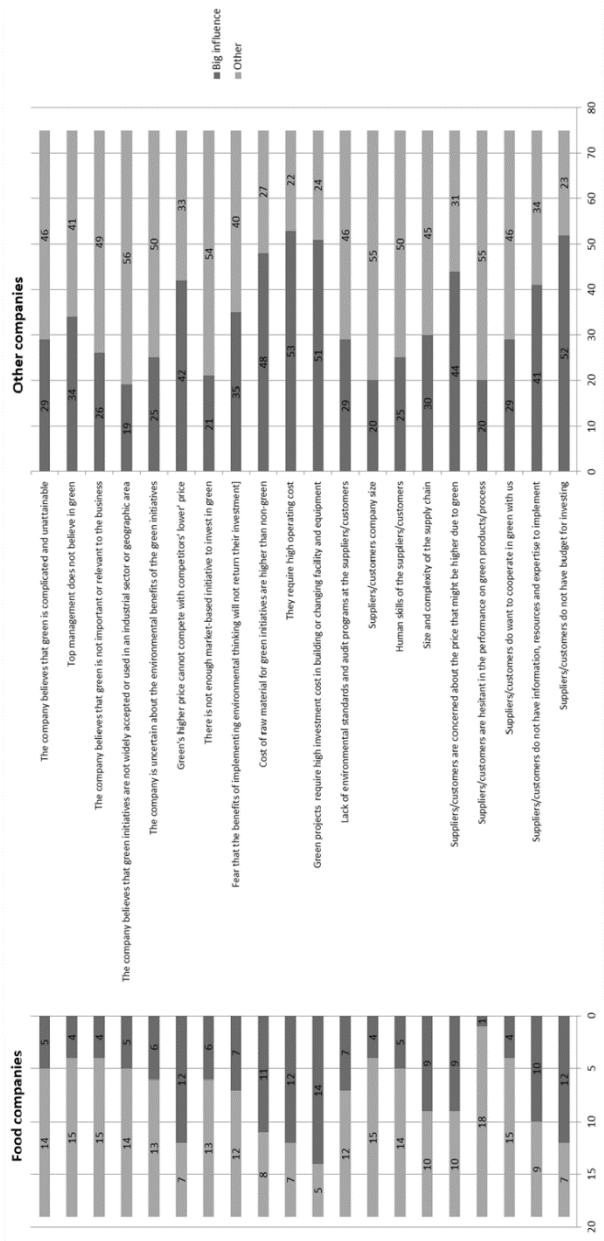

Image 13. The influence of the barriers for implementing the GSCM
Source: own.

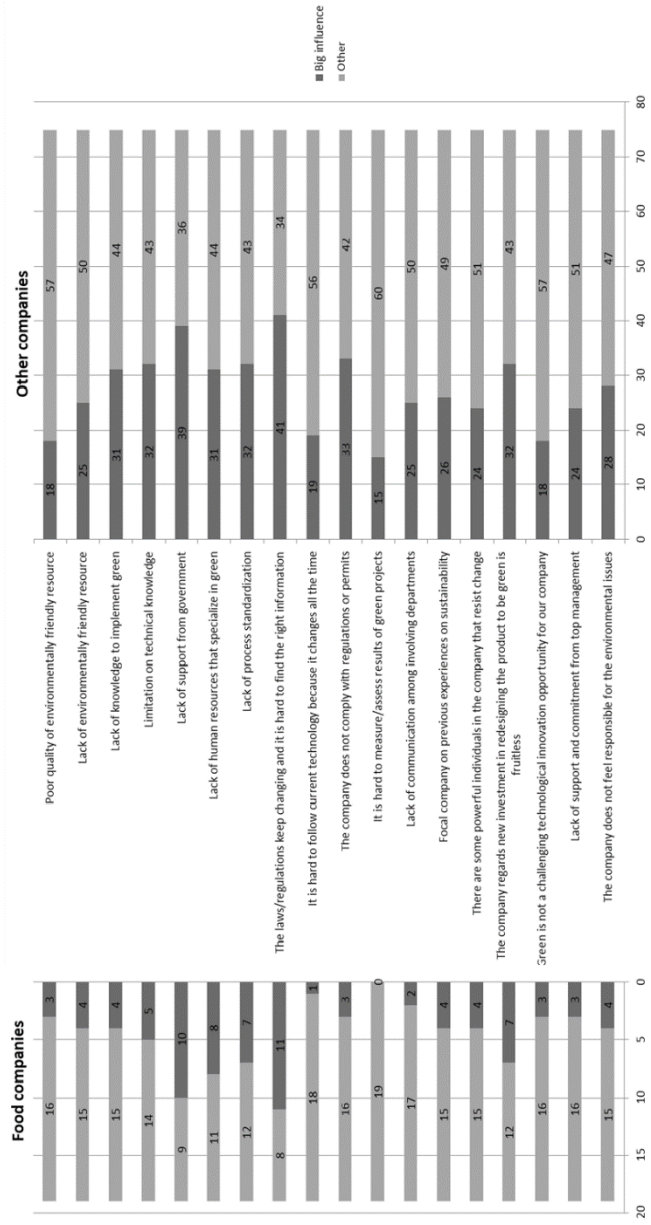

Image 13 cont. The influence of the barriers for implementing the GSCM
Source: own.

6. Conclusion

First part of paper investigates an interrelation between GSCM, LCA and PLM/PLCM/LCM appearing as topics in scientific literature. The vast numer of papers could be found dealing with one or more mentioned concepts, methods and models. One of the purposes of this paper was to narrow the set, identifying and analyzing papers with interrelations between mentioned concepts, methods and models. Regard to the research presented in the first part of the paper, the difference and similarity between above mentioned concepts are defined.

There is no paper that really connects and analyzes all of the mentioned concepts, methods and models. Most papers are only dealing with just one or two concepts, methods or models, without detailed analysis of others (just mentioning them in paper). Therefore, further research regarding interrelations of all mentioned concept, methods and models is needed. Additionally, it is necessary to link this concepts, methods and models with standards and EU directives for better understanding of trends in sustainable development.

Second part of the paper presents the survey which is carried out in Croatia business sector in view of current state and trends, barriers and drivers of sustainability. The results shows differences and similarity between company which are associated with food SCM/GSCM and those which are associated with SCM/GSCM. From image 6 to image 11 we can see there are no differences in level of familiarity and level of implementing of the standards, directives, concepts, methods and models. As expected, both category of company are most familiarity with ISO 9001, ISO 14001, OHSAS 18001, WEEE and RoHs standards and directive. Also this standards and directive are the ones which are most implemented into the company. On the other hand both category of company are equally familiarity and equally implementing (implemented) with all concepts, methods and models that are connected with sustainability.

When we look at drivers and barriers we can also see some similarity (image 12, 13 and 13 cont.). Both category of company think that one of the main drivers for implementing GSCM is government or EU environmental regulations. Other reasons are to perform better then competition and to achieve operative cost savings. For both category of company the drivers with the lowest influence are pressure from the employees, consumers, trade unions and insurance industry.

When we look barriers for implementing GSCM, both category of company thinks that the barriers with highest influence are: costs of raw material, higher operating cost and high investments cost for green initiatives. For both category of company the barriers with lowest influence are: problem with measuring results of green project, the green is not a technological innovation for company, poor quality of environmentally friendly resource and it is hard to follow current technology because it changes all the time. The differences in barriers are that food

related company don't think that barriers: it is hard to follow current technology because it changes all the time, it is hard to measure/assess results of green projects and suppliers/customers are hesitant in the performance on green products/process have influence while other company think that this barriers have influence on implementing GSCM, but that influence isn't big.

Nowadays, supply chains are generating a lot of data, which are not analyzed sufficiently so right decisions based on these data can rarely be brought. Since predictive analytics and big data are no longer just buzzwords representing futuristic thinking and unrealized corporate strategy, both researchers and practitioners are trying to incorporate these methods in their processes. Considering the growth on both GSCM and predictive analytics and big data in last year's, it seems logical to expect that predictive analytics and big data techniques will be used in every element of green supply chain, in which it will generate savings for GSCM processes as well as transform and enhance decision making process to data-driven strategy. Implementation of predictive/forecasting methods in food industry SCM should improve both production and logistics processes to more sustainable. Currently, practitioners are not fully aware of connecting these concepts to enhance sustainability measures, which leads to the conclusion that it is necessary to carry out further research investigating link between predictive analytics and green supply chain.

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