DOI: 10.20472/IAC.2018.036.022

T. BARTOSZ KALINOWSKI
Faculty of Management, University of Lodz, Poland

AGATA RUDNICKA
Faculty of Management, University of Lodz, Poland

GRAŻYNA WIETESKA
Faculty of Management, University of Lodz, Poland

ANNA WRONKA
Faculty of Management, University of Lodz, Poland

ANTONIO DIGLIO
Department of Industrial Engineering (DII), University of Naples "Federico II", Italy

CARMELA PICCOLO
Department of Industrial Engineering (DII), University of Naples "Federico II", Italy

GIUSEPPE BRUNO
Department of Industrial Engineering (DII), University of Naples "Federico II", Italy

ADRIAN SOLOMON
South Eastern European Research Centre / The University of Sheffield International Faculty, CITY College, Greece

S.C. LENNY KOH
Management School, University of Sheffield, United Kingdom

ANDREA GENOVESE
Management School, University of Sheffield, United Kingdom

COMPETENCES REQUIRED FOR ENVIRONMENTALLY RESPONSIBLE MANAGERS - A EUROPEAN PERSPECTIVE

Abstract:

The main purpose of this paper is to identify the competences required for environmentally responsible managers in sustainable supply chain management. The proposed paper will analyze skills needed for green management. Along with theoretical study it will present the research results of the international TrainERGY project (http://www.trainergy-project.eu/) aimed at promoting green thinking among enterprises and academics across four European countries: Poland, United Kingdom, Italy and Greece. The findings of the research cover the differences between countries in terms of managers' environmental skills presence index which is a measure representing presence of particular skills in the surveyed companies. It also highlights the essential directions of a design and a content of the current and future environmental education and practice.

Keywords:

environmental management, green management, supply chain management, competences, manager, research

JEL Classification: F64, M10, O13

1 Introduction

One of the most important challenges for current supply chains is environmental protection. The scarcity of natural resources, declining biodiversity or air, soil and water pollution, push corporations to include environmental issues to their business goals. The precautionary principle (World Charter for Nature) and the pollution prevention approach (Pollution Prevention Act, 1990) show main direction of acting for business organizations. The precautionary principle says about the need to protect environment in any case to anticipate the possible risk and avoid harmful consequences. In broader sense it could be used in decision making process of planning business activities without additional environmental risks. Pollution prevention is more than working in line with minimum environmental requirements. It assumes environmental friendly choices that minimize the negative effects on environment such as: waste reduction, energy efficient operations, water saving etc. The challenge for current enterprises seems to be the shift from theoretical consideration about the environment to practical realization and implementation into strategy.

The concept of sustainable development understood as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987) is still broadly discussed despite its long tradition. The concept is strictly related to the problem of satisfying needs of different stakeholders in changing socio-economic circumstances. Moreover the concept from macro level approach was transferred to different sub concepts which evolved as new ideas like sustainable supply chain management which is it the point of interest of this paper. The concept of sustainable supply chain management is well identified in literature (Seuring and Müller, 2008a, 2008b; Carter and Rogers, 2008; Linton et al., 2007; Hassini et. al, 2012). The issue of sustainability in supply chain is used to manage social and environmental aspects directly related to the business processes. It means that some specific competences and knowledge of managers are required to understand and correctly implement noneconomic goals into the company and its supply chains. There are many different research and theoretical papers oriented on the problem of education for sustainability covering different aspects like conceptualization of competences, key competences needed, methods of acquiring competences etc. (Byrne, 2000; Barth et al., 2007; Sipos et al., 2008; Willard et al., 2010; Steiner and Posch, 2006). Different kinds of competences can be identified like e.g.: system-thinking, normative, strategic, anticipatory and interpersonal competences (Wiek et. al, 2011). Following the set of competences required, equally important aspect appears to be the integration of sustainability in management education (Raufflet, 2013) and in universities (Nicolaides, 2006). The issue of competences for sustainability is crucial, due to fact, the acquired competences will be reflected in the way decision makers tackle with business processes.

Education for sustainability continues to be a challenge not only in formal education but also in long-life learning approach. A success of sustainability oriented projects depends on the personal engagement of managers and their awareness of environmental challenges developed during educational process. Therefore, it would seem reasonable to examine not only the general competences but also specific areas of knowledge and skills crucial for developing sustainability practices.

The main purpose of the paper is to analyze the issue of different skills needed for developing green / sustainable practices in supply chains. The attention will be put on different areas related to sustainability required for appropriate management abilities, grouped in categories like: technologies, databases and specific software tools for reducing processes' environmental impact, strategic orientation on green issues or green internal and external management operations. Two different indexes were proposed to analyze the presence and level of possessing different skills / competences supporting sustainability on managerial level. The study will present comparative research results of the international project: Training for Energy Efficient Operations (Trainergy) (http://www.trainergy-project.eu) aimed at promoting green thinking among enterprises and academics across Europe.

2 Environmental problems in supply chains

Environmental issues, next to social, are noneconomic aspects of business activities, which continuously gain the relevance as a focal point of sustainable development. Any business process may be the source of environmental aspects. In the table below the exemplary environmental issues are presented.

Table 1: General environmental issues of supply chain management

Business Process	Possible Environmental Issues
Extraction	• emissions including CO2 • depletion of non-renewable resources • water and energy consumption • degradation of the landscape • reduce biodiversity • pollution of the water, air and soil (including chemical pollution) • eutrophication
Transportation/ Distribution	• emissions including CO2 • noise • vibration • leaks • natural resources depletion
Production	• dangerous materials and resources • emissions including CO2 • sewage

	• noise • vibration • water and energy usage • non-recyclable materials • insufficient waste management • heat emissions
Consumption	• over consumption • extra emission due to improper consumption • waste production • insufficient waste management • soil, water and ground pollution • exposure to dangerous materials and substances
End-of use processes	• soil air and water pollution • emissions

Source: own elaboration based on environmental, sustainability and social reports of companies.

The scale and scope of environmental impact will differ due to the type and size of the company and the complexity of its supply chain. The environmental consideration is the result of tightening law regulations and other motivations identified by business like e.g. expected benefits (Diabat and Govindan, 2011).

Much attention is put on international and national level to improve the living conditions and assure decent environmental quality nowadays, without compromising the needs of future generations to meet their needs under the conditions of sustainable development. It is equally seen in environmental policies and projects set by individual entities and in whole supply chains (e.g. Carter and Rogers, 2008; Kleindorfer et al., 2005; Seuring and Muller, 2008a; Seuring and Muller, 2008b) “A focus on supply chains is a step towards the broader adoption and development of sustainability, since the supply chain considers the product from initial processing of raw materials to delivery to the customer. However, sustainability also must integrate issues and flows that extend beyond the core of supply chain management: product design, manufacturing by-products, by-products produced during product use, product life extension, product end-of-life, and recovery processes at end-of-life (Linton et al., 2007). The problem of environmental issues in supply chain is confronted with the concept of green supply chain (Sarkis, 2014) or sustainable supply chain oriented to ecological aspects like greener partners selection (Wu and Barnes, 2016), eco-efficiency (Michelsen, 2006; Verfaillie and Bidwell, 2000) or environmental performance (Gualandris and Kalchschmidt, 2016). The current supply chain management practices are expected to take into consideration environmental impacts and the ways to increase efficiency while reducing negative externalities (Diabat and Al-Salem, 2015). The environmental principles used at the stage of design of supply chain cover such areas as: product design, packaging, collection and transportation, recycling

and disposal, greening the internal and external business environment (Tsoulfas and Pappis, 2006).

The mentioned problems required to be addressed by managers and in order to do that successfully they need special competences, identified and described in the following study.

3 Research methodology

The research was conducted in four European countries: Poland, United Kingdom, Italy and Greece. The aim of the research was to identify the presence of the energy efficient operations (EEO) competences at each specific location. The questionnaire was prepared following the enumerated steps:

(1) Skill areas definition: i.e. definition of priorities areas in which SMEs need to improve their energy efficient operations skills. The skill areas was defined basing on the results of an international project PrESS - Promoting Environmentally Sustainable SMEs undertaken by the same consortium as for the Trainergy project.

(2) Analysis of existing EEO curricula identified within the countries the project is implemented and beyond (Italy, UK, Poland, Greece, Spain, France, and Germany) and databases specialized in the higher education web marketing[1].

(3) Main topics identification: i.e. analysis of the topics included in the courses of the curricula identified in step 2.

(4) Main topics classification: allocation of the main topics identified to the skill areas defined in step 1.

(5) Skills definitions: defining the specific requirements for each skill within the identified areas and adapting them for the research questionnaire.

For the purpose of the research 64 programs have been analyzed in the countries covered by the project and beyond, which resulted in 282 main topics identification, that further have been allocated into 18 specific competences areas. Additionally, the specific competences areas belonging to the same category have been grouped in 5 categories as shown in table 2.

[1] Master studies, https://www.masterstudies.com/, accessed 10.11.2016.

Table 2: Competences required for implementing energy efficient and sustainable operations

Category	Specific competences areas
Technologies, databases and specific software tools for reducing processes' environmental impact	1. Technologies for reducing energy consumption 2. Technologies for reducing pollution 3. Technologies for reducing consumption of raw materials 4. Technologies for reducing waste 5. Tools and Decision Support Systems for supporting environmental decisions 6. Database management systems for supporting environmental decision
Strategic orientation in terms of Green Innovation, Purchasing, Marketing	7. Green Innovation 8. Green Purchasing 9. Green Marketing
Green internal and external operation management	10. Green internal operations management 11. Green external operations management
Environmental principles, regulations, certifications and activities reporting	12. Environmental regulatory frameworks 13. Environmental certifications 14. Audit principles 15. Reporting activities
Definition of objectives and performance indicators, Checking and Interventions Planning	16. Definition of environmental objectives and environmental performance indicators (EPIs) 17. Measuring Environmental Performance Indicators (EPIs) 18. Interventions identification

Source: Own elaboration based on the results of the project

The research focused on testing the theoretical and practical EEO skills coverage within companies. The questionnaire involved two questions per each skill, investigating the following dimensions (defined according to the Dublin Descriptors):

(1) Knowledge and understanding;

(2) Applying knowledge and understanding.

For all surveyed EEO skills a 5 point Likert scale was used, ranging from 1 (minimum) to 5 (maximum).

The survey was conducted from October to December 2016. A total number of 134 valid responses was obtained with the following distribution among the participating countries: Poland - 56 questionnaires, United Kingdom - 25 questionnaires, Italy - 28 questionnaires and Greece - 25 questionnaires. The survey can be further characterized by:

(1) Business sectors, including: manufacturing (26.1%), construction (23.1%), retail/commerce (11.9%), food and winery (10.4%), transportation/logistics (9.0%), healthcare services (6.7%) and other (12.7%).

(2) Number of employees, including: under 25 (41.0%), 26 to 50 (22.4%), 51 to 250 (26.1%) and more than 250 (10.4%).

On the basis of the survey results a skill matrix for each country was developed. The skill matrix development methodology involved the calculation of the two following indexes: covering index (CI) and presence index (PI), explained in table 3.

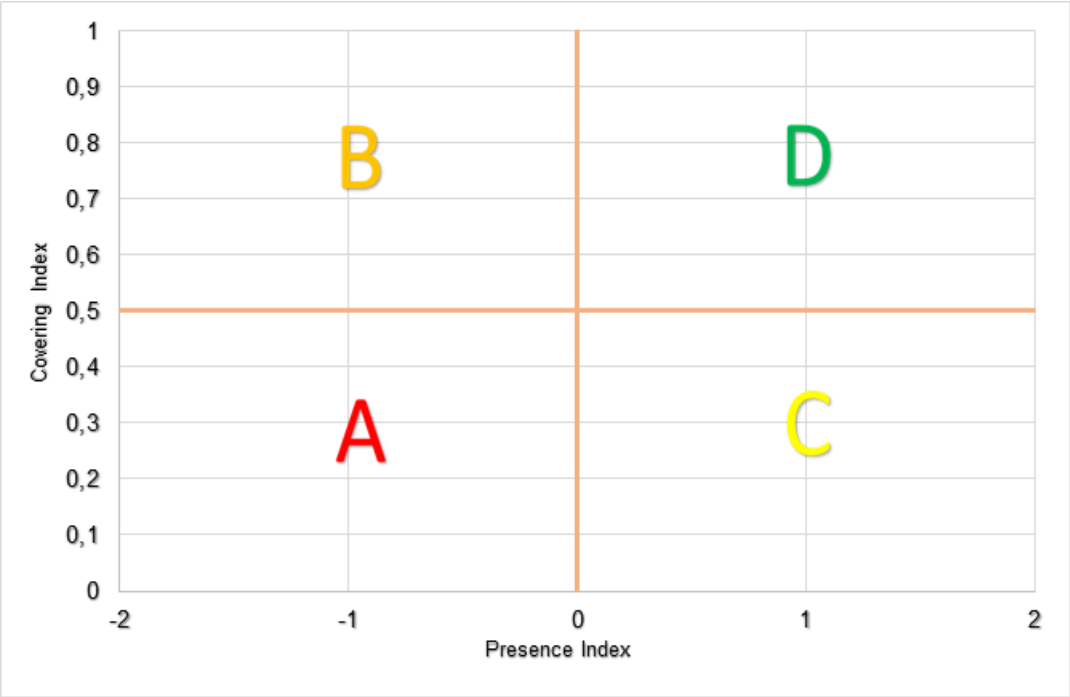
Table 3: Covering index and presence index definitions

Index name	Index definition
Covering index (CI_{ik})	$CI_{ik} = \frac{n_{ik}}{N_i}$ n_{ik} - number of courses provided by country i covering the skill k; N_i - total number of courses provided by country i;
Presence index (PI_k)	$PI_k = \sum_{j=1}^{5} (RR_{jk} * w_j)$ w_j - weight associated to the response j, $\forall\ j$ = 1,2,3,4,5 RR_{jk} - rate of response j recorded per skill k

Source: Own elaboration based on the results of the project

Considering these two dimensions, the EEO skills can be presented in a graph with the PI on the x-axis and CI on the y-axis. The four main quadrants can be identified in the graph, as shown in Figure 1.

Figure 1: Skill Matrix



Source: Own elaboration based on the results of the project

Particular skills are the points in this graph and according to the position occupied on it, they will be classified as belonging to one of the following categories:

A - Slightly covered or not covered skills, but not possessed/used at all;

B - Covered skills, but not possessed/used at all;

C - Slightly covered or not covered skills, but possessed/used at all;

D - Covered skills, possessed/used at all.

This approach allowed to prepare an individual skill matrix for each country what is presented in the next section of the paper.

4 Research results and findings

The results of the CI and PI calculations, as well as class categorization according to the developed skill matrix methodology is presented in the table below.

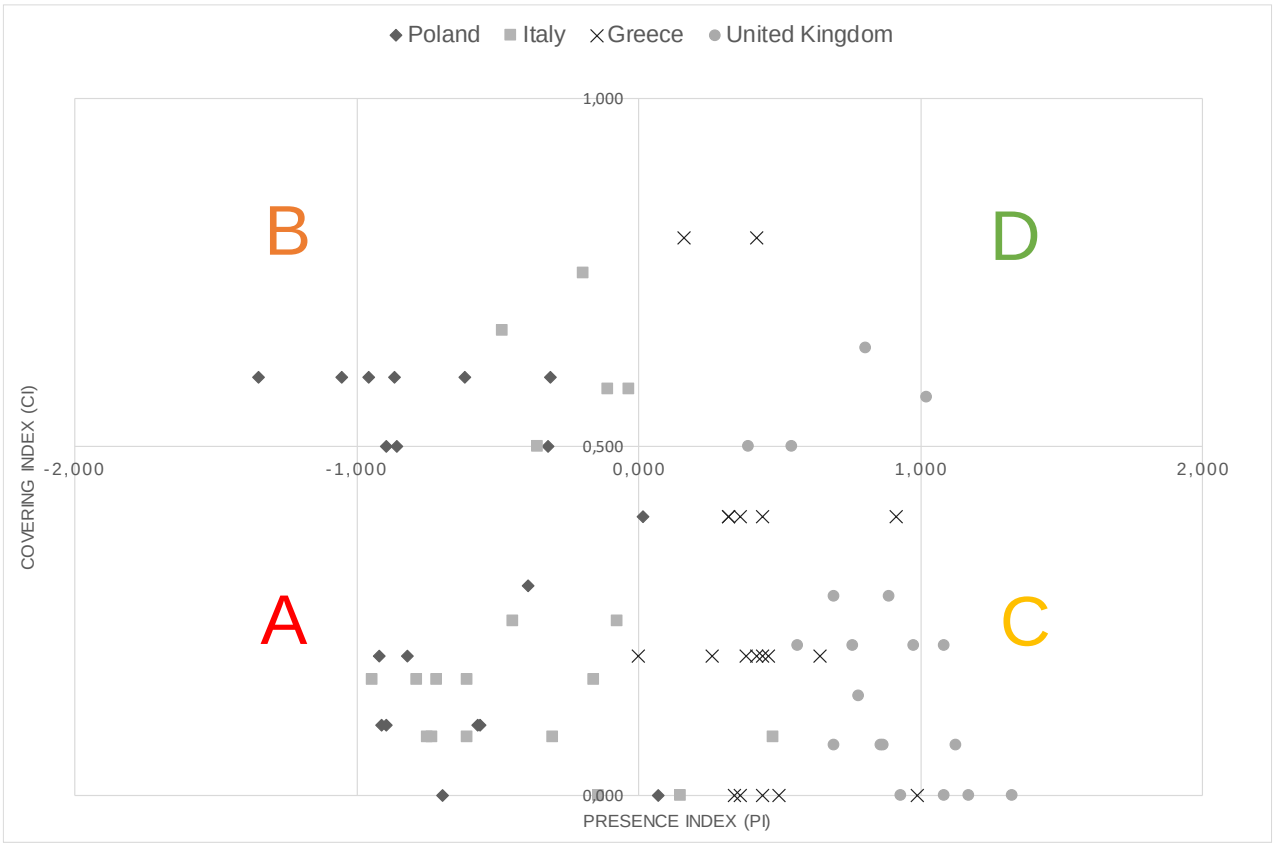
Table 4: Covering index (CI), presence index (PI) and class according to the skill matrix for Poland, Italy, Greece and United Kingdom

Skills	*Poland*			*Italy*			*Greece*			*United Kingdom*		
	CI	*PI*	*Class*	*CI*	*PI*	*Class*	*CI*	*PI*	*Class*	*CI*	*PI*	*Class*
Technologies for energy consumption (reducing consumption)	0.50	-0.32	B	0.58	-0.04	B	0.20	0.42	C	0.50	0.54	D
Technologies for energy consumption (renewable sources)	0.50	-0.86	B	0.58	-0.11	B	0.20	0.46	C	0.50	0.39	D
Technologies for reducing pollution	0.30	-0.39	A	0.00	-0.14	A	0.00	0.44	C	0.29	0.70	C
Technologies for reducing consumption raw materials	0.60	-0.31	B	0.08	-0.30	A	0.00	0.50	C	0.21	0.57	C
Technologies for reducing waste	0.40	0.02	A	0.08	0.48	C	0.20	0.64	C	0.07	0.86	C
Tools and DSS for supporting environmental decisions	0.50	-0.89	B	0.17	-0.71	A	0.80	0.16	D	0.14	0.78	C
Database management systems	0.60	-1.35	B	0.17	-0.95	A	0.20	0.00	C	0.00	1.09	C
Green innovation (new product/services development. eco-design)	0.60	-0.87	B	0.67	-0.48	B	0.40	0.32	C	0.64	0.80	D
Green purchasing	0.00	0.07	A	0.00	0.15	A	0.00	0.99	C	0.00	0.93	C
Green marketing	0.00	-0.70	A	0.25	-0.45	A	0.00	0.34	C	0.07	0.70	C
Green internal operations management	0.10	-0.56	A	0.50	-0.36	B	0.40	0.44	C	0.21	0.98	C
Green external operations management	0.10	-0.57	A	0.25	-0.08	A	0.40	0.91	C	0.07	1.13	C
Environmental regulatory frameworks	0.60	-0.62	B	0.75	-0.20	B	0.80	0.42	D	0.57	1.02	D
Environmental certifications	0.20	-0.82	A	0.17	-0.16	A	0.20	0.38	C	0.00	1.33	C
Auditing activities	0.10	-0.91	A	0.17	-0.61	A	0.20	0.44	C	0.21	1.09	C
Reporting activities	0.20	-0.92	A	0.08	-0.75	A	0.00	0.36	C	0.07	0.87	C
Definition of Environmental objectives and Environmental Performance Indicators (EPIs)	0.60	-0.96	B	0.08	-0.61	A	0.40	0.32	C	0.29	0.89	C
Measuring EPIs	0.60	-1.05	B	0.17	-0.79	A	0.40	0.36	C	0.21	0.76	C

Source: Own elaboration based on the results of the project

For better visualization, the results are also presented on a chart (Figure 2).

Figure 2: Covering index (CI), presence index (PI) and class according to the skill matrix for Poland, Italy, Greece and United Kingdom



Source: Own elaboration based on the results of the project

The differences in distribution of the CI and the PI were analyzed using Kruskal-Wallis one-way ANOVA on ranks (Spurrier, 2003). According to the calculations there were no significant differences in the covering index between the analyzed countries (H=3.446916; p=0.3277) and there were significant differences in the presence index (H=60.43321; p=0.0000). The detailed analysis revealed that there were no differences in distribution of the presence index between Poland and Italy (p=1.000000), as well as Greece and United Kingdom (p=0.136632), which means that Polish and Italians companies as well as Greek and British are on similar level in terms of the advancement of the analyzed skills implementation. All other comparisons disclosed significant differences between the analyzed countries (Poland vs Greece: p=0.000014; Poland vs United Kingdom: p=0.000000, Italy vs Greece: p=0.005117, Italy vs United Kingdom: p=0.000000).

The analysis of research results exposed that skills requiring the strongest intervention (those with the lowest values of the covering index and the presence index) overlap between the countries, as shown in table 5.

Table 5: Competences required for implementing energy efficient and sustainable operations

Category	Priority skills
Poland	1. Green marketing 2. Auditing activities 3. Interventions identification 4. Green purchasing 5. Green external operations management
Italy	1. Green purchasing 2. Reporting activities 3. Interventions identification 4. Database management systems 5. Definition of Environmental objectives and Environmental Performance Indicators (EPIs)
Greece	1. Green marketing 2. Reporting activities 3. Technologies for reducing pollution 4. Technologies for reducing consumption raw materials 5. Green purchasing
United Kingdom	1. Green purchasing 2. Technologies for reducing waste 3. Green marketing 4. Database management systems 5. Green external operations management

Source: Own elaboration based on the results of the project

"Green purchasing" was identified as top priority skill in Italy and United Kingdom, whereas "green marketing" was the top priority skill in Poland and Greece. Low coverage in terms of skills' presence in educational programs and company's experiences could also be observed with relation to "auditing activities" (rank 2 in Poland), "reporting activities" (rank 2 in Italy and Greece) and "interventions identification" (rank 3 in Poland and Italy). Among other skills requiring the strongest intervention were also those connected with operations management (green external operations management) and various types of technologies used for improving the sustainability of operations (technologies for reducing pollution, technologies for reducing consumption raw materials and technologies for reducing waste).

5 Conclusions

The paper presents a comparative research results on the managerial skills needs which development should be primarily taken into account by both top management and academics. The article brings the information on the environmental skills needed to manage companies in more environmentally responsible way. It also highlights the essential directions of design and content of the current and future environmental education and practice.

The methodology developed within the TrainERGY project and used in the research is also innovative. The calculation of covering index and presence index allowed to create an individual skill matrix for each researched country. The same methodology can be further extended to other European countries in order to create a Pan-European skill matrix.

The limitation of this research, can be a small number of respondents from particular countries what can limit the full comparative analysis. However the main purpose of this research project was to develop and pilot the skill matrix development methodology, thus wider studies are required in order to collect more comprehensive data.

The analysis provides empirical support for the development of meaningful competence development schemes for employees and managers, as well as guidelines for successful implementation of energy efficient and sustainable operations across Europe.

The findings from this research are also applicable to cross-cultural and cross-sectoral settings, and expand the existing institutional and supply chain management theoretical models with new variables, viable at the European level. The results of the survey is one of the few attempts to address the competency gap mitigation for European companies and highlight to policy makers the necessary actions required to create an environment that promotes energy efficient and sustainable business activities.

Disclaimer

The TrainERGY project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

This scientific work (publication / conference participation) is financed from financial resources for science in the years 2016-2018 granted (by the Polish Ministry of Science and Higher Education) for the implementation of the co-financed international project.

Reference

CARTER, C. R.; ROGERS, D. S. (2008) A framework of sustainable supply chain management: Moving toward new theory. *International Journal of Physical Distribution & Logistics Management*. Vol. 38, No. 5, p. 360-387.

DIABAT, A.; AL-SALEM, M. (2015) An Integrated Supply Chain Problem with Environmental Considerations. *International Journal of Engineering Production*. Vol. 164, p. 330-338.

DIABAT, A.; GOVINDAN, K. (2011) An analysis of the drivers affecting the implementation of green supply chain management. *Resources, Conservation and Recycling.* Vol. 55, No. 6, p. 659-667.

GUALANDRIS, J.; KALCHSCHMIDT, M. (2016) Developing environmental and social performance: the role of suppliers' sustainability and buyer–supplier trust. *International Journal of Production Research*. Vol. 54 No. 8, p. 174-178.

KLEINDORFER, P. A.; SINGHAL, K.; VAN WASSENHOVE, L. N. (2005) Sustainable operations management. *Production and Operations Management.* Vol. 14, No. 4, p. 482-492.

LINTON, J. D.; KLASSEN, R.; JAYARAMAN, V. (2007) Sustainable supply chains: An introduction. *Journal of Operations Management*. Vol. 25, No. 6, p. 1075-1082.

MICHELSEN, O.; MAGERHOLM, A.; DAHLSRUD, A. (2006) Eco-efficiency in extended supply chains: A case study of furniture production. *Journal of Environmental Management*. Vol. 79, No. 3, p. 290-297.

SARKIS, J. (2014) Green Supply Chain Management, Series: Technologies for Sustainable Life. New York, [New York]: Momentum Press, eBook.

SEURING, S.; MÜLLER, M. (2008a) From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*. Vol .16, No. 15, p. 1699-1710.

SEURING, S.; MÜLLER, M. (2008b) Core issues in sustainable supply chain management – A Delphi study. *Business Strategy and the Environment*. Vol .17, No. 8, p. 455-466.

TSOULFAS, G. T.; PAPPIS, C. P. (2006) Environmental principles applicable to supply chains design and operation. *Journal of Cleaner Production*. Vol. 14, No. 18, p. 1593-1602.

VERFAILLIE, H.A.; BIDWELL, R. (2000) Measuring Eco-Efficiency-A Guide to Reporting Company Performance, World Business Council for Sustainable Development, p. 2-37.

WU, C.; BARNES, D. (2016) An integrated model for green partner selection and supply chain construction. *Journal of Cleaner Production*. Vol. 112, p. 2114-2132.

BARTH, M.; GODEMANN, J.; RIECKMAN, M.; STOLTENBERG, U. (2007) Developing Key Competences for Sustainable Development in Higher Education. *International Journal of Sustainability in Higher Education*. Vol. 8, No. 4, p. 416-430.

BYRNE, J. (2000) From Policy to Practice: Creating Education for a Sustainable Future, In: WHEELER, K.A., BIJUR, A.P. (eds) Education for a Sustainable Future: A Paradigm of Hope for the 21st Century. Kluwer/Plenum, New York, p. 35-72.

CARTER, C. R.; ROGERS, D. S., (2008) A Framework of Sustainable Supply Chain Management: Moving Toward New Theory. *International Journal of Physical Distribution & Logistics Management*. Vol. 38, No. 5, p.360-387.

HASSINI, E.; SURTI, Ch.; SEARCY, C., (2012) A literature Review and a Case Study of Sustainable Supply Chains with a Focus on Metrics. *International Journal of Production Economics.* Vol. 140, No. 1, p. 69-82.

LINTON, J. D.; KLASSEN, R.; JAYARMAN, V. (2007) Sustainable Supply Chains: An Introduction. *Journal of Operations Management*. Vol. 25, No. 6, p. 1075-1082.

NICOLAIDES, A., (2006) The Implementation of Environmental Management Towards Sustainable Universities and Education for Sustainable Development as an Ethical Imperative. *International Journal of Sustainability in Higher Education.* Vol. 7, No. 4, p. 414-424.

Pollution Prevention Act of 1990.

RAUFFLET, E., (2013) Integrating Sustainability in Management Education. *Humanities.* Vol. 6, No. 2, p. 439-448.

SEURING, S.; MÜLLER, M., (2008a) Core Issues in Sustainable Supply Chain Management - a Delphi Study. *Business Strategy and the Environment*. Vol. 17, No. 8, p. 455-466.

SEURING, S.; MÜLLER, M., (2008b) From a Literature Review to a Conceptual Framework for Sustainable Supply Chain Management. *Journal of Cleaner Production*. Vol. 16, no. 15, p. 1699-1710.

SIPOS, Y.; BATTISTI, B.; GRIMM, K. (2007) Achieving Transformative Sustainability Learning: Engaging Head, Hands, and Heart. *International Journal of Sustainability in Higher Education*. Vol. 9, No. 1, p. 68-86.

SPURRIER, J.D., (2003) On the Null Distribution of the Kruskal-Wallis Statistic. *Journal of Nonparametric Statistics*. Vol. 15, No. 6, p. 685-691.

STEINER, G.; POSCH, A., (2006) Higher Education for Sustainability by Means of Transdisciplinary Case Studies: an Innovative Approach for Solving Complex, Real-World Problems. *Journal of Cleaner Production*. Vol. 14, No. 11, p. 877-890.

World Charter for Nature (1982) 28 October, United Nations General Assembly.

WCED, (1987) Our Common Future, World Commission on Environment and Development, Oxford University Press, Oxford.

WIEK, A.; WITHYCOMBE, L.; REDMAN, Ch. L., (2011) Key Competencies in Sustainability: a Reference Framework for Academic Program Development. *Sustainability Science*. Vol. 6, No. 2, p. 203-218.

WILLARD, M.; WIEDMEYER, C.; FLINT, R.W.; WEEDON, J.S.; WOODWARD, R.; FELDMAND, I.; EDWARDS, M. (2010) The Sustainability Professional: 2010 Competency Survey Report. *Environmental Quality Management*. Vol. 20, No. 1, p. 49-83.