8th International Scientific Conference
"Business and Management 2014"
May 15–16, 2014, Vilnius, LITHUANIA
Section: Logistics and Supply Chain Management
http://www.bm.vgtu.lt

ISSN print 2029-4441/ ISSN online 2029-929X
ISBN print 978-609-457-652-2/ ISBN online 978-609-457-651-5
Article number: bm.2014.093
http://dx.doi.org/10.3846/bm.2014.093

SELECTING SUPPLIERS IN GREEN SUPPLY CHAIN MANAGEMENT

Jolanta Tamošaitienė[1], Edmundas Kazimieras Zavadskas[2], James J. H. Liou[3], Gwo-Hshiung Tzeng[4]

[1,2]Vilnius Gediminas Technical University, Research Institute of Smart Building Technologies,
Saulėtekio al. 11, LT-10223 Vilnius, Lithuania
Email: jolanta.tamosaitiene@vgtu.lt; edmundas.zavadskas@vgtu.lt

[3]Department of Industrial Engineering and Management,
National Taipei University of Technology,
No. 1, Section 3, Chung-Hsiao East Road, Taipei, Taiwan
Email: jhliou@ntut.edu.tw

[4] Graduate Institute of Urban Planning, College of Public Affairs,
National Taipei University,
151, University Rd., San Shia District, New Taipei City, 23741, Taiwan
Email: ghtzeng@mail.ntpu.edu.tw

Abstract. The traditional supply chain management (SCM) model must be developed be applying new condition and dynamic construction industry. Greening the supply chain is an increasingly important concern for many business enterprises and a challenge for different type of industry. Green supplier improvement and selection is a critical function within green supply chain management (GSCM). In this study, the authors propose a complex assessment model based on MCDM methods and used information from decision-makers selecting the supplier company. The numerical example shows that the created model can by applied in praxis.

Keywords: Green supplier improvement and selection, green supply chain management (GSCM), complex assessment model, multiple criteria decision making (MCDM).

JEL classification: J22, C44, C51.

1. Introduction

In the last decade construction was one of the most important industrial branches. The quality of building highly depends on rational selection of a construction process, planning, technical and management problem. Today, the creation of mathematical models for management decisions, in order to get the best economic rates becomes the background of rational construction.

2. Green supplier chain management

Supply Chain Management (SCM) is considered as one of the most important aspects of production planning and control (Yigin *et al.* 2007; Xia,Wu 2007) and it has recently been taken into account by developer's managers and researchers. The general task of SCM is to manage multiple relationships across the Supply Chain (SC) be applying to the entire flow different type of information, resource, and services to fulfill customer demand in an efficient manner (Li, Wang 2007). Supply Chains comprise of potential suppliers, researches, developers, consultants, contractors, dealers, manufacturers, producers, distributors, retailers and customers, etc. In this regard, the integration of cooperation partnership with suppliers with better performance is recommended within the SC, while leads to enhance the performance of the chain in many types goals such as costs reduction through waste elimination, spend in time, reputation protection, continuous improvement of quality to achieve zero defects, flexibility improvement to meet the end-customers' requirements, decrease lead time at different stages of the SC (Amin, Razmi 2009).

The research is based on comprehensive review of literature on lean in the supply chain there are presented articles and the corresponding supply chain scopes, industry sectors, research objectives and methods.

Previous research on supply chains suggests that quality, cost, flexibility and delivery are considered very important issues in the supply chain (Amy, Lee 2009; Behrouzi, Wong, 2011; Taj, Mo-

rosan 2011; Agus, Hajinoor 2012 Tamošaitienė *et al.* 2013a). In order to perform the activities identified in the above definition better, supply chain managers and coordinators have been thinking of approaches to adopt in order to achieve reduced cost, efficient delivery, high quality and flexibility with the supply chain. The general SSCM areas are presented in Fig. 1.

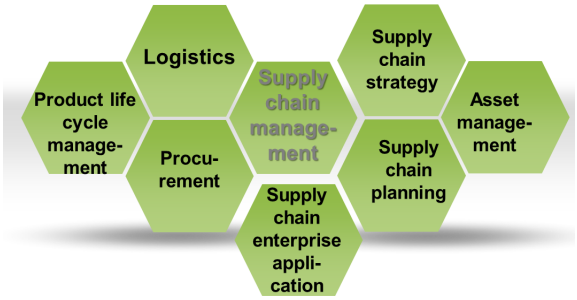

Fig. 1. The SCM areas (Tamošaitienė *et al.* 2013a)

The goal of SSCM is new created methods, algorithms there oriented in to sustainable development of environment, building life cycle and human life.

The SSCM process in construction provides such advantages:

- Minimizes the risk in construction;
- Forms the clear understanding of the tasks;
- Establishes standards of processes performance;
- Composes the sequence of works;
- Provides the relevant procedures of control;
- Provides the minimum time and least attempt to the best results.

For these reasons the SSCM in construction assumes the processes in micro, macro and mezzo environments and implemented construction industry transformation processes, changes in construction management, organization developments and business processes. All SSCM processes are oriented in to product customer (Fig. 2) (Tamošaitienė *et al.* 2013a).

The customer in construction industry can be many different types. This also depends on the requirements of construction processes. In each stage of building life cycle are many numbers types of the suppliers'. The types of suppliers in construction, in building life cycle are presented in Fig. 3.

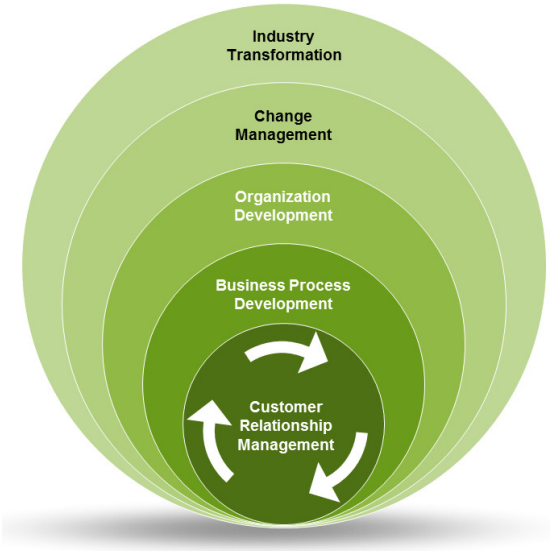

Fig. 2. The SSCM processes orientation in to customer (Tamošaitienė *et al.* 2013a)

3. Green supplier selection criteria

For the new management results must the new development of MCDM methods. Multi-attribute decision making (MADM) methods and analysis is a useful tool in many economic, managerial, and construction industries problems. The task models of construction process management, technical and technology solution problems can be used at the decision making stage in the construction process for the more effectiveness results in the future. Models and problem solution instruments, in the field of civil engineering and management, sustainability and other aspects, including complexity, creation and application in SSCM under dynamic and risky environment creation.

Supplier selection is a multiple criteria decision-making (MCDM) problem that is affected by several conflicting factors. Consequently, a purchasing manager must analyze the trade-off between the several criteria. MCDM techniques support the decision-makers (DMs) in evaluating a set of alternatives. The supplier selection problem in a

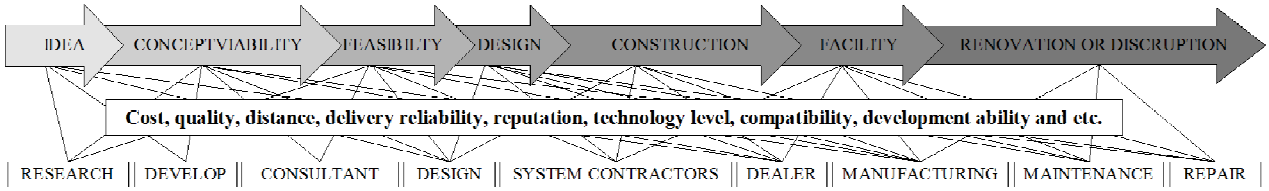

Fig. 3. The suppliers' types in construction industry (Hashemkhani Zolfani *et al.* 2012)

supply chain system is a group decision based on multiple criteria.

Besides, purchase managers should especially know the most appropriate method and then use it to select the right supplier. It is because the right supplier could work with companies closely and offer the sustained companies competitive advantages such as low purchase price, on time products, high product quality, and customer satisfaction. Supplier selection is therefore one of the most important problems for many companies due to the fact that most of companies currently failed to be benefited by selecting their suppliers.

In the future the research fields of Sustainable Supplier Chain Management in Construction must by developed on Sustainable Development, complexity aspects where are presented in Fig. 4.

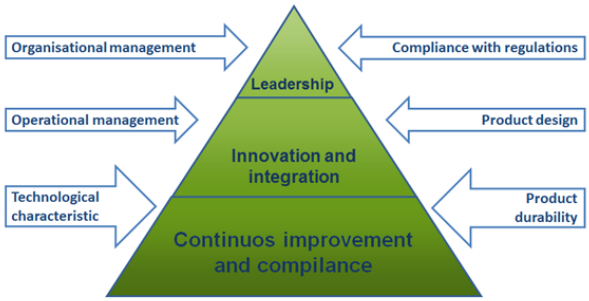

Fig. 4. The GSCM in construction

Since the process of green supplier selection is a complex system composed of many factors, such as environmental management, design, manufacturing, and compliance with regulations, there is no universal agreement among researchers and practitioners about what exactly constitutes evaluation indicators in the selection processes. This suggests that green supplier selection is context-dependent and selection should reflect the real operating environment of the investigated industry or company. Based on the above evaluation process, the evaluation system and its sources within each dimension are identified is presented in Table 1.

MADM methods and analysis is a useful tool in many economic, managerial, and construction industries problems. The task models of construction process management, technical and technology solution problems can be used at the decision making stage in the construction process for the more effectiveness results in the future. Models and problem solution instruments, in the field of civil engineering and management, sustainability and other aspects, including complexity, creation and application in SSCM under dynamic and risky environment (Zavadskas *et al.* 2010; Tamošaitienė *et al.* 2013b) creation.

4. Case study

In case study, after consulting with four senior managers and referring to the prior studies, a green supplier selection system having four alternatives. Then, through a questionnaire survey we asked managers from related departments to rank the importance of each criterion with respect to green supplier selection. The weight of the criteria is determined applying the AHP method (Saaty 1980, 1990; Podvezko *et al.* 2010; Podvezko 2011; Vodopivec *et al.* 2014). The rate the importance of the evaluation criteria on a 9-point scale ranging from 9 (absolutely superior criteria) to 1 (criteria are equal). Finally the results then used to construct initial date for a system for green supplier selection. For the problem were assesst four supplier selection companies from construction industry. For the supplier selection was used COPRAS - *COmplex PRoportional ASsessment* method (Zavadskas *et al.* 2009). The initial date, the weights of the criteria, normalization and calculation results are presented in Table 2.

Table 2. Green supplier selection criteria

	Initial date matrix			
Alternative	***Criteria***			
	x_1	x_2	x_3	x_4
	min	***max***	***max***	***max***
Weight	***0.08***	***0.24***	***0.64***	***0.04***
S_1	5	9	3	9
S_2	7	7	5	8
S_3	6	8	4	9
S_4	8	7	6	7
	Normalized matrix			
S_1	*1.00*	*1.00*	*0.50*	*1.00*
S_2	*0.71*	*0.78*	*0.83*	*0.89*
S_3	*0.83*	*0.89*	*0.67*	*1.00*
S_4	*0.63*	*0.78*	*1.00*	*0.78*
	Normalized weighted matrix			
S_1	0.080	0.240	0.320	0.040
S_2	0.057	0.187	0.533	0.036
S_3	0.067	0.213	0.427	0.040
S_4	0.050	0.187	0.640	0.031
	P_i		R_i	
S_1	0.080		0.600	
S_2	0.057		0.756	
S_3	0.067		0.680	
S_4	0.050		0.858	
	Q_i		N	***Rank***
S_1	0.937		100.00	***1***
S_2	0.738		78.72	***3***
S3	0.823		87.80	***2***
S4	0.649		69.30	***4***

5. Calculation results

According to calculation results of supplier selection priority line is as follows: $Supplier_1 \succ Supplier_3 \succ Supplier_2 \succ Supplier_4$.

Table 1. Green supplier selection criteria

Criteria group	**Organisational management – x_1**			
Criteria	**Environmental management system**	**Training related green management**	**Commitment of GSCM from managers**	
Sources of literature	Hsu *et al.* (2011); Zhu *et al.* (2007); Hsu & Hu (2009); Tseng (2011); Huang & Keskar (2007); Yang (2006); Handfield *et al.* (2002); Humphreys *et al.* (2003), Abernathy, *et al.* (2000); Suhong & Visich (2006); Wamba *et al.* (2008).	Hsu *et al.* (2011); Fu *et al.* (2012); Collins *et al.* (2010); Schuster *et al.* (2007); Smart *et al.* (2010); Struker & Gille (2010).	Zhu *et al.* (2007) ; Tseng (2011); Burgess *et al.* (2006); Mentzer (2001); Vainiūnas *et al.* (2009, 2010) Zavadskas *et al.* (2012, 2011, 2009), Alimardani *et al.* (2013); Zolfani *et al.* (2012); Amy & Lee (2009); Behrouzi & Wong (2011).	
Criteria group	**Operational management – x_2**			
Criteria	**Decreased consumption of hazardous/harmful/toxic materials during manufacturing processes**	**Pollution control initiatives and decrease of frequency of environmental accidents**	**Environmental collaboration and information sharing with firm**	**Use of cleaner technological processes**
Sources of literature	Zhu *et al.* (2007); Hsu & Hu (2009); Tseng (2011); Handfield *et al.* (2002); Lin *et al.* (2011); Chatterjee *et al.* (2011); Chatterjee & Chakraborty (2012), Agus & Hajinoor (2012); Taj & Morosan (2011).	Zhu *et al*. (2007); Giovanni & Vinzi (2012); Lin *et al*. (2011); Attaran (2007); Kayakutlu & Buyukozkan (2010)	Zhu *et al.* (2007); Giovanni & Vinzi (2012); Hsu *et al.* (2011); Lin *et al.* (2011); Tseng (2011); Fu *et al.* (2012); Andersenas et. al. (2009); Angeles (2005); Attaran (2007); Barjis and Wamba (2010); Bose and Lam (2009); Bottani *et al.* (2009); Cachon & Fisher (2000); Kelepouris *et al.* (2007); Kim *et al.* (2008); Lee & Ozer (2007); Li *et al.* (2010); Reyes *et al.* (2007).	Hsu & Hu (2009); Giovanni & Vinzi (2012); Tseng (2011)
Criteria group	**Product design – x_3**			
Criteria	**Applying life cycle analysis to carry out eco-report**	**Design of products forreduced consumption of materials/energy**	**Design of products for reuse and recycling of materials and packaging**	
Sources of literature	Buyukozkan & Cifci (2012); Diabat & Govindan (2011)	Zhu *et al.* (2007); Hsu & Hu (2009); Fu *et al.* (2012); Akadiri *et al.* (2013); Peldschus *et al.* (2010)	Diabat & Govindan (2011); Zhu *et al.* (2007); Zhu & Sarkis (2007)	
Criteria group	**Compliance with regulations – x_4**			
Criteria	**Green certification**		**Government regulation and environmental legal-compliance**	
Sources of literature	Zhu *et al.* (2007); Tseng (2011); Diabat & Govindan (2011); Green *et al.* (2013); Schiederig *et al.* (2012)		Zhu *et al.* (2007); Diabat & Govindan (2011); Hsu & Hu (2009); Yigin *et al.* (2007); Xia & Wu (2007).	

6. Conclusions

Nowadays, dynamic business environments lead to the selection of the best suppliers, which is very important for companies. Typically, supplier selection is the foundation of supply chain cooperation and is an MCDM problem. It is because supply chain cooperation involves numerous tasks (evaluation criteria).

The aim of this study is to utilize a hybrid model of MCDM method in supplier selection. It used AHP to weigh the eight evaluation criteria and the COPRAS method to evaluate the performance of three suppliers of international company with adopting weighted evaluation criteria.

Furthermore, organizations could satisfy such tasks by working along with good suppliers. The hybrid model of MCDM method is developed in this research. The case study's focusing on an international company. The presented model proposed can also be a guide for other foreign companies for their supplier selection with efficiency in the decision-making process of top managers. Based on the calculation result of the AHP and COPRAS method, the best supplier for company is thus verified.

References

Abernathy, F.; Dunlop, J.; Hammond, J.; Weil, D. 2000. Retailing and supply chains in the information age, *Tecnology in Society* 22: 5–31. http://dx.doi.org/10.1016/S0160-791X(99)00039-1

Agus, A.; Hajinoor, M. S. 2012. Lean production supply chain management as driver towards enhancing product quality and business performance: Case study of manufacturing companies in Malaysia, *International Journal of Quality & Reliability Management* 29(1): 92–121. http://dx.doi.org/10.1108/02656711211190891

Akadiri, P. O.; Olomolaiye, P. O.; Chinyio, E. A. 2013. Multi-criteria evaluation model for the selection of sustainable materials for building projects, *Automation in Construction* 30: 113–125. http://dx.doi.org/10.1016/j.autcon.2012.10.004

Alimardani, M.; Zolfani, S. Z.; Aghdaie, M. H.; Tamošaitienė, J. 2013. A novel hybrid SWARA and VIKOR methodology for supplier selection in anagile environment, *Technological and economic development of economy* 19(3): 533–548.

Amin, S. H.; Razmi, J. 2009. An integrated fuzzy model for supplier management: A case study of ISP selection and evaluation, *Expert Systems with Applications* 36: 8639–8648. http://dx.doi.org/10.1016/j.eswa.2008.10.012

Amy, H.; Lee, I. 2009. Fuzzy supplier selection model with the consideration of benefits, opportunities, costs and risks, *Expert Systems with Applications* 36: 2879–2893. http://dx.doi.org/10.1016/j.eswa.2008.01.045

Andersenas, C. R.; Baldwin, J.; Ridgway, K. 2009. Communicative interaction as an instrument for integration and coordination in an aerospace supply chain, *Journal of Management Development* 29(3): 193–209. http://dx.doi.org/10.1108/02621711011025740

Angeles, R. 2005. RFID technologies: Supply-chain applications and implementation issues, *Information Systems Management* 22(1): 51–65. http://dx.doi.org/10.1201/1078/44912.22.1.20051201/85739.7

Attaran, M. 2007. RFID: an enabler of supply chain operations, *Supply Chain Management: An International Journal* 12(4): 249–57. http://dx.doi.org/10.1108/13598540710759763

Barjis, J.; Wamba, S. F. 2010. Organizational and business impacts of RFID technology, *Business Process Management Journal* 16(6): 897–903. http://dx.doi.org/10.1108/14637151011092973

Behrouzi, F.;Wong, K. Y. 2011. An investigation and identification of lean supply chain performance measures in the automotive SMEs, *Sci. Res. Essy* 6(24): 5239–5252.

Bose, I.; Lam, C. W. 2009. Facing the Challenges of RFID Data Management, *International Journal of Information Systems and Supply Chain Management* 1: 1–19. http://dx.doi.org/10.4018/jisscm.2008100101

Bottani, B.; Bertolini, M.; Montanari, R.; Volpi, A. 2009. RFID-enabled business intelligence modules for supply chain optimisation, *International Journal of RF Technologies: Research and Applications* 1(4): 253–278.

Burgess, K.; Singh, P. J.; Koroglu, R. 2006. Supply chain management: a structured literature review and implications for future research, *International Journal of Operations & Production Management* 26(7): 703–729. http://dx.doi.org/10.1108/01443570610672202

Buyukozkan, G.; Cifci, G. 2012. A novel hybrid MCDM approach based on fuzzy DEMATEL, fuzzy ANP and fuzzy TOPSIS to evaluate green suppliers, *Expert Systems with Applications* 39(3): 3000–3011. http://dx.doi.org/10.1016/j.eswa.2011.08.162

Cachon, G.; Fisher, M. 2000. Supply chain inventory management and the value of shared information, *Management Science* 46(8): 1032–1048. http://dx.doi.org/10.1287/mnsc.46.8.1032.12029

Collins, J. D.; Worthington, W. J.; Reyes, P. M.; Romero. M. 2010. Knowledge management, supply chain technologies, and firm performance, *Management Research Review* 33(10): 947–960. http://dx.doi.org/10.1108/01409171011083969

Chatterjee, P.; Athawale, V. M.; Chakraborty, S. 2011. Materials selection using complex proportional assessment and evaluation of mixed data methods, *Materials and Design* 32(2): 851–860. http://dx.doi.org/10.1016/j.matdes.2010.07.010

Chatterjee, P.; Chakraborty, S. 2012. Material selection using preferential ranking methods, *Materials & Design* 35: 384–393. http://dx.doi.org/10.1016/j.matdes.2011.09.027

Diabat, A.; Govindan, L. 2011. An analysis of the drivers affecting the implementation of green supply chain management, *Resources, Conservation and Recycling* 55(6): 659–667. http://dx.doi.org/10.1016/j.resconrec.2010.12.002

Fu, X.; Zhu, Q.; Sarkis, J. 2012. Evaluating green supplier development programs at a telecommunications systems provider, *International Journal of Production Economics* 140(1): 357–367. http://dx.doi.org/10.1016/j.ijpe.2011.08.030

Giovanni, P. D.; Vinzi, V. E. 2012. Covariance versus component-based estimations of performance in green supply chain management, *International Journal of Production Economics* 135(2): 907–916. http://dx.doi.org/10.1016/j.ijpe.2011.11.001

Green, K. W.; Zelbst, P. J.; Meacham, J.; Bhadauria, V. S. 2012. Green supply chain management practices: impact on performance, *Supply Chain Management: An International Journal* 17(3): 290–305.

Handfield, R.; Walton, S.; Sroufe, R.; Melnyk, S. 2002. Applying environmental criteria to supplier assessment: a study in the application of the analytical hierarchy process, *European Journal of Operational Research* 141(1): 70–87. http://dx.doi.org/10.1016/S0377-2217(01)00261-2

Hsu, C. W.; Hu, A. H. 2009. Applying hazardous substance management to supplier selection using analytic network process, *Journal of Cleaner Production* 17(2): 255–264. http://dx.doi.org/10.1016/j.jclepro.2008.05.004

Hsu, C. W.; Kuo, T. H.; Chen, S. H.; Hu, A. H. 2011. Using DEMATEL to develop a carbon management model of supplier selection in green supply chain management, *Journal of Cleaner Production* 56(1): 1–9.

Huang, S.; Keskar, H. 2007. Comprehensive and configurable metrics for supplier selection, *International Journal of Production Economics* 105(2): 510–523. http://dx.doi.org/10.1016/j.ijpe.2006.04.020

Humphreys, P.; McIvor, R.; Chan, F. 2003. Using case-based reasoning to evaluate supplier environmental management performance, *Expert Systems with Applications* 25(2): 141–153. http://dx.doi.org/10.1016/S0957-4174(03)00042-3

Kayakutlu, G.; Buyukozkan, G. 2010. Effective supply value chain based on competence success, *Supply Chain Management: An International Journal* 15(2): 129–138.

Kelepouris, T.; Pramatari, K.; Doukidis, G. 2007. RFID-enabled traceability in the food supply chain, *Industrial Management & Data Systems* 107(2): 183–200. http://dx.doi.org/10.1108/02635570710723804

Kim, E. Y.; Ko, E. L.; Kim, H.; Koh, C. E. 2008. Comparison of benefits of radio frequency identification: implications for business strategic performance in the US and Korean retailers, *Industrial Marketing Management* 37(7): 797–806. http://dx.doi.org/10.1016/j.indmarman.2008.01.007

Lee H.; Ozer, O. 2007. Unlocking the value of RFID, *Production and Operations Management* 16(1): 40–64. http://dx.doi.org/10.1111/j.1937-5956.2007.tb00165.x

Li, X.; Wang, Q. 2007. Coordination mechanisms of supply chain systems, *European Journal of Operational Research* 179: 1–16. http://dx.doi.org/10.1016/j.ejor.2006.06.023

Li, S.; Godon, D.; Visich, J. K. 2010. An exploratory study of RFID implementation in the supply chain, *Management Research Review* 33(10): 1005–1015. http://dx.doi.org/10.1108/01409171011084003

Lin, R. J.; Chen, R. H.; Nguyen, T. H. 2011. Green supply chain management performance in automobile manufacturing industry under uncertainty, in *Procedia - Social and Behavioral Sciences* 25: 233–245.

Mentzer, J. T.; DeWitt, W.; Keebler, J. S.; Min, S.; Nix, N. W.; Smith, C. D.; Zacharia, Z. G. 2001. Defining Supply Chain management, *Supply Chain Management* 1: 1–25.

Peldschus, F.; Zavadskas, E. K.; Turskis, Z.; Tamošaitienė, J. 2010. Sustainable assessment of construction site by applying game theory, *Inžinerinė ekonomika = Engineering economics* 3(21): 223–237.

Podvezko, V.; Mitkus, S.; Trinkuniene, E. 2010. Complex evaluation of contracts for construction, J*ournal of Civil Engineering and Management* 16(2): 287–297. http://dx.doi.org/10.3846/jcem.2010.33

Podvezko, V. 2011. The Comparative Analysis of MCDA Methods SAW and COPRAS, *Inzinerine Ekonomika – Engineering Economics* 22(2): 134–146.

Reyes, P. M.; Frazier, G. V.; Prater, E. L.; Cannon, A. R. 2007. RFID: The state of the union between promise and practice, *International Journal of Integrated Supply Management* 3(2): 125–134. http://dx.doi.org/10.1108/01409170710773706

Saaty, T. L. 1980. *The analytic hierarchy process: Planning, priority setting, resources allocation*, London: McGraw-Hill.

Saaty, T. L. 1990. How to make a decision: the analytic hierarchy process, *European Journal of Operation Research* 48(1): 9–26. http://dx.doi.org/10.1016/0377-2217(90)90057-I

Schiederig, T.; Tietze, F.; Herstatt, C. 2012. Green innovation in technology and innovation management – an exploratory literature review, *R&D Management* 42(2): 180–192. http://dx.doi.org/10.1111/j.1467-9310.2011.00672.x

Schuster, E. W.; Allen, S. J.; Brock, D. L. 2007. *Global RFID. The Value of the EPC global Network for Supply Chain Management*, Berlin: Springer.

Smart, A. U.; Bunduchi, R.; Gerst, M. 2010. The costs of adoption of RFID technologies in supply networks, *International Journal of Operations &*

Production Management 30(4): 423–447. http://dx.doi.org/10.1108/01443571011029994

Struker, J.; Gille, D. 2010. RFID adoption and the role of organisational size, *Business Process Management Journal* 16(6): 972–990. http://dx.doi.org/10.1108/14637151011093026

Suhong, L.; Visich, J. K. 2006. Radio frequency identification: supply chain impact and implementation challenges, *International Journal of Integrated Supply Management* 2(4): 407–424. http://dx.doi.org/10.1504/IJISM.2006.009643

Taj, S.; Morosan, C. 2011. The impact of lean operations on the Chinese manufacturing performance, *Journal of Manufacturing Technology Management* 22(2): 223–240. http://dx.doi.org/10.1108/17410381111102234

Tamošaitienė, J.; Zavadskas, E. K. 2013. The multistage decision making system for complicated problems, *World Conference on Psychology and Sociology 2012. Amsterdam, Procedia - Social and Behavioral Sciences* 82: 215–219.

Tamošaitienė, J.; Zavadskas, E. K.; Turskis, Z.; Merkuryeva, G.; Merkuryev, Y. 2013a. The Concept of Sustainable Supply Chain Management in Construction, in *the 14th German-Lithuanian-Polish colloquium "Innovative solutions in construction technology and management"*, 59–63.

Tamošaitienė, J.; Zavadskas, E. K.; Turskis, Z. 2013b. Multi-criteria risk assessment of a construction project, in *Procedia Computer Science : first international conference on Information Technology and Quantitative Management (ITQM 2013)*, Suzhou, China, 16-18 May, 2013. Berlin : Springer, 2013. 17: 129–133.

Tseng, M. L. 2011. Green supply chain management with linguistic preferences and incomplete information, *Applied Soft Computing* 11(8): 4894–4903. http://dx.doi.org/10.1016/j.asoc.2011.06.010

Vainiūnas, P.; Zavadskas, E. K.; Peldschus, F.; Turskis, Z.; Tamošaitienė, J. 2009. Model of construction design projects' managers qualifying by applying analytic hierarchy process and bayes rule, *in EURO mini conference "Knowledge-Based Technologies and OR Methodologies for Strategic Decisions of Sustainable Development" (KORSD-2009): 5th international conference. September 30-October 3, 2009, Vilnius Lithuania : selected papers*,148–153.

Vainiūnas, P.; Zavadskas, E. K.; Turskis, Z.; Tamošaitienė, J. 2010. Design projects' managers ranking based on their multiple experience and technical skills, *in 10th International Conference Modern Building Materials, Structures and Techniques: selected papers*. *May 19-21, 2010,* p. 1: 544–548.

Wamba, S. F.; Lefebvre, L. A.; Bendavid, Y.; Lefebvre, E. 2008. Exploring the impact of RFID technology and the EPC network on mobile B2B eCommerce: A case study in the retail industry, *Int. J. Production Economics* 78: 614–629. http://dx.doi.org/10.1016/j.ijpe.2007.05.010

Vodopivec, B.; Žarnić, R.; Tamošaitienė, J.; Lazauskas, M.; Šelih, J. 2014. Renovation priority ranking by multi-criteria assessment of architectural heritage: the case of castles, *International journal of strategic property management* 18(1): 88–100.

Xia, W.; Wu, Z. 2007. Supplier selection with multiple criteria in volume discount environments, *Omega* 35(5): 494–504. http://dx.doi.org/10.1016/j.omega.2005.09.002

Yang, B. B. 2006. How does the manufacture practice environment protection rules in the market, *in Second International Conference on Power Electronics Systems and Applications* 108–112.

Yigin, I. H.; Taşkin, H.; Cedimoglu, I. H.; Topal, B. 2007. Supplier selection: an expert system approach, *Production Planning and Control* 18(1): 16–24. http://dx.doi.org/10.1080/09537280600940655

Zavadskas, E. K.; Kaklauskas, A.; Turskis, Z.; Tamošaitienė, J. 2009. Multi-attribute decision-making model by applying grey numbers, *Informatica*. 20(2): 305–320.

Zavadskas, E. K.; Turskis, Z.; Tamošaitienė, J. 2010. Risk assessment of construction projects, *Journal of civil engineering and management* 16(1): 33–46.

Zavadskas, E. K.; Turskis, Z.; Tamošaitienė, J. 2011. Selection of construction enterprises management strategy based on the SWOT and multi-criteria analysis, *Archives of civil and mechanical engineering* 11(4): 1063–1082.

Zavadskas, E. K.; Vainiūnas, P.; Turskis, Z.; Tamošaitienė, J. 2012. Multiple criteria decision support system for assessment of projects managers in construction, *International journal of information technology & decision making* 1(2): 501–502. http://dx.doi.org/10.1142/S0219622012400135

Zavadskas, E. K.; Vainiūnas, P.; Turskis, Z.; Tamošaitienė, J. 2009. Construction design project's managers ranking by applying game theory, *in the 12th German-Lithuanian-Polish Colloquium "Sustainable Development in Civil Engineering and Multi-Attribute Decision Making": abstracts, May 20-24, 2009 Vilnius*, 58.

Zhu, Q.; Sarkis, J.; Lai, K. H. 2007. Initiatives and outcomes of green supply chain management implementation by Chinese manufacturers, *Journal of Environmental Management* 85(1): 179–189. http://dx.doi.org/10.1016/j.jenvman.2006.09.003

Zolfani, S. H.; Chen, I-S.; Rezaeiniya, N.; Tamošaitienė, J. 2012. A hybrid MCDM model encompassing AHP and COPRAS-G methods for selecting company supplier in Iran, *Technological and economic development of economy* 18(3): 529–543.