Taylor & Francis
Taylor & Francis Group

Edinburgh Napier UNIVERSITY

INTERNATIONAL JOURNAL OF STRATEGIC PROPERTY MANAGEMENT
ISSN 1648-715X print / ISSN 1648-9179 online

2011 Volume 15(1): 60–73
doi: 10.3846/1648715X.2011.568675

RISK MANAGEMENT IN PROJECTS: PECULIARITIES OF LITHUANIAN CONSTRUCTION COMPANIES

Nerija BANAITIENĖ [1] ✉, Audrius BANAITIS [2] and Artūras NORKUS [3]

[1] *Department of Construction Economics and Property Management, Vilnius Gediminas Technical University, Sauletekio al. 11, LT-10223 Vilnius, Lithuania*
E-mail: nerija.banaitiene@vgtu.lt
[2] *Department of Construction Economics and Property Management, Vilnius Gediminas Technical University, Sauletekio al. 11, LT-10223 Vilnius, Lithuania*
E-mail: audrius.banaitis@vgtu.lt
[3] *Panevėžio statybos trestas SC, Panevėžys, Lithuania*
E-mail: anorkus@pst.lt

Received 6 September 2010; accepted 17 November 2010

ABSTRACT. Risk analysis and management is nowadays a critical factor to successful construction project management, as construction projects tend to be more complex, dynamic, always unique, and competition increasingly tougher. Risk management helps the project participants – client, contractor or developer, consultant, and supplier – to meet their commitments and minimize negative impacts on construction project scope, cost, schedule (and quality, as a result). The benefits of the risk management process include identifying and analyzing risks, and improvement of construction project management processes and effective use of resources. This paper reports the research that aims to discover how construction companies perceive the significance of the construction projects risks they face and the extent to which they employ potential risk responses.

KEYWORDS: Risk analysis; Risk management; Construction companies; Project management

1. INTRODUCTION

The financial and economic crisis has had an adverse impact on the Lithuania's economy and construction industry. The GDP of Lithuania decreased 14.7% in 2009, in contrast to an increase of 2.9% in 2008 (GF, 2010). Some industries, such as construction; trade, transport and communications; and the industry sectors were most affected by the crisis. In the same period, the gross value added within the construction sector decreased by 43.3 %, and in the trade, transport and communications sector – by 16.6% (SL, 2010). The construction sector, one of the engines of economic growth in Lithuania over the last decade, is now facing with serious challenges as companies' closures, rising unemployment, and postponed or even cancelled investments. These events also have changed the clients' and construction companies' behaviour. A reduced demand and shortage of orders dramatically increased a competition between companies of the construction sector. This increased pressure to improve quality, productivity and reduce costs, and the need for project strategies and management that can appropriately and effectively manage project risk.

Risk management is one of the nine knowledge areas (i.e., integration management, scope management, time management, cost management, quality management, human resource management, communications management, risk management, and procurement management) propagated by the Project Management Institute (PMI, 2008). Furthermore, risk management in the construction project management context is a comprehensive and systematic way of identifying, analyzing and responding to risks to achieve the project objectives (ICE, 2005; PMI, 2007). The benefits of the risk management process include identifying and analyzing risks, and improvement of construction project management processes and effective use of resources.

Construction projects can be extremely complex and fraught with uncertainty. Risk and uncertainty can potentially have damaging consequences for the construction projects (Flanagan and Norman, 1993; Mills, 2001, Schieg, 2006). Therefore nowadays, the risk analysis and management continue to be a major feature of the project management of construction projects in an attempt to deal effectively with uncertainty and unexpected events and to achieve project success.

Construction projects are always unique and risks raise from a number of the different sources (Oyegoke, 2006; Pheng and Chuan, 2006). Construction projects are inherently complex and dynamic, and involve a lot of participants (Sterman, 1992; Uher and Loosemore, 2004). Different participants with different experience and skills usually have different expectations and interests (Dey and Ogunlana, 2004). This naturally creates problems and confusion for even the most experienced project managers and contractors.

Cost of risk is a concept many construction companies have never thought about despite the fact that it is one of the largest expense items (Cavignac, 2009). Risk management helps the key project participants – client, contractor or developer, consultant, and supplier – to meet their commitments and minimize negative impacts on construction project performance in relation to cost, time and quality objectives.

The current economic downturn and challenges in a highly competitive Lithuania's construction sector require contractors to manage risks by themselves. This paper reports the research that aims to examine the risk analysis and risk management practices in the Lithuanian construction companies.

2. LITERATURE REVIEW

Construction projects can be unpredictable. Managing risks in construction projects has been recognized as a very important process in order to achieve project objectives in terms of time, cost, quality, safety and environmental sustainability (Zou et al., 2007).

The risk analysis and management techniques have been described in detail by many authors (Ahmed et al., 2007; Chapman, 2001; Chapman and Ward, 2003; Mbachu and Nkado, 2007; Smith et al., 2006; Burduk and Chlebus, 2009). A typical risk management process includes the following key steps: risk identification, risk assessment, risk mitigation, and risk monitoring (Wysocki, 2009). Risk identification is an important step in the risk management process, as it attempts to identify the source and type of risks. It includes the recognition of potential risk event conditions in the construction project and the clarification of risk responsibilities (Wang and Chou, 2003). Risk identification develops the basis for the next steps: analysis and control of risk management. As Skorupka (2008) emphasize, the risk definition is crucial for accurate assessment of risks, because a risk is understood and defined in a variety of ways, which leads to problems when it comes to its interpretation. Correct risk identification ensures risk management effectiveness. Carbone and Tippett (2004) stated that the identification and mitigation of project risks are crucial steps in managing successful projects.

Many approaches on risk classification have been suggested in the literature for effective construction project risk management. Tah and Carr (2000) categorized risks into two groups in accordance with the nature of the risks, i.e. external and internal risks. Combining the fuzzy logic and a work breakdown structure, the authors grouped risks into six subsets: local, global, economic, physical, political and technological change. Carr and Tah (2001) introduced a hierarchical risk breakdown structure (HRBS), and the HRBS represents a formal model for qualitative risk assessment.

The risk identification process would have highlighted risks that may be considered by project management to be more significant and selected for further analysis (Adams, 2008). Generally two broad categories, namely, qualitative and quantitative analysis are distinguished in literature on risk assessment. Quantitative risk analysis attempts to estimate the frequency of risks and the magnitude of their consequences by different methods, such as fault tree analysis, event tree analysis, probability and impact grids, sensitivity analysis, estimation of system reliability, failure mode and effect analysis, and Monte Carlo simulation (Ahmed et al., 2007; Modarres, 2006). Qualitative risk analysis usually attempts to rank the risks into high, medium and low, depending on two criteria: the severity of impact, and the probability of the event occurring (Ahmed et al., 2007). Though Ebrahimnejad et al. (2010) introduced new criteria based on developing risk concepts for more precise risk analysis: (1) probability criterion; (2) impact criterion; (3) quickness of reaction toward risk criterion; (4) event measure quantity criterion; and (5) event capability criterion.

There are four alternative strategies – risk avoidance, risk transfer, risk mitigation, and risk acceptance, for treating risks in a construction project. As stated by Hillson (1999), risk mitigation and risk response development is often the weakest part of the risk management process. The proper management of risks requires that they be identified and allocated in a well-defined manner. This can only be achieved if contracting parties comprehend their risk responsibilities, risk event conditions, and risk handling capabilities (Perera et al., 2009). Once the risk allocation is agreed and defined in the contract, contracting parties can move to the risk treatment stage in contract management (Tieva and Junnonen, 2009).

Risk transfer means the shift of risk responsibility to another party either by insurance or by contract. Wang and Chou (2003) reported that contractors usually use three methods to transfer risk in construction projects: (1) through insurance to insurance companies; (2) through subcontracting to subcontractor; and (3) through modifying the contract terms and conditions to client or other parties.

Construction projects can be managed using various risk management tolls and techniques. Ahmed et al. (2007) reviewed techniques that can be used for development of risk management tools for engineering projects. Techniques for context establishment, risk identification, risk assessment and treatment were provided. Application of risk management tools depends on the nature of the project, organization's policy, project management strategy, risk attitude of the project team members, and availability of the resources (Dey and Ogunlana, 2004). A risk assessor model (RAM) presented by Jannadi and Almishari (2003) was developed to determine risk scores for various construction activities. The model provides an acceptability level for the risks and determines a quantitative justification for the proposed remedy. While Mills (2001) and Schieg (2007) offer another tool for risk analysis of construction projects: the post-mortem analysis as a method for company knowledge management. Through post-mortem analysis, the project manager may identify areas (i.e., resource allocation, change management, and risk and uncertainty) to be emphasized or more closely managed in future construction projects.

Risks and uncertainties, involved in construction projects, cause cost overrun and schedule delay (Wang and Chou, 2003; Wysocki, 2009). As stated by Baloi and Price (2001), poor cost performance of construction projects seems to be the norm rather than the exception, and both clients and contractors suffer significant financial losses due to cost overruns.

Oyegoke et al. (2008) discusses the problems of managing risk and uncertainty in construction project due to the owner dissatisfaction in project outcome and dynamism within agile construction environment. The authors identified some areas in supply chain processes which are prone to greater risks and uncertainty and propose an agile management principle based on the concept of integration and fragmentation in product development and execution processes respectively. While Wang and Yuan (2011) identified the critical factors affecting contractors' risk attitudes, which pervade in a large number of decision making activities in construction projects.

Many authors have reviewed problems on time performance in construction projects (Aibinu and Odenyinka, 2006; Aramvareekul and Seider, 2006; Baloi and Price, 2001; Nasir et al., 2003). Aibinu and Odenyinka (2006) investigated and assessed the causes of delays in building projects in Nigeria. The nine factor categories evaluated include: client, contractor, quantity surveyor, architect, structural engineer, services engineer, supplier, and subcontractor-caused delays, and external factors (i.e. delays not caused by the project participants). Finally, ten overall delay factors were identified, namely: contractors' financial difficulties, client' cash flow problems, architects' incomplete drawings, subcontractors' slow mobilization, equipment breakdown and maintenance problems, suppliers; late delivery of ordered materials, incomplete structural drawings, contractors' planning and scheduling problems, price escalation, and subcontractors' financial difficulties. The authors pointed the poor risk management as one of the principal delay factors and concluded that actions and inactions of construction project participants contribute to overall project delays.

According to Baloi and Price (2001), the construction contractors highlight that delay in payments is common both in private and public projects, with the public sector being the worse defaulter. Moreover, most types of contracts presume compensation clauses for delay in payments, but clients rarely agree to pay the interests due to the contract. Nasir et al. (2003) analysed schedule risks and developed a comprehensive construction schedule risk model is referred to as Evaluating Risk in Construction–Schedule Model (ERIC-S). The ERIC-S model provides decision support to project owners, consultants, and researchers as a project delay prediction tool. Similarly, the Cost-Time-Risk diagram (CTR) proposed by Aramvareekul and Seider (2006) helps project managers consider project risk issues while monitoring and controlling their project schedule and cost performance in one diagram.

In business relations, as stated by Kaklauskas et al. (2010), the global economic crisis brought about distrust of other stakeholders. Ward and Chapman (2008) concluded that stakeholders are a major source of uncertainty in construction projects. Wilkinson (2002) found that project management companies need to overcome problems in their relationships with other professionals on the project team and with the client.

Construction projects are tendered and executed under different contract systems and payment methods (Öztas and Ökmen, 2004). According by Zaghloul and Hartman (2003), there is no possibility to eliminate all the risks associated with a specific project. All that can be done is to regulate the risk allocated to different parties and then to properly manage the risk. Chapman and Ward (2008), Maniar (2010) argue that the contract choice decisions are central to both stakeholder management and the management of risk and uncertainty. Chapman and Ward (2008) proposed an integrated approach based on a balanced incentive and risk sharing (BIARS) approach to contracting as well as a best practice approach to risk management in terms of the whole project life cycle. As Chan et al. (2010) emphases, the determination of key risk factors and the assessment of their relative importance are essential in the risk management of target cost contracts (TCC) and guaranteed maximum price (GMP) contracts and in enhancing the cost effectiveness of the whole procurement process.

A vast number of methods have been suggested for risk assessment in construction projects. These studies include the application of quantitative methods (Luu et al., 2009; Zeng et al., 2010), semi-quantitative methods (Dey, 2002; Imbeah and Guikema, 2009), and qualitative methods (Pinto et al., 2010; Shevchenko et al., 2008; Ustinovichius et al., 2010). Lyons and Skitmore (2004) survey found qualitative methods of risk assessment are used most frequently, ahead of quantitative and semi-quantitative methods, which is consistent with Nieto-Morote and Ruz-Vila (2011) findings.

Multiple criteria decision analysis (MCDA) has been applied to a variety of project management problems, such as construction project risk assessment (Zavadskas et al., 2010a), multi-criteria risk analysis (Zavadskas et al., 2010b), and construction bidding (Zavadskas et al., 2008; Podvezko et al., 2010). Contractor selection is a vital part of the project management cycle and deals with risk and risk management (Plebankiewicz, 2010). Zavadskas et al. (2008) developed a model for contractors' assessment and selection in a competitive and risky environment. The model is based on a multi-attribute evaluation of contractors and the determination of their optimality criterion values according to Hodges-Lehmann rule. Another model for contractor selection is developed by Zavadskas et al. (2009). Some research also proposes the applications of fuzzy approaches (Baloi and Price, 2003; Ebrahimnejad et al., 2010; Ismail et al., 2008; Nieto-Morote and Ruz-Vila, 2011; Zeng et al., 2007), to deal with risk assessment problems.

del Cano and de la Cruz (2002) presented PUMA (Project Uncertainty MAnagement), a generic project risk management process that has been particularized for construction projects from the point of view of the owner and the consultant who may be helping the owner. This hierarchically structured and flexible process can also be adapted to the needs of the contractor or other project participants. Ökmen and Öztas (2010) proposed a new simulation-based model – the correlated cost risk analysis model (CCRAM) – to analyse the construction costs under uncertainty when the costs and risk-factors are correlated. The CCRAM model captures the correlation between the costs and risk-factors indirectly and qualitatively. While the model proposed and developed by Ebrahimnejad et al. (2010) allows risks to be ranked for management priority via Fuzzy Multi Attribute Decision Making (FMADM). The fuzzy project risk ranking model based on Fuzzy Technique for Order Preference by Similarity to Ideal Solution (FTOPSIS) as rapid FMADM and Fuzzy Linear Programming Technique for Multidimensional Analysis of Preference (FLINMAP) as exact FMADM is used for identifying and assessing risks in BOT projects.

Baloi and Price (2003) determined the most critical risk factors affecting construction cost performance. The authors stated that global risk factors pose more challenges to contractors, which are less familiar with them. The authors introduced a fuzzy decision framework for a systematic modelling, analysis and management of global risk factors affecting construction cost performance from contractor's perspective and at a project level. Similarly, Ismail et al. (2008) provide a 'Level-Severity-Probability' approach to determine the critical risk source and factors. Fuzzy logic is used in the proposed methodology for evaluation of the risk level, severity and probability. As stated by Zeng et al. (2007), the application of fuzzy reasoning techniques provides an effective tool to handle the uncertainties and subjectivities arising in the construction project.

The review of the literature revealed a wide range of risk types and sources in construction projects, and that various risk management methods and techniques can be employed in the management of construction projects in order to control potential risks.

3. METHODS AND DATA

The aims of the research were: first, to identify contractors' opinion on the significance of the construction projects risks; and second, to explore the risk analysis and risk management practices in the Lithuanian construction companies.

The initial survey was distributed during February through March 2008. A second, similar questionnaire was distributed during February through March 2009. A questionnaire containing three sections was developed to facilitate data collection. The first section includes the respondents' opinion on the risk factor in terms of its probability and impact to overall construction project success. The second section includes the respondents' opinion on the risk consequences for construction project performance measures as well as the risk assessment and response practices. The third section aims to collect the background information of the respondents, e.g. their age, gender, position, education, work experience and professional background.

The questionnaire of first survey was distributed either personally or via e-mail to 40 members of top and middle management in the construction companies. A sample of 40 practitioners received the questionnaire and 38 valid questionnaires were returned for analysis with a response rate of 95%. The second questionnaire was distributed either personally or via e-mail to 35 members of top and middle management in the construction companies. Of the 35 questionnaires distributed in the second survey, 35 were returned, but 5 were incompletely completed and so were excluded from the data analysis. The response rate was 86%.

The Likert scale was selected to obtain the probability of the risk factors in construction project that are identified in the literature review. A 5-point Likert scale was adopted, where 1 represented "rare", 2 "occasional", 3 "somewhat frequent", 4 "frequent", and 5 "very frequent". Likewise, the Likert scale was selected to obtain the impact of the risk factors in construction project that are identified in the literature review. A 5-point Likert scale was adopted, where 1 represented "very low", 2 "low", 3 "moderate", 4 "high", and 5 "very high".

In both surveys, the baseline characteristics of the respondents were relatively similar. Of the 38 respondents in the first study, site managers comprise 29%, project managers 26%, other position senior managers 21%, civil engineers 16%, and designing engineers 8%. Of the 30 respondents in the second study, site managers, project managers, and other position senior managers comprise 80%. In both surveys, the majority of the respondents have more than 15 years experience in construction/project management or working knowledge of construction/project management activities. Based on work experience and employment position, it was inferred that the respondents have adequate knowledge of the activities associated with construction project risk. This makes them as reliable and credible sources of information which is crucial to satisfy the research goal. The procedure, findings, and relevant discussion of the analyses are detailed in the following section.

4. RESULTS

As outlined in Section 2, risk factors on construction projects can be split into two major groups: (1) Internal risks, which fall within the control of clients, consultants and contractors; and (2) External risks, which include risk elements that are not in the control of key stakeholders.

The potential risk sub-factors were adapted from studies by Baloi and Price (2003), Chapman and Ward (2003), Kartam and Kartam (2001), Lahdenperä (2009), Majamaa et al. (2008), Mbachu and Nkado (2007), Mitkus and Trinkuniene (2008), Perera et al. (2009), Pinto et al. (2009), Tah and Carr (2000), and Yang et al. (2009).

In order to illustrate the respondents' opinions regarding the importance of analysed risk factors, an average was calculated for each factor. Next, the Kendall coefficient of concordance *W* (Savić and Vučković, 2004; Zavadskas et al., 2001) was calculated to test the reliability of the responses, and significance testing was based on the Chi-square distribution at the 1% significance level. The *W* coefficients were calculated for each defined group of risk factors created by the analysis perspectives.

In both surveys, the respondents agree as regards the external risks impact and probability. The respondents agree as regards the external risks impact, what can be judged by values $W = 0.183$; $\chi^2 = 34.669$ ($\alpha = 0.01$), in the first survey; and $W = 0.10$; $\chi^2 = 12.38$ ($\alpha = 0.01$), in the latter survey. As regards the assessment of the external risks probability, the respondents also agree what can be judged by values $W = 0.157$; $\chi^2 = 41.667$ ($\alpha = 0.01$), in the first survey. The identified external risks according to their potential effect on construction project objectives were ranked. In the first survey, the top three important external risks identified are: (1) Natural forces; (2) Inflation and interest rate; and (3) Fiscal policy. In the second survey, the top three important external risks identified are: (1) Fiscal policy; (2) Natural forces; and (3) Political controls. Probability assessment of risks of the external project constrains is reflected in Figure 1. Impact assessment of risks of the external project constrains is reflected in Figure 2.

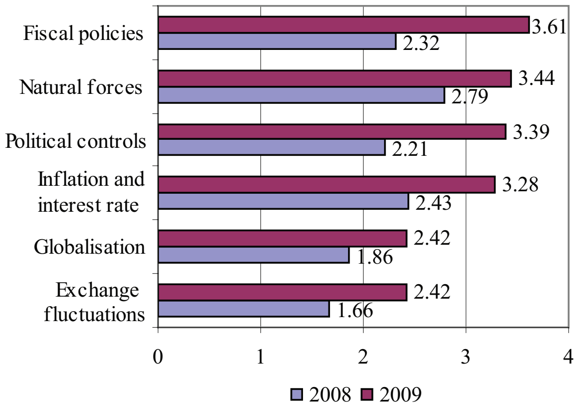

Figure 1. Probability assessment of external project risks

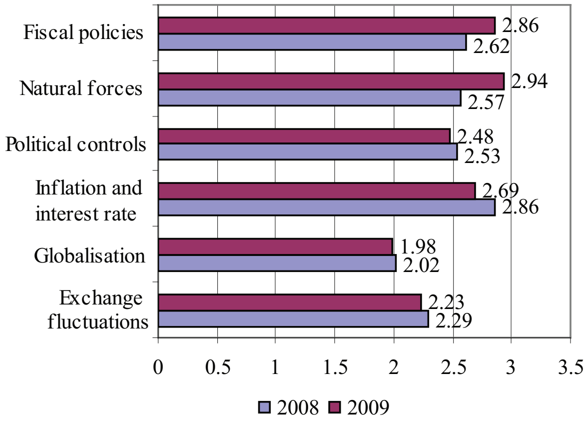

Figure 2. Impact assessment of external project risks

The risk management perceivers are the project participants, and a contractor is any entity which has the power to influence project decision making directly. Related to experience, only 11% of the respondents affirmed that they have experience in risk management. Most of them are project manager and have more than 15 years experience; it proofs that the relationship between risk perception and experience of respondents. And even 34% of the respondents affirmed that they have no experience in risk management, while 55% of the respondents affirmed that they do not have enough experience in risk management. And 97% of the respondents answered that risks must be managed at the early stages of the construction project.

In terms of the sources and providers of the data and information required in the risk analysis, the most frequently used technique is experiential or documented knowledge analysis with 92% of the respondents' agreement in the first survey, and 93% of the respondents' agreement in the second survey (Figure 3). And the project documentation reviews, project team brainstorming, and analysis of other information resources are frequently used in the risk assessment.

Comparison between the two surveys in terms of risk analysis showed a decrease in reviews of project documentation, from 63% in the first survey to 47% in the second survey, as well as greater use of experts' judgement, from 26% in the first survey to 43% in the second survey, and project team brainstorming, from 45% in the first survey to 53% in the second survey, in the risk assessment.

In terms of the risk response tools and techniques, the most frequently used tool is performance bonds and warranties with 95% of the respondents' agreement in the first survey, and 77% of the respondents' agreement in the second survey (Figure 4). And the some resource reservation, insurance, and risk transference to another project party are frequently used risk response techniques.

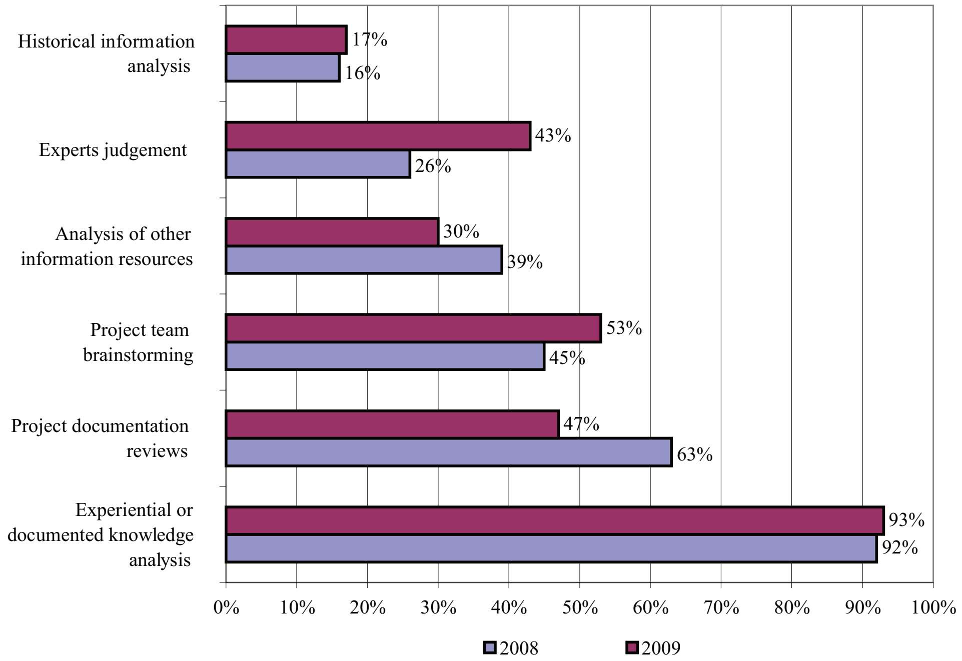

Figure 3. Risk analysis practices in construction projects

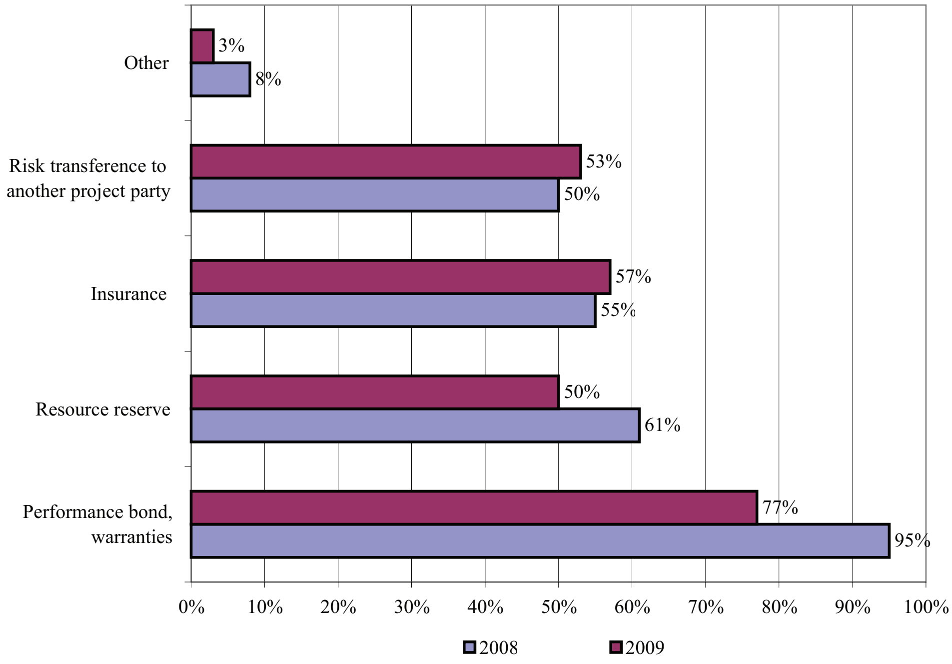

Figure 4. Risk response techniques employed for construction projects

Comparison between the two surveys in terms of risk response tools and techniques showed a decrease of performance bond and warranties, from 95% in the first survey to 77% in the second survey, and resource reservation, from 61% in the first survey to 50% in the latter survey; as well as greater use of risk transference to another party, from 50% in the first survey to 53% in the second survey, and insurance, from 55% in the first survey to 57% in the latter survey, for the risk responses.

5. CONCLUSIONS

An effective risk management process encourages the construction company to identify and quantify risks and to consider risk containment and risk reduction policies. Construction companies that manage risk effectively and efficiently enjoy financial savings, and greater productivity, improved success rates of new projects and better decision making.

Risk management in the construction project management context is a comprehensive and systematic way of identifying, analyzing and responding to risks to achieve the project objectives. The research results show that the Lithuanian construction company significantly differ from the construction companies in foreign countries in the adoption of risk management practices. To management the risk effectively and efficiently, the contractor must understand risk responsibilities, risk event conditions, risk preference, and risk management capabilities.

The lack of experience makes it very difficult to change Lithuanian contractors' attitude towards risk management. Nevertheless, the construction companies need to include risk as an integral part of their project management. In our view, the use of risk management in the Lithuanian construction companies is low to moderate, with little differences between the types, sizes and risk tolerance of the organizations, and experience and risk tolerance of the individual respondents.

Qualitative methods of risk assessment are used in construction companies most frequently, ahead of quantitative methods. In construction project risk management, risks may be compared by placing them on a matrix of risk impact against a probability. Mitigation options are then derived from predefined limits to ensure the risk tolerance and appetite of the construction company.

The risk management framework for construction projects can be improved by combining qualitative and quantitative methodologies to risk analysis, as well as using the multiple criteria decision making, and the scoape of this approach can be focused to the internal sources such as contractors and consultants.

REFERENCES

Adams, F. K. (2008) Construction contract risk management: a study of practices in the United Kingdom, *Cost Engineering*, 50(1), pp. 22–33.

Ahmed, A., Kayis, B. and Amornsawadwatana, S. (2007) A review of techniques for risk management in projects, *Benchmarking: An International Journal*, 14(1), pp. 22–36.

Aibinu, A. A. and Odeyinka, H. A. (2006) Construction delays and their causative factors in Nigeria, *Journal of Construction Engineering and Management*, 132(7), pp. 667–677. doi:10.1061/(ASCE)0733-9364(2006)132:7(667)

Aramvareekul, P. and Seider, D. J. (2006) Cost-time-risk diagram: project planning and management, *Cost Engineering,* 48(11), pp. 12–18.

Baloi, D. and Price, A. D. F. (2001) *Evaluation of global risk factors affecting cost performance in Mozambique*. [Online] RICS Foundation, London, COBRA 2001. Available at: http://www.rics.org/site/download_feed.aspx?fileID=2483&fileExtension=PDF [accessed 18 October 2010].

Baloi, D. and Price, A. D. F. (2003) Modeling global risk factors affecting construction cost performance, *International Journal of Project Management*, 21(4), pp. 261–269. doi:10.1016/S0263-7863(02)00017-0

Burduk, A. and Chlebus, E. (2009) Methods of risk evaluation in manufacturing sistems, *Archives of Civil and Mechanical Engineering*, 9(3), pp. 17–30.

Carbone, T. A. and Tippett, D. D. (2004) Project risk management using the project risk FMEA, *Journal of Engineering Management*, 16(4), pp. 28–35.

Carr, V. and Tah, J. H. M. (2001) A fuzzy approach to construction project risk assessment and analysis: construction project risk management system, *Advances in Engineering Software*, 32(10-11), pp. 847–857. doi:10.1016/S0965-9978(01)00036-9

Cavignac, J. (2009) Managing risk in a construction company, *Construction Business Owner*, November. [Online] Available at: http://www.constructionbusinessowner.com/topics/construction-insurance/managing-risk-in-a-construction-company.html [accessed 18 October 2010]

Chan, D. W. M., Chan, A. P. C., Lam, P. T. I., Yeung, J. F. Y. and Chan, J. H. L. (2010) Risk ranking and analysis in target cost contracts: empirical evidence from the construction industry, *International Journal of Project Management*, In Press. doi:10.1016/j.ijproman.2010.08.003

Chapman, C. and Ward, S. (2003) *Project risk management: process, techniques and insights.* 2nd ed. Chichester: John Wiley and Sons.

Chapman, C. and Ward, S. (2008) Developing and implementing a balanced incentive and risk sharing contract, *Construction Management and Economics*, 26(6), pp. 659–669. doi:10.1080/01446190802014760

Chapman, R. J. (2001) The controlling influences on effective risk identification and assessment for construction design management, *International Journal of Project Management*, 19(3), pp. 147–160. doi:10.1016/S0263-7863(99)00070-8

del Cano, A. and de la Cruz, M. P. (2002) Integrated methodology for project risk management, *Journal of Construction Engineering and Management*, 128(6), pp. 473–485. doi:10.1061/(ASCE)0733-9364(2002)128:6(473)

Dey, P. K. (2002) Project risk management: a combined analytic hierarchy process and decision tree approach, *Cost Engineering*, 44(3), pp. 13–26.

Dey, P. K. and Ogunlana, S. O. (2004) Selection and application of risk management tools and techniques for build-operate-transfer projects, *Industrial Management & Data Systems*, 104(4), pp. 334–346. doi:10.1108/02635570410530748

Ebrahimnejad, S., Mousavi, S. M. and Seyrafianpour, H. (2010) Risk identification and assessment for build-operate-transfer projects: a fuzzy multi attribute decision making model, *Expert Systems with Applications*, 37(1), pp. 575–586. doi:10.1016/j.eswa.2009.05.037

Flanagan, R. and Norman, G. (1993) *Risk management and construction*. Oxford: Blackwell Publishing.

GF (2010) *Lithuania: country economic reports & GDP data*. [Online] Global Finance (GF). Available at http://www.gfmag.com/gdp-data-country-reports/231-lithuania-gdp-country-report.html [accessed 6 September 2010]

Hillson, D. (1999) Developing effective risk responses. In: *Proceedings of the 30th Annual Project Management Institute 1999 Seminars & Symposium, 10-16 October*, Sylva. NC: Project Management Institute.

ICE (2005) *Risk Analysis and Management for Projects (RAMP)*. 2nd ed. Institution of Civil Engineers and the Actuarial Profession (ICE). London: Thomas Telford Ltd.

Imbeah, W. and Guikema, S. (2009) Managing construction projects using the advanced programmatic risk analysis and management model, *Journal of Construction Engineering & Management*, 135(8), pp. 772–781. doi:10.1061/(ASCE)0733-9364(2009)135:8(772)

Ismail, A., Abbas, M. A. and Zamri, B. C. (2008) Approach to analyze risk factors for construction projects utilizing fuzzy logic, *Journal of Applied Science*, 8(20), pp. 3738–3742. doi:10.3923/jas.2008.3738.3742

Jannadi, O. A. and Almishari, S. (2003) Risk assessment in construction, *Journal of Construction Engineering and Management*, 129(5), pp. 492–500.

doi:10.1061/(ASCE)0733-9364(2003)129:5(492)

Kaklauskas, A., Zavadskas, E. K., Bagdonavicius, A., Kelpsiene, L., Bardauskiene, D. and Kutut, V. (2010) Conceptual modelling of construction and real estate crisis with emphasis on comparative qualitative aspects description, *Transformations in Business & Economics*, 9(1), pp. 42–61.

Kartam, N. A. and Kartam, S. A. (2001) Risk and its management in the Kuwaiti construction industry: a contractors' perspective, *International Journal of Project Management*, 9(6), pp. 325–335. doi:10.1016/S0263-7863(00)00014-4

Lahdenperä, P. (2009) Phased multi-target areal development competitions: algorithms for competitor allocation, *International Journal of Strategic Property Management*, 13(1), pp. 1–22. doi:10.3846/1648-715X.2009.13.1-22

Luu, V. T., Kim, S. -Y., Tuan, N. V. and Ogunlana, S. O. (2009) Quantifying schedule risk in construction projects using Bayesian belief networks, *International Journal of Project Management*, 27(1), pp. 39–50. doi:10.1016/j.ijproman.2008.03.003

Lyons, T. and Skitmore, M. (2004) Project risk management in the Queensland engineering construction industry: a survey, *International Journal of Project Management*, 22(1), pp. 51–61.

Majamaa, W., Junnila, S., Doloi, H. and Niemistö, E. (2008) End-user oriented public-private partnerships in real estate industry, *International Journal of Strategic Property Management*, 12(1), pp. 1–17. doi:10.3846/1648-715X.2008.12.1-17

Maniar, H. (2010) Risk analysis of infrastructure projects: a case study on build-operate-transfer projects in India, *IUP Journal of Financial Risk Management*, 7(4), pp. 34–54.

Mbachu, J. and Nkado, R. (2007) Factors constraining successful building project implementation in South Africa, *Construction Management and Economics*, 25(1), pp. 39–54. doi:10.1080/01446190600601297

Mills, A. (2001) A systematic approach to risk management for construction, *Structural Survey*, 19(5), pp. 245–252. doi:10.1108/02630800110412615

Mitkus, S. and Trinkuniene, E. (2008) Reasoned decisions in construction contracts evaluation, *Technological and Economic Development of Economy*, 14(3), pp. 402–416. doi:10.3846/1392-8619.2008.14.402-416

Modarres, M. (2006) *Risk analysis in engineering – techniques, tools, and trends*. 1st ed. Boka Raton: CRC Press.

Nasir, D., McCabe, B. and Hartono, L. (2003) Evaluating risk in construction-schedule model (ERIC-S): construction schedule risk model, *Journal of Construction Engineering and Management*, 129(5), pp. 518–527. doi:10.1061/(ASCE)0733-9364(2003)129:5(518)

Nieto-Morote, A. and Ruz-Vila, F. (2011) A fuzzy approach to construction project risk assessment, *International Journal of Project Management*, 29(2), pp. 220–231. doi:10.1016/j.ijproman.2010.02.002

Ökmen, Ö. and Öztas, A. (2010) Construction cost analysis under uncertainty with correlated cost risk analysis mode, *Construction Management and Economics*, 28(2), pp. 203–212. doi:10.1080/01446190903468923

Othman, A. A. E., Hassan, T. M. and Pasquire, C. L. (2005) Analysis of factors that drive brief development in construction, *Engineering, Construction and Architectural Management*, 12(1), pp. 69–87. doi:10.1108/09699980510576907

Oyegoke, A. S. (2006) Construction industry overview in the UK, US, Japan and Finland: a comparative analysis, *Journal of Construction Research*, 7(1/2), pp. 13–31. doi:10.1142/S1609945106000529

Oyegoke, A. S., Khalfan, M. M. A., McDermott, P. and Dickinson, M. (2008) Managing risk and uncertainty in an agile construction environment: application of agile building specialist model, *International Journal of Agile Systems and Management*, 3(3/4), pp. 248–262.

Öztas, A. and Ökmen, Ö. (2004) Risk analysis in fixed-price design-build construction projects, *Building and Environment*, 39(2), pp. 229–237. doi:10.1016/j.buildenv.2003.08.018

Perera, B. A. K. S., Dhanasinghe, I. and Rameezdeen, R. (2009) Risk management in road construction: the case of Sri Lanka, *International Journal of Strategic Property Management*, 13(2), pp. 87–102. doi:10.3846/1648-715X.2009.13.87-102

Pheng, L. S. and Chuan, Q. T. (2006) Environmental factors and work performance of project managers in the construction industry, *International Journal of Project Management*, 24(1), pp. 24–37. doi:10.1016/j.ijproman.2005.06.001

Pinto, A., Nunes, I. L. and Ribeiro, R. A. (2010) Qualitative model for risk assessment in construction industry: a fuzzy logic approach. In: Camarinha-Matos, L. M., Pereira, P. and Ribeiro, L. (eds.) *Emerging Trends in Technological Innovation, IFIP Advances in Information and Communication Technology*, 314, pp. 105–111.

Pinto, J. K., Slevin, D. P. and English, B. (2009) Trust in projects: an empirical assessment of owner/contractor relationships, *International Journal of Project Management*, 27(6), pp. 638–648. doi:10.1016/j.ijproman.2008.09.010

Plebankiewicz, E. (2010) Construction contractor prequalification from polish clients' perspective, *Journal of Civil Engineering and Management*, 16(1), pp. 57–64. doi:10.3846/jcem.2010.05

PMI (2007) *Construction Extension to the PMBOK® Guide*. 3rd ed. Newtown Square: Project Management Institute.

PMI (2008) *Guide to the Project Management Body of Knowledge (PMBOK® Guide)*. 4th ed. Newtown Square: Project Management Institute.

Podvezko, V., Mitkus, S. and Trinkūniene, E. (2010) Complex evaluation of contracts for construction, *Journal of Civil Engineering and Management*, 16(2), pp. 287–297. doi:10.3846/jcem.2010.33

Savić, S. and Vučković L. (2004) Forming of reliability model in order to evaluate the operator's activity risk, Series: *Working and Living Environmental Protection*, 2(4), pp. 259–265.

Schieg, M. (2006) Risk management in construction project management, *Journal of Business Economics and Management*, 7(2), pp. 77–83.

Schieg, M. (2007). Post-mortem analysis on the analysis and evaluation of risks in construction project management, *Journal of Business Economics and Management*, 8(2), pp. 145–153.

Shevchenko, G., Ustinovichius, L. and Andruškevičius, A. (2008) Multi-attribute analysis of investments risk alternatives in construction, *Technological and Economic Development of Economy*, 14(3), pp. 428–443. doi:10.3846/1392-8619.2008.14.428-443

Skorupka, D. (2008) Identification and initial risk assessment of construction projects in Poland, *Journal of Management in Engineering*, 24(3), pp. 120–127. doi:10.1061/(ASCE)0742-597X(2008)24:3(120)

SL (2010) *GDP by production, by expenditure, by income approach III Q 2010*. [Online] Statistics (pre-defined tables). Statistics Lithuania (SL). Available at: http://www.stat.gov.lt/en/pages/view/?id=1867 [accessed 2 November 2010]

Smith, N. J., Merna, T. and Jobling, P. (2006) *Managing risk: in construction projects*. 2nd ed. Oxford: Blackwell Publishing.

Sterman, J. (1992). *System dynamics modeling for project management*. [Online] Sloan School of

Management, MIT. Available at: http://web.mit.edu/jsterman/www/SDG/project.html [assessed 10 October 2010]

Tah, J. H. M. and Carr, V. (2000) A proposal for construction project risk assessment using fuzzy logic, *Construction Management and Economics*, 18(4), pp. 491–500. doi:10.1080/01446190050024905

Tieva, A. and Junnonen, J. -M. (2009) Proactive contracting in Finnish PPP projects, *International Journal of Strategic Property Management*, 13(3), 219–228. doi:10.3846/1648-715X.2009.13.219-228

Uher, T. E. and Loosemore, M. (2004) *Essentials of construction project management*. Sidney: University of New South Wales Press.

Ustinovichius, L., Shevchenko, G., Barvidas, A., Ashikhmin, I. V. and Kochin, D. (2010) Feasibility of verbal analysis application to solving the problems of investment in construction, *Automation in Construction*, 19(3), pp. 375–384. doi:10.1016/j.autcon.2009.12.004

Wang, J. and Yuan, H. (2011) Factors affecting contractors' risk attitudes in construction projects: case study from China, *International Journal of Project Management*, 29(2), pp. 209–219. doi:10.1016/j.ijproman.2010.02.006

Wang, M. -T. and Chou, H. -Y. (2003) Risk allocation and risk handling of highway projects in Taiwan, *Journal of Management in Engineering*, 19(2), pp. 60–68. doi:10.1061/(ASCE)0742-597X(2003)19:2(60)

Ward, S. and Chapman, C. (2008) Stakeholders and uncertainty management in projects, *Construction Management and Economics*, 26(6), pp. 563–577. doi:10.1080/01446190801998708

Wilkinson, S. (2001) An analysis of the problems faced by project management companies managing construction projects, *Engineering, Construction and Architectural Management*, 8(3), pp. 160–170.

Wysocki, R. K. (2009) *Effective project management: traditional, agile, extreme.* Indianapolis: John Wiley and Sons.

Yang, J., Shen, G. Q., Ho, M., Drew, D. S. and Chan, A. P. C. (2009) Exploring critical success factors for stakeholder management in construction projects, *Journal of Civil Engineering and Management*, 15(4), pp. 337–348. doi:10.3846/1392-3730.2009.15.337-348

Zaghloul, R. and Hartman, F. (2003) Construction contracts: the cost of mistrust, *International Journal of Project Management*, 21(6), pp. 419–424. doi:10.1016/S0263-7863(02)00082-0

Zavadskas, E. K., Kaklauskas, A. and Banaitiene, N. (2001) *Pastato gyvavimo proceso daugiakriterinė analizė* [Multiple criteria analysis of a building life cycle]. Vilnius: Technika. (In Lithuanian)

Zavadskas, E. K., Turskis, Z. and Tamošaitiene, J. (2008) Contractor selection of construction in a competitive environment, *Journal of Business Economics and Management*, 9(3), pp. 181–187. doi:10.3846/1611-1699.2008.9.181-187

Zavadskas, E. K., Kaklauskas, A. and Vilutiene, T. (2009) Multicriteria evaluation of apartment blocks maintenance contractors: Lithuanian case study, *International Journal of Strategic Property Management*, 13(4), pp. 319–338. doi:10.3846/1648-715X.2009.13.319-338

Zavadskas, E. K., Turskis, Z. and Tamošaitiene, J. (2010a) Risk assessment of construction projects, *Journal of Civil Engineering and Management*, 16(1), pp. 33–46. doi:10.3846/jcem.2010.03

Zavadskas, E. K., Turskis, Z., Ustinovichius, L. and Shevchenko, G. (2010b) Attributes weights determining peculiarities in multiple attribute decision making methods, *Inzinerine Ekonomika-Engineering Economics*, 21(1), pp. 32–43.

Zeng, J., An, M. and Smith, N. J. (2007) Application of a fuzzy based decision making methodology to construction project risk assessment, *International Journal of Project Management*, 25(6), pp. 589–600. doi:10.1016/j.ijproman.2007.02.006

Zeng, S. X., Tam, C. M. and Tam, V. W. Y. (2010) Integrating safety, environmental and quality risks for project management using a FMEA method, *Inzinerine Ekonomika-Engineering Economics*, 21(1), pp. 44–52.

Zou, P. X. W., Zhang, G. and Wang, J. (2007) Understanding the key risks in construction projects in China, *International Journal of Project Management*, 25(6), pp. 601–614. doi:10.1016/j.ijproman.2007.03.001

SANTRAUKA

RIZIKOS VALDYMAS PROJEKTUOSE: LIETUVOS STATYBOS ĮMONIŲ SAVITUMAI

Nerija BANAITIENĖ, Audrius BANAITIS, Artūras NORKUS

Šiandien rizikos analizė ir valdymas yra svarbūs sėkmingam statybos projektų valdymui, nes statybos projektai tampa vis sudėtingesni, dinamiškesni, visada unikalūs, o konkurencija tarp statybos bendrovių taip pat didėja. Rizikos valdymas padeda projekto dalyviams – užsakovui, plėtotojui, rangovui, konsultantui ir tiekėjui – vykdyti savo įsipareigojimus ir sumažinti neigiamą taką statybos projekto apimčiai, išlaidoms, tvarkaraščiui ir kokybei kaip rezultatui. Rizikos valdymo proceso metu sistemingai nustatomi, analizuojami ir reaguojama į potencialius rizikos veiksnius, todėl statybos projektai valdomi efektyviau, veiksmingai naudojami ištekliai. Šiame straipsnyje trumpai pristatomas tyrimas, kuriuo siekiama sužinoti, kaip statybos bendrovės suvokia statybos projektų rizikos veiksnius, su kuriais jiems tenka susidurti, ir kokią reagavimo strategiją ir atsakomuosius veiksmus jos renkasi.