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Risk management analysis in construction enterprises in selected regions in Poland

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Abstract

This paper aims to outline the selected issues of risk management in construction enterprises operating in the Silesian and Małopolskie voivodships (Poland). In this context, it seems vitally important to have risk accurately identified, quantified and, consequently, responded to in the right way. Although the paper is mainly empirical in its character, it is based on a theoretical background, particularly when it comes to risk management in the construction industry, which is referred to in the literature on the subject as CRM (Construction Risk Management). The paper contains a review of the literature in this field and uses the method of synthesis. It emphasises the applicability and methodology of the issues discussed here, i.e. those which were verified in the empirical research conducted among construction contractors as participants of investment and construction processes.

Keywords: construction risk, risk management, construction enterprise, construction, survey research

1. Introduction

Risk is an inherent feature of operations conducted by every participant of an investment and construction process (Tworek, 2013). It invariably concerns all participants taking part in the building project, including the investor, the general contractor and all the other entities involved in the process. Therefore, managers from construction companies, along with employees working for these companies, need to be able to identify, quantify and respond to risks in an effective way; to put it in simple terms, they need to manage the risks. This is why all the individuals who deal with risk management in the building industry not only need to gain an understanding of the construction risk mechanisms (Flanagan, Norman, 1993) but also be well acquainted with risk management methods (Skorupka, 2007; 2009). The present paper evolves around these issues and aims to present selected problems of risk management in business activities of construction enterprises operating in the Silesian (Śląskie) and Małopolskie voivodships. In particular, it attempts to find an answer to the question about the awareness of risk management among the construction managers surveyed. As a lot of research has already been performed on these issues in the scholarly literature, both by domestic and foreign authors[1], this paper has been given an empirical character. It contains a synthesis of the studies conducted in this area, following the review of the literature. The authors focus only on selected problems in the field of highly specialised knowledge, which is referred to in professional publications as CRM (construction risk management) (Flanagan, Norman, 1993; Boothroyd, Emmett, 1996; Hatem, 1998; Bunni, 2003; Smith, Merna, Jobling, 2006). This may be one of the reasons behind a future decision to conduct a wide-ranging empirical study among construction contractors operating in Poland.

2. Research design and methods

The basic research technique was a two-part questionnaire, which contained a total of fifty-six questions that the respondents were requested to address. Some of these questions were descriptive in nature. The research was also supplemented with face-to-face interviews. The researched group comprised students of part-time (weekend) programs at a degree course of Construction and Environmental Engineering at Akademia Techniczno-Humanistyczna in Bielsko-Biała (University of Bielsko-Biała); these are the same students who were employed by the entities surveyed in 2016. As the group of respondents to take part in the survey had been predetermined, all the individuals concerned participated. When analysing and evaluating the findings of the empirical studies, the characteristics that are typical for surveys with a wide territorial scope were not taken into account. As this was just a regional survey, advanced analytical instruments were not employed the outcome of the research is limited to the basic findings only and presented using graphic techniques, such as drawings. A cross-analysis was also not used here. The key reason behind adopting such a procedure was the aim to determine the current awareness of risk management among the people working for construction companies which operate mainly in

[1] See: Flanagan, Norman, 1993; Boothroyd, Emmett, 1996; Kosecki, Madyda, 1996; Palmer, Maloney, Heffron, 1996; Hatem, 1998; Bizon-Górecka, 1999; Tah, Carr, 2000; Kowalczyk, 2001; Hickman, 2002; Bunni, 2003; Sawczuk, 2004; Weatherhead, Owen, Hall, 2005; Holland, 2006; Smith, Merna, Jobling, 2006; Skorupka, 2007; 2009; Glavinich, 2008; Marcinkowski, Koper, 2008; Burtonshaw-Gunn, 2009; Cristóbal, 2009; Zavadskas, Turskis, Tamošaitien, 2010; Turskis, Gajzler, Dziadosz, 2012; Bizon-Górecka, Górecki, 2013; Tworek, 2013; Dziadosz, Rejment, 2015; Zhao, Hwang, Low, 2015; Tworek, Myrczek, 2015; 2017; Dziadosz, Kapliński, Tomczyk, Rejment, 2016; Sekunda, Marcinkowski, 2016; Babar, Thaheem, Ayub, 2017; Hyari, Shatarat, Khalafallah, 2017; Kaczorek, 2017; Kasprowicz, 2017;Liu, Low, Zhang, 2017; Shoe, Leite, 2017; Sullivan, Asmar, Chalhoub, Obeid, 2017; Meouche, Abunemeh, Hijaze, Mebaraki, 2018; Mirković, 2018; Nguyen, Garvin, Gonzalez, 2018; Ogwueleka, Udoudoh, 2018; Tempo-Silungwe, Khatleli, 2018; Kosmalski, Myrczek, 2019.

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the south of Poland. The assumption behind the research was an attempt to evaluate the extent of knowledge on construction risk management processes, with the construction risk being perceived as an important research category from the scientific perspective. The research covered small, medium-sized and large construction enterprises, grouped according to their headcounts; the majority of them were contractors belonging to the SME sector. Specifically, the survey was conducted among thirty-one selected contractors operating in the Silesian and Małopolskie voivodships. Participation was voluntary and anonymous. The paper uses methods of deduction and synthesis and presents only a selection of the empirical results obtained from the research. This may be seen as a clear manifestation of the authors' interests in this research issue based on the literature on the subject, which constitutes its integral part[2] and provides the foundation for the discussions outlined herein. Some of the items listed in the bibliography served as the inspiration for the drafting of the survey questionnaires (Bizon-Górecka, 1999; Kosecki, Madyda, 1996; Tworek, 2013).

3. A risk manager in construction enterprises

The general conclusion which results from the empirical research is that none of the companies surveyed had any specifically designated role in their structure for dealing with risk management only. The main reasons given by the respondents include (Kosecki, Madyda, 1996), first of all, the fact that such roles also do not exist in similar companies (32% of the respondents); secondly, the risk is not considerable enough to justify the employment of a person just to deal with risk in a company and/or the risk mitigation measures which are in place seem sufficient, therefore no such role appears to be needed (25% of the respondents); thirdly, construction risk categories cannot be finally and exhaustively identified (9% of the respondents). In addition, 9% of the respondents indicate some other reasons, for example, a lack of awareness among managers in companies with regard to the importance of integrated risk management, which may be seen as a result of the traditional approach towards management adopted by Polish managers in the construction business. This issue is illustrated in Fig. 1.

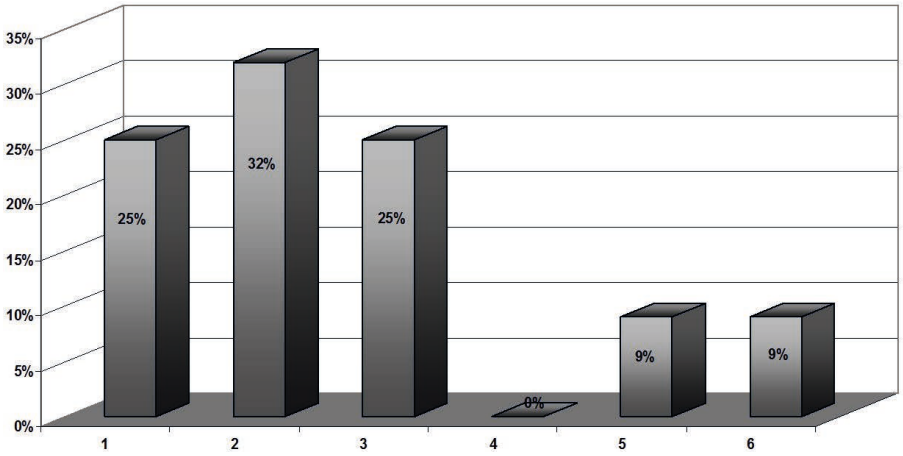

Fig. 1. Reasons for not appointing construction risk managers by the surveyed construction enterprises
1 – obligatory risk mitigation methods (e.g. insurance) are sufficient
2 – enterprises of a similar business profile do not have such roles (units)
3 – the risk is not high enough to justify the hiring of a person to deal with risk only
4 – the enterprise can afford to bear potential losses
5 – risk categories cannot be fully identified
6 – other

From among the respondents, 56% express no intention to hire any risk-management professional. Only 41% of those surveyed would be willing to employ such specialists. A small number of the contractors, 26%, have someone in their organisation who deals with risk among other issues, which is generally not a satisfactory finding. This means that the enterprises surveyed are strongly convinced that there is no need to hire anyone to only tackle risk issues. For the

[2] See: all references.

sake of comparison, the situation looks almost the same in a group of twenty-nine small, medium-sized and large construction and assembly enterprises from the southern part of the Silesian Voivodeship (Bielsko-Biała, Czechowice-Dziedzice, Żywiec, Tychy, Jastrzębie Zdrój, Wodzisław Śląski and Rybnik), the representatives of which were surveyed in 2015 at the University of Bielsko-Biala (Myrczek, Sadlik-Lenczewska, Tworek, 2015). They stated that all the risk management activities were mostly considered on the basis of previous experience, following the intuition of the people who managed these companies (Myrczek, Sadlik-Lenczewska, Tworek, 2015). It should be added that in the US construction sector, for example, there is a separate managerial role – a construction risk manager (Myrczek, Tworek, 2019). In the Polish construction sector, however, such a position is still missing. The general conclusion drawn from the research is as follows: despite the fact that contractors may be aware of the need to manage risk in an organised and systemic manner, the participating construction companies have not established any special risk management divisions as such.

4. Types of risk in construction management

The research findings confirm the results of the scholarly literature review (Cristóbal, 2009; Tworek, 2013). This risk category primarily involves the risk of schedule slippage when performing an investment project (81% of the respondents). At the same time, 41% of those surveyed indicate the risk of failure to perform the construction project according to the investor's quality requirements as well as the risk of cost overruns. In the survey, 19% of the respondents highlight insufficient safety on construction sites as a risk to which individuals who are directly involved in the construction process may be exposed. As many as 94% of the respondents also point out that the construction risk concerns, first of all, the execution phase of the investment undertaking. A mere 9% of the people surveyed would rather choose the facility operation phase as being the most critical in this respect, while 19% express the opinion that the phase of planning and preparing to perform the project is such a risk-prone stage. This result comes as no surprise as the nature of risk in the construction business originates in the way in which the execution processes of construction and assembly work are conducted. These, however, are not the only risks which tend to accompany investment and construction processes. What other risks should be taken into account, then, as the ones contributing to the overall profile of risk in the construction sector? (Kosecki, Madyda, 1996). An attempt to provide a graphic illustration of this issue is shown in Fig. 2.

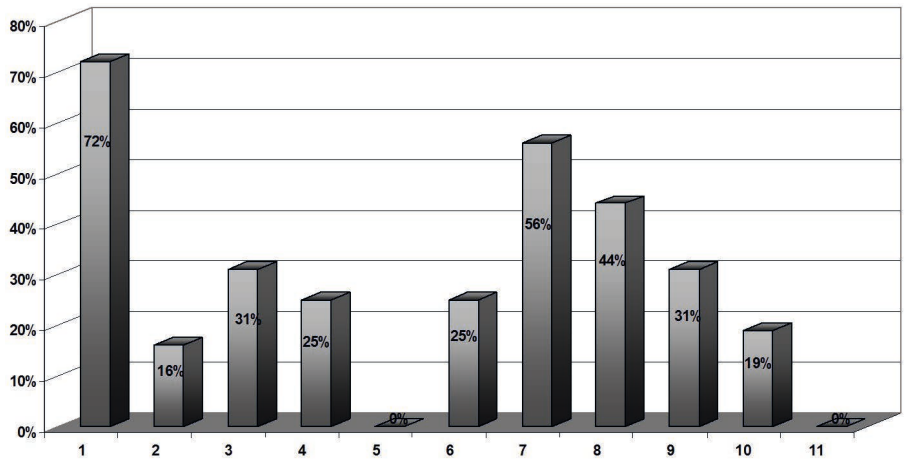

Fig. 2. Types of risk in the process of construction project execution
1 – risk related to human resources (personnel risk)
2 – risk related to information resources (information risk)
3 – risk related to the organisation of the investment and construction project (organisational risk)
4 – risk related to environmental protection (environmental risk)
5 – risk related to the social and political situation (social and political risk)
6 – risk related to technical resources (technical risk)
7 – risk related to financial difficulties faced in the project (financial risk)
8 – risk related to natural disasters (force majeure)
9 – risk related to third party interference (risk of theft, vandalism)
10 – risk related to changes in legal regulations (legal risk)
11 – other types of risk

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Apparently, not all types of construction risks, as can be seen in Fig. 2, tend to be experienced by the surveyed contractors at the same time and with the same frequency. When performing a construction project, the risk is most often related to human resources (72% of the respondents), in other words, it directly results from the involvement of construction workers on a construction site. Here, attention should be drawn to some financial concerns that are frequently linked to the process of financing a building undertaking (56% of respondents). In practical terms, contractors frequently face problems with lenders, specifically banks which provide funds for investment projects. In addition, financial difficulties are also likely to occur on the part of an investor. In the studies, as many as 38% of the respondents believe that an investor is the party to the investment and construction process which is the most usual source of financial risk encountered by a contractor. In Poland, when looking at investment and construction processes, we are used to seeing that investors are often unable to settle their payments to contractors on a timely basis, for example, due to their own cash-flow problems (Tworek, 2013). As a result, contractors may lose liquidity or, in the worst-case scenario, become insolvent or even go bankrupt. According to the research, some of the contractors surveyed have suffered particular problems with their financial condition over the last few years also, including the complete loss of financial liquidity (25% of the respondents), with 50% of them blaming their financial troubles on the generally challenging situation of the construction market and assembly services in Poland, as well as the consequences of the financial crisis of 2008-2016. As many as 59% of those participating in the survey have noticed an improvement in the domestic market of construction and assembly services due to the infrastructural projects which have been financed, most of all, with UE funds.

Which sources of risks are usually taken into consideration in the day-to-day management of construction enterprises? (Bizon-Górecka, 1999). The conducted research also included a question about this issue and the following answers were given in response: firstly, failures of construction equipment (47% of the respondents); secondly, force majeure (44% of the respondents); thirdly, calculation errors (41% of the respondents); fourthly, an investor's cash-flow problems (34% of the respondents); fifthly, competition on the investment and construction market (31% of the respondents); sixthly, correctness of technical documentation (28% of the respondents); seventhly, human error (28% of the respondents); eighthly, construction disasters (22% of the respondents); ninthly, an investor's failure to meet the terms and conditions (22% of the respondents); tenthly, the organisation of a project, including logistical errors (19% of the respondents); eleventhly, the quality of work performed (19% of the respondents); twelfthly, availability of raw materials and consumables (19% of the respondents); for the thirteenth, a lack of experience in the performance of a given type of project (19% of the respondents); for the fourteenth, the reliability of subcontractors (16% of the respondents), for the fifteenth, the availability of bank loans (16% of the respondents); for the sixteenth, inadequate technical knowledge (13% of the respondents); for the seventeenth, a sluggish market for construction and assembly services (13% of the respondents); for the eighteenth, economic and financial problems faced by contractors (13% of the respondents); for the nineteenth, the social situation in Poland (9% of the respondents); for the twentieth, frequently changing legal regulations (6% of the respondents); for the twenty-first, increasing fiscal burden (6% of the respondents); and for the twenty-second, inflation in the economy (3% of the respondents). None of the surveyed contractors indicated the Polish zloty exchange rate as a risk factor (exchange-rate risk) for a construction company. This should come as no surprise, however, as the sample of businesses participating in the research did not include any companies quoted on the stock exchange within the index of WIG-Construction. Unlike the largest listed construction enterprises, the surveyed contractors operate on the domestic (local) market only. For the sake of comparison, a reference to results of research into construction risk management experiences of contractors from the Kujawsko-Pomorskie voivodship might be

worth making here (Bizon-Górecka, 1999). The survey report clearly indicates that the empirical verification of factors behind the construction risk and its specific categories (Bizon-Górecka, 1999) is determined by the general definition of the construction risk as a separate scientific and research category. As already underlined in the introduction, the scholarly literature tends to refer to this as a risk mechanism (Flanagan, Norman, 1993). In this context, attention should be drawn to the classification presented in Table 1 (Boothroyd, Emmett, 1996).

Table 1. Risks in construction (Source: Boothroyd, Emmett, 1996)

Client Team Type of client Constraints on choice of contractor Competence Bureaucratic procedures Change in requirements Confirmed brief Delay in decisions/approvals Change in policy/buy-out/ Government Funders' requirements Approval procedures Communications Interpretation of requirements	**Design Team** Experience of team Continuity of team Authority of team Project management role Duplication of roles Tolerances Level of design information Practicality of concept
Financial Interest rates Delay in funding approval Restrictions on cash flow Inflation rates Fixed/fluctuating contract Exchange rates	**Public and Safety Regulations** Fire service requirements Health and safety requirements Client department regulations Planning approvals and public consultations Building regulations
Scope of Project Additional rates Car parking Access roads Basement floors Storey heights Extra buildings Additional facilities Floor span/plan shape Air conditioning and other service requirements	**Design** Practicality of concept Extent of foundations Service voids Pioneer/experimental design Specification of materials Tolerances Increase in specifications Foreign specifications Foreign specified items Change in regulations
Contractual Form of contract Type of tender action	**Programme** Postponement of start date Early occupation Acceleration of works Slippage of programme Accuracy of design/construction programming Fixed end dates
Pricing/estimating Market conditions/tender price level Upgrade quality from brief stage Changes in labour/materials rates Tax changes Inflation level Accuracy of information and BQ measurement [a bill of quantities]	**Site Parameters continued** Demolition Soil type/ground water Party walls and adjoining owners Rights of light Guest considerations
Site Parameters Location Access problems Contaminated ground Rights of way Sewage/waste treatment Noise abatement Services/diversions Infrastructure requirements Occupied site/partial possession Legal restrictions	**Construction** Bankruptcy of contractor Industrial action Variations and change orders Construction delays Number and performance of sub-contractors Site management and supervision Defective works Fire risks Force majeure Materials and plant availability Extent of refurbishment Hidden foundation problems

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Table 1 provides a highly comprehensive list of all types of risks which are specific for investment and construction processes (the subjective approach to risk) and the construction risks listed concern almost all of the most relevant participants of the construction process (the objective approach to risk), while it should be kept in mind that both in theory and in practice, the key risk categories which tend to be emphasised include the risks of time, costs, quality and construction site safety (Flanagan, Norman, 1993; Boothroyd, Emmett, 1996; Bunni, 2003; Weatherhead, Owen, Hall, 2005; Smith, Merna, Jobling, 2006; Cristóbal, 2009; Tworek, 2013; Tworek, Myrczek, 2017; Kosmalski, Myrczek, 2019). Furthermore, in the construction sector, the risk of force majeure is of high importance, which is due to the very nature of construction and assembly production that is conducted directly on construction sites (Flanagan, Norman, 1993; Boothroyd, Emmett, 1996; Smith, Merna, Jobling, 2006).

5. Methods of risk management in construction enterprises

As emphasised in the introduction, the risk management process in a construction business consists of three basic stages – risk identification, risk quantification and reaction to risk – and contractors are expected to apply a suitable risk management method in an appropriate way. How is risk managed, then, by the surveyed contractors when it comes to the methodology that they apply? (Kosecki, Madyda, 1996). The risk identification methods selected by them in the research are shown in Fig. 3.

The research findings illustrated in Fig. 3 are a clear confirmation that brainstorming remains the most popular method of risk identification among the participating contractors (72% of the respondents). Its popularity results from the fact that it is easy to use and commonly known (Tworek, 2013). In practice, it seems to bring the best results in the identification of potential risk sources in activities performed by almost every company (Tworek, 2013). The second most frequent technique is field inspections (44% of the respondents), which is typical for the way construction companies work.

What about risk estimation, which is considered to be the most challenging issue within risk management? The research shows that 56% of the contractors attempt to quantify risks by using two complementary approaches – qualitative risk assessment and quantitative risk analysis (Tworek, 2013). Contractors prefer the qualitative method (47% of the respondents), which is much easier and usually does not need a lot of expertise; by contrast, the quantitative risk analysis requires extensive professional experience from individuals involved in the process of construction risk quantification (Tworek, 2013). The application of the quantitative approach normally requires specialised computer software which is designed for the analysis and assessment of risk in the construction sector (Tworek, 2013).

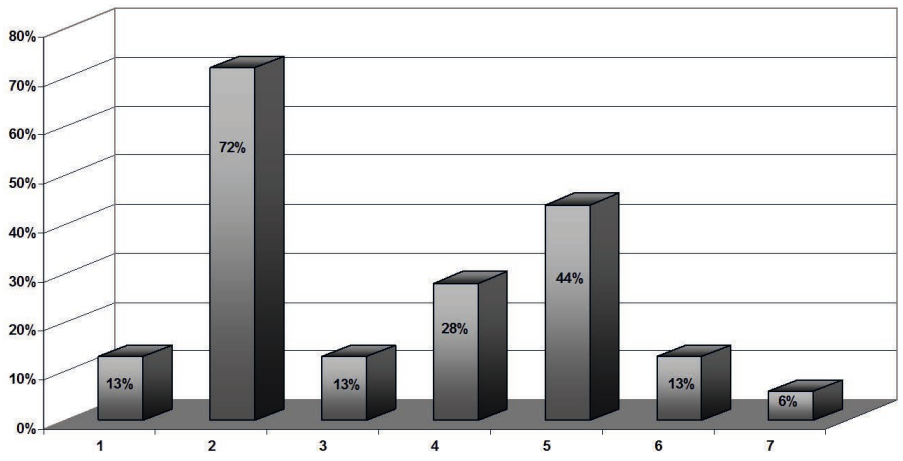

Fig. 3. Risk identification methods used in construction enterprises
1 – risk studies conducted by specialists
2 – brainstorming by a team involved in a construction project
3 – ready-to-use checklists
4 – interviews with key project participants
5 – field inspections directly on construction sites
6 – business intelligence
7 – public debate

Which quantitative methods are used, then, by the companies surveyed? (Kosecki, Madyda, 1996). The detailed research findings are presented in Fig. 4.

When looking at Fig. 4, one can see that as many as 41% of respondents do not use any of the quantitative methods shown there, which is a relatively poor result. When asked about specific quantitative methods, only one contractor states that they use the stochastic risk simulation method of Monte Carlo. The reason for this may be the fact that only 16% of the surveyed contractors collect data on risks in databases created specifically for that purpose. In general, construction companies do not tend to tap into any sources of historical data on risk, which would allow them to quantify risks in an appropriate way using the methods recommended for this task in the scholarly literature (Bunni, 2003, Sawczuk, 2004; Weatherhead, Owen, Hall, 2005).

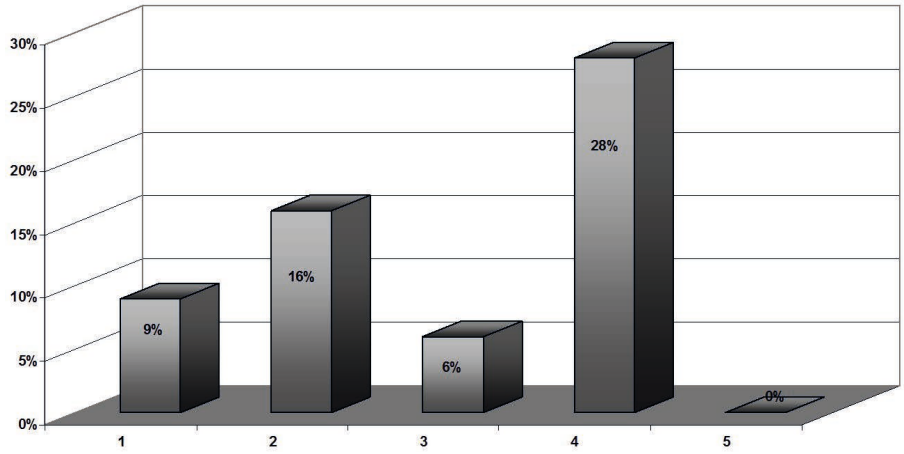

Fig. 4. Use of quantitative methods in the risk quantification process in the investigated construction enterprises
1 – decision tree analysis
2 – probabilistic analysis
3 – analysis of sensitivity
4 – risk simulation
5 – no answer given in the survey

What, then, are the ways in which the surveyed construction enterprises respond to risk? (Kosecki, Madyda, 1996; Sawczuk, 2004). This may be illustrated by the research findings shown in Fig. 5.

Figure 5 presents four major responses to risk in the construction sector (Kosecki, Madyda, 1996). According to the survey, 38% of the respondents eliminate risk by, for example, introducing changes to the designs or their project execution technology. Another essential method is risk mitigation by distribution among parties to the contracts performed in the construction business (34% of the respondents). Clearly, fewer respondents, only 13%, transfer their risks to other participants of an investment and construction process. At the same time, 9% of the respondents answer that they normally decide to accept risks, which means that any potential losses due to risks are compensated by the contractors. In this context, another outcome of the study on risk should also be mentioned

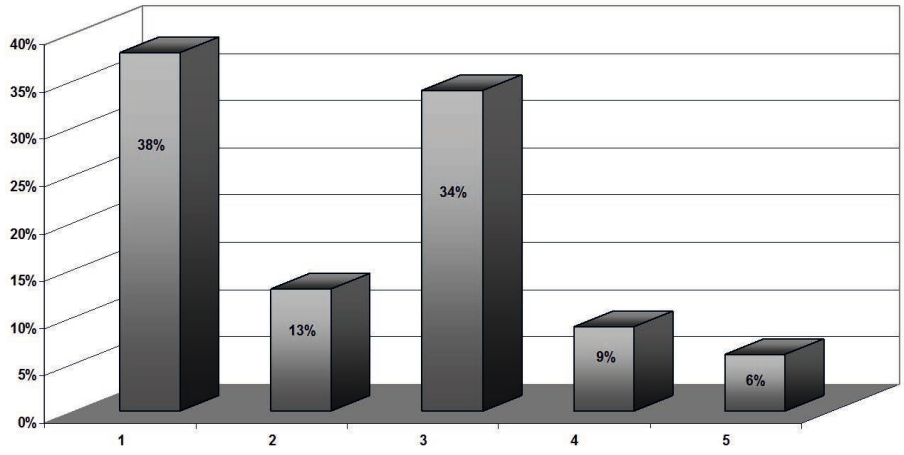

Fig. 5. Methods and ways of responding to risk used in the management of construction enterprises
1 – risk studies conducted by specialists
2 – risk transfer (contracts, insurance)
3 – risk mitigation
4 – risk absorption
5 – no answer given in the survey

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here, namely, the fact that in response to the survey question "Do you think that complete elimination of risk by refusing to undertake an investment project which carries too much risk would be justified as an effort to ensure the general 'safety' of the company?" 47% of the respondents gave affirmative answers, 44% of them disagreed with the statement and 9% of those surveyed did not express any views. This outcome, however, seems difficult to interpret as some of the contractors may be willing to accept high risks, while others may not.

6. Conclusion

The discussion presented in the paper may lead to the general conclusion that the industry-specific profile of construction risk is not only limited to the categories of costs, time, quality or safety in the building sector, but there are also a variety of risks which may potentially appear at any moment across the entire investment and construction process. Risks may also emerge during the operation phase of the facility and can even bring about the worst or all consequences – human deaths. Construction disasters also happen after ready-to-use facilities are handed over to investors for operation. The research shows that 22% of the participants surveyed take into account such a risk factor. Another, somewhat natural, part of operations performed by construction companies is the risk related to force majeure events. According to the research findings, as many as 44% of the respondents take notice of this risk. To sum up, these two factors constitute 'natural' components of the broadly understood construction risk, which make it different to its counterparts in the other industries.

Taking into account the industry specific profile of risk in the construction sector, as outlined above, what also appears to be worthy of consideration are the remaining results of the research performed among the contractors. Due to the character of construction and assembly production, an important issue is the distribution of risk among participants of an investment and construction process. This is mostly about spreading of costs related to the construction project execution. Depending on the type of contract, the ways in which risk is shared may differ. On the whole, 54% of the contractors mostly use fixed price contracts in their business dealings, while for the rest of the respondents, cost reimbursement contracts are the most popular (44% of the respondents); these, however, seem to be more favourable for the contractors themselves since such agreements guarantee the reimbursement of any extra costs incurred during the performance of building projects. For 53% of the respondents, construction contracts do not contain any special clauses with risk-related provisions. Since risk in the construction industry is not only a technical category but is also expressed in legal and economic terms, contractors frequently have to pursue their claims in court in business practice, which is quite often the case when it comes to subcontractors performing construction and assembly works. In Poland, this mainly concerns small and medium-sized companies, which may easily be forced out of business as a result of a single wrong decision or due to the occurrence of a relatively rare type of construction risk or a risk factor. Although no contractor participating in the study indicated bankruptcy as the key type of risk, many construction companies went bust in Poland during the economic crisis. This result shows the limitations that the research has faced due to the selected sample and its narrow territorial scope.

The general conclusion which may stem from the conducted research is that the surveyed contractors do not generally manage risks in any organised or integrated way. As a result, there are significant differences between the theoretical approach and the managerial practice in the enterprises in question. Based on the conducted research, it may be assumed that the first choice methods include: brainstorming for risk identification (72% of the respondents), risk simulation for risk analysis and assessment (28% of the respondents) and risk elimination for risk reaction (38% of the respondents). None of the

surveyed enterprises employ a person whose only task and responsibility is to deal with risk management. In face-to-face interviews, most of the respondents highlighted the fact that it would be too costly for SME construction companies to hire risk managers, and the effects of such managers' work were perceived as not really tangible or reasonable enough to justify the costs. Therefore, it may be concluded that in order to have today's construction enterprises managed in an effective way, a separate managerial role of construction risk manager should be created. In small companies this role could possibly be combined with the one of a contract manager. This may also serve as the general conclusion to be drawn from the conducted research. Risk management, however, cannot be considered without paying attention to the methodology that is applicable in this field, as one incorrect decision in the building business may jeopardise the entire construction project and thus affect the very existence of the construction company concerned. The surveyed contractors, however, also demonstrated some less reasonable attitude, as 47% of them stated that they could decide to perform an investment project even if it turned out to bear a considerably high risk. In contrast, 47% of the surveyed contractors avoid risk and do not agree to perform any high-risk undertakings. The contractors' behaviour in conditions of uncertainty and risk may therefore be the subject of further studies into risk in the construction sector.

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Analiza zarządzania ryzykiem w przedsiębiorstwach budowlanych w wybranych regionach w Polsce

Streszczenie

Celem artykułu jest przedstawienie wybranych problemów zarządzania ryzykiem w działalności przedsiębiorstw budowlanych w województwie śląskim i małopolskim. W tym kontekście szczególnie istotne jest właściwe zidentyfikowanie ryzyka, co następnie umożliwi jego odpowiednią kwantyfikację oraz reakcję na ryzyko. Chociaż artykuł posiada charakter empiryczny to bazuje na wiedzy teoretycznej, szczególnie w zakresie zarządzania ryzykiem w budownictwie, określanej w piśmiennictwie naukowym mianem CRM (*Construction Risk Management*). Artykuł zawiera przegląd literatury przedmiotu. Wykorzystano w nim metodę syntezy. W artykule wskazano na walory utylitarne i aspekt metodyczny przedstawianej problematyki, tj. zagadnień zweryfikowanych w drodze przeprowadzonych badań empirycznych wśród wykonawców budowlanych jako uczestników procesów inwestycyjno-budowlanych.

Słowa kluczowe: ryzyko budowlane, zarządzanie ryzykiem, przedsiębiorstwo budowlane, budownictwo, wyniki badań