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RISK IN PRODUCTION ACTIVITIES OF THE LARGEST CONSTRUCTION AND ASSEMBLY COMPANIES IN POLAND – SURVEY RESEARCH

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Abstract. Effective risk management requires thorough examination of the nature and uniqueness of risks, which occur in a given area. Similarly, in risk management carried out in the construction industry, the first steps to be taken are to accurately identify risks and determine risk factors. This applies, in particular, to large construction and assembly companies, which act as general contractors and tend to conduct big and risky investment projects. Therefore, contractors need to possess appropriate knowledge in this area. These problems are addressed in the paper, which is aimed at discussing risks that occur in production activities performed by construction and assembly companies. The background to the deliberations included in the paper is the results of the empirical research done among a selected group of the largest contractors in Poland.

Keywords: risk, risk identification, production activity, construction industry, contractors, Poland.

Jel classification: D24, G32, L74

1. Introduction

Risk is an inherent part of the construction industry. In practical terms, implementation of investment projects faces certain risks and any participant of an investment and construction process bears certain negative consequences of such risks. A specific cause leads to a risk, which then brings about specific consequences. The scope of risks, which occur, varies according to the type of investment projects, which are conducted and different conditions in which the investment and construction process is carried out. Investments in the construction industry may be looked upon from various perspectives. For example, investment projects may be performed in the areas of tunnel construction or civil engineering. There may be specific projects in which military facilities or some untypical sites, such as nuclear power plants, are built. Irrespective of the type of investment project, however, they are invariably carried out by construction and assembly companies, which have to tackle every difficulty and threat that comes in their way. Contractors often perform projects in which they have to bear all the risks; therefore they need to know how to manage these risks by means of a variety of methods, techniques and tools. In particular, an important stage within practical risk management is risk identification. At this stage risk has to be adequately specified and its specific character and risk factors have to be identified. In every area, including the construction industry, there are always a number of risks and risk factors which are universal, i.e. risks that are industry specific. Force majeure risks may serve as an example of threats, which occur in activities performed by a typical contractor, i.e. no matter how big the entity is and what portfolio of projects it plans to do. Such risks may be treated as the ones specifically related to construction and assembly production. All these issues are addressed in the paper, which aims to discuss the problems of risks occurring in production activities carried out by construction and assembly companies. In particular, the author focuses on the discussion about the specific types of risks, as well as risk factors, in construction and assembly production. The theoretical deliberations complement the results of the empirical research carried out by the author among the twenty-five, out of one hundred, biggest construction and assembly companies operating in Poland. The survey research, supplemented with the direct interview, was conducted within the framework of the author's research project in the Department of Investments and Real-Estate, the University of Economics in Katowice, in 2009. The research was limited to the biggest contractors in Poland as only large construction and assembly companies usually have the appropriate resources and possibilities to manage risks professionally. Furthermore, large and very large construction and assembly companies act as general contractors and deal with the biggest investment projects which, by implication, carry the highest risk. Therefore, in such projects risks have to be identified at every stage of the investment and construction process, using the specific methods, techniques and tools.

In the paper the author draws on his own knowledge and experience gained during the long-term research into risk in the construction industry. The background for the deliberations is the literature review. In the paper the author presents the selected problems in this field in a synthetic way. The paper also deals with the methods used for risk identification in construction and assembly production.

2. Risks and methods of risk identification in the construction industry in theory and practice

As already emphasised in the introduction, risk is an inherent part of the construction industry and is particularly significant in this field. Risks occurring in the construction sector vary. The worst kind of risks is construction disasters, which usually cause fatalities among construction site workers. Also Acts of God on a construction site may bring serious consequences for many contractors. This is due to the fact that construction and assembly production is carried out in specific conditions, i.e. facilities are built on an open site or in particularly difficult and dangerous conditions, e.g. in tunnel construction. From the theoretical point of view, a list of potential risks, which may occur in the construction industry is infinite and includes also environmental risks, which are typical for investment projects carried out in post-industrial areas. For instance, the basic types of risks in the construction industry include: „(…) client team: type of client, constraints on contractor choice, competence, bureaucratic procedures, change in requirements, confirmed brief, delay in decisions/approvals, change in policy/buy-out, government, founders' requirements, approval procedures, communications, interpretation of requirements; financial: interest rates, delay in funding approval, restrictions on cash flow, inflation rates, fixed/fluctuating contract, exchange rates; 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, tenants' fit-out; contractual: form of contract, type of tender action; 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 measurement; 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; 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; public and safety regulations: fire service requirements, health and safety requirements, client department regulations, planning approvals and public consultations, building regulations; 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; programme: postponement of start date, early occupation, acceleration of works, slippage of programme, accuracy of design/construction programming, fixed end dates; site parameters cont'd.: demolition, soil type/ground water, party walls and adjoining owners, rights of light, guest considerations; 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" (Boothroyd, Emmett 1996). No matter what project is performed, however, every risk which occurs in activities of a typical contractor has its sources. These sources are risk factors, which are plentiful in the investment and construction process. „(…) In the construction industry, risks need to be appropriately identified before the performance of a specific contract can start. (…) A contractor, using appropriate methods and techniques, needs to specify individual risk factors, as any mistakes, flaws or negligence in this area may lead to the occurrence of risks in subsequent stages of the project cycle, including the project operation stage" (Tworek 2010). In practice, in order to identify risks, checklists are particularly useful. „(…) Checklists as a risk identification instrument, may be helpful, when applied to a specific variant of an investment project, as well as the entire portfolio of projects accepted for implementation. (…) A contractor using this tool is able to determine, with high accuracy, the impact of specific risk factors on the global project risk" (Tworek 2010). When making a practical use of specific methods, techniques and tools, one should always remember about the advantages and disadvantages demonstrated by a given instrument or method. Not always can the same method or tool be used to identify risks in every project. This depends, to a large extent, on the specific character of a given investment project and a stage of project execution. The research into this area indicates that 68 % of contractors use the brainstorming technique (Tworek 2010). „(…) The second most frequently used risk identification technique is an interview with key participants of investment projects (48 % of the respondents). (…) Further on, the contractors participating in the research indicated the following:

18 % of them carry out field visits on construction sites in order to identify risks (in practice, this is done by employees with long work history and a lot of experience, who have participated in similar projects before); 24 % of the contractors make use of business intelligence, 7 % of the respondents hire third party experts on risks (so far, an independent profession of risk manager has not been established in Poland in the construction industry); only two contractors used check lists; also, only two contractors used a public debate in their business practice" (Tworek 2010). The literature on the subject broadly describes these issues (Saporita 2006; Bunni *et al.* 2003; Godfrey, Halcrow 1996; Palmer *et al.* 1996; Kähkönen *et al.* 1997; Barkley 2004; Chapman, Ward 2002; Chapman, Ward 1996; Dallas 2006; Glavinich 2008; Grey 1995; Kendrick 2003; Loosemore *et al.* 2006; Royer 2002; Schuyler 2001; Smith, Merna, Jobling 2006; Wideman 1992; A Guide to the…, 2009; Managing risks…, 1997; A simple guide to…, 2002; Practice Standard…, 2009; Project Risk…, 2007. As emphasized by Flanagan and Norman (1993) „(…) a clear view of the event is the first requirement, focusing on the source of risk and the effect of the event". No matter which method is employed to identify risk, a contractor has to remember that their choice of a risk identification method is determined by the main type of risk that a given investment project carries and its stage of execution.

3. Risk specification in production activities of construction and assembly companies - survey research

In particular, risks in a construction and assembly company should be identified with respect to, first of all, production processes which are performed in the company. The problems of risks occurring in production processes are illustrated in Table 1. As you can see in Table 1, the scope and place where risks occur within the analysed area may vary. In particular, due to the specific character of construction and assembly production, risks that contractors face result from the following factors (Bizon-Górecka 1999): 1) too low prices on a competitive market, i.e. especially in case of public procurement.

Table 1. Risk identification (Source: Kulińska, Dornfeld 2009)

Types of processes	Risk groups
Processing customer orders	missing order delivery deadlines; lower order intake; mistakes in order processing

Continued of table 1

Types of processes	Risk groups
Logistic customer service	defective solutions; machine breakdowns; a lack of experience
Offering added value for customers	changes in values
Cost cutting leading to reduced prices of products and services on offer	deteriorated quality; loss of some elite customers
Accepting and dispatching products by performing such processes as transport, transshipment storage, packing and marking of products	missing order delivery deadlines, lower order intake; no integration between production, distribution and transport processes
Ensuring required level of logistic customer service	inadequate level of services; service process not customer-oriented enough; employees, logistic operators, etc. failing to meet contractual terms; suppliers failing to meet technical standards; material quality control system; delivery accuracy
Analysing and forecasting logistic situations on the market	unreliable logistic information system
Identifying customer preferences and expectations in terms of logistic service	difficulty in identification of key customers or customer groups; incorrect prediction of customer needs
Identifying logistic market segments	failing to tailor logistic services to suit a given segment; no integration between all activities related to the given logistic segment
Preparing and developing logistic strategies	mistaken choice of distribution channel management strategies; too late product launch
Developing a set and structure of components logistics-mix	decisions about the service level; planning material demand; issuing orders; forecasting supplies; location of storage places and warehouses; division into sellable and packed units; decisions about the type of transport; scheduling; service level; material demand planning
Ensuring and developing personnel competences related to planning and execution of logistic processes	incorrect production planning
Ensuring quality of service provision processes	inadequate level of provided services

End of table 1

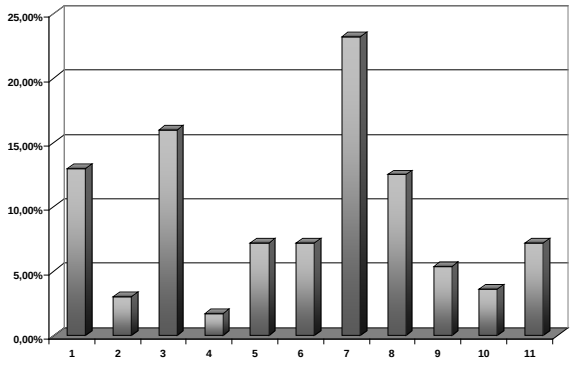
Types of processes	Risk groups
Ensuring quality of product purchasing and selling processes	incorrect evaluation of material quality; incorrect supplier assessment; incorrect supplier selection; incorrect evaluation of finished product quality
Controlling product flows by determining the course of transport, transshipment, storage, goods packing and marking processes	no internal and external integration in supply chain management
Giving instructions about processing of customer orders	too long time for information flow; unclear information; incorrect interpretation of instructions
Identifying goals and preparing assumptions for logistic customer service	partners' insufficient ability to respond to unexpected orders (low flexibility, failure to meet requirements promptly enough)
Ensuring capacity and potential for creating added value	no innovative solutions; no implementation of strategies and plans; using only slogans; no execution; power of promotion and advertising
Logistic infrastructure research and development	changes in terms of delivery; incorrect production planning; inflexible production processes
Development of IT and ICT technology	insufficient flow of information about demand from points of sale and key customers; inappropriate demand forecasting methods, information flow problems
Managing and maintaining relationships with the environment	a lack of balance between customer expectations and possibilities of all supply chain links, misunderstanding market needs; a lack of integration with customers; changeability of demand, relationships with contracting parties; competitive forces on the market; market potential
Disposal of waste, packaging, damaged products	a lack of regulations on waste recycling; insufficient environmental awareness; no system for collecting hazardous waste; no storage sites, which comply with legal regulations; no selective waste collection
Securing sales and turnover	mistakes in material supply planning; keeping unnecessary stock of supplies
Securing financial aspects of logistics (customer accounts)	incorrect evaluation of customer profitability; too high service costs; changeable costs of materials; incorrect estimation of future costs

Risks most often result from a tougher battle on the competitive market. During public tenders other contractors offer very low prices for construction works; as a consequence, the prices are lowered to a level which is very dangerous for contractors themselves; 2) a rise in costs of construction due to incorrect adjustment of construction design solutions to the operating conditions. The risk finds its sources in numerous mistakes committed at the construction design stage and resulting from e.g. insufficient knowledge or negligence on the part of designers, acceptance of incorrect project design assumptions etc.; 3) impact of weather conditions. Basically, the unfavourable impact of weather conditions is an inherent part of any construction project. As a consequence, this leads to additional costs, especially in autumn and winter; 4) changes in project design solutions introduced by the investor during the execution of works. The contractor's risk most frequently results from delayed completion of construction works due to e.g. the need to introduce new, or additional, design solutions during the facility construction period. This could lead to a higher price of the investment; 5) advances on account of supplies of materials. The risk is connected with the contractor's need to incur additional costs (also their own funds are tied up); 6) changes in materials made by the investor, compared to the ones planned in the project. The risk tends to stem from insufficient information about the selected materials needed in construction works; 7) delays in obtaining access to project documentation. The direct reason for this risk is the investor's negligence. Contractors cannot start construction works without complete project documentation; 8) delays in obtaining access to a construction site. These delays tend to be the investor's fault. A lack of required approvals (under the Construction Law) makes it difficult for the contractor to commence construction works. This postpones the date when the investment project may be handed over for use; 9) a rise in costs of execution in specific conditions. This rise mostly results from e.g. the need to have additional transports of materials and equipment or transports of employees to distant places of work; 10) deviations from planned labour intensity. Such deviations are connected, first of all, with the inability to establish a precise scope of works that need to be performed at specific stages of the construction process; 11) difficulties in evaluation of new execution solutions. This risk is normally connected with a lack of experience shown by subcontractors and providers of construction services, as well as mistakes made by them directly on construction sites; 12) changeable transport costs. This risk concerns an unexpected rise in prices of means of transport. The differences due to higher prices, i.e. additional costs, are almost invariably borne by the contractor; 13) accidents during work. They result, most of all, from the violation of work discipline and OHS regulations. The most frequent reasons for accidents on construction sites are insufficient attention, when

performing works and unexpected events. 14) changeable distance from sources of supplies. Additional costs result from periodic difficulties in the provision of material supplies. This is caused, most of all, by the need to use, for the construction of the facility, the materials and raw materials which are different from the ones included in the technical and engineering documentation i.e. it concerns e.g. purchase of appropriate aggregate materials and other raw materials used in ground works from remote parts of the country; 15) delays in deliveries of machines and equipment. They are caused by the need to hire highly specialised equipment; most frequently in cases when additional construction works need to be performed. The additional costs are incurred during such works, e.g. for lease of equipment; 16) deviations from costs of equipment. The deviations from the planned costs of equipment usually result from incorrect work organization directly on construction sites. These are, most often, short downtimes on construction sites; 17) damaged or destroyed materials. When executing construction works, materials may be damaged or destroyed during internal transport or due to incorrect warehousing and storage of materials on the construction site. Bad weather conditions may lead to the destruction of materials stored, such as e.g. cement or wood. As a consequence, new materials need to be purchased to replace the damaged or destroyed ones; 18) quality of materials and raw materials. Poor quality of raw materials, materials and prefabricated elements used in contracting results from hidden faults. Therefore, quality risk is connected with the need to remove the discovered hidden faults and defects; 19) breakdowns and disasters. The risk is connected with a possible breakdown or a construction disaster which are mostly due to the negligence on the part of employees directly on a construction site. This is sometimes caused by factors beyond people's control, e.g. strong winds.

The results of the research in this area are presented in Fig. 1.

Figure 1 presents the risks that are most frequently dealt with by the contractors at the stage of project execution. The results show that the contractors most frequently cope with the risk connected with financing the project execution. It's also about the difficulties associated with timely settlement of payments by the investors as well as the financial problems on the part of the general contractors themselves (problems with liquidity). (In the time of the financial crisis, these types of difficulties are frequent among contractors.) In turn, 16% of the respondents indicate the problems associated with the project execution organisation as well as the risk connected with human resources, i.e. 13% of those surveyed (e.g. the absence at work due to accidents at work). Then, 12.5% of the respondents indicate the risk associated with the force majeure impact (Acts of God). The remaining risk categories listed in Fig. 1 are of lesser significance in the activity of entities, where, for example, from among the remaining types of risk, the contractors bring forth „(…) the risk associated with the raw material prices instability and sub-contracting services; lengthiness of administrative proceedings (administrative decisions), etc." (The answers have been transferred directly from the surveys, i.e. they are quoted in their original wording.)



1 – risk associated with human resources, i.e. 13 % of those surveyed
2 – risk associated with IT resources, i.e. 3 % of those surveyed
3 – risk associated with the project organization, i.e. 16 % of those surveyed
4 – risk associated with the environment protection, i.e. 2 % of those surveyed
5 – risk associated with the social and political situation, i.e. 7.2 % of those surveyed
6 – risk associated with technical resources, i.e. 7.2 % of those surveyed
7 – risk associated with the project financial problems, i.e. 23.2 % of those surveyed
8 – risk associated with the force majeure impact, i.e. 12.5 % of those surveyed
9 – risk associated with the third persons impact (e.g. thefts), i.e. 5.4 % of those surveyed
10 – risk associated with the change of the legal regulations, i.e. 3.6 % of those surveyed
11 – other types of risk, i.e. 7.2 % of those surveyed

Fig. 1. Different types of risk in activities of construction and assembly companies (Source: prepared by the author on the basis of the replies given. The foregoing catalogue of risk categories developed on the basis of Kosecki, Madyda 1996).

4. Conclusions

Risk cannot be completely eliminated from construction activities. The research conducted in 2009 shows that risk in an investment and construction process tends to concern contractors at the stage of construction execution, i.e. as many as 70 % of the respondents indicate that the risks they had to face occurred at the stage of construction

and assembly works; only 1 respondent, out of all the surveyed ones, states that it was the operational stage. However, 28 % of the contractors state that they most often faced such risk at the stage when an investment project was prepared for execution. The results indicate that system solutions related to risk management need to be implemented in activities conducted by the biggest construction and assembly companies in Poland. This should help them to manage risks in an effective and consistent way. An integral part of this system is risk management methodology. If risks are to be managed effectively in the construction industry they need to be well identified in the first place. These issues are addressed in the paper, which attempts to explain the nature and specificity of risks occurring in production activities carried out by construction and assembly companies.

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