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**INTEGRATED RISK MANAGEMENT
IN CONSTRUCTION ENTERPRISES
– THEORETICAL APPROACH**

Introduction

Risk is an indispensable element of any business activity. It occurs in all the areas in which a given entity, or a construction enterprise, functions. It may appear in the least expected moment due to the least expected factors. Risk in a construction enterprise may be caused by people, physical factors (on a construction site) beyond people's control and various circumstances, including economic or fortuitous events. In business practice, risk in an entity's economic activities increases in the times of an economic downturn, and risk in a construction enterprise, as such, should be analysed in a comprehensive way, i.e. in the areas of operating, investment and financial activities. Therefore, construction enterprises need an integrated risk management system, which first of all, enables contractors to identify, in a correct way and well in advance, any hazards they may face, to quantify risks and then respond to them appropriately. „This is, firstly, about incorporating risks into a corporate management process and, secondly, about integrating risk management processes of individual business lines and, thirdly, about integrating management processes for various types of risks” [Jajuga (ed.), 2007, p. 380].

The key aim of the paper is to present the theory behind integrated risk management systems operated in construction enterprises. The study of literature is used for this purpose. In addition, the paper contains some practical strands related to the discussed issues. The author also draws from his own experience and observations made during his many years' research into risks faced by construction and assembly companies in Poland.

1. Risk in construction – selected issues

Both in the theory and in practice, there are a number of different definitions of risk [See: Cleden, 2009, p. 121]. Risk is a multifunctional category, which cannot be defined explicitly [See: Horine, 2009, p. 193]. In broad terms, risk may be defined as a common and dynamic phenomenon, which is related to a threat of a loss, is characterized by intensity, tends to have a wide-ranging impact and occurs over time [See: Tworek, 2010, p. 17]. In the scientific literature, apart from risk, there is also a notion of uncertainty; these two categories being significantly different [See: Karmańska, 2008, p. 38]. Furthermore, there's also certainty, which is an opposite state to uncertainty [See more: Wideman,

1992, p. I-2]. Especially in insurance, the risk definition is of utmost importance; as in insurance risk is understood as a loss or a damage [See e.g. Karmańska, 2008, p. 38]. This is a so-called defensive trend in risk definition; unlike the offensive trend, where risk is understood not just as a threat but also as an opportunity [See more: Dinsmore, Cabanis-Brewin, 2006, p. 189]. Skilful risk management in a company may prevent any possible adverse effects of risk or even ensure considerable benefits (including cost savings). „(...) Risk may be expressed in the form of a mathematical equation, as follows:

$$\begin{aligned} &\textbf{Risk = probability, or frequency, of the occurrence} \\ &\textbf{of a defined event} \times \textbf{consequences of the occurrence of that event,} \\ &\textbf{or } \mathbf{R = P \times C} \textbf{'' [Bunni, 2003, p. 29].} \end{aligned}$$

Risk is defined here as a product of probability of the occurrence of a defined event and consequences of this occurrence, where, for example, in the area of *project management* an event of risk is defined as „(...) the precise description of what might happen to the detriment of the project” [Wideman, 1992, p. E-2]. “Beyond mathematics, risk and its likelihood are a function of: the type of loss that is addressed, risk factor(s) characterizing loss likelihood, prevailing market volatility, and amount of leverage behind the transaction or inventoried position” [Chorafas, 2007, p. 24]. “In broad terms, risk may be defined as a possibility that a market value of an economic entity’s (a company’s, a bank’s, a financial institution’s, etc.) equity may decrease or increase (or another market value be realized, different from the one expected, planned or intended), in a specific moment in the future, due to adverse or favourable changes of internal or external factors” [Marciniak, 2001, p. 104]. In terms of types of insurance policies used in the construction industry, risk is perceived as a purely negative category. It’s usually connected with a possible occurrence of a loss or damage on a construction site. When defining risk in the construction industry, one should also not forget about the parties involved in it. Depending on a participant of an investment and construction process, risk may be perceived in a different way, i.e. it will be analysed differently by an investor (developer), differently by a designer*, and differently by a contractor (sub-

* “Engineers begin their design endeavor by answering ‘what might work and what can go wrong’”. See: Wang X.J, Roush L.M. [2000]: *What Every Engineer Should Know about Risk Engineering and Management*. Taylor & Francis, New York, p. 4.

contractor) performing the work. The investor, for example, may define risk as a possible occurrence of deviations of the final results of an investment project from the expected ones, which means that the NPV value of the project, as expected by the investor, will differ from the actually achieved NPV (to the disadvantage). These deviations may be quantified by means of appropriate measurements*, i.e. using specific quantitative methods. In particular, „(...) the owner has many risks with which to contend, including:

- risk of loss of development capital,
- risk of a cost increase for the project,
- risk of loss of the project's value due to inadequate performance,
- risk of adverse publicity from the press or the public,
- risk to the partially completed project of damage during construction,
- risk of differing site conditions and related claims,
- risk of losing eligibility of grant or other funding sources due to mismanagement of the project” [Abbott, 1998, p. 97].

In turn, „(...) the contractor's risk may be summarized as:

- risk of not making a profit or even losing the contractor's own capital on the project through underestimating the complexity of the work, i.e., underestimating the effort required to complete the work,
- risk of damage to adjacent property due to construction work activities, especially construction means and methods,
- risk of construction delays, causing the owner to impose liquidated damages for late completion,
- risk of injury to workers due to construction activities or job site conditions,
- risk of the impact of the ‘unknowns’, especially those relating to subsurface conditions on the project, or the risk of incompletely or inaccurately assessing the cost or time impact of certain events (e.g. differing site conditions), especially in the absence of contract provisions allowing for equitable adjustment,
- risk of negative recommendations and associated reputation damage (and consequent loss of revenue and possibly bonding capacity) in the event of adverse project experience due to claims, disputes, and associated litigation” [Abbott, 1998, pp. 97-98].

Therefore, risk in the construction industry should always be analysed in terms of parties and issues involved as well as in all the areas where an enterprise, i.e. a participant of an investment and construction process, operates.

* The simplest risk measurement is a standard deviation of σ . It may also be used to measure risk in the performance of the same enterprise. Here, the achievements of such methods as e.g. Earnings At Risk (*EaR*) or Cash Flow At Risk (*CfaR*) should be emphasised. See more: [Jajuga, (ed.), 2007, p. 382 and subsequent}. The problems of risk measurements in investments are discussed in more detail in: [Jajuga, Jajuga, 2007].

2. Integrated risk management in construction enterprises – methodical proposal

However, irrespective of how risk is defined and which area or entity it concerns, risk should definitely be managed appropriately. Risk in a construction enterprise should be reduced, because its reduction will result in a rise in the company's goodwill (for shareholders), on one hand, and it will contribute to a rise in the efficiency of the company's activities, on the other hand. There are, consequently, substantive reasons [Jajuga (ed.), 2007, p. 9], why risk in the construction enterprise should be managed in a comprehensive and regular way, using the right methods and techniques*. The experience of The International Risk Management Institute (IRMI) in Dallas, i.e. currently the biggest institution worldwide, which carries out wide-ranging research into risk in numerous areas of a business life (including the construction industry)** may prove to be particularly valuable in this respect. From among reputable worldwide publications and guidelines concerning risk management, attention should be drawn to *ISO 31000:2009 Risk management Principles and guidelines* of 2009, prepared by the International Organisation for Standardization (ISO)***. It should be added that a new managerial function has appeared in the business practice all over the world – a risk manager. A risk manager in a construction company, in particular, is responsible for managing risk in a comprehensive, formalized and professional way, using appropriate methods and techniques. As a consequence, two important issues emerge here, namely:

- a process approach to risk management in a construction enterprise,
- creation of an integrated risk management system.

An attempt to provide a graphic presentation of these issues is shown in Figure 1.

Risk management in all the areas, where a modern construction enterprise operates requires the knowledge of risk management methodology. Therefore, every participant of an investment and construction process (not just a contractor) should become familiar with the methods, techniques and appropriate tools used in risk management. The methods used in *project management***** may prove to be particularly helpful because through these

* 'In a comprehensive way' means in all the areas where a construction company operates, namely in the areas of operating, investment and financial activities.

** This institute produced so-called 101 rules of risk management. These are a collection of universal rules concerning risk management, which may be applied in many organizations and entities worldwide. See more: [International Risk Management Institute 2003]: See also: [Tworek, 2010, pp. 62-68].

*** See more: Webpage: <http://www.iso.org>.

**** See more: Project Management Institute [2000, p. 168].

methods the contractor will be able to identify risk (its sources) properly, assess this risk and respond to it appropriately. All these efforts need to be subject to control and monitoring, which should be dealt with by the enterprise's risk manager.

Figure 1 shows an overall picture of a risk management concept for a construction enterprise (in all areas where it operates), with four key steps, i.e. risk identification, risk analysis, risk response and monitoring. It should be emphasized that risk management in the areas of investment, operating and financial activities requires the appropriate knowledge and background from a risk manager, i.e. certain methods will be needed in order to measure risks in investment activities and other methods will be used for risks which occur in financial activities. One should also remember about a need to adjust appropriate assumptions, procedures and solutions (within risk management methodology) to the enterprise's specific situation and the conditions, in which a project will be carried out. Consequently, the concept presented in Figure 1 may be freely developed further to include other steps, procedures and actions.

The risk management process in the construction enterprise starts with the identification of specific sources of risks and their categories. Risk identification is a process itself. In order to identify risks, we may use e.g. brainstorming, site inspections, check lists, etc. The next step in the entire risk management procedure is the quantitative and qualitative analyses of risks. A number of methods are used to this end, and the main aim here is to assess the risk as accurately as possible. The literature of the subject presents various concepts of methods used for that. According to N.J. Smith, for instance, „(...) typical qualitative risk assessment usually includes the following issues: a brief description of the risk, the stages of the project when it may occur, the elements of the project that could be affected, the factors that influence it to occur, the relationship with other risks, the likelihood of it occurring, how it could affect the project” [Smith, 1999, p. 50]. The quantitative process of risk management, in turn, involves such methods as MERA, sensitivity analysis, decision trees, risk simulation, etc. Risk simulation is specially valuable in this respect. Owing to IT techniques, risk may be assessed quickly and accurately. The Monte Carlo [See more: Flanagan, Norman, 1993, p. 153 and n.; Vose, 1997, p. 45 and n.; Schuyler, 2001, p. 81 and n.] simulation method is particularly worth using. Another step in the overall risk management process is the selection of appropriate risk responses. In accordance with the concept presented in Figure 1, this may be done in a number of ways. In practical terms, a special role here is played by contracts [Kalinowski, 2007, p. 86] and insurance [See also: Saporita, 2006, p. 16]. These two instruments are regarded as the most effective ways of responding to risks. „Traditionally the risk in a construction project is allowed as follows: 1) client to designer and contractor, 2) contractor to subcontractors, 3) client, designer, contractor and subcontractors to insurers, 4) contractor and subcontractors to sureties or guarantors” [Thompson, Perry (ed.), 1992, p. 32].

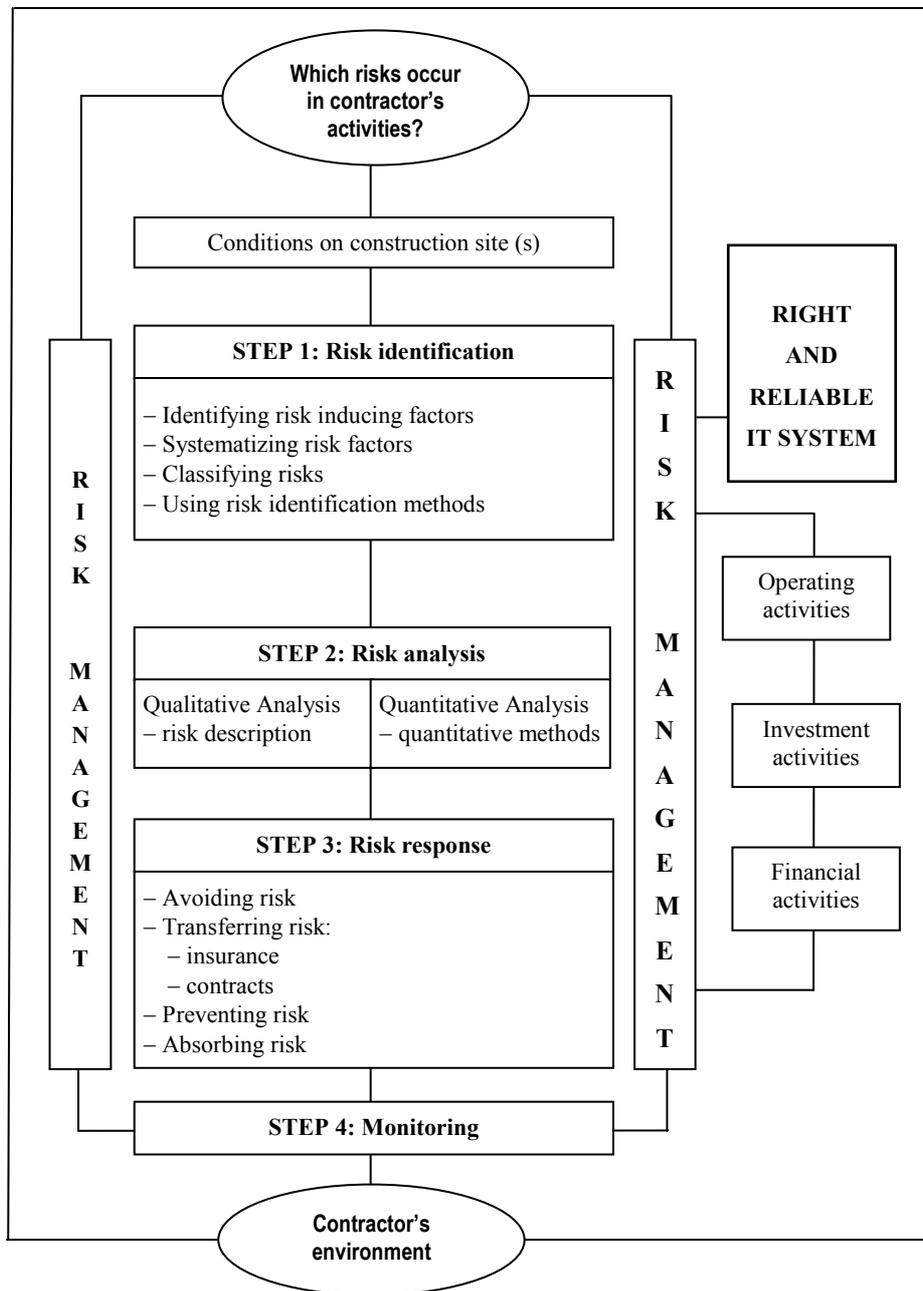


Figure 1. An idea diagram of an integrated risk management system in a construction company

In the area of insurance used in the construction industry, two insurance products are of particular importance, i.e. CAR (Constructors All Risks) and EAR (Erection All Risks) policies [See more: Tworek, 2009, p. 1 and n.]. (These are ‘all risks’ insurance types; a contractor is always free to choose the ‘specific risks’ [See more: Tworek, 2009, p. 1 and n.] types of insurance as well). Owing to that, the contractor passes the risk, in part or in whole, onto another contractual party (or the insurer) [See more: Tworek, 2005, pp. 386-389]. All the work on risks is subject to monitoring – risks are thoroughly controlled. This is aimed at preventing any possible mistakes from being made and, in particular, any significant risk from being ignored. Risks tend to recur. As emphasized by K. Marcinek „(...) risk is dynamic in its nature, which means that (...) types of risks change, roles performed in risk management by individual participants of the project change, the scale of specific risks changes” [Marcinek, 2006, p. 139]. All these actions should be based on a solid IT foundation, which is used to collect data about risks, i.e. to create databases and then process the data. An efficient and reliable IT system (Figure 1) should provide updated market information about risks to staff working throughout an enterprise. Integration contributes to the enterprise’s growth and limits a possibility of serious mistakes in management over the enterprise (in this case, in risk management). In particular „(...) an effective integrated risk management program should include the following elements:

- corporate governance should implement appropriate control procedures and systems in risk measurement and management processes carried out in enterprises,
- chief operating officers should ensure that risk management will be integrated with revenue-generating activities, taking into account the growth of their business, their products, customer relationships and pricing policies,
- portfolio management should aggregate the components of the portfolio, taking into account the effects of diversification and monitoring risk concentration against assumed limits,
- risk transfer should minimize an exposure to risk, which seems to be too high or more profitable, when compared to the cost of keeping it in the portfolio,
- risk analysis should provide risk measurement and reporting tools, in order to quantify the exposure to risk and observations of the external risk factors,
- databases and technological resources should support the processes of analyses and reporting,
- liaison with stakeholders should involve communication and providing them with information about the enterprise’s risk profile” [Lam, 2003, p. 45 follow: Krysiak, 2007].

Therefore, in the case of big construction enterprises, it isn't enough to manage risk on an ad hoc basis. Only a comprehensive risk assessment guarantees a success. Risk management carried out in a construction enterprise, in a systemic and formalized (integrated) way, is an expression of a modern formula of corporate management. To sum up:

- „(...) risk management in an enterprise should be a continuous process and a regular activity, not just an occasional action;
- risk management in an enterprise should include the activities related to the determination and performance of the enterprise's strategy;
- risk management in an enterprise is always aimed at ensuring that the key objectives of the enterprise can be achieved;
- risk management in an enterprise should be seen, first of all, as using the opportunities embedded in risks, not just avoiding the hazards connected with these risks;
- risk management in an enterprise should form an important element of the entire corporate management process;
- risk management in an enterprise should be integrated and cover all types of risks which occur in the enterprise's operation” [Nowak (ed.), 2010, p. 23; see also: Godfrey, Halcrow, 1996, p. 110].

Conclusions

A construction enterprise is managed throughout all the areas, in which it operates. This also concerns management in the area of risks. Due to the specificity of the construction industry and the types of risks which occur there, this issue cannot be ignored in any way. The consequences of risks could be very dramatic for a contractor. Risk management in the construction enterprise, in particular, requires a formalized approach. In practical terms, this may be manifested by the creation and implementation of integrated risk management systems in enterprises. These systems will facilitate their risk identification processes, risk quantification and will allow enterprises to respond to risks in a better way. At the same time, integrated risk management supports the overall management of construction enterprises.

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