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Risk management in a municipal construction enterprise: A theoretical and methodical study

Abstract

Objectives: The key aim of the paper is to outline the concept of integrated risk management in municipal construction enterprises, seen as a supportive function that facilitates the overall management of an organisation. What matters most, both in the theory and in practice, is the ability to use appropriate methodology in this respect. Such issues now constitute an integral element of public management in Poland.

Research Design & Methods: A cognitive gap, identified in the scholarly literature, has served as a starting point for the theoretical and conceptual discussions addressed in this paper, in particular, within the scope of risk management methods. This paper contains a review of the literature on this subject. Deduction and induction have been used to formulate the conclusion. Another method employed in this paper is synthesis. The conclusions drawn in this paper result also from the observations made during long-term research into risk, including in the public construction sector, which has been conducted by the author at the University of Economics in Katowice.

Findings: The concept proposed in this paper is the outcome of the author's studies, conducted with a view to identifying solutions, both theoretical and methodical ones, in the area of risk management in municipal construction enterprises operating in Poland. Integrated risk management provides the basic framework for the concept which is drawn up as a result of the research.

Implications / Recommendations: In its main body this paper presents a recommendation which consists of a modification of the general concept of Construction Risk Management (CRM) into Integrated Construction Risk Management (ICRM), with a simultaneous proposal that the general risk management concept (theory), which is followed by commercial companies (Enterprise Risk Management; ERM), should be implemented in municipal construction enterprises as well. The proposed solutions may then be transferred to the practical operations of such municipal entities or of public organisations at large (the utilitarian dimension of knowledge).

Contribution / Value Added: This paper is an attempt to add to the theoretical background to risk management in the public sector, which refers, in particular, to New Public Management (NPM), the notion used by municipal construction enterprises in Poland.

Article Classification: conceptual article

Keywords: risk management, public management, municipal enterprise, construction enterprise management, public construction

JEL classification: D81, H4, H76, L7, L32

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1. Introduction

Both in theory and in practice it is commonly recognised that risk in the construction industry has its own unique profile. This also applies to the public construction sector, where risk may be analysed by adopting the subjective and the objective approach. A key participant in a construction project conducted in the public sector is a municipality/a commune or, in general, local government authorities. In addition, there is always a contractor, as an organisation which has undertaken to carry out a given construction project or, more generally, a municipal company which provides services related to maintenance of existing infrastructure. There are also other forms of construction activities which are connected with the public sector, such as municipal, social, rental, business-related and public benefit ones. It should be noted that in the scholarly literature risk management in the construction sector is usually perceived through operations of commercial companies which provide construction and assembly services, rather than by looking at municipal enterprises performing the roles of contractors, which can be treated as a separate subject of risk. Therefore, the key aim of this paper is to outline the risk management issues as analysed from the point of view of municipal construction enterprises, as such entities operate in Poland. In particular, the discussions presented in this paper concern methodical issues related to risk management as a sub-process supporting governance in municipal companies. An attempt is made to transfer the risk management patterns from the commercial sector to organisations operating in the public sector.

This paper is mostly theoretical and conceptual (the theory-cognitive dimension of knowledge) in its character but, at the same time, many of the insights presented here are of an applicable nature (the utilitarian dimension of knowledge). In the main body of this paper a proposal is put forward that the general concept of Construction Risk Management (CRM) should be modified to arrive at Integrated Construction Risk Management (ICRM)

(Tworek, 2013, pp. 180–186), while the general approach to (the theory of) risk management applied to commercial businesses (Enterprise Risk Management; ERM) (Walker & Greenwood, 2002, p. 11–34; Dallas, 2006, p. 14–48) may be implemented in the operations of municipal enterprises that provide maintenance services for existing infrastructure as well as carrying out new public construction projects. The method of synthesis is used. This paper also contains a review of the scholarly literature in this field.

2. Materials and methods

A review of the literature may lead to the assumption that it offers no response to the most essential question, namely in what ways risk should be managed (i.e. identified, quantified and responded to) by municipal enterprises that provide services related to the maintenance of existing infrastructure and perform new public construction undertakings. What is of vital importance here is the understanding of the very notion of risk in the public construction sector, as it first needs to be identified by a public investor and a contractor, is that of carrying out a construction project. Another important factor is the knowledge of an array of methods that can be used in the risk management process, so that risks in the public construction sector can be estimated and, consequently, responded to in an appropriate and effective manner by contractors. In this respect, the patterns (standards) of risk management in the commercial sector may be considered, since many Polish construction companies which are listed on the stock exchange manage their risks in an organised way, using numerous modern methodical solutions, including the ones offered by the scholarly literature. Municipal companies with a construction profile, however, do not seem to manage their risks in any formalised way, and the methods which help to identify, quantify and react to risks are applied in a highly limited manner. Moreover, it should be added that there is a statutory requirement for public sector entities in Poland to manage their risks (MF,

2017). Similar conclusions may also be drawn with regard to municipal companies, perceived as a group (Kachniarz, 2012, p. 29), which offer public services of other types (Brown & Osborne, 2013, pp. 186–208).

Apart from the literature studies, the conceptual discussions presented in this paper draw on the author's expertise gained from long-term research into risk, conducted independently as well as in research teams at the University of Economics in Katowice. Many of the conclusions mentioned here come from the studies carried out in 2017 as part of the project titled "Risk in public management. Stage II: Theory versus practical experience of risk management in public organisations in Poland" performed in the Department of Public Management and Social Sciences, the University of Economics in Katowice, where the author acted as a project leader. At the same time, this paper is an integral part of this project as well as the first stage of the research conducted in 2016 within the project titled "Risk in public management. Stage I: Methods of risk management in public organisations in Poland", which used, *inter alia*, a case study. The methods of deduction and induction are employed in this paper, which contains a review of the basic legal documents that govern the subject matter analysed herein.

In this context it should be noted that a regulatory attempt has already been made in Poland in the area of construction risk identification for projects conducted within the framework of public-private partnership (PPP) (Adamek-Hyska & Tworek, 2011, pp. 7–11). Under the Regulation of the Minister of Economy dated 21 June 2006 on risks connected with the implementation of ventures under private-public partnership, the following basic types of risks are enumerated, *i.e.* first, "(...) construction site risk; second, availability risk (a risk which affects the provision, quality or quantity of services to be provided under a PPP agreement); third, demand risk (a risk which leads to changes in a demand for particular services); fourth, enterprise planning risk (a risk which affects the cost and the time of a bidding process); fifth,

market risk related to availability of funding for the execution of a project (a risk which affects the cost, quantity, quality and the time of provision of funds needed to execute the project); sixth, political risk (a risk of changes on the political scene which affect the directions of development for public-private partnership projects); seventh, legislative risk (a risk of changes in legal regulations which affect projects executed under public-private partnerships); eighth, macroeconomic risk (*e.g.* risks of inflation, fluctuations of interest rates and currency exchange rates); ninth, regulatory risk (a risk of changes in regulations on payment schemes in specific public benefit services, which may affect the costs of a project or which may lead to changes in the scope of rights and obligations of contractual parties in a project); tenth, return-on-investment risk (a risk which may affect the level of profit to be generated from a project); eleventh, force majeure risk; twelfth, dispute resolution risk (a risk which affects the way in which a dispute will be settled and the effectiveness of such settlement for disputes arising out of PPP agreements); thirteenth, environmental risk; fourteenth, project location risk (a risk which affects accessibility of the area on which a project is to be executed); fifteenth, asset transfer risk (a risk which affects the conditions under which and the time at which assets are transferred as part of the project); sixteenth, final asset value risk (a risk involving the material value of the assets as at a PPP project delivery date); and seventeenth, lack of social approval risk (a risk of protests and objections from local communities, *e.g.* during the planning and execution of infrastructural projects under PPP partnerships)" (ME, 2006). Therefore it may be assumed that these are the key types of construction risks, perceived from the subjective and the objective perspectives, which make up the general picture of this phenomenon, and which need to be taken into consideration by a private investor and by a public investor when planning and executing infrastructure construction projects (Tworek, 2013, p. 41); although the said regulation has ceased to be formally valid.

Looking from the scientific point of view, however, this list should refer to risk quantification issues. In economic sciences risk is regarded as a measurable category, unlike uncertainty, which cannot be fully estimated (Knight, 1921, pp. 6–17). That is why a question arises about the suitability of the methodical solutions offered by international risk management standards and, in particular, the one created having in mind public sector organisations – i.e. the UK's FERMA standard (Federation of European Risk Management Associations). It takes into account the fact that risks may be associated both with opportunities (the positive aspect) and with threats (the negative aspect) (FERMA, 2002, p. 2). This overlaps with the position expressed by the offensive approach to the definition of risk in the scholarly literature, which is represented by, for example, Drucker (1974, pp. 17–62). It is particularly important to be able to differentiate between the categories of risk and uncertainty, as risk is a function of uncertainty and, at the same time, it is always accompanied by uncertainty (Karmańska, 2008, p. 59). Risk, however, may be defined as a combination of the likelihood of an event and its consequence (FERMA, 2002, p. 3). The usefulness of the standard solutions offered in public management is indirectly referred to by, for example, Young and Fone (2001, pp. 9–58). Their risk management concept in the public sector (Public Sector Risk Management), however, does not take into account a complete range of the methodology solutions which public risk managers could possibly find useful when doing their jobs.

3. Literature review and theory development

The preconditions for managing risk in the construction industry in an effective and efficient way are accurate risk identification and risk definition. What is needed, therefore, is to have risks for municipal enterprises performing construction and assembly activities specified.

Even though the scholarly literature – as mentioned in the introduction – explains this problem in an in-depth manner when it comes to commercial construction companies, this issue still requires more scientific research in the case of the public sector and, to be more specific, the operations conducted by municipal construction entities. Reference should here be made to Drucker (1964, p. 17), who states that almost every branch of industry has its specific risks which need to be handled well, to be able to continue in operations. This also applies to any forms of public sector construction activities. In the international literature attention is drawn – by a large group of authors (Saporita, 2006, pp. 13–51; Bender, 2000, pp. 14–189; Revere, 2003, pp. 13–76; Flanagan & Norman, 1993, pp. 51–118; Edwards, 1995, pp. 4–68; Bunni, 2003, p. 44; Burtonshaw-Gunn, 2009, pp. 48–93; Godfrey & Halcrow, 1996, pp. 13–59; Smith, Merna & Jobling, 2007, pp. 26–92; Hatem, 1998, pp. 432–453) – to the need to manage risk in the construction industry. The methods suggested in the literature, however, tend to focus on the attempts to attain the key objective pursued by commercial providers of construction and assembly services, which is maximising value (Walker & Greenwood, 2002, pp. 11–38; Dallas, 2006, pp. 14–48). In municipal construction enterprises, in turn, due to a different form of ownership (local government ownership), a risk management process may run differently. This may be caused by the importance and the impact of political risk, among others – a factor which is normally of a negligible relevance for contractors operating in the commercial sector. That is why, apart from the identification of a typical construction risk – which is related, first of all, with the quality of construction and assembly work (quality risk), secondly, the time for execution of infrastructural projects (time risk), thirdly, a contractual price established in an agreement between an investor and a contractor (the price risk resulting also from construction project cost calculations) and fourthly, safe execution of a construction project (the safety risk) – political risk should always be taken into

consideration due to the specific settings in which the public sector operates, as well as the specific form of ownership of municipal construction entities. These core categories of risks combined present an overall picture of risk in the public construction sector, which should also be analysed against the theoretical background. A particularly relevant category is political risk, which, in broad terms, is connected with political events occurring, and political decisions made, in a given country (Buła, 2015, p. 17). When it comes to construction undertakings operating at the local government level, such risk is associated with the dependence of building entities on the political decisions made by the local authorities. This – according to the literature – is regarded as an external construction risk factor (Adeleke *et al.*, 2017, p. 3). Additionally, risk sources for public contractors include public procurement regulations (PPO, 2017), which also demand special consideration. On the whole, construction risk is a research category that needs to be reviewed in a multi-disciplinary way.

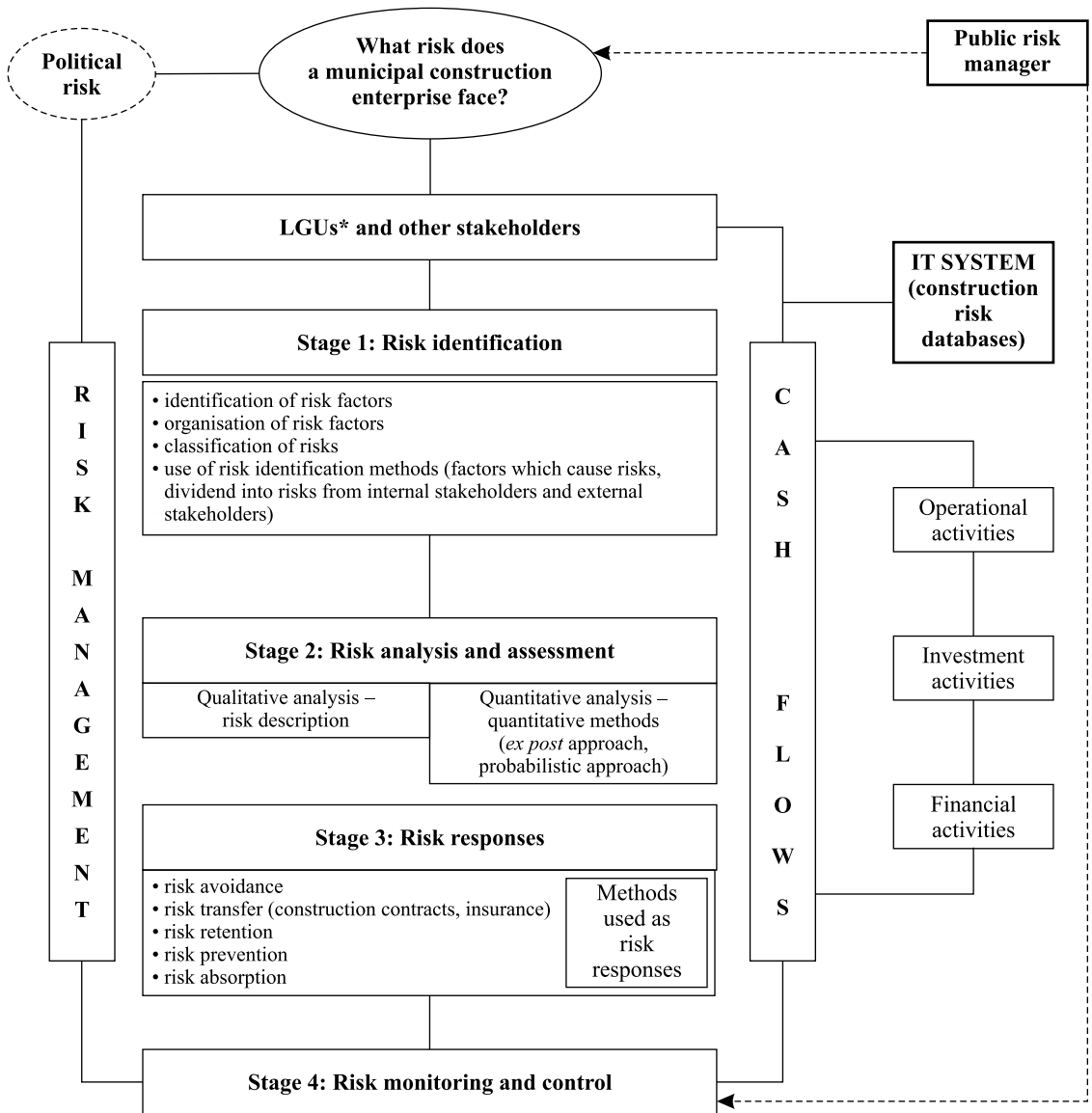
4. Discussion

The initial studies conducted in this area lead to the conclusion that municipal enterprises manage their risks indirectly and without having any formalised system in place. This means that, in practical terms, risk is not managed in any on-going, comprehensive or organised way, using a complete set of methods or across all the functional areas in which a given (municipal) enterprise works, with a special focus on investment, operational and financial ones. No integrated risk management system is implemented in these entities and risk management is limited to identification of the risks related to the quality of construction or repair work (the risk of quality, including quality of services). Risk is not managed in any integrated way due to several reasons, i.e.: firstly, there isn't sufficient willingness and motivation to introduce such a formula in enterprises; secondly, the implementation of such a solution (system) is

costly, i.e. operation of the system generates high expenses; thirdly, no independent managerial role – a (public) risk manager – has been established in the Polish public construction sector yet; fourthly, contractors generally share the belief that ordinary optimisation methods suffice, as risk cannot be avoided completely on any construction site and, consequently, the only effective method of risk financing is insurance (Tworek, 2013, pp. 164–176).

Consequently, it can generally be concluded that if risk management is to be looked upon as a practical and cross-functional type of knowledge, it should be implemented by municipal construction enterprises across all of the areas in which they operate, with the focus on operational, investment and financial ones (Tworek, 2013, p. 186). That is why – both in practice and in the theory – a common denominator needs to be found so that risk may be identified, estimated and responded to appropriately, using the right set of methods, in the three main types of activities conducted by municipal entities: operational, investment and financial activities. Such a common denominator may be cash flows (CFs) generated in a construction municipal enterprise, as all economic events, including risk-bearing ones, have their reflections in financial reporting (Tworek, 2013, p. 186). A graphic illustration of this point is given in Fig. 1.

Figure 1 generally presents a conceptual flow of a risk management process in municipal construction enterprises, analysed by adopting an integrated approach. Only such a formula, if followed by a municipal enterprise, may be expected to ensure success, i.e. the achieving of a desired outcome in the area of risk management, irrespective of the type of public services which are provided. This concept is underpinned, first of all, by a core value established by an enterprise, around which a public risk manager (Fig. 1) would be able to deal with or, to be more specific, quantify encountered risks in an effective way. According to this approach, the most vital phase in the entire risk management process is risk analysis and assessment (Stage 2), where special knowledge of risk quantification methods which can possibly be



* local government units

Figure 1. A conceptual diagram of integrated risk management in a municipal construction enterprise – methodical proposal, process-based approach

Source: Own elaboration based on Tworek (2014, p. 498).

used is required. When quantifying risk by looking at cash flows (CFs) generated by a construction municipal enterprise, a historical method may be used to analyse financial reporting data (the *ex*

post approach), as a starting point for specific financial methods, but a probabilistic approach may also be adopted (Fig. 1), based on specific probabilistic methods (Tworek, 2013, p. 186).

In the case of the former approach the methods developed in the field of corporate finance, including an index analysis, are suggested, and these can further be supplemented by, for example, financial and operational leverages (Tworek, 2013, p. 186). In the latter approach, in turn “(...) taking into consideration a criterion of net cash flows and a net profit generated by an enterprise, (...) two methods are recommended for risk measurement, i.e.: Earnings at Risk (EaR), focusing on the earnings which may be exposed; and Cash Flow at Risk (CFaR), focusing on the cash flows which may be affected” (Jajuga, 2007, p. 383).

The selection of these methods for risk quantification in a (typical) construction enterprise seems justified, as net cash flows are a source of value creation for an entity (Tworek, 2013, p. 193). In addition, the methods result from the expansion and modification of the Value at Risk (VaR) concept (Tworek, 2013, p. 193). This constitutes a foundation for the methodical approach illustrated in Fig. 1, which results from the proposal of having the risk management methods available in the commercial sector transferred to municipal enterprises which provide building services. This approach also seems justified due to another substantive reason, namely the fact that municipal enterprises in Poland, in addition to their construction and assembly activities, also provide a range of services (such as lease of building machines and equipment, transport services for the building industry) for example for commercial construction companies, as well as manufacturing and selling concrete or aggregates for building purposes, etc. That is why profit (net income) needs to be calculated, taking into account risk and employing the methods for risk analysis and assessment in typical construction and assembly production, such as a sensitivity analysis. The methods which are available for municipal construction enterprises in this area are presented in Table 1.

Table 1 outlines the pros and cons of the risk quantification methods which are available to municipal enterprises performing the role

of contractors in infrastructural projects. The methods may be employed in a variety of ways, depending on the type of construction project to be executed or the scope of construction and assembly work to be carried out. These are standard methods, designed for the general construction sector, and they address typical construction risks. However, when looking at the specific character of municipal construction enterprises and, first of all, their form of ownership, what needs to be noted in a process of risk quantification or, more importantly, risk identification (Stage 1), is political risk – a category which should be re-emphasised here. Potential options available to identify such risk by applying a separate set of methods should also be highlighted. This predominantly refers to the risks originating from internal and external stakeholders (Fig. 1), while the most relevant risk is the one resulting from a founding body (local government authority). Hence what matters in the risk identification process is the selection of the correct risk identification method, which should largely be linked here with the qualitative approach, including when it comes to risk analysis and assessment. To that end a number of methods are recommended in the foreign literature in this field (Saporita, 2006, pp. 13–51.; Revere, 2003, pp. 13–76.; Flanagan & Norman, 1993, pp. 51–118.; Edwards, 1995, pp. 4–68; Bunni, 2003, p. 44; Burtonshaw-Gunn, 2009, pp. 48–93; Godfrey & Halcrow, 1996, pp. 13–59; Smith, Merna & Jobling, 2007, pp. 26–92; Hatem, 1998, pp. 432–453), and special relevance is attached to a public debate. From the methodical perspective, an important thing is, first of all, the need to modify risk identification methods to tailor them better to the needs of organisations which offer municipal services; secondly, the fact is that in the risk identification process one has to consider the advantages and the drawbacks of every single method; thirdly, there is a need to use these methods complementarily, just like in the case of risk quantification methods (Tab. 1). Consequently, two different approaches – the qualitative one and the quantitative one – may

Table 1. Risk quantification methods in the infrastructural construction sector

| Method | Key Strengths | Key Weaknesses |
|---|--|---|
| Decision Tree Analysis | Graphical layout of expected value calculation | Must convert continuous into discrete distributions |
| | Evaluating alternatives with sequential decisions (e.g. value of information) | Must limit the number of decision alternatives and chance event outcomes Requires a decision policy value function |
| Monte Carlo Simulation | Can accommodate complexity easily, such as dynamic behaviour under contingencies | Time versus accuracy tradeoff; solution can be computationally time-consuming |
| | Very generally applicable | Solution is approximate and changes with random number seed Poor precision with regard to low-probability events |
| Influence Diagram | Similar to decision trees | For EV calculation the theory and calculations are more difficult |
| | Better represents relationships between variables | |
| Scenario Analysis | Simple | Seldom quantifies risk and uncertainties |
| Moment Methods (parameter method) | Medium complexity; quick; reproducible solutions | Provide only statistics about the shape of the solution distribution |
| | | Calculations often ignore important details, such as correlation |
| Fuzzy Logic | Low/medium complexity; quick | Only approximates probabilistic reasoning |
| | Reproducible solutions | Potential developments needed to improve accuracy |
| CPM, PERT, and PDM | Simple | Simplistic project network model may be inadequate |
| | | Only one critical path is recognised and, with PERT, used in stochastic calculations |
| Sensitivity Analysis | Simple | Does not recognise risk versus value tradeoffs |
| Multi-Criteria Approaches; Analytic Hierarchy Process | Simple, if non-probabilistic | Risk or uncertainty is merely one of several attributes; problems with consistency |
| | | Probabilities can be used if the criteria hierarchy represents the value function |
| Design of Experiments; Taguchi Methods | Value optimising or variance reduction with efficient handling of many decision (controllable) variables | Limited representation of uncertainty, noise, e.g., using low and high for each chance event |
| Approximate Integration | Rapid, repeatable solution | Little recognition in practice and literature; emerging technique |

Source: Schuyler, 2001, p. 222.

be followed at the same time, as a requirement for a comprehensible assessment of risk. Only such behaviour would enable one to come up with the correct risk response (Stage 3), and here a special role in the public construction sector is attributed to all-risk insurance, which enables contractors to transfer risks to insurers (Fig. 1). Not only in the theory but also in practice, every public risk manager in a municipal construction enterprise should be able to control a risk management process in an accurate and on-going way, and introduce required improvements if and when needed (Stage 4). As risk in the construction sector is a dynamic category and contractors may always be exposed to some extraordinary risks, which have not been anticipated before, there may be a need to use an additional new method for managing the risk (Tworek, 2013, p. 186). No matter which risk management method is selected, what should be kept in mind is the specific profile of the construction work to be performed by the given contractor. Risks which can occur in projects where buildings are erected by assembling are managed differently to risks in typical civil engineering projects (roads, tunnels, etc).

Conclusions

The integrated risk management concept to be implemented in modern municipal construction enterprises (Fig. 1), as suggested in the paper, should mean that: first of all, it is clearly defined in the given enterprise who is to manage risk and bear the related responsibility; secondly, risk is managed across all the areas in which the enterprise operates; thirdly, a full set of risk management methods are used in a complementary way; fourthly, risk management supports the overall governance of the enterprise; fifthly, risk management conducted by risk managers also applies to other participants of the construction process and stakeholders in general; sixthly, risk is managed in a continuous and reliable manner and seen as a process; and seventhly, effective risk management reduces the overall risk faced by the municipal construction

enterprise (Tworek 2013, p. 205–214). The main conclusion in this paper states that integrated risk management may, on one hand, effectively support general management of a municipal construction enterprise and, on the other hand, it reflects the modern concept of strategic management in organisations, fully compatible with the notion of New Public Management (NPM), which in practical terms should be performed by public risk managers. Therefore, to put it in a broader perspective, today's practical risk management in public sector organisations (Drennan & McConnell, 2007, pp. 13–25; Farnetia & Young, 2008, pp. 89–99; Hunt, 2010, pp. 377–402; Chen & Bozeman, 2012, pp. 277–400; Brown & Osborne, 2013, pp. 186–208; Asenova, Stephen, Bailey & McCann, 2015, pp. 552–465; Flemig, Osborne & Kinder, 2016, pp. 426–430) should be analysed both as a functionality and as a function (Tworek, 2014, pp. 498–499). The methodical considerations seem to play the most important role here (Tab. 1), which should be referred to municipal enterprises that provide services related to the maintenance of existing infrastructure and carry out new public projects in their municipalities or communes. The methodology is then key to the concept depicted in Fig. 1, if risk is to be managed successfully, effectively and, what is most important, in an integrated fashion. Municipal enterprises need to determine their core value around which risk should be estimated; cash flows (CFs) – both in the theory and in practice – should be recommended for this purpose. Only then will a public contractor be able to measure their risk by using risk management methods which have frequently been tried and tested in the commercial construction sector. Therefore, risk management in the public construction sector is a complex and highly specialised phenomenon, which still seems to require substantial scientific research. This is one of the reasons why cross-functional teams are often assembled, including experts from various fields and with various professional backgrounds, when organisations executing public projects need to examine their risks. These teams tend to be

composed of (construction) engineers, economists and lawyers. Now such professional teams should also include public managers and the problem addressed in this paper can be an integral element of public management as a specific type of scientific knowledge (Kožuch 2004, pp. 49–59; Hausner, 2008; Frączkiewicz-Wronka, 2009, pp. 11–47; Ćwiklicki, Jabłoński & Mazur, 2016, pp. 13–390). Such a concept is advocated worldwide by, for example, PRAM (the Public Risk Management Association) and PURMA (the Public Utilities Risk Management Association) in the US, and PRIMO (the Public Risk Management Organisation) in Europe. At the same time, in the scholarly literature special attention is drawn to the research options in risk management in the public sector, as indicated by Young and Fone (Young & Fone, 2001, pp. 9–112).

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