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Overview of Risk Allocation between Construction Parties

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Abstract

Certain risks are inherent in all construction projects. These risks are faced by all parties involved in a project – owners, contractors, designers, suppliers, etc. However, the more important role the parties play in the development and successful completion of the project, the greater risks they have to carry. Such parties are the owner and the contractor who conclude a contract to carry out construction works. Shifting the risk onto one of the parties to a construction contract agreement is inequitable and unreasonable. Equitable allocation of risks among parties is very important. Analysis results shows that in the area of risk allocation between construction parties many research is done and work is still ongoing, the most work in this area is done by scientists of China, USA, Australia and Great Britain. Although, on the one hand, relevant studies emphasise equitable risk allocation, on the other hand, the task of proper allocation of risks among parties is placed within one party only, i.e., the owner. This automatically “programmes” improper risk allocation results. According to the author, risk allocation among the parties to a construction contract agreement should invoke cooperative game theory which application for the aforementioned purpose is the object of further research of the authors.

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1. Introduction

All construction projects are unique and carry their own risks. Such projects involve a number of parties concerned, starting with the owner, contractor, designer, suppliers, and others. All parties involved in a project inevitably carry certain risks. Risk can be defined as a hazard, a probability of it to occur and the potential of losses and resulting gains [1]. Risk can be defined as a difference of actual and expected results [2]. Risks can be managed, reduced, transferred or accepted, but it cannot be ignored [1]. The process of risk management usually consists of four stages: risk identification, risk analysis, selection of risk management technique and monitoring of the management of risk consequences [1], [3].

Any construction project shall start with signing of a contract between owner and contractor for carrying out construction works. The purpose of a construction contract agreement is to allocate rights, duties, responsibilities and risks between the parties. In construction projects, risks can hardly be ever eliminated; they can only be transferred to another party to a construction contract agreement or shared on the basis of relevant contractual conditions [4]. It means that, in addition to the aforementioned four stages of the risk management process, there is the fifth stage – risk allocation (sharing) between the parties to a contract. Terms and conditions is an object for negotiations, but usually the contract is drawn up by the owner, i.e., the party initiating a project [1]. As a rule, the owner tends to allocate more risks for the contractor and accept as little risk as possible. In this case, the contractor may increase the project bid price basing on a mere fact that responsibility for circumstances likely to occur during the project is vested solely upon him. Proper allocation of risks between contractual

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parties is obviously very important in order to put the parties on equal footing. Otherwise, only one party or none of them would have a benefit from project implementation. The purpose of this article is to make statistical analysis of articles that rise question of risk allocation between construction contract parties and evaluate suitability of proposed methods from both contract parties points.

2. Literature review

Construction projects have an abundance of risk. Contractors cope with it and owners pay for it. The construction industry is subject to more risk than any other industries. This process requires a multitude of people with different skills and interests. Construction projects are also influenced by a number of external, uncontrollable factors.

Wang and Yuan [5] analysed contractors' risk attitudes and found out that they depend on a number of factors in construction practice. The paper identified 26 factors likely to affect contractors' risk attitudes in construction projects in China. Results from factor analysis revealed that they can be grouped into four categories, namely: (1) knowledge and experience; (2) contractors' character; (3) personal perception; and (4) economic environment.

Risks in construction projects have been identified and analysed by Zou and Li [6], Adams [7], Ke *et al.* [8], Nieto-Morote and Ruz-Vila [9], Wibowo and Mohamed [10], Xu *et al.* [11], Zayed [12].

The processes of risk identification and management in various projects have been analysed by Banaitienė *et al.* [13], Zavadskas *et al.* [14], Chen *et al.* [15], Doloi [16], Jun *et al.* [17], Perminova *et al.* [18], Reed and Knight [19], Kutsch and Hall [20], Sanderson [21].

In many cases, underestimated risks lead to financial losses. For example, in the construction of a big-value public purpose building there could be different subcontract packages. In any one of the subcontracts, such as mechanical or electrical services installation, there could be another four or five subcontractors. In every situation there will a certain construction contract agreement, but a small specialist subcontractor with a small package of work might expected to carry the potential risk of a very large claim when the project implementation is delayed due to poor work of his team or delayed delivery of materials. Usually, when things go wrong, everybody will find good reasons why it is somebody else's fault – that is human nature [22].

Risk allocation among parties to a construction contract agreement has been studied by Perera *et al.* [23], Doloi [24], Alexandersson *et al.* [25], Jin and Zhang [26], Witt and Lias [27], Jin and Doloi [28], Roumboutsos and Anagnostopoulos [29].

Osipova and Eriksson [30] in the article identified three factors as a basis for determining risk allocation in construction projects, namely, the form of a contract, the form of payments (price fixing) and risk management in partnership projects. Lam *et al.* [1] identified 16 risk options classified into five major groups, namely, (1) capability risks, (2) contractual and legal risks, (3) economic risks, (4) physical-factor risks, and (5) political and societal risks. The authors followed the principle that risk should be allocated to the contracting party best able to handle that risk. The article used an expert approach to obtain initial data on risk allocation among the contracting parties, provided calculations and determined the risk to be accepted by a specific party. El-Sayegh [31] has analysed the construction industry in the United Arab Emirates. Risks significant for the construction industry were identified and allocated among parties involved in construction. Factual data was obtained through interviews with construction experts. The experts were asked to assess risks found in various literary sources and classified into group (a total of 42 risk groups were analysed).

According to KarimiAzari *et al.* [32], risk assessment is the main procedure in the risk management process. The article describes the *fuzzy TOPSIS* method to assess risks. The proposed approach is demonstrated using a *real* case involving an Iranian construction corporation. Andi [4] argues that to effectively manage risks in construction projects, it is crucial to correctly identify important risks and properly allocate them to the contractual parties. The article contains a survey of Indonesian contracts. The survey covered owners and contractors with different experience in the area of construction and 27 construction risks were identified and evaluated. The article demonstrated significant differences in perceptions of construction contractors and owners on the importance and allocation of risks to a specific party (i.e., owner or contractor).

Xu *et al.* [33] carried out a study of nine public-private partnership projects. After the analysis, a total of 11 critical risks were identified and categorized, including: (1) political risk; (2) legal risk; (3) government credit risk; (4) market demand change risk; (5) inflation risk; (6) product price risk; (7) inaccurate market forecast risk; (8) contract risk; (9) financing risk; (10) lack of supporting infrastructure risk; and (11) technical risk.

Bing *et al.* [34] analysed the process of risk allocation in public-private partnerships. The authors argue without question that contractors offer higher project implementation prices when the burden of risk is shifted on the private sector than they would offer if the public sector (i.e., the owner) accepted more risks. The authors further suggest dividing risks into three major levels – micro, mezzo and macro. They identify four categories of risk allocation, namely, (1) risk should be allocated to the public sector; (2) risk should be allocated to the private sector; (3) risk should be shared between the public and

private sectors; and (4) risk allocation is highly dependant on individual circumstances of a project (when risk cannot be allocated to any of the aforementioned three categories). Survey of professionals in the public and private sector served as a basis for allocating particular risks (such as *force majeure*, tax changes, etc.) to the above-mentioned four categories.

Ke *et al.* [35] analysed preferred risk allocation between contracting parties in China's public-private partnership. Based on literature reviews and surveys, 37 potential types of risk were identified. The research employed the *Delphi* method.

Shen *et al.* [36] studied typical public-private partnership contracts in Hong Kong. When allocating risks to any of the parties, the principle was observed to allocate risk to the party best able to handle it.

Khazaeni *et al.* [37] carried out a research of risk allocation among parties to a standard contract agreement. A hierarchy structure was developed for risk allocation criteria. The research was based on the principle that risk should be accepted by the party best able to manage it at the least cost. Experts were invoked to evaluate the significance of each risk criteria. The evaluation employed the pairwise comparison method; calculations were based on the *fuzzy AHP* method.

3. Analysis methodology and results

In a contract agreement, risk is legally allocated on the basis of contractual provisions. Risk allocation among contracting parties has been studied by a number of researchers all over the world. This article presents statistical analysis of global scientific articles in which analysed risk allocation between construction contract parties. Main objective of statistical analysis is to identify:

- how widely this theme is examined, that is how many articles is released in period of 22 years, more specifically since year 1990;
- in which country the scientist examined this theme mostly;
- methods that are used to examine risk allocation between construction contract parties.

Analysis was executed with the help of ISI Web of Science database data. Request to database was executed with keywords "risk allocation" and "construction contract". Accumulated data was organized and statistically processed.

From results of analysis was found that, number of articles since year 1990 is 77. More detailed statistics is presented in Fig. 1(a).

Year in which most frequently question as examined is 2008, just slightly behind are year 2009. In contrary year in which was no articles written was 1993 and 1999. So as see from Fig. 1(a), risk allocation question is still quite widely examined, despite decrease in year 2010, number of analyses in this area is still increasing.

Statistics of articles taking origin country (Fig. 1(b)), shows that to this area mostly contributed countries are China, USA, Australia and Great Britain scientists. Scientists of the all rest countries contributed with 1 or 2 articles in this area, excluding Iran and Taiwan scientists which contributed with 3 articles each. This can be explained with large ongoing construction projects in examined countries.

Final objective of this analysis was to determine methods used to analyze risk allocation between construction contract parties (Fig. 2).

The most popular method in analyzed articles is questionnaire survey – 55% of articles (Fig. 2), that's is authors of the article organize questionnaire survey of construction specialists and based on results of each risk factor assigns specific risk to one of construction contract part. Because understanding of risks and their sources are country depended results are different each time. In minority of articles *Delphi* survey method was used. Also in minority of articles methods *fuzzy AHP* and *fuzzy TOPSIS* were used. And only in few articles for risk allocation were applied game theory methods.

4. Conception of cooperative game theory

To sum up, risk allocation among parties to a construction contract agreement appears to be a relevant problem currently explored by a vast number of researchers from all over the world. Review of research papers on this topic leads to a conclusion that equitable and balanced risk allocation among contracting parties is emphasised on the one hand, but on the other hand, the task of risk allocation/sharing among contracting parties is dealt with on one side only, i.e., by owner. This approach predetermines improper or contractor-unfavourable risk allocation outcome which results in cost and/or time overrun and, undoubtedly, in legal disputes. According to the author, risk allocation among the parties to a construction contract work should employ cooperative decision-making techniques. Cooperative decision-making techniques are methods of the game theory. The game theory applies when two or more groups of operators – states, armed forces or, in the case at issue, contracting parties – confront each other. In this case, decisions are to be made in a conflict situation [38].

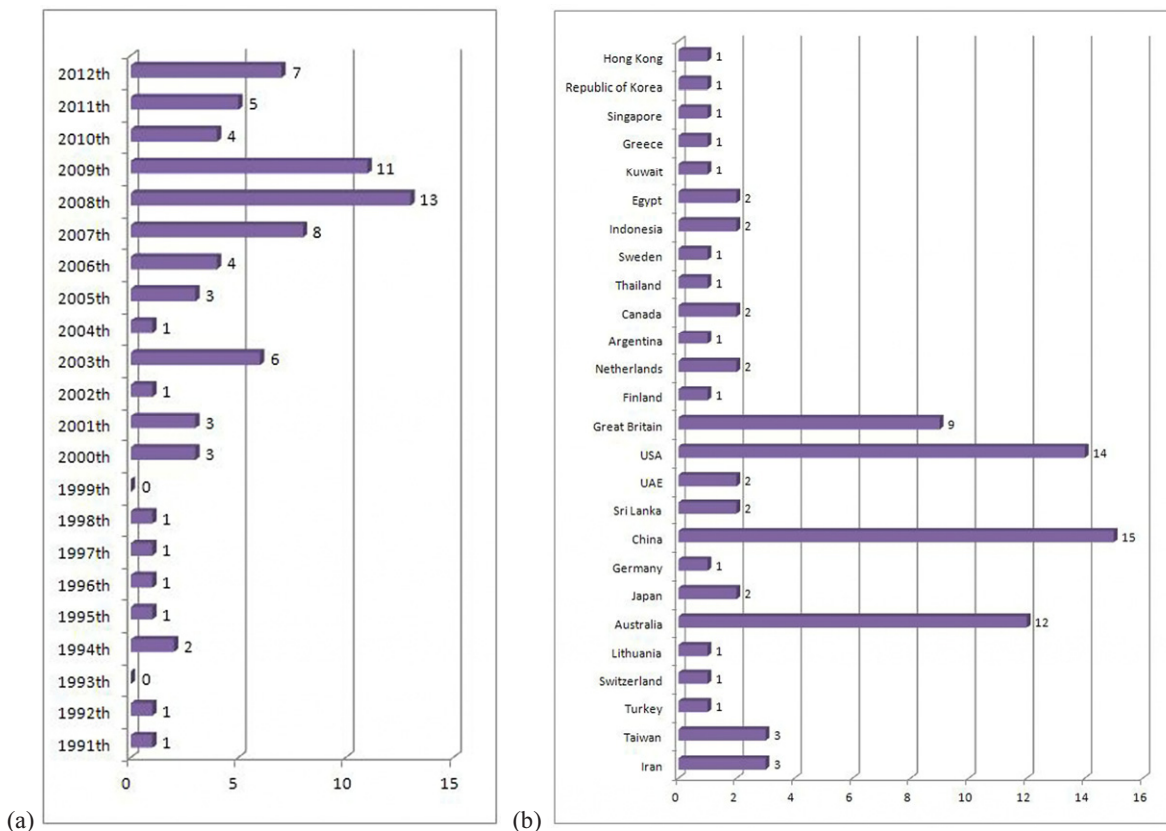


Fig. 1. Statistics of risk allocation articles in the world in period of 22 years (a) by year and (b) by country

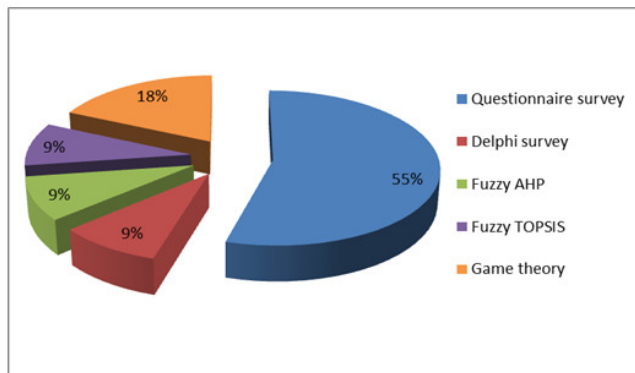


Fig. 2. Methods used to evaluate risk allocation between parties

Game theory is a method originated from the mathematical sciences in which is used in competitive or cooperative position to find optimal choices that will lead to desired outcome. Non-cooperative game theory is applied where players only focus on their objectives and attempt to bring more benefits for themselves. In cooperative game theory, cooperation of players can lead to win-win situation and bring more benefits for all involved players. A game is called cooperative, if the decision makers in a joint activity work together with forming the coalition to achieve more benefits than individual activities. Researchers use cooperative game theory for allocating the costs or benefits from a cooperative coalition to find adistinct ratio vector of all outcomes. This ratio vector should be not only optimized but also be fair and equitable [39].

Cooperative game theory has these solution concepts: the stable set, the core, the core of a simple game with respect to preferences, the strong epsilon-core, the Shapley value, the kernel and the nucleolus [40].

Application of cooperative decision-making techniques for risk allocation among parties to a contract agreement is the object of further research of the authors.

5. Conclusions

No construction project is risk free. Risk should be share among contracting parties in such a manner that not of the parties is harmed. In the area of risk allocation between construction contract parties many research is done and work is still ongoing. Statistical analysis results shows that most work in this area is done by scientists from countries such like China, USA, Australia and Great Britain. Found that findings enable making decisions that are favourable only to one party to a construction contract agreement, i.e., owner. Decisions made through the prism of one party to a construction contract agreement are often wrong for the other party. This gives rise to numerous legal disputes, rendering implementation of construction projects irrational in general terms. Risk allocation among parties to a construction contract agreement should employ cooperative game theory where under decision are made taking into account the needs of all the parties concerned. Application of cooperative game theory for risk allocation among parties to a construction contract agreement is the object of further research of the authors.

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