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IDENTIFICATION AND ANALYSIS OF RISKS IN CIVIL ENGINEERING PROJECTS

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RESUME

The main and primary goal of the research in this paper is to analyze the actual current situation in domestic civil engineering, by determining the causes of missing deadlines and exceeding budgets of civil engineering projects. Since the results of this research also indicate the most likely problems that could arise during the construction of a project, the findings and conclusions could be used in risk assessment and drawing up dynamic plans for actual projects, which would improve the situation in domestic civil engineering and increase productivity of this important industry.

The results obtained in this paper provide a modern approach to the problem of risk in construction, provide a realistic insight into risk factors on civil engineering projects in the Republic of Serbia and the surrounding area, and facilitate the establishment of a better correlation between theory and practice in project management and risk management.

Key words: *risk management, project management, civil engineering projects*

INTRODUCTION

Due to the volume, value and socio-economic importance of building structures, as the final results of the production process, civil engineering represents one of the most important and specific economic activities and an extremely important factor in the development and preservation of the national economy. The more funds, experts, labor, materials, equipment and capital are provided from domestic sources, the higher and more pronounced the level of development of the local economy and its independence in relation to foreign aid and investments is. In addition, the growing tendencies of European integration include an increase in the number of international projects and cooperation with partners from a materially and technically more advanced and economically stable environment, with countries in transition expected to successfully keep pace with more developed partners and respond to business requirements imposed by modern international standards and conditions of international market competition.

Civil engineering projects are always unique, whereby, due to a number of various sources, the occurrence rate of undesirable situations increases [1,2]. They are intrinsically complex and dynamic and they include multiple feedbacks from different processes [3].

According to [4], risk is the cumulative effect of the uncertainty of phenomena that will negatively affect the objectives of the project. Risk and uncertainty characterize situations in which the actual outcome of a particular event or activity is likely to deviate from the estimated one [5]. According to [6], risk is a measurable part of the uncertainty, for which we are able to assess the probability of occurrence and the magnitude of the damage. Risk is also defined as a deviation from the desired level. It can have a positive or, more often, an adverse effect on civil engineering projects [7,8]. In addition, exceeding costs and missing deadlines does not only affect the civil engineering industry, but also the overall economy and development of countries in general [9].

The previously mentioned concepts suggest that it is necessary to implement advanced project management techniques and methodological approaches that will provide the highest level of service, while achieving maximum profit and minimum unforeseen costs, when designing, planning and performing construction works. Successful management of a construction project, while observing the planned deadlines and budget, depends on the methodology that requires knowledge, experience and the so-called "engineering thinking", i.e. a practical and realistic approach to perceiving and solving problems.

In order to achieve this, it is necessary, among other things, to take a professional approach to risk management, which means anticipating possible causes of downtimes, delays and failures, in order to prevent or eliminate the causes of their occurrence, and develop a strategy to overcome significant negative consequences of their occurrence on the planned budget, deadlines, duration and unimpeded running of the project [10].

It is important to start using risk management from an early stage of the project, in which the main decisions are the way of coordination and the choice of construction methods [11]. On the other hand, the problems that accompany the realization increase with the size of the project, i.e. the uncertainty about the outcome of the project increases with the increase of its size [12,13]. The causes of missing deadlines and exceeding budgets, from the aspect of the project and company size, are discussed in papers [14,15,16,17,18]. The paper [14] presents an analysis of 806 large projects around the world, and it was concluded that the average cost overrun is 35.5%.

Risk analysis and management techniques have been described in detail by many authors [19,20,21,22,23,24]. In general, risk identification is the first and perhaps most important step in the risk management process, as it attempts to identify the source and type of risk [25]. This includes identifying potential conditions for a risk event in the construction project and clarifying risk responsibilities [26]. Risk identification develops the basis for the next steps, i.e. analysis and control of risk management. Identification actually improves and ensures the effectiveness of risk management. According to [27], project risk identification and mitigation are key steps in managing successful projects. In the paper [28], the identification of risks to the achievement of project objectives was investigated, while the identification of risks through the phases of project implementation is presented in the paper [10].

Qualitative and quantitative analyzes represent an important step in the risk management process [25]. Qualitative analysis is considered to be an evaluation process that includes a description of each risk and its impact or a subjective risk labeling (high / medium / low) in terms of the impact of the risk and the likelihood of its occurrence [10]. Quantitative risk analysis attempts to assess the frequency of risks and the magnitude of their consequences, using various methods such as decision tree analysis, cost risk analysis, and Monte Carlo simulations [29].

Uncertainties and risks involved in civil engineering projects cause price overruns, missing construction deadlines and lack of quality in project progress and completion [26,30,31]. A review of the literature reveals a wide range of types and sources of risk in civil engineering projects, as well as that different risk management methods and techniques can be included in construction project management in order to control potential risks. A review of the scientific and professional literature also points to the fact that many authors have dealt with risk assessment and their impact on missing the planned deadlines and budgets [14-16,32-46].

Missing deadlines and overrunning costs in construction projects knows no geographical boundaries and it is a global phenomenon. The research was conducted in various locations around the world [China [10], the Netherlands [14], Saudi Arabia [16,42], Great Britain [28], Nigeria [34,46], Sweden [41], Turkey [44], Egypt [47], Poland [48,49], Lithuania [50], Korea [51], United Arab Emirates [52], Chile [53], Qatar [54], Australia [55,56], Serbia [57,58], and many others).

Unfortunately, in most civil engineering projects in the Republic of Serbia and the immediate surroundings, the phenomenon of missing the planned deadlines and overrunning the budget is evident and pronounced. This is especially pronounced in the projects where the criterion for the selection of contractors is exclusively the lowest offered price at the public auction, which is the most common practice in the construction of large public structures and when implementing the projects of national importance. As noted in [32], low construction costs are more a rule than an exception, where both the investor and the contractor have significant financial losses due to cost overruns.

The authors [34] indicate that poor risk management is one of the main factors of delay and conclude that the actions and inactions of participants in the construction process can contribute to the overall delay and budget overrun.

The paper [53] states that risk management is either not used or is not implemented effectively enough in many countries where civil engineering projects are implemented. One of the main reasons for this is the lack of experience, skills and knowledge about risk management.

Although advanced risk management methods are highly supported by mathematical tools [15,38,59-64] and contemporary computer tools [51,53,65], in some countries risk management in construction projects is still not efficient. For efficient and effective risk management, it is necessary to have an appropriate and systematic methodology and, more importantly, knowledge and experience from various types of projects that have been previously implemented [46].

Increasing efficiency in terms of time, material and human resources requires careful planning and comprehensive analysis, which includes the analysis of potential risks, as well as a strategy for overcoming them. Identifying the most common and important causes of delays and budget overruns would ensure, if not a complete avoidance of such situations, then at least their timely prediction in order to avoid an adverse surprise factor and to mitigate their consequences.

The research conducted and presented in this paper was aimed at determining as many causes as possible of budget overruns and missing deadlines on actual civil engineering projects, which took place in the period 2000-2016 (in the Republic of Serbia and neighboring countries), with special reference to subjective attitudes from the point of view of investors, contractors and supervisory authorities. The research was conducted through a survey of eighty engineers, and the selection of participants was done so that all target groups in terms of experience, territorial affiliation, types of projects and other aspects that could have a subjective impact on their responses and attitudes expressed in survey are addressed. Sample formation, data collection and their statistical processing were performed in accordance with the rules of scientific research.

Statistical data processing should confirm whether the applied approach was correct and whether the obtained results give a realistic picture of the situation from different points of view, primarily from the point of view of contractors, investors and supervisors.

MATERIAL AND METHODS

In order to gain as objective appraisal of the real situation as possible, the research was conducted in the form of a survey designed and conducted in accordance with the rules and requirements of scientific research, where questions are formulated based on theoretical and practical knowledge of the author, in collaboration with civil engineers who have experience in carrying out construction projects.

The questionnaires were distributed to practical engineers, selected to form a sample that demographically accurately reflects the population, i.e. to comprise members of all age/experience groups from Belgrade, Sarajevo, Zagreb and the interior, from different companies and with different experience.

The primary classification differed between construction engineers, supervisors and investor representatives, as these three groups are directly involved in the execution of construction projects, and by the nature of their work they have different and very often opposing opinions. Consideration and comparison of different points of view enabled the acquisition of a realistic insight into the causes for missing deadlines and overrunning budgets of construction projects.

The standard methodology of scientific research was implemented in the research, which includes a quantitative and qualitative approach. The quantitative approach included the formation of a sample, data collection through a survey and their adequate processing, while the qualitative approach included the analysis of the obtained results, the establishment of cause-and-effect relationships and their interpretation and explanation.

The formation of the sample, the choice of the form of the questionnaire, the compilation of questions and the choice of the method for the qualitative assessment of the research results were conducted in consultation with experts from the agency "Source" from Belgrade, which surveys public opinion and markets.

The research was conducted in six carefully prepared and conducted phases:

1. Defining of problems and goals of research and formation of the research plan;
2. Making of survey questionnaires based on the consultation with practicing engineers;
3. Formation of samples, i.e. choice of respondents from all observed categories;
4. Conducting of the survey;
5. Statistical processing of the collected data;
6. Conclusions, recommendations and potential for further research.

Survey questionnaires were formed in accordance with the rules for this type of research, whereby the questionnaires were preliminarily formulated based on experience in project management and construction technology, and the final form was obtained after consultation with five civil engineers, who have experience in construction projects.

For more thorough and accurate data processing, the factors that may affect the missing deadlines and budget overrun are divided into the six following groups:

1. General factors;
2. Contractor responsibility;
3. Supervision responsibility;
4. Investor responsibility;
5. Material;
6. Design and design documents.

Since the subject of the research is the analysis of personal attitudes of the respondents, the ordinal (numbered) Likert scale was adopted as an appropriate measuring device.

It was planned that ninety engineers would participate in the survey, thirty each from the territories of Bosnia and Herzegovina, Serbia and Croatia, selected so that all the above groups and classifications would be better and more evenly covered. Eighty of them returned the completed questionnaires (28 from Bosnia and Herzegovina, 27 from Serbia and 25 from Croatia). The analysis of the survey results showed that there are no differences in opinions that could be attributed to regional (state) affiliation, so that the sample can be viewed collectively, regardless of which country the respondent is from. It was also shown that the gender of the respondents (45 men and 35 women) was not relevant.

Of the eighty survey participants, forty participated in construction projects as contractors (50%), twenty-four as supervisors (30%), and sixteen as investor representatives (20%).

Twenty-four of them had less than three years of experience (30%), twelve between three and five years of experience (15%), twenty between five and ten years of experience (25%), and twenty-four more than ten years of experience (30%).

Of the eighty survey participants, thirty-two were from capitals (40%), twenty from cities with more than 100,000 inhabitants (25%), sixteen from cities with 50–100,000 inhabitants (20%), and twelve from cities with less than 50,000 inhabitants (15%).

Twenty-four (30%) participated in projects with a total annual value of over € 3,000,000, thirty-two (40%) on projects worth € 1–3,000,000, and twenty-four (30%) on projects worth less than € 1,000,000 €.

Of the eighty survey participants, twenty (25%) were from small, twenty-eight (35%) from medium, and thirty-two (40%) from large firms.

The ranking of results by importance was performed based on the value of the importance index (Iv), which is calculated according to the following expression [66]:

$$I_v = \sum_{i=1}^{5} a_i x_i \quad (1)$$

where:

- I_v - is importance index;
- $a_i = 1, 2, 3, 4$ or 5 - numerical response value;
- x_i - response frequency a_i, expressed as the respondent percentage that selected this response in relation to the total number of respondents.

Expressing the results through the index of importance is especially convenient and important when the population, i.e. the sample as its representative part, can be divided into subgroups in several different ways. In such cases, depending on the division into subgroups of respondents observed, the ranking of the importance of the impact may differ significantly.

For example, the attitudes of respondents younger than twenty years will differ significantly from the attitudes of respondents older than fifty, but also the attitudes and priorities will differ significantly within each age group separately, i.e. if each age group is divided according to some other criterion, e.g. education, income, education, etc. Full insight into the attitude of the population can be gained only if the problem is viewed from as many angles as possible, i.e. through several different divisions of the population into target groups.

Another advantage of ranking different factors according to the index of importance, lies in the fact that in this way not only the comparison of factors is performed, but also the opinion of a group of respondents on the importance of each factor is obtained. For example, if none of the top ten factors on the ranking list has an importance index greater than 50%, it means that no factor is actually "overly" important. Also, if the first-ranked factor has an importance index in the range of 60-70%, it means that it is the most influential in a given set or for a given group of respondents, but that it does not actually have a primary impact on the subject of research.

On the other hand, if the first five factors from the list have factors of importance greater than 90%, it means that they are all extremely important and that the fifth-placed is no less influential than the first-placed.

RESULTS AND DISCUSSION

Factors affecting missing the deadlines

Table 1 shows a consolidated ranking list of respondents' attitudes about the importance of certain factors that affect the missed deadlines in construction projects. Table 1 (figures 1, 2 and 3) gives a ranking list in relation to the attitudes of contractors, investors and supervisors.

The table shows that the attitudes of contractors and investors are similar when it comes to the most influential factors and that the first five places in their rankings are almost identical, both in order and in indices of importance. The attitudes of supervision are somewhat different, but the first three of the first five places on the ranking list are repeated, so it can be said that there is uniformity in attitudes.

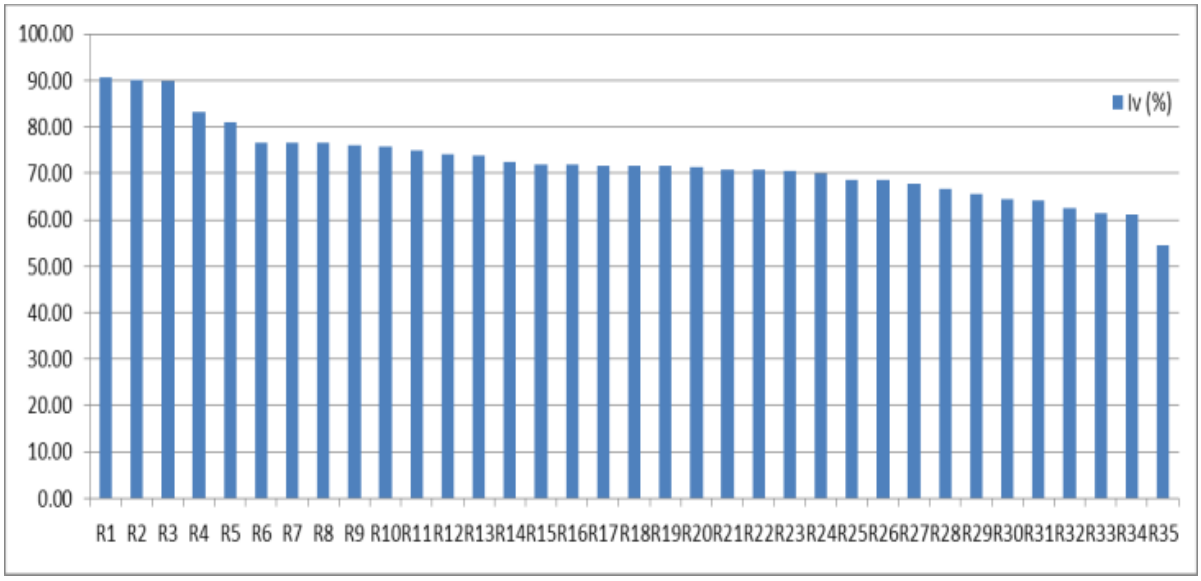

Figure 1. Index of importance of factors affecting missing deadlines - contractor opinion

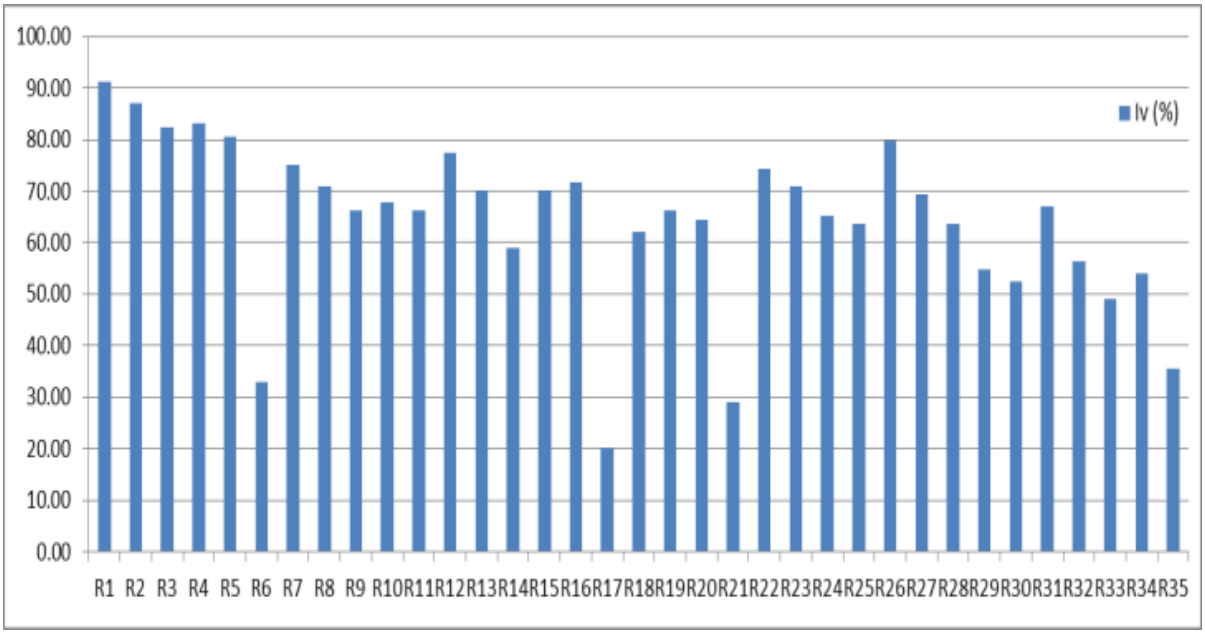

Figure 2. Index of importance of factors affecting missing deadlines - investor opinion

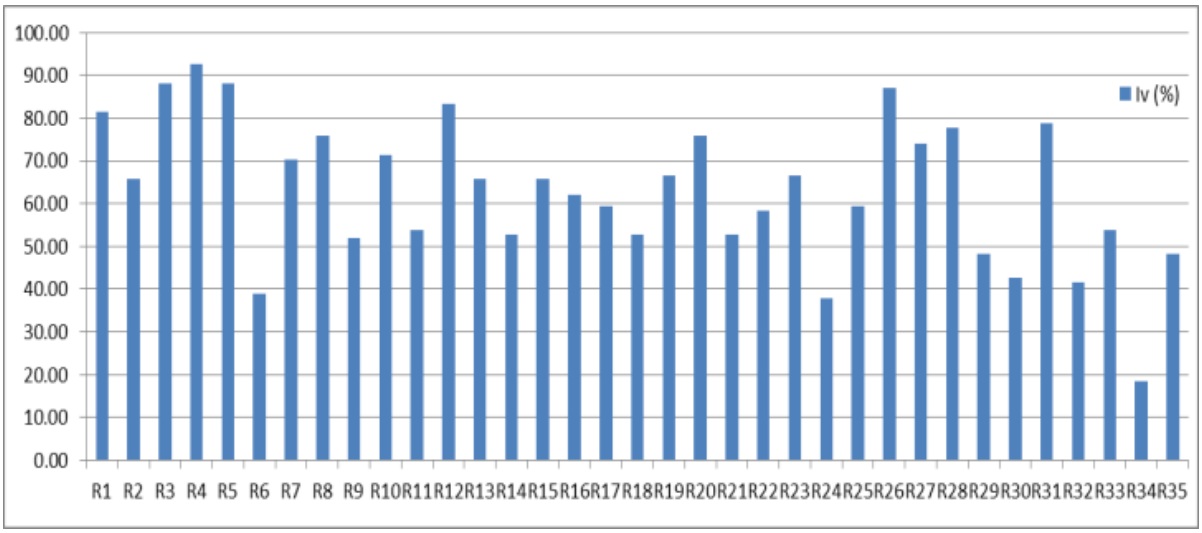

Figure 3. Index of importance of factors affecting missing deadlines - supervision opinion

Table 1. Summed comparative view of the results

No	Factor	Contractors		Investors		Supervision	
		I_v (%)	Rank	I_v (%)	Rank	I_v (%)	Rank
1.	Shortage of material on the market	90.53	1	91.13	1	81.48	6
2.	Shortage of material on the construction site	90.15	2	87.10	2	65.74	16
3.	Delays in material delivery	89.77	3	82.26	4	87.96	2
4.	Financial problems during construction	83.08	4	83.06	3	92.59	1
5.	Poor construction site management	81.06	5	80.65	5	87.96	3
6.	Delay of due payment	76.52	6	33.06	33	38.89	33
7.	Inadequate material quality	76.52	7	75.00	8	70.37	13
8.	Lack or breakdown of machinery and equipment	76.52	8	70.97	12	75.93	10
9.	Sluggishness in issuing permits	76.15	9	66.13	18	51.85	28
10.	Subsequent design alterations	75.76	10	67.74	16	71.30	12
11.	Poor assessment of time and material resources	75.00	11	66.13	19	53.70	24
12.	Self-initiated interruption of works as requested by contractors or investors	73.97	12	77.42	7	83.33	5
13.	Inadequate handling of material on the site	73.86	13	70.16	13	65.74	17
14.	Insufficient training level of workers	72.35	14	58.87	26	52.78	27
15.	Lack of knowledge or lack of implementation of project management	71.97	15	70.16	14	65.74	18
16.	Slowness in solving problems and making decisions at the project level	71.97	16	71.77	10	62.04	19
17.	Unrealistic investor requirements (deadlines)	71.59	17	20.16	35	59.26	20
18.	Incomplete drawings	71.59	18	62.10	25	52.78	26
19.	Poor and/or slow communication between the project participants	71.48	19	66.13	20	66.67	14
20.	Errors in execution of works	71.21	20	64.52	22	75.93	9
21.	Investor interfering in work	70.83	21	29.03	34	52.78	25
22.	Construction site manager inexperience	70.83	22	74.19	9	58.33	22
23.	Centralized decision making system in supervision	70.45	23	70.97	11	66.67	15
24.	Lack of experience and/or of expertise of supervision	70.08	24	65.32	21	37.96	34
25.	Incomplete documents and/or imprecise descriptions and specifications	68.56	25	63.71	24	59.26	21
26.	Insufficient number of workers	68.46	26	79.84	6	87.04	4
27.	Repairs and subsequent works due to poor quality and errors in construction	67.80	27	69.35	15	74.07	11
28.	Self-initiated withdrawal from the project	66.67	28	63.74	23	77.78	8
29.	Designer inexperience	65.53	29	54.84	28	48.15	30
30.	Design errors	64.39	30	52.42	30	42.59	31
31.	Stubbornness in case of a dispute between contractor, investor, and/or supervision.	64.02	31	66.94	17	78.70	7

32.	Insufficient number of supervision personnel	62.50	32	56.45	27	41.67	32
33.	Slowness in correcting errors in the design	61.36	33	49.19	31	53.70	23
34.	Human factor (personal conflicts and dislike, corruption, political games)	61.15	34	54.03	29	18.52	35
35.	Special requirements (high finish quality etc..)	54.55	35	35.48	32	48.15	29

Contractor opinion

Problems related to the material occupy the first three places in the ranking list of contractors' opinions, with a slight difference in the value of the importance index (value range less than 2%). This is followed by financial problems during construction (83.08%) and poor construction site management (81.06%). From sixth place downwards, the list continues with a relatively steady rate of decline in the importance index and ends with special investor requirements (54.55%), as the least important factor. It is interesting to note that the contractors in the evaluation were much less rigid than their counterparts from the other two groups (supervision and investor), as most factors received relatively moderate ratings of importance (55-76%), while only the first three (about 90) %) and the other two (81–83%) differ significantly. In addition, the contractors were more self-critical and objective than their counterparts, as they attached more importance to the factors for which they were responsible. The only significant difference in opinions, compared to the other two groups of respondents, can be seen in the item "Insufficient number of workers", which is only in the twenty-sixth place among contractors (68.16%), while among investors and supervisors it ranks high, in the sixth (79.84%) and fourth (87.04%) places, which testifies to the previously stated position that the problem should be viewed from different angles and that the analysis of only one standpoint would give a one-sided and inaccurate view of the problem.

Investor opinion

It is noticeable that there is a strong subjectivity in the attitudes of engineers who participated in construction projects as representatives of investors, since the factors directly or indirectly related to their responsibility received extremely low grades, i.e. the importance index less than 40%. However, it is noticeable that the representatives of supervision gave relatively low marks to the same factors, but that the position of investors and supervision almost coincides (very low index of importance) when it comes to delays in cash payments by investors, while contractors gave this factor a high sixth place and relatively high importance (76.52%). The most noticeable deviation can be seen in the last place of the list, where there are unrealistic demands of investors in terms of deadlines, which is a factor to which investors do not attach any importance (20.16%), while it is relatively high among contractors and supervisors, whereby contractors attach much greater importance to it (71.59%) than supervision (59.26%). The upper part of this ranking list is almost the same as that of the contractors, and the first five places are in the same range of importance index (80-91%). The difference in relation to the contractors is reflected in somewhat more rigid attitudes, which can be seen by the faster decline of the importance index. While with contractors only one factor has an index of importance of less than 55%, with investors there are as many as eight, four of which have almost no importance (less than 40%).

Supervision opinion

Engineers from this group had the most definite opinions, with the largest range of importance indexes (18.52-92.59%) and with as many as thirteen opinions that they declared little or not important for the project. As with the representatives of investors, there is a noticeable subjectivity and low self-criticism, as the representatives of the supervision assessed all the factors from their domain of responsibility as little important or almost unimportant. As the most important factor in mission the planned deadlines, supervising engineers pointed out the poor handling of finances by the contractor (92.59%), and the next three places are almost equally occupied by delays in material delivery and poor site management, with 87.96% and insufficient number of workers with an importance index of 87.04%, which are all factors in the contractor responsibility domain. It is also noticeable that in the first ten factors there is only one that is from the domain of force majeure, and that is the shortage of

materials on the market (81.48%, sixth place), which is in the first place for both contractors and investors.

Factors affecting budget overrun

Table 2 (figures 4, 5 and 6) provides a comparative ranking of respondents' opinions on the factors influencing the budget overrun in construction projects. It can be noticed that in this case the opinions were more uniform both qualitatively and quantitatively, i.e. that the lists of contractors and investors are almost identical, while the list of supervision engineers is somewhat different, but the importance indices are approximately the same order of magnitude.

Table 2. Factors affecting budget overrun

No	Factor	Contractors		Investors		Supervision	
		I_v	Rank	I_v	Rank	I_v	Rank
1.	Works and procurement of materials and equipment delay (contractor responsibility)	83.71	1	83.87	2	95.37	1
2.	Changes in prices of materials and equipment	81.06	2	87.96	1	80.65	4
3.	Inflation (change of value of domestic currency in respect to euro)	78.79	3	77.42	3	88.89	2
4.	Alterations of the project during construction (investor responsibility)	76.92	4	75.81	4	69.44	8
5.	Additional requirements (investor responsibility)	76.52	5	72.58	7	66.67	9
6.	Poor planning and control of financial resources investment dynamics	75.38	6	74.19	6	82.41	3
7.	Poor expenses record	72.73	7	75.00	5	75.93	6
8.	Poor organization structure at the level of project	71.59	8	62.90	8	75.00	7
9.	Incomplete design documents	67.42	9	57.26	10	57.41	10
10.	Errors and flaws in the bill of quantity	64.77	10	61.29	9	77.78	5

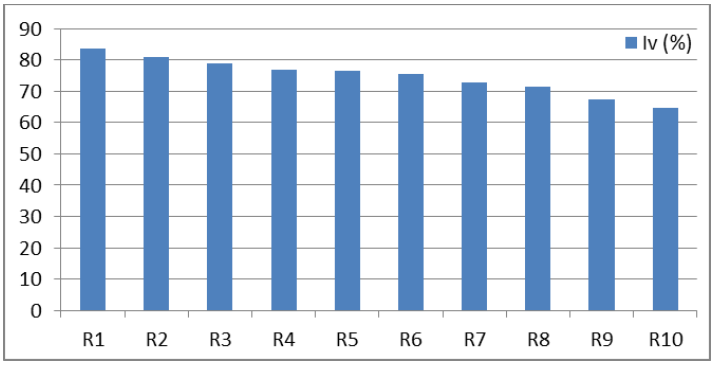

Figure 4. Index of importance of factors affecting budget overrun - contractor opinion

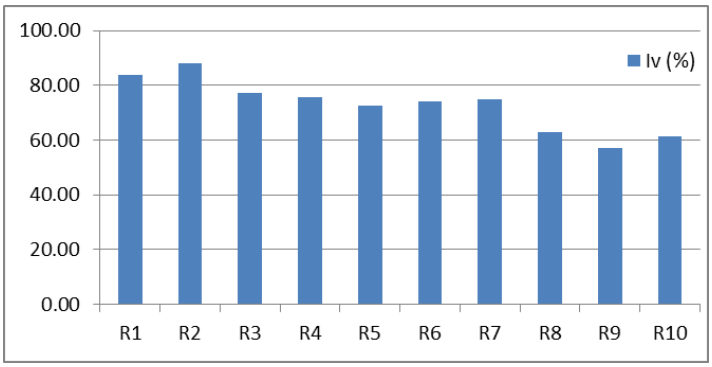

Figure 5. Index of importance of factors affecting budget overrun - investor opinion

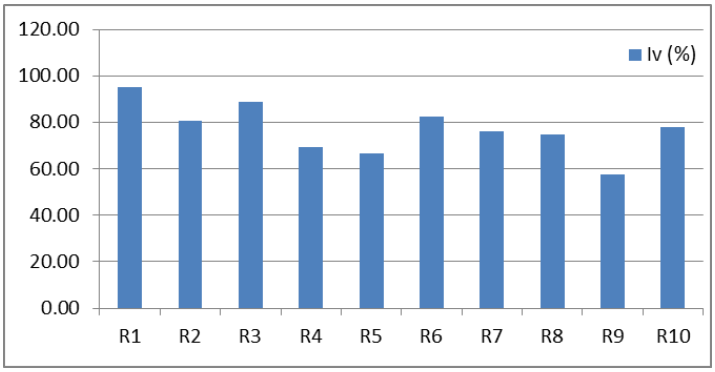

Figure 6. Index of importance of factors affecting budget overrun - supervision opinion

Contractor opinion

The contractors stressed the delay of works and procurement of materials and equipment and the change in the price of materials as the most important factors, with importance indices of 83.71 and 81.06%, followed by inflation (78.79%), project changes (76, 92%) and additional investor requirements (76.52%). As the least important factor, at the bottom of the list there are errors in the bill of quantities with an importance index of 64.77%.

Investor opinion

As already mentioned, the ranking of investors' opinions is almost identical to the ranking of contractors, with clearer divisions between important and unimportant factors, as evidenced by the fact that the last three items have a noticeably lower importance index than others (difference between seventh and eighth place is ten percent).

Supervision opinion

The supervising engineers had a very definite position on the main cause of the budget overrun, which can be seen by the fact that they almost unanimously assigned the extreme importance of 95.37% to the delay of the works. In second place is inflation (88.89%), and in third place, with an importance index of 82.41%, is poor planning and control of dynamics. Of all the categories and groups of factors, in the study presented in this paper, this is the group with the most pronounced differences in the values of the importance index, since the difference between the first and third place is as much as 13%.

The range in importance indices here is even larger than in the other two groups of respondents (almost 40%), which indicates a greater resolution and determination of engineers from this group. It is interesting that on the lists of contractors and investors, flaws and errors in the bill of quantities and estimate are positioned very low, while in the case of supervision engineers they are around the middle of the list, with a noticeably higher importance index.

CONCLUSION

Statistical data processing showed that the applied approach was correct and that the obtained results give an overview of the situation from different standpoints, primarily from the standpoint of contractors, investors and supervisors. Respondents within the same groups had relatively similar views, but the views of the groups differed, leading to the conclusion that this issue should not be generalized, but that factors of budget overruns and missingdeadlines should be viewed and assessed from different aspects.

Although the initial expectation was that the attitudes of contractors and investors would differ significantly, and that the opinions of supervisors would be somewhere between theirs, the results showed that the opinions of contractors and investors were, in most cases, relatively similar while the supervision opinions differed moderately to considerably. In addition, it is noticeable that contractors were more reserved in attitudes, as the range of importance index generally ranges between 65 and 85% and has a predominantly even distribution of values, while the range of values with investors and supervision respondents is broader and with larger peaks, which testifies to more assertive attitudes. Another fact that testifies to the greater moderation of the contractors as a group, is that they were much more self-critical than their colleagues from the other two groups. In contrast, representatives of investors and supervisors gave strikingly low ratings to factors related to their accountability. Such differences in attitudes and mindsets can also be attributed to a relatively small sample (twenty engineers in total), so a significantly larger sample would likely yield more balanced results with a more even distribution of importance indices within the same group of factors.

From the analysis of the causes of missing the deadlines, it is noticeable that the vast majority of respondents ascribed a primary importance to factors directly related to materials and equipment, whether it is force majeure (shortage of materials on the market) or the responsibility of the contractor and poor material handling). It is followed by the factors that are in the domain of responsibility of the contractor (poor management of the construction site, insufficient number of workers, etc.). The general opinion is that the factors related to the project documentation have the least impact on delays during construction. The importance of the shortage of materials on the market and on the construction site was especially pointed out by the respondents from smaller cities, which shows that this problem is more pronounced in less developed environments, where the supply of materials and equipment is lower both in qualitative and quantitative terms. It is also interesting to note that in all groups, younger survey participants, much more than older colleagues, insisted on the importance of knowing project management. Respondents' views on the reasons for overrunning the planed budget were much more uniform. The most important factors of budget overruns are delays in works, changes in material prices and changes in the design during construction. As with deadlines, the least importance is given to shortcomings in the project documentation.

The results of the presented research met the expectations, because they clearly indicate the most likely problems that could arise during the realization of a civil engineering project. The acquired knowledge and conclusions can be used in risk assessment and in drawing up dynamic plans for actual projects, which would improve the situation of civil engineering in the country and the region.

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