

Evaluation of Subcontractor Selection Criteria and Comparison With Their Financial Performance Indicators

Stefan Koprivica¹

¹ Faculty of Civil Engineering and Management, University Union - Nikola Tesla, Belgrade, Serbia
e-mail: stefankoprivica@unionnikolatesla.edu.rs

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ABSTRACT (10 PT)

The successful selection of subcontractors is a crucial process for any construction project. Many factors affect the subcontractor selection, and in most cases, the subcontractor is chosen based on the lowest bid. However, selecting an improper subcontractor can cause delay of works and delay in the project, low work quality, and additional resources. As the research methodology, a survey was carried out by 30 project managers, construction managers and site engineers participating in the construction sector as Main Contractor. This survey aimed to evaluate 20 subcontractors based on the evaluator's experience. For each subcontractor, financial performance indicators were calculated. The paper presents the connection between the survey results and financial ratios, improving the subcontractor's selection and the Main Contractor's decision-making process.

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Corresponding Author:

Stefan Koprivica,

Faculty of Civil Engineering and Management, University Union - Nikola Tesla, Belgrade, Serbia. Email: stefankoprivica@unionnikolatesla.edu.rs

1. Introduction

The subcontractor selection is crucial for the realization of any project in the construction industry. It determines the levels of risk in the project and defines the future quality and the relationships between project parties. In recent years, about 90% of the construction work has been carried out by subcontractors (Polat et al., 2015) and thus main contractor transfer much of the risk and responsibility to the subcontractor. Risk hedging will enable the main contractor to perform control and coordination of works, while subcontractors are expected to be independent in managing construction works, labour and mechanization. In addition, the reasons for subcontracting include the required high quality of work, cash flow planning and reduction of overhead costs (Mbachu, 2008), the complexity of specific projects and the need for specialized equipment and skilled labour (Polat et al., 2015).

Regardless of when the subcontracting is approached, the contracted price of the subcontractor should be lower than the agreed dry cost price for the contracted works. Based on that, it can be concluded that the calculated dry cost price or the price of the contracted position directly affects the choice of the subcontractor. Although there are different procedures and methodologies for subcontractor selection in practice, in most cases, the subcontractor is selected based on the lowest bid (Arslan et al., 2008). In a Study by Darvish, Yasaei, & Saeedi (2009), some countries have defined criteria for selecting the "cheapest" contractor in the framework of public procurement - Table 1.

Table 1. Approaches for contractor's selection (Darvish et al., 2009)

Country	Decision making approach
Denmark	Rejecting the highest two and the lowest two and selecting the contractor that offers a price closest to the average.
Italy, Portugal, South-Korea	Rejecting the highest one and the lowest one and selecting the contractor that offers a price closest to the average.
France	Rejecting the contractor that offers an abnormally low price.
Australia	The process is implemented in two stages: first, evaluating the contractor's experience; second, bargaining for a price then occurs.
Saudi-Arabia	The lowest bidder is selected provided that the bid is not less than 70 per cent of the owner's cost estimate.
Turkey	The lowest price determines the selection.
Canada, USA	The lowest bidder is selected.
Lithuania	The lowest bidder is selected.
Iran	The lowest bidder is selected. The process occurs in two stages: first, the contractor's pre-qualification is evaluated; second, the lowest price mechanism works.

Choosing subcontractors becomes most noticeable when it comes to "smaller" contracts and contract values for works up to 100,000 EUR. Then the subcontractor does not have to have significant references because these works are not considered a priority. On the other hand, selecting an unsuitable subcontractor can cause delays in specific works and delay of the project itself, poor quality of performed work, and additional subcontractors engagement. This paper presents the connection between experience-based performance indicators and financial ratio indicators to make a quick and correct decision on the selection of subcontractors.

2. Literature Review

2.1. Subcontractor selection criteria

The subcontracting process is a problem that generally includes quantitative and qualitative criteria. So, in recent decades, several researchers have been involved in studying, identifying, ranking, and prioritizing the most important criteria that can influence subcontractor preselection and selection.

Cooke and Williams (2013) defined a Checklist for subcontractor selection which depends on previous experience with the subcontractor; the subcontractor's ability to manage his resources and liaise with the main contractor's staff, including good relationships between parties; financial standing; expertise; reputation; current workload; competitiveness of the subcontractor's price; contractual risk; quality; trade and bank references. A model for subcontractor selection in refurbishment projects (Okoroh & Torrance, 1999) identifies further criteria: financial strength; prior experience; the potential of submitting a credible bid; labour and management capability; workload; quality; transportation; safety records and trustworthiness. A study conducted by Turksis (2008) presented 13 criteria for selecting the best contractor: history of reasonable bid price submissions; work history that indicates specialization and quality of craft in a particular construction skill; contractor's degree of participation and quality control; cooperation with other contractors; timely notification, scheduling and coordination of works; responsiveness to warranty issues; safety consciousness; job site cleanliness; flexibility and cooperation when resolving delays; ability to meet project schedule and workload. Arslan, Kivrak, Birgonul & Dikmen (2008) created a system for evaluating subcontractors so that it is not possible to choose if there was no previous experience in working with that subcontractor.

Further subcontractor selection criteria could draw from Marzouk, El Kherbawy & Khalifa (2013): flexibility and cooperation when resolving delays; reputation; delay; failure to comply with the quality specifications; quality; supplier's incompetency to deliver materials on time; failure to complete the contract; physical resources; tender price; contractor's difficulty in reimbursement; flexibility in critical activities and safety consciousness on the job site. Ulubeyli, Kazaz & Arslan (2017) stated that essential criteria factors are: prior experience; past performance, relationships from previous projects; financial strength; workload; safety records and reputation. El-khalek, Aziz & Morgan (2019) surveyed by using 55 influencing factors. The result was that the most significant criteria among all the surveyed are: on-time delivery of materials, failure

to complete the contract due to financial problems, subcontractor's difficulty in reimbursement, reputation, tender price, and dealing with the critical activities during the construction stage.

Several other criteria exist in the literature for subcontractor selection. However, we have defined our criteria for evaluating subcontractors and conducting a survey among experts using this literature.

2.2. Financial performance indicators

As presented in the previous section, financial strength is a crucial criterion in the Subcontractor selection. In addition, financial performance evaluation determines financial strength by using a set of indicators for performance measurement – financial ratios. Financial ratios can generally be grouped into following ratio types:

- Liquidity ratios
- Profitability ratios
- Leverage ratios
- Efficiency ratios

The specifics of the construction industry should be taken into account when determining financial indicators.

Through qualitative and quantitative analysis Yu, Kim, Jung & Chin (2007) developed a set of financial key performance indicators: return on equity (ROE), economic value added (EVA), net sales growth rate and debt ratio. El-Sawalhi, Eaton & Rustom (2007) used credit rating, turnover, bank arrangement, debt ratio, liquidity and profitability as financial stability prequalification criteria. In a benchmarking model by Hegazy & Hegazy (2012), financial KPIs were: current ratio, quick ratio, gearing times interest earned, accounts turnover, inventory turnover, average collection, gross profit margin, profit margin, ROI and ROE.

Mohamad, Ibrahim & Massoud (2013) used factors such as sales growth, operating cash flow, return on assets, leverage and firm debt ratio in their neural network model design. In the research by Apostola, Aretoulis, Papaioannou & Kalfakakou (2013), nine financial ratios were used: current ratio, cash ratio, accounts receivable/total assets, current assets/total assets, earnings before interest and taxes/interest expense, inventory turnover ratio, assets turnover ratio, long term assets turnover ratio, accounts receivable turnover ratio. Tserng, Chen, Huang, Lei & Tran's (2014) study indicates that liquidity plays a vital role in predicting the default probability for construction firms. Besides, debt ratio, accounts payable ratio and return on assets (ROA) strongly affect the default probability. Kim, Oh, Yun, Youn, Do & Lee (2021) developed Management performance Evaluation Indicators for small construction companies for measuring management performance. They used ROIC, cost of sale ratio, ordinary profit, increase in revenues, debt ratio and turnover ratio.

3. Research Methodology

On the one hand, the research investigates the assessment of financial indicators of selected Serbian construction companies, and on the other hand, their evaluation is based on expert experience.

Firstly, 20 subcontracting construction companies from Serbia were selected. The second step examined the availability and reliability of data - balance sheets and income statements. Attention is paid to selecting companies that operate on similar projects and work with the same main contractors.

An extensive literature review registered the frequency of occurrence of specific financial indicators and criteria for the subcontractor selection in international research. The most commonly used criteria were identified, and 15 were included in the current research. In the same way, ten financial indicators were selected.

The calculation of financial indicators followed this according to the financial statements for each company. At the same time, a survey with selected criteria for the subcontractor selection was sent to experts for evaluation. The group of experts consists of project managers, construction managers and construction engineers who worked on the projects as main contractors and coordinated with companies that evaluate. Therefore, in addition to evaluating companies, the evaluation of the importance of each criterion was performed.

After analyzing the survey results, the average values of the criteria were calculated.

The next step was to compare the values from the surveys with the calculated financial indicators. Then finally, conclusions were drawn, and a simplified system for rapid selection of subcontractors was made.

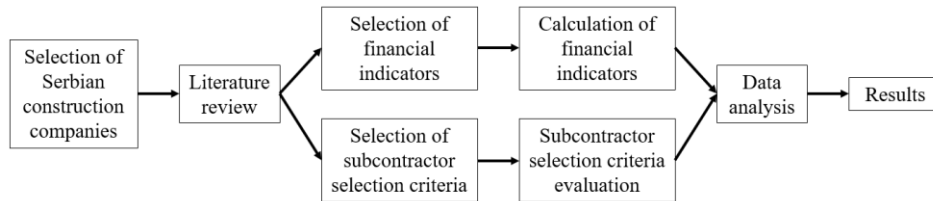


Fig. 1. Overview of Research Methodology

3.1. Selection of financial indicators

The calculation employed in this paper has incorporated ten financial ratios in table 2.

Table 2. Incorporated financial ratios

ID	Group	Financial Ratio
CUR	Liquidity ratios	Current ratio
QR	Liquidity ratios	Quick ratio
CSR	Liquidity ratios	Cash ratio
NPM	Profitability ratios	Net profit margin
ROE	Profitability ratios	ROE (Return on equity)
ROA	Profitability ratios	ROA (Return on assets)
DR	Leverage ratios	Debt ratio
DER	Leverage ratios	Debt-to-equity ratio
AT	Efficiency ratios	Asset turnover ratio
FAT	Efficiency ratios	Fixed asset turnover ratio

3.2. Selection of subcontractor selection criteria

The survey employed in this paper has incorporated 15 subcontractor selection and evaluation criteria in table 3.

Table 3. Subcontractor selection and evaluation criteria for survey

ID	Criteria	Definition
CR1	High quality of performed works	The subcontractor performs works with the required quality.
CR2	Quickly resolve objections QA / QC	The subcontractor cooperates and eliminates objections as soon as possible and has a responsible person
CR3	Completion of works on time	The subcontractor respects the dynamics and commits to the agreed objectives.
CR4	Cooperation with contractor	The subcontractor has a cooperative attitude with the contractor on the project.
CR5	Cooperation with the other subcontractors on the project	The subcontractor has a cooperative attitude with other subcontractors on the project.
CR6	Jobsite cleanliness	Workers leave the construction site clean during and after their work time.
CR7	Safety consciousness on the job site	Engineers and subcontractors have HSE equipment; workers are registered.
CR8	Timely procurement and delivery of materials	Subcontractor delivers materials on time.
CR9	Flexibility and cooperation when resolving delays	In case of delays due to other participants in the project, the subcontractor cooperates and is ready to adapt to new circumstances.
CR10	Flexibility in critical activities	In case of the need to speed up the work, work in 2 shifts or hire a larger workforce, the subcontractor

		cooperates and is ready to adapt to new circumstances.
CR11	Experience and knowledge of work areas	The subcontractor is experienced in the business.
CR12	Experience of technical staff	The technical staff of the subcontractor is experienced in the work they do.
CR13	Workforce experience	The subcontractor's workforce is experienced in the work it does.
CR14	Ongoing work commitments	The scope of the contracted work corresponds to the possibilities and capabilities of the subcontractor.
CR15	Possession of appropriate equipment and tools	The subcontractor has appropriate equipment and tools.

4. Calculation of Financial Indicators

The calculation of financial indicators was performed according to each company's financial statements. Data from the balance sheet and income statement for 2019. and 2020. were used. The following companies participated in the evaluation and calculation: Andromeda Consulting DOO, BBR Sistemi DOO Beograd-Vračar, Beton Com DOO Beograd, Biro - Stevanović DOO Prokuplje, Coloring DOO Beograd, DMA Koping DOO Beograd, Gama Consulting DOO Prokuplje, Goal Team DOO, Gremet Stolarija doo, Kopra DOO, Kovač Mont DOO Stari Banovci, Lemix DOO, Mega Pod DOO Beograd, Miloš Pantelić PR City Lend, Predrag Stojšić PR PNK-Beton II Progar, Put-Inženjering DOO Niš, Rinol DOO Surčin, Studio M DCS DOO Beograd, Širbegović DOO Novi Beograd and Aleksandar Obrenović PR Aleksandar 95 Beograd. Company names have been replaced by codes (CO1, CO2, ... CO20). The values of financial ratios are presented in table 4.

Table 4. Financial ratios values

ID	CUR	QR	CSR	NPM	ROE	ROA	DR	DER	AT	FAT
CO1	1,09	0,29	0,17	0,01	0,15	0,04	0,88	7,15	4,06	103,0
CO2	2,56	1,47	0,58	0,07	0,17	0,11	0,37	0,59	1,71	6,05
CO3	1,04	0,65	0,06	0,05	0,39	0,06	0,90	8,76	1,16	3,84
CO4	1,59	1,26	0,32	0,05	0,98	0,46	0,63	1,69	9,86	N/A
CO5	1,18	0,78	0,05	0,03	0,37	0,11	0,73	2,74	4,15	7,94
CO6	1,13	0,87	0,06	0,04	0,52	0,13	0,80	3,98	2,88	12,74
CO7	1,88	0,78	0,03	0,18	0,51	0,32	0,53	1,14	1,80	18,62
CO8	3,69	1,72	0,72	0,03	0,03	0,02	0,34	0,52	0,70	1,43
CO9	3,29	1,04	0,69	0,07	0,38	0,27	0,41	0,69	3,93	78,46
CO10	0,73	0,55	0,00	0,02	-0,12	0,11	1,44	-3,28	5,87	204,7
CO11	0,96	0,50	0,04	0,11	0,72	0,18	0,76	3,12	1,65	3,47
CO12	1,50	0,73	0,02	0,02	0,53	0,12	0,82	4,49	5,26	23,17
CO13	1,18	0,50	0,02	0,01	0,05	0,01	0,72	2,56	1,47	2,71
CO14	0,38	0,11	0,00	0,00	-0,18	0,00	0,99	158,9	1,98	3,34
CO15	1,18	0,66	0,10	0,02	0,19	0,07	0,71	2,48	3,02	16,92
CO16	1,50	1,19	0,65	0,24	1,00	0,54	0,57	1,35	2,26	13,37
CO17	2,12	1,03	0,25	0,12	0,75	0,62	0,45	0,83	5,06	43,21
CO18	1,67	0,54	0,21	0,01	0,11	0,05	0,63	1,88	3,93	13,19
CO19	0,81	0,31	0,01	0,13	0,36	0,11	0,74	2,87	0,87	1,51
CO20	0,48	0,32	0,00	0,08	1,18	0,20	0,82	4,45	2,34	7,90

Considering that a wide range of values of financial indicators has been obtained, detailed analysis is possible only after the survey results.

5. SUBCONTRACTOR SELECTION CRITERIA EVALUATION

A group of 30 experts of project managers, construction managers and civil engineers completed a subcontractor evaluation survey based on experience (CR1, CR2,...CR20). Experts evaluated only the

companies they coordinated. Apart from the companies, they also assessed the importance of each of the criteria (CRE). The evaluation is conducted from 1 as the least important to 5 as the most important. Any factor with a mean score greater than 4,00 is considered important.

After the survey was completed, evaluation factors (EF) for each company were calculated. First, the evaluation factor was calculated by summing multiplied criteria mean scores and the evaluated firm's mean scores, divided by the number of firms (15) and the highest possible score (5). Secondly, the ranking of subcontractors according to the evaluation factor is included in the table with financial ratios. Finally, the subcontractor evaluation factors were compared with their financial ratios.

Table 5. Survey results for 1-8 companies

ID	CR1	CR2	CR3	CR4	CR5	CR6	CR7	CR8
CRE	4,82	4,36	5,00	4,45	3,91	4,18	4,18	4,73
CO1	4,67	3,67	4,67	4,67	4,33	4,00	4,33	4,67
CO2	4,00	3,67	3,67	4,00	3,67	4,00	4,00	4,67
CO3	4,33	4,00	3,67	4,67	4,33	4,00	3,67	4,33
CO4	5,00	5,00	5,00	5,00	5,00	4,00	3,50	5,00
CO5	3,00	2,00	2,75	3,00	3,00	2,00	2,75	3,50
CO6	3,50	2,75	3,25	3,75	4,00	4,00	4,25	3,75
CO7	3,33	2,50	2,67	2,83	3,50	3,17	3,17	2,33
CO8	4,00	4,00	3,67	4,00	4,00	3,00	3,33	4,00
CO9	4,67	4,67	4,67	5,00	5,00	4,00	4,00	5,00
CO10	2,80	2,40	2,80	3,40	3,00	2,20	2,40	3,60
CO11	4,71	3,71	4,57	4,29	4,00	3,57	3,86	4,57
CO12	4,00	3,67	4,33	4,67	4,67	4,00	3,67	4,67
CO13	3,75	3,50	3,00	4,00	4,25	4,50	3,75	3,00
CO14	1,33	1,33	1,33	1,67	1,67	2,00	2,00	3,00
CO15	3,50	3,25	3,50	4,25	3,00	3,50	2,75	3,25
CO16	4,20	3,80	3,80	4,20	3,80	3,40	3,20	3,75
CO17	4,00	4,00	4,33	4,33	4,00	3,00	3,67	4,33
CO18	4,00	4,00	4,00	4,00	3,50	3,00	3,00	3,00
CO19	3,50	3,50	3,50	4,00	3,00	4,00	4,00	3,00
CO20	3,67	3,67	4,00	4,33	4,00	2,67	3,00	4,00

Table 6. Survey results for 9-15 companies and evaluation factor

ID	CR9	CR10	CR11	CR12	CR13	CR14	CR15	EF
CRE	4,55	4,64	4,91	4,64	4,91	4,82	4,09	
CO1	4,33	4,00	5,00	5,00	5,00	5,00	5,00	4,15
CO2	4,33	4,00	4,67	4,33	4,00	4,67	4,67	3,78
CO3	4,33	4,33	4,33	4,33	4,00	4,33	5,00	3,85
CO4	5,00	5,00	5,00	5,00	4,50	5,00	5,00	4,37
CO5	2,25	3,25	2,50	2,75	3,00	3,00	2,25	2,50
CO6	3,75	3,50	4,50	3,50	4,25	4,00	4,50	3,46
CO7	3,17	2,17	3,50	2,67	3,00	2,33	3,83	2,66
CO8	3,33	3,33	4,00	3,67	4,00	4,33	4,00	3,44
CO9	4,67	5,00	4,67	5,00	4,67	4,67	5,00	4,29
CO10	2,20	3,00	3,40	3,00	2,60	2,80	2,40	2,56
CO11	4,14	4,14	4,86	4,14	4,57	4,29	4,86	3,91
CO12	4,67	4,33	5,00	4,67	4,00	4,67	4,67	3,98
CO13	3,75	3,75	4,25	4,25	4,00	4,00	4,25	3,50
CO14	2,33	2,00	2,67	1,00	2,67	1,67	2,33	1,76
CO15	3,25	3,75	4,25	3,00	3,25	4,00	4,25	3,20
CO16	3,75	3,80	4,40	3,40	4,00	4,40	4,60	3,55
CO17	4,33	4,33	4,00	3,67	4,00	4,00	3,67	3,63
CO18	3,00	3,00	4,00	3,00	4,00	4,00	3,00	3,23
CO19	2,50	3,50	4,50	3,50	4,00	4,00	3,00	3,28
CO20	4,00	4,67	4,67	3,67	4,33	4,33	4,00	3,61

6. CONCLUSION

The survey results indicated that the most important criteria for subcontractor evaluation are: completion of works on time (CR3), experience and knowledge of work areas (CR11), workforce experience (CR13), and quality of performed works (CR1) and Ongoing work commitments (CR14). The best-rated companies are CO4, CO9, CO1, CO12 and CO11. Conversely, the lowest scores were given to CO14, CO5, CO10 and CO7.

By comparing financial indicators of companies and evolutionary factors, the following is concluded:

- Companies with negative values of Net profit margin, ROE, ROA and Debt-to-equity ratios should not be considered for job assignments - CO14 and CO10 are loss-making companies and are among the lowest-rated companies according to the survey.
- ROE and other profitability ratios should be taken into account when choosing a subcontractor - it largely coincides with the results of the survey.
- Cash ratio and other liquidity ratios are reliable indicators for subcontractor preselection - most of the best-rated companies have high liquidity ratios, while the lowest-rated companies have low Cash ratio values.
- Leverage ratios and efficiency ratios should not be used in the subcontractor preselection - they did not show a significant correlation between the survey results.

These results contribute to business practice, making selecting an appropriate subcontractor easier for the main contractor. In addition, financial profitability and liquidity indicators enable quick decision-making and identification of unsuitable subcontractors. By implementing this method, the main contractors will reduce the risks and improve the quality and relationships on the project.

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